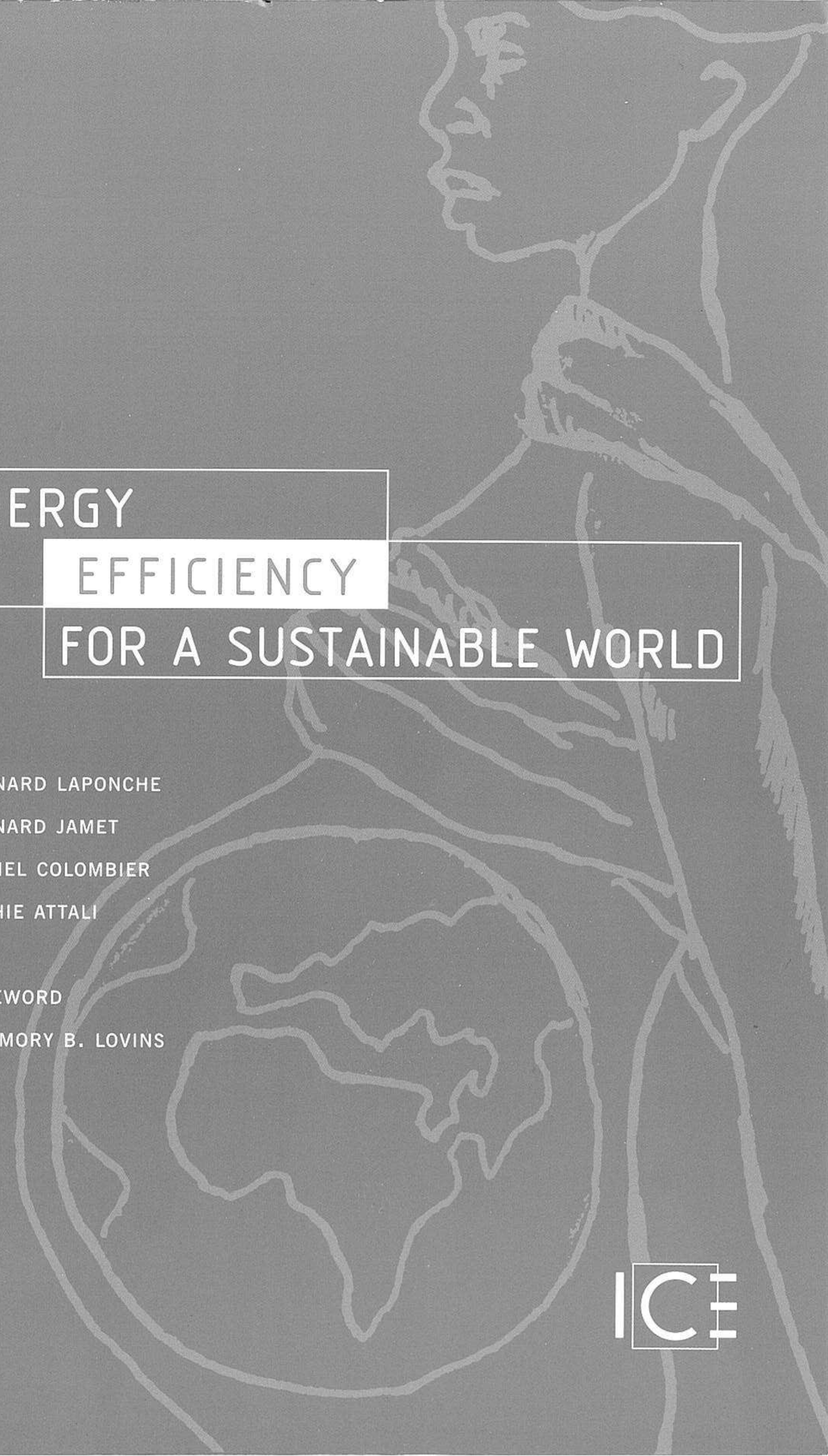

ENERGY EFFICIENCY FOR A SUSTAINABLE WORLD

BERNARD LAPONCHE
BERNARD JAMET
MICHEL COLOMBIER
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FOREWORD
BY AMORY B. LOVINS

ICE

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To Michel Rolant,

in memoriam

Founder and first Chairman
of the French Agency
for Energy Management
(AFME)

ICE Éditions
International Conseil Énergie
46, rue de Provence, 75009 Paris, France
© 1997, Paris

This document was published with
the support of the SYNERGY Programme
of the European Commission

ISBN 2-9510798-1-8
Dépôt légal : septembre 1997

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The authors wish to thank their colleagues, experts in energy efficiency, for their help in preparing this document. The English version was elaborated by **Mrs. Kenya Tillerson,** project manager at ICE.

Foreword

This book could not be more timely nor more important. Most of the world's energy continues to be wasted by inefficient devices and practices that simply turn resources into pollution, incurring staggering costs at both ends. The global climate experiment becomes steadily more risky and less reversible. Other hazards of energy profligacy become ever more painfully evident. And with the expansion of electricity supply alone consuming about one-fourth of the world's total development capital, the rapidly growing economies, especially in Asia, are facing an increasing prospect that unless they quickly make very efficient use of energy into the cornerstone of the development process, they may soon find energy-supply infrastructure swallowing up their budgets, leaving too little money to buy the things that were supposed to "use" all that energy.

After all, expanding the supply of electricity can easily take hundreds of times, even more than a thousand times, as much capital as building a factory to make (say) compact fluorescent lamps in Bombay or super windows in Bangkok to produce the same increments of light and comfort. And since the power plant also ties up its capital for about ten times as long as the factory, the product of capital intensity times capital velocity can make electrical supply effectively about one thousand to ten thousand times more capital-consumptive than investing in devices that use less electricity far more productively to provide the same service with the same or better quality. No country, even the richest, can afford to get that choice wrong for very long.

The notion that inefficient energy development could cripple the whole development process by drying up its needed capital is hardly new. But it gains a sharper edge in a world where East Asian nations alone were recently increasing their peak electricity demands for air-conditioning alone by some 15-25 gigawatts "per year" – with each gigawatt (thousand megawatts) costing on the order of US $1-2 billions for investment in classical thermal stations and grid expansion. The answer is not simply to carpet Asia with project-financed power stations, which are often built largely for transactional rewards rather than for economic fundamentals. Most such projects will disappoint, either because the host government reneges on its promise to raise electricity tariffs to the levels needed to pay for the project, or because the host government "keeps" that promise and thereby depresses demand below the levels needed to pay for the project. (If paying for the project would require a great many customers in, say, India to devote about one-fifth of their disposable income to buying electricity, as not uncommonly turns out to be the case, then it's time to redo the sums.) As my friends Bernard Laponche and Bernard Jamet and their colleagues emphasise, the answer is rather to start by asking what we want all that electricity "for", and what's the cheapest way to do those jobs.

In the United States, we didn't do that before we had already misallocated (at marginal cost) on the order of US $1 million million to buying air-conditioning equipment, and 200 peak GW of power supplies to run it, that we would not have bought if we had optimally designed the buildings in the first place to provide the same or better comfort at least cost. (For example, a retrofit design for a California office recently decreased its air-conditioning energy by about 97% while improving comfort.) Other countries, especially developing countries totalling about ten times America's population, should learn from that mistake, not repeat it. With so many calls on scarce resources, countries developing or reorganising their economies today can afford to build massive new energy supplies or to develop their societies, but not both.

Wasted energy, then, is not just a minor blemish in the fabric of global development. It is rather a basic structural flaw that threatens to tear the whole process apart. An inefficient motor or lamp is really a thief that steals money from clean water, infant immunisations, female literacy, and all the other development basics. But the reverse of that threat of perpetuating human misery is the splendid opportunity this book describes : to turn the energy (especially the electric) sector from a black hole for capital into a net exporter of capital for other development needs; to make the energy sector not a major polluter requiring costly cleanup but a relatively benign contributor to a vibrant and sustainable economy; and in partnership with energy efficiency (which reduces demands enough so that dispersed solar sources such as photovoltaics become readily affordable) to bring the benefits of efficiently used, freely available, and justly distributed renewable energy to all who need and want energy for a decent life.

To this challenging task, the Laponche team brings enormous experience and insight, hard-won in field practice around the world. From their rich experience over the past couple of decades, they synthesise the broad principles of the effective, well-established approach to energy efficiency implementation that has its roots mainly in European governmental work but has found fruitful application world-wide. As such, this primer will be of special value to all policymakers and practitioners who want to know both how to do the right things and how to do things right.

This is not a book about the technical details of saving energy. If it were, it would have to be many times longer and far more technical. Indeed, it would risk becoming not a book but a newspaper, because both the technologies of energy productivity and our understanding of how best to choose, integrate, and combine them are evolving so rapidly that potential electrical savings (for example) are doubling about every five years, while their cost meanwhile falls by about threefold. (That statement has been continuously true for at least the past 15, perhaps 20, years, and progress shows no sign of slackening.) The new technical developments are not merely incremental but often radical improvements on those of the recent past. For example, in many technical systems - most buildings, motor and lighting and hot-water systems, computer design, even car design - we can now frequently make large energy savings cost "less" than small energy savings, typically by achieving multiple benefits from single expenditures through careful whole-system engineering.

This surprising potential is not merely a theoretical possibility. Recent experiments have eliminated space-heating and cooling equipment in new houses in climates ranging from -44° to +46°C while reducing capital cost and increasing comfort. Energy savings around 90% in fan and pump systems while reducing capital cost and improving performance are no longer unusual in industry and in large buildings. New buildings can now achieve energy savings around 80-90% with decreased capital cost and better comfort and aesthetics, while retrofits can often save nearer three-fourths than the classical 10-30%. In a few more years, even these astonishing results may well seem pass. Next, very soon, come ultralight hybrid-electric "hypercars" that will ultimately save as much oil as OPEC now extracts, and that have already attracted some US $2 billions of world-wide industrial commitments by established and emerging automakers eager to capture their decisive competitive advantages. After that come cheap polymer fuel cells whose commercialisation those hypercars will greatly accelerate – all in the context of the rapidly emerging "distributed utility", where the power station shifts from a remote central plant to your back-yard, basement, driveway, or rooftop. After that, who knows? Even fundamentally new energy sources cannot be wholly excluded, and the ones we have certainly suffice for a cost-effective global supply meeting all needs of a populous and prosperous world – if we become modestly more efficient first.*

* For the latest news on fast-changing technologies, my colleagues at Rocky Mountain Institute, http://www.rmi.org, and at E source, http://www.esource.com, provide a wide range of popular and technical information – the latter on an instantly searchable CD-ROM.

Nor is this book particularly about new ways, now emerging, to use market forces more creatively by specifically addressing market failures and adopting "trimtabs" targeted at correcting them. Architects and engineers could be rewarded for what they save, not for what they spend. For new buildings, when you connect to the energy, water, or sewer grids, you could pay a fee or get a rebate – which and how big depends on the building's technical efficiency – and the fees could pay for the rebates. Such "performance-based fees" and "feebates" are now being tried, with encouraging results, as sketched in our recent book with Prof. Ernst Ulrich von Weizsäcker ("Factor Four : Doubling Wealth, Halving Resource Use", Earthscan {London} May 1998 or Dromer Knaur, München, 1995; other translations in press). It is not surprising that if we reward the results we want rather than the opposite, we are more likely to achieve those desired outcomes. The Laponche team, being such sage practitioners, will doubtless add such improved tools to their brimming toolbox as soon as they're widely proven and available.

But their purpose in this book is not mainly to assess cutting-edge ideas; rather, it is to codify and consolidate the proven, eminently practical fundamentals of public policy and private action to use energy in a way that saves money. Nothing in this book is speculative or experimental: the authors, and their vast network of practitioners world-wide, have already done it all. A great strength of this guide to principles, practices, policies, and partners is therefore its reliance on tried-and-true ways for making energy services work better and cost less, and giving the coordinates and activities of many experienced implementing organisations that can help spawn new efforts anywhere in the world.

Within that context and in that spirit, there is only one issue to which I might perhaps have wished more prominence to be given. The world spends the best part of a trillion dollars a year (and a third of all fuel) on electricity, most of it wasted, largely for two artifactual reasons that are both readily correctable. The first is that nearly all countries reward utilities for selling more energy but penalise them for cutting your bill. In about eight of the United States, we've solved this problem by using a simple accounting mechanism to decouple utilities' profits from how much energy they sell, so they're no longer rewarded for selling more nor penalised for selling less — and then, if the utility helps cut your bill, to let its shareholders keep part of that saving as extra profit. Naturally, this alignment of the previously contrary interests of shareholders and customers causes impressive changes in utilities' culture and practice. It is also fully compatible with implementation through market mechanisms and with liberalisation of electricity markets; but in seeking the undoubted benefits of more competitive generation, it does not discard, but specifically seeks to capture, the even larger benefit of also "using" electricity in an economically efficient way.

An even more basic reform is to add the missing "third principle" to power systems. Today those systems are run on two basic principles: (1) Make electricity in the cheapest way (subject to constraints of reliability, health, safety, environment, and perhaps fuel diversification). (2) Use the resulting electricity efficiently. But missing in nearly all countries is a third principle: (3) Allocate resources between (1) and (2) by least cost – best buys first. Lacking such a principle, resources are allocated between supply and demand-side investments according to habit and bureaucratic power. The result is like the classical recipe for Elephant and Rabbit Stew – one elephant, one rabbit. And it's the wrong way round. When the World Bank's power sector (under previous management) allocated about 99% of its US $2-billions-a-year budget to producing more electricity and only about 1% to using electricity more productively, that was just the opposite of what least-cost investment would have required. We must therefore augment the wise advice in this book with one further bit: pay careful attention to these institutional structures and incentives; otherwise you will probably get what you're rewarding, even if it's the opposite of what you really want.

With that little addition, I gladly commend this pithy and valuable work to the practitioners, policymakers, businesspeople, and active citizens on whose efforts the world's energy efficiency, economic prosperity, and environmental future depend. Implementation is not easy, but it's far easier than not doing it. Success requires hard work, persistence, a little cunning, a lot of good humour, and eagerness to give the credit to those who need it (whether or not they deserve it). But though the challenges are great, greater still are the rewards, for all of us and for those who come after us. With gratitude to the authors, therefore, who have given us so freely of their wealth of experience, implementation is therefore left, in high spirits and with high hopes, as an exercise for the reader.

Amory B. Lovins

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Director, The Hypercar Center.
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This book was first published in French with the following foreword written by Michel Rolant

Let's face it

There are two common beliefs which must be thrashed again and again.

The first is that the natural resources we need to survive (space, water, air, energy...) cannot be exhausted and are (almost) free.

The second is that a minority of the planet's inhabitants can continue to hoard these resources and expect to get away with it.

This book written by Bernard Laponche, Bernard Jamet, Michel Colombier and Sophie Attali presents us with yet another opportunity to do so.

It also has the immense merit of potently countering those who pretended at Rio in 1992 and continue to do so today that the environmental concerns of the planet's "rich" is in conflict with the social needs of the planet's "poor".

This book clearly explains how energy consumption efficiency and its positive impacts on environmental quality are one of the rare realist means to ward off the entanglements and crises of which the development countries are the first and foremost victims.

The authors also resolutely count themselves among the "unsurrendered", who believe that the developing countries have a future and that this future is not one of pursuing the spoliation of resources.

They show how, if local actors and decision-makers take charge of energy end use efficiency, rational use of resources cannot be confused with the organisation of shortage at the detriment of those who already suffer from it.

This is not, for them, pure intellectual speculation. The present book precisely indicates paths for the necessary cooperation; it describes the programmes and the means available, including the financial ones.

We should warmly thank the authors for this.

It is likely that the positive approach described here will, tomorrow, encompass the water sharing/distribution issue at local as well as planetary level.

In brief, this book is a precious "mine" filled with un-or under-exploited deposits. It is a service rendered to those who refuse to despair of the future (for a better world to live in and a more sustainable development).

Michel Rolant

President and Founder of the French
Agency for Energy Management (AFME)
from 1982 to 1987

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Introduction

Throughout human history, certain civilisations have followed the path of sustainable development, most often without searching to formulate such a concept in an explicit manner. Other civilisations were characterised by their massive destruction, usually of both human beings and nature.

In this field, the production-oriented industrial civilisation which has developed since the 19th century, first in the so-called "Western" world, then over most of the planet, has reached never dreamed of heights: in many aspects, the twentieth century will probably remain – if humankind ever manages to cease this folly – the most ruinous in all human history. It will most likely take the whole of the twenty-first century to repair the damage brought on by Progress and to attempt to establish the foundations of a sustainable and perennial development, both throughout space – for the entire planet – and throughout time – for those living today as well as the future generations. The difficulties are tremendous but the stake is immense.

Turning human activity towards sustainable development is a question of global policy which implies the establishment of a democratic decision-making process, the respect of humans and nature, the right to education, culture, creative activity, the satisfaction of basic needs. This issue goes far beyond simple economy and we will not discuss all of its aspects here.

In many human activities, solving the dramatic problems humankind is confronted with is not a simple task, in spite of the rising awareness of experts and citizens who realise that it is time to use our imagination, intelligence and cooperation to establish a radically different kind of development.

On the contrary, significant progress has been made over a little more than twenty years in the field of energy-related activities. The genuine revolution which took place in the Western industrialised countries under the concept of "energy efficiency" gives reason to believe that satisfying the energy needs of humankind, in the framework of sustainable development, is a relatively simple matter.

Exploiting fossil resources (coal, oil, natural gas) in a rational and economical manner; extending end use energy efficiency to all activity sectors ; developing renewable energies (biomass, hydropower, solar energy, wind power and geothermal energy); joining these three options within a global strategy should enable humankind to dispose of the energy resources which permit a sustainable and perennial development during the 21st century.

The object of the present book is to present the methods, the experiences and the concepts which make it possible to implement energy efficiency policies in all economic and social activities.

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The development of a society finds expression in its increasing capacity to meet certain needs: quality of the natural environment, health and food; housing, clothing, comfort; education, information, culture, democracy; transportation facilities; quality of and interest in work, sport and leisure activities.

In varying degrees, satisfying most of these needs requires the consumption of energy, either by direct use for certain purposes, or to permit the production of the goods and services required to meet the needs, such as: agriculture, livestock breeding, fishing; preparation, conservation and cooking of food; lighting, heating or cooling of dwellings, offices, commercial or industrial buildings; production and processing of raw materials, energy production; construction of buildings and infrastructure, manufacture of equipment and appliances; transportation systems, information and communication facilities.

The use of energy is thus vital to economic and social development and contributes to improving living conditions by increasing comfort, transportation facilities, the quality of work, etc.

One of the foundations of the industrial civilisation has been the large-scale and increasing use of energy, in both production and consumption activities. In some countries the risks to the natural environment, human life and health caused by the production and consumption of energy have reached unacceptable levels.

Energy production and consumption involve significant problems and constraints: hazards for the environment (air and water pollution, waste, accidents, degradation of soils and landscapes, desertification); the increasing costs required to access energy resources, the gradual depletion of non-renewable sources; the increased need for capital and foreign exchange to guarantee energy supply by national production or importation; the political risks connected with the strategic, geopolitical or military significance of a particular source of energy.

Until recently, economic constraints or in certain cases difficulties in accessing energy resources (geographical or political constraints) were the only constraints limiting the growth in energy production and use. The expansion of the energy sector was designed to provide ever more energy to meet a demand the growth of which, like that of the presumed needs of the population and their economic activities, was considered unlimited.

Per capita energy consumption is very unequal, in different countries as well as within a single country. For "commercial" energy resources, annual per capita consumption in North America is one hundred times greater than in the countries of Africa. Energy use in one country can be double that of another country with comparable levels of production and living standards. In some countries, there are shortages in energy supply while large quantities of energy are wasted due to inefficient consumption.

Despite a strong slowdown in the growth of energy consumption in the Western industrialised countries since the mid-1970s, if current trends persist, world energy consumption will have doubled before 2030. The lack of relatively easily accessible resources or their concentration in certain geographical areas, the increase in the cost of energy products and the exploitation of more dangerous forms of energy are likely to provoke crisis situations and ecological catastrophes and will slow or stop development for most of the World.

Today, environmental constraints combine with economic and political constraints to make it essential to draw up a strategy that will both fulfil the needs of sustainable development – the quality of life of all the earth's inhabitants and future generations – and minimise the hazards for the environment and the economic and social costs arising from energy production and consumption. This is what we call an energy efficiency strategy.

Such a strategy is based, first and foremost, on a dramatic revision of the very concept of energy need. The same service can be obtained – or more generally, the same development achieved – using a lesser amount of energy than is currently the case, at a total cost also well below today's levels. This is true even in the countries with the most advanced technologies and apparently the most efficient economies.

The industrialised nations, above all those which are most inefficient in using energy, can reduce their energy consumption markedly. Developing countries can increase their energy use, but at growth rates much lower than those of the rich countries in the past. For both, energy efficiency will be an important factor improving both the economic growth rate and the quality of the environment.

Energy efficiency is an economic development factor, for experience has shown that in numerous circumstances it is cheaper to save a given quantity of energy – or to avoid using it – than it is to produce it. This means that financial resources which would have been allocated to energy production (for example, building power stations) or energy importation (which requires hard currency) could be devoted to other activities, allowing improvements in living standards, comfort levels, and the quality of life: building housing, developing public transportation, building hospitals, etc. This qualitative improvement of the content of growth will of course be determined by the development priorities.

Beyond this global effect of transferring financial resources to more valuable or more profitable activities which better fulfil the needs of the population, the direct effects of energy efficiency on productive activity are significant: improvement in industrial productivity and competitiveness; development of an industry producing advanced and high-efficiency equipment and appliances which will also sell well on exportation markets.

In a world increasingly concerned about unemployment, implementing energy efficiency programmes leads to the development of new activities and helps create jobs throughout all sectors of activity and all geographical areas.

The environmental benefits of such programmes are even clearer: the energy which creates the least pollution is the energy which is neither used nor produced. Each time the energy consumption for a given need is reduced (by insulating dwellings, improving motor efficiency, etc.), the emission of pollutants is also, automatically and proportionally, reduced. This is a familiar and perfectly true argument used to advertise the reduced output of SO_2, (sulphur dioxide) CO_2 (carbon dioxide) or radioactive waste when compact fluorescent bulbs are used instead of incandescent bulbs, for the same level of lighting.

Energy efficiency measures are the cheapest way of protecting the environment since they are themselves cost-effective (energy gains) and thus the environmental benefit they incur is a no cost bonus (compared with the cost of pollution control measures, for example). For this reason, environmental policies must pay particular attention to energy efficiency operations.

An energy efficiency strategy is not just a slight adjustment to an energy policy but a new concept of economic policy which takes into account the costs of environmental degradation and which seeks to reduce hazards and to bring about efficient national and international economies. National energy efficiency strategies must form an integral part of economic strategies for a healthy environment and sustainable development.

Today the economy and the environment are global concerns. A national energy efficiency strategy will only be fully effective if it is guided by the following principles:

- the close inter-relation of economy and environment on a regional level and at world scale must be recognised;
- the environment and the quality of life in both developing and industrialised countries need to be improved;
- consumers must be implicated in the policy process from the onset, for their support and their involvement are essential for the successful implementation of these policies.

In this context, the energy and economic policies of each country and each region must be diversified and tailored to the needs, resources and local and regional environmental conditions.

International cooperation on energy efficiency must be strengthened and given powerful and effective resources, starting with the existing activities of the regional and international organisations, development banks, bilateral cooperation institutions, and so on.

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This book presents the foundations and contents of an energy efficiency strategy, the methods for its elaboration, the manners in which it is implemented and the instruments it uses.

Chapters I and II are devoted to the general aspects of drawing up and implementing an energy efficiency strategy.

Chapter III is an in-depth presentation of the main lines of energy efficiency action programme elaboration and preparation.

Chapter IV presents the various means of action: information, training, voluntary agreements, regulation, financial incentives.

Chapter V describes financing mechanisms for energy efficiency projects and their use.

CHAPTER I

Energy efficiency and sustainable development: an integrated strategy

Summary

Today, environmental constraints reinforce economic and political constraints in encouraging policy-makers to design strategies which simultaneously fulfil the needs of sustainable development and minimise environmental damage and the economic and social costs arising from energy production and consumption.

Such strategies are, first and foremost, based on a profound revision of the concept of energy demand: a service – economic production or social need – requiring energy is obtained by a combination of practices or types of use, a specific technique or equipment, and the use of a certain quantity of an energy product. If the use and the equipment are "energy-efficient", energy consumption can be brought well below its current level, at which waste and non-rational uses are common.

This integrated approach brings about a fairly radical change in energy planning and energy policies: the needs of consumers in terms of services are the starting point of such an approach, which then integrates all economic, industrial and energy policy orientations and actions to ensure that an optimal service is provided for users at minimum economic and environmental cost.

In this planning effort, the same degree of attention must be given to actions and instruments which improve the efficiency of energy use as to those which concern energy supply.

Adopting an integrated strategy is even more capital for the developing countries and the countries in transition than for the Western industrialised countries. Strong energy efficiency policies are of special and urgent importance for countries whose economies are in transition from planned to market economy since, as a general rule, large amounts of energy are wasted in these countries. For the developing countries, the challenge is not to reduce their overall energy consumption as the industrialised nations must do, but to achieve their economic and social development with a much lower energy consumption than was characteristic of the industrialised nations in the past.

Energy efficiency and sustainable development: an integrated strategy

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Energy efficiency: an essential component of sustainable development

Energy is necessary to development. However, the way in which we produce and consume energy is characterised by strong financial and environmental constraints. For the Northern countries, the question, today, is that of the quality of development. For the Southern countries, the issue is development itself which risks meeting with the impossibility of extending to the whole planet the energy model adopted by a minority. Preparing a sustainable world for tomorrow implies reforming our model of development today.

1.1 ENVIRONMENTAL RISKS AND DAMAGE ARISING FROM ENERGY PRODUCTION AND CONSUMPTION

The damage energy production and consumption causes to the natural environment, human life and health can be distributed into several categories. Described below, these categories highlight the extent of the problem.

Accidents

Major technological risks are a growing concern, above all in large industrial or urban conurbations. There are many risks of serious accidents arising from energy production and supply and their extent has already been shown in many cases:
- explosions and fires on oil platforms, at storage or refinery sites or in hydrocarbon transportation networks;
- oil spills caused by tanker accidents;
- cave-ins, landslides or explosions in coal mines;
- breaches in hydroelectric dams;
- explosions or fires in nuclear power plants, nuclear reactors, reprocessing plants or radioactive waste storage sites.

WATER POLLUTION

- power stations and refineries produce effluents which may contaminate watercourses;
- coal mines can do the same;
- the cooling of power stations produces thermal pollution which can destroy aquatic life;
- non accidental oil tanker discharges pollute regularly the oceans.

RADIOACTIVE EMISSIONS

Radioactive emissions result from the combustion of fossil fuels and above all from the different stages of the nuclear fuel cycle under normal operation and in case of incidents (frequent): uranium mines, mineral processing plants, irradiated fuel reprocessing centres, incidents in the operation of nuclear power plants (besides serious accidents).

RADIOACTIVE WASTE

Irradiated fuels issued from the use of nuclear energy to produce electricity contain fission products and transuranic elements, some of which remain radioactive and dangerous for hundreds, if not thousands, of years. No satisfactory solution has yet been found for the destruction or safe long-term storage of such waste. The dismantling of major nuclear facilities, and in particular of nuclear reprocessing plants, is likely to pose problems which have not yet been properly identified.

AIR POLLUTION

Air quality is affected by two categories of pollutants arising from industrial or domestic fossil fuel combustion and the consumption of oil products such as fuel oils:

- directly emitted pollutants, such as sulphur oxides, nitrogen oxides, dust, hydrochloride acid, volatile organic compounds and carbon monoxide;
- pollutants which are formed in the atmosphere through photochemical reaction, leading to the creation of ozone, in particular.

Sulphur dioxide and nitrogen oxide emissions produce acid rain, the dire effects of which range from the destruction of aquatic life and of forests to the decay of buildings. The release into the atmosphere of chlorofluorocarbons (CFCs) used for refrigeration and air conditioning contributes to the destruction of the ozone layer.

Aggravation of the greenhouse effect

The accumulation in the atmosphere of "greenhouse gases", gases which absorb the infrared radiation emitted by the earth and thus warm the atmosphere, is likely to bring about climate changes within several decades. Emissions resulting from human activities markedly increase the concentration and persistence of greenhouse gases in the atmosphere: carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and nitrous oxide (N_2O).

Deforestation and desertification

The use of wood and charcoal in regions where this natural resource is not renewed leads to deforestation, accompanied in many cases by the destruction of the soil, and indeed desertification (in the Sahel countries of Africa, for example, but also in many mountainous regions). This problem is particularly alarming since "fuelwood" is the only or at least the main energy source used in much of the rural or peri-urban population of developing countries.

Land intrusion and destruction

Land intrusion and the damaging or destruction of natural sites by hydroelectric dams, mining operations, energy transportation networks (particularly high-voltage power lines), etc., is a nuisance that the affected populations find harder and harder to accept.

The issue of transportation

This is a major issue which is not directly linked with the energy industry or energy consumption as such, but rather with one of the most significant types of energy use: transportation. The policies adopted in the Western industrialised nations during the 20th century and now emulated throughout the world, which favour road transportation of passengers and goods, have resulted in a large number of road accidents which cause an estimated 300 000 deaths and 15 million injuries a year world-wide. This extremely serious toll is added to the pollution generated by road transportation and the traffic congestion typical of all large cities as well as to the intrusion and destruction of sites by the development of transportation infrastructure.

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Thus, any action which, under favourable economic and environmental conditions, can bring about a decrease in energy consumption and therefore in the quantity of energy produced to perform the same service should be taken in account to reduce the hazards and damage to the environment caused by this production and/or this consumption.

1.2 BUILDING A SUSTAINABLE WORLD, TOMORROW AND TODAY

Although we can already observe or conceive of some of the effects of the energy system briefly described above, they are but one aspect of more global economic crises which confront the world as a whole and almost all the contemporary societies taken separately. Under these conditions, to reflect on the place of energy within a development sustainable at long term can seem trivial or simplistic when compared to the immediate difficulties: unemployment and pauperisation in the North, the development crisis in the South. It is neverthelees increasingly admitted that these difficulties are neither temporary themselves nor linked to temporary circumstances: on the contrary, they demonstrate that our model of development is in the process of reaching its limits.

Such a crisis is both an opportunity and a challenge: we are confronted with the necessity to invent a new model of sustainable development, which "meets the needs of the present without compromising the ability of future generations to meet their own needs". First, sustainable development requires the elimination of poverty and deprivation. Second, it requires the conservation and enhancement of the resource base which alone can ensure that the elimination of poverty is permanent. Third, it implies a broadening of the concept of development so that it covers not only economic growth but also social and cultural development. Fourth, and most important, it requires the unification of economics and ecology in decision-making at all levels. (*Our Common Future*, World Commission for Environment and Development, 1987.)

The coupling of the environment and economic and social development is thus one of the essential components of sustainable development. However, it is not certain that energy constraints (availability of resources, risks, environmental problems, economic problems, etc.) will be the most intense or the most imminent (or at least considered as such) among the various constraints which humankind may face during the 21st century. It is even highly probable that questions linked to demography, development, inequalities, peace, health, land and water resources, etc. will be considered by future generations as far much stronger constraints than those of the energy system. Among these major constraints, only a few have a direct link with energy.

It would thus be simplistic to consider the constraints and risks linked to the evolution of energy systems as purely endogenous, in spite of the fact that energy system development can generate very specific constraints (nuclear waste, fossil resource depletion, the greenhouse effect, etc.).

Therefore, two pitfalls must be avoided: the first consists in considering the long term exclusively from the viewpoint of energy and thus risking omitting the major parametres of societal evolution and the living conditions around the planet; the second is to consider that the constraints of the energy system are entirely external to these parametres.

A second difficulty is related to the recent appearance of the concept of global problems or global risk at the heart of which energy is often found. Within this notion of globality, a spatial aspect surfaces (the problem is global if it addresses all human societies) as well as a temporal one since it covers the concerns of humankind for future generations. It is in this sense that a number of long-term problems linked to the energy systems (fossil resource depletion, global warming, nuclear waste storage) appear today as prototypes of global problems.

To sketch new paths of development, hierarchise the stakes and the elements of solution, and to orient research and action, prospective analysis is a highly beneficial tool: contrary to forecasting, which is based on examining the immediate past to predict the future at short term, prospective analysis is based on the elaboration of scenarii which attempt to portray coherent images of society at relatively distant horizons. This practice is widely developed in the energy sector where the weight of investments and the importance of anticipation (building plants, exploiting resources) forbid short term navigation. For the last few years, environmental concerns, and in particular those related to the climate change issue, have reinforced the need of an elaborated reflection on the long-term.

The analysis of the most recent prospective energy scenarii, and notably those of IIASA (International Institute for Applied System Analysis) for the World Energy Conference, which gathers most of the large energy sector enterprises, is extremely enlightening. The various scenarii presented can be schematically gathered in two large categories:

• The first group of scenarii explores various energy development paths which differ on the relative importance of energy vectors in the energy balance: a strong development of natural gas, nuclear energy or renewable energies, etc. No particular effort is made in terms of the efficiency of energy consumption. All these scenarii lead to genuine constraints both for oil resources (which by 2020 would be concentrated in the Middle East, thus increasing the risk of tensions) and for nuclear waste generation (the amount of waste to be stored would be multiplied by a factor between 8 and 18 when compared to 1990) or greenhouse gas emissions, which would reach, by the middle of the next century, 200 to 250% of their 1990 level. According to the profiles established by the experts of the International Climate Change Convention, this means that the concentration of CO_2 would increase up to 500 to 700 ppmv in 2100 (compared to 360 ppmv currently) and would continue to augment after 2100.

• A second group of scenarii has the common characteristic of favouring deliberate public policies to improve energy efficiency, which would permit the reduction of the consumption of the industrialised countries and curb the increase in the industrialising countries (China, South East Asia, etc.). Several supply-side combinations are then explored (developing coal, gas, nuclear energy or renewable energies, etc. more or less). Globally, this second group of scenarii envisages both an alleviation of the constraints on natural resources with a moderation of the generation of nuclear waste and a stabilisation, or even a reduction, of greenhouse gas emissions. The concentration of CO_2 in the atmosphere would thus stabilise at a level around 400 ppmv before 2100. These are also scenarii which offer the best equilibrium of wealth between the developing and the OECD (Organisation for Economic Cooperation and Development) countries.

Despite the progress made on energy supply and in the gradual development of new energy sources (renewable energies), the energy needs of the planet will continue, for a long time still, to be essentially satisfied by fossil fuels. Covering the needs linked to the development of humankind (agricultural and industrial production, domestic comfort, services, communication) while diminishing energy consumption will simultaneously permit the reduction of tensions on fossil resources (prices, crises and conflicts) and augment the impact of new resource development.

Building a sustainable world for the future generations implies, of course, knowing how to satisfy the needs of the present generations. Energy efficiency action programmes should take into account the economic conditions and could be limited in the initial stage to actions and investments which are less expensive than producing an equivalent amount of energy to that saved. On the basis of this principle, a large number of actions can be highlighted, which both prepare the future and appear judicious at short-term.

Likewise, energy supply strategies must exclude options which are associated with unacceptable risks for the environment, all the more so since implementing these options sometimes involves irreversible action, since they call for substantial and costly technological developments and investments which result in high levels of inertia.

2

The basis of an economic and energy strategy for sustainable development: integrated optimisation of the final service to the consumer

Fuel and electricity are secondary goods in the economy and their consumption is derived from a more fundamental demand for energy services, i.e. services which consume energy. This simple fact is now widely acknowledged. We are, however, only beginning to apprehend its profound implications with respect to the way we regard energy security, energy trade opportunities, energy technologies and the environmental impacts of the energy system.

From this perspective, the measures which emerge as the key to energy and environmental security at both short and long term are those which improve the efficiency of fuel and electricity use and which thus avoid the production of energy. Compared to the traditional commodity-oriented approach to energy, the energy service approach provides the basis for a much larger range of technological opportunities to reduce the environmental impact of energy.

2.1 ENERGY SEEN FROM THE DEMAND SIDE

The quantities of energy required to meet a given need (development needs detailed in the introduction) vary widely according to the method chosen: the energy product consumed, the equipment or apparatus used, and the way in which it is used.

To take a few examples:

Cooking

Fully different energy expenditures are involved in the act of cooking depending on the method used: whether a solar cooker, wood in an open fire, charcoal in an enhanced fire, bottled or network gas, or electricity in a stove or microwave (all meeting the same need). These various methods also involve different financial expenses and have very different environmental effects, right along the chain of operations from the primary energy resource to end use.

Space heating and air conditioning

A well-designed (orientation, solar heating, openings) and well-insulated residential, commercial or office building uses much less energy for heating, cooling and ventilation purposes than an average building. In many cases – particularly in temperate climates – it is possible to avoid any external energy input for air conditioning and to considerably reduce the energy requirements for heating whilst at the same time maintaining an agreeable indoor environment. In buildings, insulation which boosts energy efficiency also reduces noise pollution.

Lighting and domestic electrical appliances

In the European Union as a whole, refrigerators, freezers, washing machines, dryers and dishwashers together account for 9% of the total electricity consumption (all sectors). Introducing the best appliances now available on the market would bring about a total reduction of almost 40% of this electricity, i.e. the equivalent of the electricity consumption of Portugal and Denmark together. There are also significant savings to be made in lighting: a compact fluorescent bulb uses five times less electricity than an incandescent bulb for the same luminosity.
Likewise, the increasing use of computers, and more generally, of information technologies, has led to a boom in electricity consumption in the service sector: currently, the annual electricity consumption for these end uses increase entails building two 1000 MW (one megawatt = one million watts) power plants each year in the European Union. It is estimated that new technologies and standby modes could bring about electricity savings of more than 50%.

Industrial processes and products

In industrial production, three factors combine to reduce the energy required to meet a given need:

- technical progress makes it possible in almost all areas to manufacture the same product using less of or a different material: a well-known example is the high-resistance steel girders used to repair the Eiffel Tower which weigh only one third as much as the girders they replace. The same is true of cars, lorries, trains, machinery, etc.;

- improvements or changes in industrial processes currently make energy efficiency gains of between 30 and 50 percent possible for an identical level of production;
- the trend to higher value-added output within specific industries leads to a decrease of energy use per unit of value added.

TRANSPORTATION

The case of transportation provides the most obvious example of different levels of energy efficiency:

- *The nature of the requirement*

A very substantial proportion of energy consumption for passenger transportation is devoted to travel between home and the workplace (also a major expenditure of time: three hours of commuting per day is not uncommon in the so-called "developed countries"). A first focus of concern, related to land use and urban planning, is thus to reduce commuting distances in order to reduce the time wasted and the energy consumed and to improve the quality of life and protect the environment.
The "just in time" distribution adopted in industrialised countries for goods transportation is also responsible for the major increase in traffic.

- *The mode of transportation used*

When it is considered necessary to transport people or goods, how is it to be done?
Urban public transport systems, especially trams and subways, use much less energy, pollute much less and result in far fewer accidents than private cars. Trains have the same advantage over lorries for freight transportation. In some countries it is pleasant – and popular – to use a bicycle in towns, particularly where protected cycle paths exist. (In many others, bicycling is, on the contrary, dangerous due to the lack of protected paths.) Most drivers could walk and refrain from using the car for very short trips (less than 1 km, for example).

- *The characteristics of the vehicle and the style of driving*

When a car is used – often because there is no other alternative – its fuel consumption and pollution levels will vary widely from one model to another, depending on the size, weight and power of the vehicle, the performance of the engine and its state of maintenance, and – last but not least – the quality of the driver.

2.2 THE REAL DEMAND: A SERVICE REQUIRING ENERGY

Conventional energy-sector activities (production, transportation, distribution of energy products) are all directed to providing the consumer with a quantity of fuel or electricity under optimal economic conditions. However, the real objective is not to provide energy products as such but to provide the means to obtain certain services. The search for an optimal solution should not focus exclusively on providing energy but on a combination of energy supply, energy-consuming equipment and methods of using such equipment.

We shall call "services requiring energy" all the economic activities (production, processing, transportation, trade, etc.) or social activities (cooking, heating and air conditioning, travel, leisure, etc.) which require some use of energy.

The performance of a "service requiring energy" (S) in order to meet a given need is the combination of three elements:

- the first term, "type of use" (U), describes the way we can or do provide this service ; for example, the mode of transportation chosen, the type of industrial production, the kind of dwelling (an apartment block or a house, for example).
- the second term, "apparatus" (A), describes the equipment or appliance used (heater, house, car, refrigerator, boiler, light bulb, etc.).
- the third term, "energy" (E), is the quantity of the energy product used in order to obtain this service.

E is the end product of the energy production and supply system: it is the end use energy for the performance of a given service. U and A describe the conditions under which this energy is used.

$$S = U \diamond A \diamond E$$

A service – economic production or social need – requiring energy is provided through the combination (symbolised by the sign $\diamond$, without any mathematical pretension) of methods or types of use (U), a specific technique or apparatus (A) and a certain quantity of an energy product (E).

The quantity of energy used varies widely according to the type of use and the apparatus used. If the use and the apparatus are "energy-efficient", energy use can be brought well below its current level, which is often characterised by wastefulness and non-rational uses.

An energy efficiency strategy should deal both with energy supply and demand. It is thus a set of economic, industrial and energy policy orientations and actions designed to provide consumers with an optimal service at a cost as low as possible, without harming existing ecosystems.

The energy end use strategy presented in this book concentrates on the demand side, that is, terms U and A, in order to optimise S. We will not discuss the efficiency of the energy production or transportation system, nor evaluate the type of energy that best suits particular uses, although these are undoubtedly important issues.

2.3 DEMAND ORIENTED ENERGY PATHWAYS AND THE COST OF PROVIDING A SERVICE

In conventional terms, an "energy pathway" is the path extending from the primary energy source (coal, oil, etc.) to the energy end use.

We argue that to find the optimal energy pathway, from an economic and environmental point of view, the same journey must be analysed in reverse, i.e. starting from needs and uses and working backwards. This "bottom-up" view of the process of energy use, illustrated in Table 1, can then be used as the foundation of an energy efficiency strategy. An energy efficiency strategy thus consists in determining this optimal pathway and implementing the measures, actions and programmes needed to bring it about.

The economic comparison between the various options (U ✧ A ✧ E combinations to provide the service S) will be made by calculating the "cost of providing the service, discounted over the period of use", which takes into account the cost of use (maintenance and operation), the cost of the equipment (investment) and the cost of the energy product, calculated from the beginning to the end of the "energy pathway" which permits going from the service provided to the primary energy source, as presented in Table 1. (The method of calculation of discounted costs is presented in Chapter III.3.2: Economic evaluation of energy efficiency projects.)

Thus, costs linked with providing an energy product (final energy) to the consumer, whether related to supply-side actions – production and distribution of the energy product – or to demand-side actions – from final energy to useful energy to the service provided – are taken into account in the same manner and with the same rationale.

The notion of cost of providing a service and the method of economic calculation it implies are extremely useful to present in a logical manner the various choices available and to rank the various supply-oriented and demand-oriented actions according to their economic cost.

This approach naturally leads to developing new economic instruments for energy policy elaboration, in particular "least cost planning", otherwise called "integrated resource planning". Least cost planning, which is presented in Chapter III.3.3, takes into account the diversity of actors implied in the implementation of programmes, permits to elaborate scenarii and programmes which are based on the final energy-consuming service and points to an optimal balance between the costs of energy saving measures and those of increasing energy production.

TABLE 1: FROM THE SERVICE REQUIRED TO THE ENERGY RESOURCE USED THE STAGES OF AN ENERGY PATHWAY

1. SOCIO-ECONOMIC NEEDS

Comfortable housing and workplace	Food Clothing Social and cultural activities	Communications Easy and safe transportation	Production of goods and services

2. SERVICE REQUIRING ENERGY

Space Heating Hot water Cooking	Lighting Domestic appliances Office and audio-visual equipment	Transportation of passengers and goods Telecommunications	Agriculture Manufacturing Mining

3. FORM OF USEFUL ENERGY

Heat - Fixed or mobile motive force
Light - Electronic
Electromagnetic - Chemical energy

4. ENERGY END USE EQUIPMENT AND APPLIANCES

Boilers - Motors - Furnaces - Bulbs
Electric appliances - Cookers - Ovens
Vehicles - Trains - Airplanes
Computers

5. END USE ENERGY DELIVERED TO CONSUMER

Solid fuels - Liquid fuels
Gas - Electricity
District heat

6. PRIMARY ENERGY TRANSFORMATION AND ENERGY TRANSPORTATION

Oil refineries - Power stations
Boilers - Tankers - Pipelines
Grids - Barges - Trains & Lorries

7. PRIMARY ENERGY

Fossil fuels: coal and lignite oil, natural gas	Renewable energies: hydropower, wind power, solar energy, biomass, geothermy, waste*	Nuclear energy: uranium

* Although certain types of waste can be exploited to produce energy, it is preferable, from an environmental point of view, to limit the generation of waste and favour recycling.

3

Integrated planning and energy policy

3.1 INTEGRATED ENERGY PLANNING

The objective of integrated energy planning is to execute the conceptual scheme presented in Table 2 and seek the optimal balance between energy efficiency action programmes and supply action programmes, by comparing their impacts on the economy and the environment. These impacts in turn influence trends in the development pattern and its sustainability.

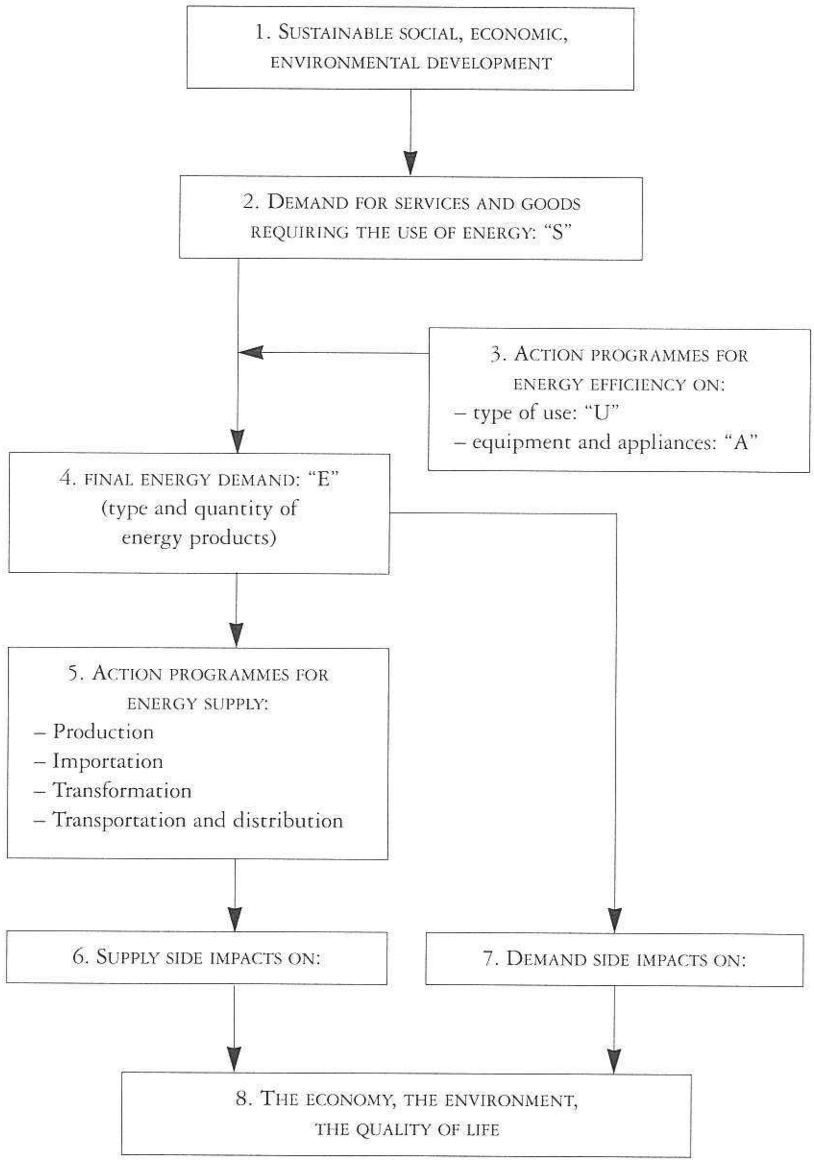
Table 2 presents the energy programming tasks needed to:
• define and programme demand-side actions;
• determine the level of energy needs to be met by the production and distribution system;
• compare options for energy demand-side action and energy supply-side action.

Table 2 presents, in graphical form, the key elements of integrated energy planning, the links between each element and the relations between the final results and the initial assumptions. Understanding the methodology presented by this diagram is of great importance for the experts in charge of setting-up the various options for energy policy and the decision-makers who have to choose between those options.

The starting point of integrated energy planning (Box 1) is the country's economic, social and environmental prospects for the future. These prospects depend on the country's current situation and its – forecast or hoped for – future development. This is the stage in which the political authorities have to provide the experts with development perspectives or options. It is also the stage where the requirements for sustainable development must be established. To be valid, these requirements must be democratically debated.

If several development options emerge, each one will be called a "development scenario" for which the basic data are: the evolution of economic activity, urban and rural development

TABLE 2: INTEGRATED ENERGY PLANNING



patterns, industrial, transportation and service development, environmental improvement or safeguarding, etc. Each development scenario induces demands for services and goods requiring the use of energy: industrial production, commercial and service activities, domestic life, transportation, etc.

Box 2 represents the term "S" of the previous chapter. Each of these activities is characterised by a type of use (mode of transportation for example), an equipment or appliance (a certain type of vehicle, boiler, refrigerator, etc.) and requires one or more energy product(s) depending on whether specific uses (electricity for lighting and domestic appliances or petrol for cars) or substitutable uses (various fuels for space heating or industrial production) are involved.

Energy efficiency end use programmes (Box 3) act on the types of use (term "U") and the energy consuming devices which are used (term "A"). Different energy end use consumption levels will be obtained depending on the scale of these programmes and the resources allocated to them. Hence, for a given "development scenario", various "energy efficiency scenarii" can be described which will provide different values of final energy demand (term "E"), both in terms of type and quantity of energy products used (Box 4).

On the basis of this final energy demand, several energy supply systems can be drawn up (or adapted), including energy production and/or importation, energy transformation, transportation and distribution (Box 5). For the same level of final energy demand, various "energy supply scenarii" must be studied to find the best energy balance in terms of costs, environmental impacts, jobs and political issues. For electricity production alone, for example, several scenarii can be envisaged and compared.

The supply system requires capital and operating expenditure, in local or hard currency, and thus has an economic impact (investment capacity take-off, borrowing, foreign trade balance). It has also environmental repercussions which we referred to earlier. At the national level, the economic and the environmental impacts are, with identical structures, generally proportional to the levels required by national energy use; however, they vary if there are substantial imports or exports.

The energy consumption system, both at the level of final use and at the level of energy efficiency actions, also has an economic impact through consumer expenditure (operating expenses or purchase of equipment and appliances) and also an impact on the environment.

Energy end use efficiency action programmes act on the consumption system (types of use and appliances) to reduce energy use, and thus can reduce the negative impact of this use, either directly (excessive consumer expenditure, damage to the environment), or indirectly, by way of the production system. They also have an impact on the economy (investment, possible importation of appliances) and an impact on the environment. The negative impact on the environment is generally very minor. This is why energy efficiency has an important advantage over energy production in terms of environmental protection.

Supply side impacts and demand side impacts on the economy, the environment, the quality of life are presented in Boxes 6, 7 and 8.

If the objective of the energy strategy is to provide a service (comfort, production, etc.) at the lowest economic and environmental cost, actions focusing on the consumption system should have exactly the same importance in strategic and policy terms (reduction of energy dependence and of risks of conflict), in economic terms (capital savings, competitiveness), in ecological terms (reduction of accidents and pollution) and in social terms (employment, quality of life and work), as actions focusing on the production system. It is thus legitimate for end use-oriented actions to be given attention and resources comparable to those for production-oriented actions in terms of structural, financial, human, technical and scientific resources. This sounds obvious but, in fact, few governments have yet devoted the same attention to end use energy efficiency actions as to their energy supply policies.
An optimisation of criteria coming from such different fields as energy, the global economy, the environment, is obviously an extremely difficult task. It has to take into consideration both quantitative data and qualitative options, and leads, at the end of the process, to political choices and decisions.

Mathematical and computerised models have been built to deal with the energy system (coupling energy demand and supply, optimising investments), but as regards the linkage between energy and economy, although models do exist, the problem is complex and the issue remains controversial. The impact of environmental problems on the economy, in particular the issue of "internalising external costs" is currently being researched. With regard to the impacts of the energy system on employment and jobs, the assessment method can, so far, only rely on sectoral analyses (the impact of a particular energy efficiency programme on job creation for example).

The idea that a large "global model" could solve the problem of such an optimisation must be rejected: on the contrary, it is the articulation of various tools in a continuous and iterative process that will allow progress in this field. The important point, in this process leading to decision making, is to organise the dialogue between the experts of various disciplines as well as the dialogue between the experts and the political decision makers.

3.2 ORGANISING AN OPEN DEBATE

In the end, the choices are political in nature: it is essential to be able to organise a democratic debate on all the options and approaches which will strongly shape the future.

Large energy policy decisions are most often debated within a tight circle of experts from administration and large energy sector enterprises. Even when the decisions are finally taken or endorsed by legitimate political authorities, the lack of a democratic debate is increasingly criticised, given that the positive impacts as well as the negative ones generated by these policies concern all of the citizens and the economic agents.

The integrated energy planning approach, because it is based on economic and social development scenarii for a region or a country, reinforces the necessity of an open political debate. Such an approach also brings the debate closer to and makes it more interesting for the "uninitiated" because the energy deliberation addresses themes and concerns which are close to daily experience: choosing modes of urban transport, urban development and social housing policies, creating new prospects in farming while managing natural and cultivated land sites better.

This approach essentially permits a discussion and the expression of all the actors concerned (citizens, associations, enterprises and representatives of the economic sphere, administrations and local elected officials, etc.) on the paths which should be favoured. They also permit the apprehension of the actors' strategies, detecting how and how much they will respond to future actions and thus better preparing their design and implementation.

The integrated energy planning "model" presented above should thus not be considered as an instrument of optimisation appropriated by a few energy experts but as a guide for action which supports debate and transparency in the decision-making process. Given the technical complexity of the issues addressed, it is equally important that the expertise does not remain in the hands of the large operators (electricity, oil companies, etc.) alone . The public authorities, the representatives of the economic sphere as well as the civil society must dispose of independent expertise.

3.3 AN INTERACTIVE, ITERATIVE AND CONTINUOUS APPROACH

The proposed approach is not limited to going through the steps indicated in Table 2 once and for all, nor even at periodical intervals. It should be interactive, iterative and continuous. Interactive, because the results of one phase or another induce modifications in the others and because, on most of the pathways between one phase and the next, the inverse pathway must be taken into consideration (for example, the influence of the action programme on forecasts and of the evaluation on the action programme).

Iterative, because the process begins anew after the last phase: evaluation provides new knowledge on the determinants of demand, new elements in consumption patterns (for example, the necessary identification of a new subsector), and thus modifications in forecasting demand and energy saving potentials, with the launching of new programmes, etc.

Continuous, because the "steering" and animation activities generated by the action planning are permanent. It is not a one-time job revised periodically (every five years, for example). It is a continuous activity which permits the adjustment of forecasts, evaluate achievements, plan new actions, refine the relationships with the partners, etc. Moreover, the evaluation permits a better understanding of the expectations of the consumers and the roles of the actors. It thus permits a more precise and targeted formulation of the action programme.

3.4 REGIONAL PLANNING

Energy efficiency is by nature a decentralised activity since it concerns a multitude of actors: industrial operators, transportation enterprises, local authorities, public and private services, households. The region is a geographical, administrative and political entity which is at an appropriate level to develop energy end use efficiency programmes.

Global energy supply policies are generally elaborated at the national level. However, depending on the administrative and political structure of the country, the administrative regions can have a considerable degree of autonomy in their energy choices.

In most regions, it is quite pertinent to elaborate a regional energy management plan, whether for energy efficiency or renewable and local energy development. This programme will be developed with the four following stages:
- consumption analysis and determinants of demand;
- exploration of future energy demand;
- action plan;
- follow up and evaluation.

In the case of a region, the various stages of the process we have described will not have the same importance as for the country. The stages "action plan" and "follow up and evaluation" are essential; on the contrary, it is not necessary (and often illusory) to attempt to analyse consumption and explore future energy demand in great detail: the aim, in this case, is not to establish a precise energy forecast (in order to discern the requirements) addressed to the energy supply system), but to highlight the most interesting potentials of rational energy use.

The essential point is that, in each region, there must be an organism capable of taking this responsibility in charge in order to organise and to implement the planning, launching, guidance, follow up and evaluation of the action.

4

The vital significance of energy efficiency for the countries in transition and the developing countries

4.1 THE COUNTRIES IN TRANSITION: THE EXAMPLE OF CENTRAL EUROPE

To make a very general comparison of the energy situation of different countries in relation to their economic situation, two indicators are used: energy consumption (primary or final) per capita, and energy intensity, i.e. the ratio of energy consumption (primary or final) to the gross domestic product (GDP). Energy intensity levels depend essentially on two factors: the structure of economic activity, and the level of energy efficiency for different energy uses.

We use as indicator of the economic level the GDP which is the sum of the positive or negative monetary exchanges of a country. Despite the problems which emerge in using this indicator – notably the fact that the level of the GDP is less important than its composition – it is the only economic indicator which is more or less universal. Although the purchasing power parity GDP figures we use approach reality much more closely than the GDP calculated with exchange rates, these aggregates should be used with caution, especially when comparing such different economic systems and situations as those of Central and Western Europe. The general findings given here must obviously be supplemented by sectoral analyses.

We have chosen the Central European countries as a typical example of the countries "in transition". The situation in the countries of the CIS (Commonwealth of Independent States) and in the Baltic countries is very similar.

In Table 3 we draw a comparison for the year 1990 between the five countries of Central Europe – Bulgaria, Hungary, Poland, Romania and the Czech and Slovak Republics (which made up a single country) – and compare them with the average for a fictive country, EUR, (the figures are obtained by dividing those for the European Union by twelve – number of member countries in 1992). It must be noted that the European Union itself is not homogeneous in terms of energy consumption indicators: consumption per capita and energy intensities are substantially different between the twelve Member States.

It is true that the economic situation and the energy consumption level and pattern have deeply changed from 1990 to 1997 in Central European countries. In some countries, energy consumption decreased considerably, due to a drop in industrial production (in particular in energy intensive industries). However, in general, energy efficiency has not improved, or only slightly, in the various sectors; in some of them, in particular in industry, it has deteriorated.

The 1990 energy consumption figures provide a good image of the energy situation of the Central European countries at the end of the period of centrally planned economy and before the deep economic crisis they have been facing since the early 1990's. These figures permit the understanding of the structural legacy in the energy consumption patterns better than more recent ones, which are, in several cases, those of deeply depressed economies.

In terms of surface area and population, the five countries of Central Europe are roughly similar to the EUR average. In 1990, per capita Gross Domestic Products were between 20% (Romania) and 53% (ex-Czechoslovakia) of the EUR average. Primary energy consumption per capita in the countries of Central Europe was between 70% and 130% of the EUR average.

Given the respective Gross Domestic Products, the primary energy intensities that result are clearly much higher for the countries of Central Europe, with the exception of Hungary. In 1990, the primary energy intensities of Bulgaria and Romania were more than triple the EUR average; for Hungary, Poland and former Czechoslovakia the factor varied between 2 and 2.4. Comparing final energy consumption gives similar results: very high energy intensities for Central Europe, between 2 and over 3 times the EUR average.

It is also instructive to compare "electricity intensities", the ratio of final electricity consumption to gross domestic product, expressed in kWh per US $. These are also markedly higher for Central Europe: compared to the EUR average, the ratio varies from 3.3 for Bulgaria to 1.6 for Hungary.

This general information is completed by a breakdown of final energy consumption by sector of activity for 1990, given in Table 4.

TABLE 3: ENERGY INTENSITIES OF CENTRAL EUROPEAN COUNTRIES (1990)

	BUL 90	HUN 90	POL 90	ROM 90	CZE 90	EUR 90
Aera (1.000 km^2)	111	93	313	238	128	197
Population (million)	9.0	10.4	38.1	22.6	15.6	28.6
GDP ($ billion)	37	67	194	80	132	454
Per capital GDP ($ 1.000)	4.1	6.5	5.1	3.5	8.5	15.9
PRIMARY ENERGY						
Total cons. (Mtoe*)	28	31	99	64	72	103
Per capita cons. (toe)	3.1	3.0	2.6	2.8	4.6	3.6
Intensity (toe/$ 1.000)	0.75	0.46	0.51	0.80	0.54	0.23
FINAL ENERGY						
Total cons. (Mtoe)	18	22	64	42	50	71
Per capita cons. (toe)	2.0	2.1	1.7	1.9	3.2	2.5
Intensity (toe/$ 1.000)	0.49	0.33	0.33	0.52	0.37	0.16
ELECTRICITY						
Total final cons. (TWh**)	35	31	96	54	73	133
Per capita cons. (1.000 kWh)	3.9	3.0	2.5	2.4	4.7	4.7
Intensity (kWh/$)	0.96	0.46	0.50	0.68	0.55	0.29

Source: ENERDATA

The energy data and GDP figures are taken from the ENERDATA data base (Grenoble, France, Fax : 33.4.76.51.61.45). GDP is expressed in US $ at 1990 values. "Purchasing power parity" GDP figures are used, calculated by CEPII (Centre d'Etudes Prospectives et d'Informations Internationales, Paris, France).
Reference : " Energy indicators for the countries of Europe and the CIS " (see bibliography).

* toe = metric ton of oil equivalent; Mtoe = million metric tons of oil equivalent
** kWh = kilowatt.hour; TWh = terawatt.hour = one million kWh

TABLE 4: FINAL ENERGY USE BY SECTOR OF THE CENTRAL EUROPEAN COUNTRIES – % – (1990)

	BUL	HUN	POL	ROM	CZE	EUR
Industry*	62	42	48	59	59	37
Transportation	15	15	12	10	7	28
Other	23	43	40	31	34	35

* including non energy uses

Source: ENERDATA

The sectoral distribution of energy consumption clearly shows the very marked difference between the countries of Central Europe – where, again with the exception of Hungary, heavy industry predominates – and the EUR average, where the three major sectors have approximately equivalent consumptions. The noticeably low energy consumption in the transportation sector is somewhat misleading because a part of goods transportation in Communist Eastern Europe was traditionally ranked as industry in energy accounting. However, the level of personal car use in Central Europe is much lower than in the Western countries.

The dominant position of industry in energy use is due to the strong expansion of highly energy-intensive basic industries, accompanied by an extensive exploitation of natural resources (particularly coal and lignite). Furthermore, this sector has a poor energy efficiency performance because of the age of the facilities and processes, an almost total lack of high-quality maintenance and, more recently, the fact that many plants have been operating below their nominal capacity, which results in further energy waste.

Energy costs as a percentage of total manufacturing costs vary greatly from one branch of industry to another, and from one country to another. In countries in economic transition, half the industrial consumption of commercial energy is accounted for by industries for which energy represents at least 15% of production costs, and sometimes much more, as in the steel, cement, fertiliser and paper industries. Energy costs are a key factor in determining the competitiveness of these industries. Yet, there have been few investments so far in measures to limit specific forms of energy consumption.
As a result, in certain countries, governments carry out policies which maintain energy prices below the real cost of production or importation, in order to protect their industrial base.

Such subsidies inevitably distort the choice between different energy sources and have a negative impact on the balance of payments and the state budget. If such policies continue for any length of time, they will necessarily entail serious consequences in terms of both the environment and balanced public finances.

Any energy savings, or the substitution of cheaper forms of energy, can therefore represent a major advance, both for the industries concerned and for the national economy as a whole.

As the service sector in the Central European countries is barely developed, consumption falling under the category: "Other" mainly involves the domestic sector, in particular district heating. The latter is generally in poor condition, from the heat production plant to the end use equipment: there are no regulating systems (even the most rudimentary taps are often lacking) and there is very little insulation in housing. In Bulgaria, the situation is exacerbated by the high degree of reliance on electric heating, which results in shortages at peak times in winter. Several countries find themselves in the apparently paradoxical situation (much to the irritation of their citizens) of having an abnormally high total energy consumption and yet experiencing power cuts and heating system shutdowns. The difficulty of assessing this situation is increased by the lack of energy use metering in the domestic sector in many Eastern European countries.

Substantial energy efficiency gains can be made in two major sectors: industry and housing. Since 1990, energy consumption in industry has sharply declined, not as the result of significant energy efficiency improvements, but rather of production cuts, particularly in heavy industry. It is clear that the first reductions in energy intensity will come mainly from industrial restructuring. However, these gains must not be used as a pretence for not launching energy efficiency programmes; the perpetuation of an inefficient energy use system will hinder economic recovery and prevent viable restructuring.

The issue of transportation is particularly interesting. In this sector, the "Western model" is a bad example, both in terms of the environment and the economy. In the West, the transportation sector is responsible for some 30 per cent of final energy use. Private cars are predominant in the transportation of people and lorries for the transportation of goods. This situation has had calamitous consequences: a high level of air pollution, especially in urban areas; an unacceptable number of accidents (in France, 10 000 deaths and 300 000 injuries each year); never-ending traffic jams which waste time, money and energy; increased use of oil products; soaring infrastructure costs, and so on. On this account, the Western model is a total failure, very difficult to rectify, and now one of the major problems in terms of energy, the environment and general quality of life for Western countries.

The countries of Central Europe have not experienced the same type of development and, on the whole, have well-developed and well-used urban public transport and rail systems providing fairly good public service. They can take action to avoid a headlong rush to a greater use of private cars and lorries. One of the first focuses of their "redevelopment" efforts should be, with the aid of international cooperation, to modernise and expand their public transport systems in urban areas and their train networks for the long-distance transportation of passengers and goods (and also their waterways, particularly the Danubian river system).

If the countries of Central Europe are to improve their economic and social situation, a sustained energy efficiency policy is essential in all sectors of activity. Without energy efficiency improvements, the energy system will impose an ever more unbearable burden on the economy and the environment of these countries and will absorb growing quantities of capital and foreign exchange, inhibiting the development of other sectors.

Energy efficiency is obviously the first energy "resource" which can be exploited. The potential is such that it leads to a approximate, but probably accurate, hypothesis: in less than twenty years, the countries of Central Europe can reach the same levels of energy productivity as the countries of Western Europe. If they do not, their economic and social development will be seriously hampered.

The findings of the European Bank for Reconstruction and Development (EBRD) report on "Energy in the Danubian countries" (see bibliography) are highly interesting in this domain. They show that consumption can fall very sharply, and be coupled with a marked growth in GDP, the composition of which must obviously undergo great changes. This is not a forecast, but sets out a reasonable objective which can be achieved if an integrated energy efficiency policy is implemented with sufficient political determination and the appropriate technical, economic and human resources.

Institutional and capacity building are prerequisites for promoting and implementing energy efficiency policies in the Central and Eastern European countries. Several countries have already set up agencies or centres devoted to this task. ARCE (The Romanian Agency for Energy Conservation) and the State Committee for Energy Efficiency in Ukraine, presented in Box 1, are two examples of such organisations.

The countries of the Commonwealth of Independent States have been studied in "La consommation d'énergie dans les pays de la CEI – Une image de l'avenir", B. Laponche, in La Revue de l'Energie, n° 478, juin 1996.

Box 1

ARCE IN ROMANIA

The Romanian Agency for Energy Conservation (ARCE) was established in 1990. It is a public organism which has the status of General Direction in the Ministry of Industries. The Director General of the Agency has under his responsibility three Departments at the headquarters in Bucharest and sixteen Regional Branches across Romania.
The total staff of ARCE is around 100.
Its operating and intervention budgets are provided for by the state budget. Its means are extremely limited. ARCE's activities are also currently supported by the PHARE Programme of the European Commission.

Contact: Bucharest, Romania. Phone: 40.1.650.64.70 / Fax: 40.1.312.31.97

THE UKRAINE STATE COMMITTEE FOR ENERGY EFFICIENCY

The Ukraine State Committee for Energy Efficiency was created by Presidential Decree in July 1995. The Committee, directly responsible to the Council of Ministers, is in charge of elaborating and implementing the governmental policy for energy efficiency. It coordinates the actions of the various Ministries and Regions in this field of activity.
The total staff is around 100.
Its budget, coming from the State's budget, is very limited. Its activities are supported by the TACIS Programme of the European Commission.

Contact: Kiev, Ukraine. Phone: 380.44.442.52.89 / Fax: 380.44.446.80.23

4.2 ENERGY EFFICIENCY IN DEVELOPING COUNTRIES

The energy consumption patterns of developing countries are quite different from those of Central and Eastern European countries. In general terms, energy consumption is low, on average ten times lower per capita than that of the industrialised nations: 0.5 toe compared to 5 toe per year. Tables 5 – 8 show the gap in energy consumption between developing countries and the industrialised nations (in the East and the West).

Of course, the term "developing countries" covers widely different situations, political and economic systems and rates of economic growth: South Korea or Mexico (now a member of the OECD), for example, cannot be equated with the Sahel countries. Nevertheless, with a

TABLE 5: COMMERCIAL 1 PRIMARY 2 ENERGY CONSUMPTION IN THE WORLD (1993)

	World	North America	Western Europe	Eastern and Central Europe	Asia	Latin America	Africa
Population (million)	5 497	290	381	421	3 265	463	678
Energy consumption (Mtoe)	8 2256	2 263	1 433	1 410	2 370	486	263
Per capita energy consumption (toe)	1,5	7,8	3,8	3,4	0,7	1,1	0,4

Source: ENERDATA

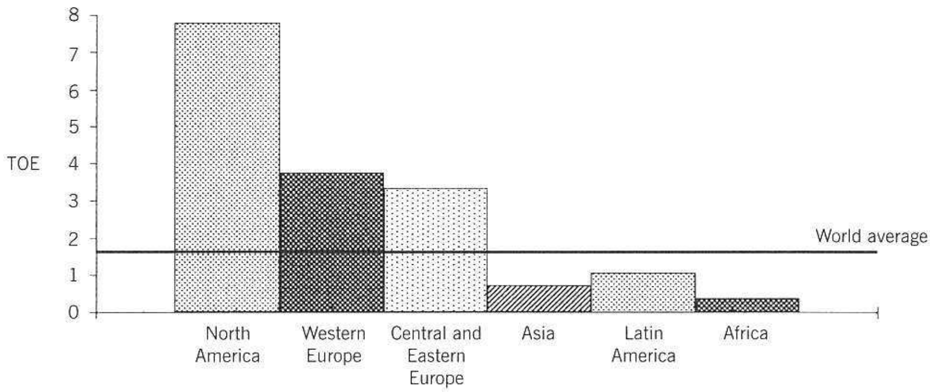
1. Oil, coal, natural gas, hydro-electric, nuclear; world biomass use, not entered here, is estimated at approximately 1 billion toe.
2. Primary electricity, hydro-power and nuclear, is calculated at 1 TWh = 0.26 Mtoe.

few exceptions, especially in South-East Asia, where energy consumption has strongly increased in the last decade and is now somewhere around the world average (1.5 toe per capita a year, still far below that of the industrialised nations), the other developing countries, particularly those with the largest populations (China, India), have very low energy consumptions per capita. For these countries, development will certainly be accompanied by an increase in energy consumption.

This low level of energy use explains why in most developing countries the initial reaction to the concept of rational energy use and, even more, to the suggestion that energy needs to be saved was one of opposition. These countries considered that their priority was boosting economic performance before they could start thinking about saving energy.

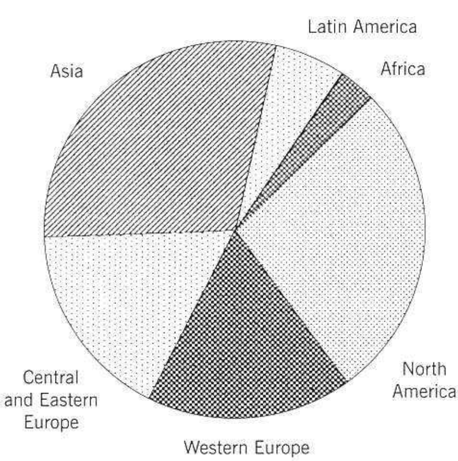
For the developing countries, the challenge is not to reduce overall energy use, but to achieve economic and social development with a much lower energy consumption than was characteristic of the industrialised nations in the past. An energy efficiency strategy will thus

TABLE 6: FINAL ENERGY CONSUMPTION PER CAPITA (1993)



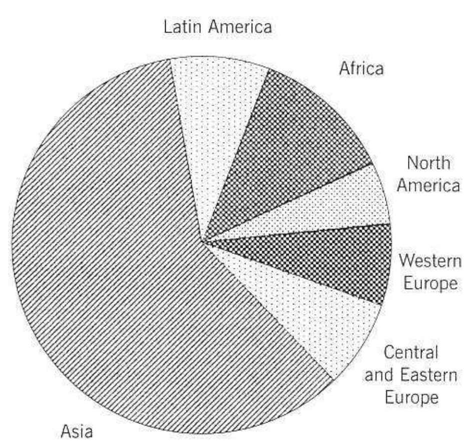
Source: ENERDATA

TABLE 7: WORLD ENERGY CONSUMPTION – MTOE (1993)



Source: ENERDATA

TABLE 8: WORLD POPULATION (1993)



Source: ENERDATA

enable them to devote more financial and human resources to other aspects of their economic development programmes.

An active energy efficiency strategy, integrated into the development process, will enable them to improve living standards and quality of life, as well as increase production of goods and services, without increasing energy consumption in the same proportions. Environmental quality will also be better safeguarded.

Despite their low levels of total energy consumption, most of these countries are characterised by strong internal contrasts: in urban centres and industrial facilities, energy is generally inefficiently used; in rural and peri-urban areas, energy consumption is very low and the low-efficiency use of wood or charcoal has dramatic consequences on the environment.

The affluent urban elite has acquired the same energy use habits as the populations of the industrialised world and are often even more wasteful. The lack of a public transport infrastructure gives free rein to the use of energy-intensive and highly polluting cars and lorries (See Table 9). Industry is often inefficient and highly polluting. In these areas and these facilities, the potential for energy saving is substantial (potential savings of between 30 and 50 per cent in industry are not unlikely).

TABLE 9: EXAMPLES OF SIGNIFICANT ENERGY CONSUMPTION GROWTH RATES IN THE TRANSPORTATION SECTOR OF DEVELOPING COUNTRIES FROM 1985 TO 1989

Country	% / annum
Philippines	35,7
Iran	21,8
South Korea	15,2
Thailand	14,0
Pakistan	11,4
Taiwan	10,9
India	9,7
World	3,4
OECD	3,6

Source: OECD

On the contrary, in rural and suburban areas, hundreds of millions of people lack the "bare minimum" of energy. Resources to meet this need can be freed by a more efficient energy use in the "wasting" sectors, and applied to the development of decentralised energy production systems together with more efficient equipment and appliances.

Because of the rapidly increasing population, many developing countries are seeing rapid increases in their demand for housing, transportation and services. There is thus a large potential for rational energy use in new factories, buildings and transportation systems. To implement this potential from the start is far less costly than to have to "recuperate" it later.

This means that an energy efficiency strategy is even more important for the economic equilibrium of developing countries than for that of Western industrialised nations. This is partly because of the large energy efficiency potential arising from the growth of their basic infrastructure and equipment use, and partly because, in general, their capital and foreign exchange expenditure to meet their energy needs accounts for a larger share of overall income.

The example of the Western industrialised nations is a useful indication of the energy efficiency methods and techniques which are effective and those which are not. However, there are a number of fields in which developing countries can apply original solutions adapted to their own situations, and which require an innovative effort on their part which goes beyond the simple transfer of technology. In many cases these countries could skip some of the stages experienced in the Western countries by technological leapfrogging, and introduce certain methods and techniques much more quickly than the industrialised countries did or are doing: low-energy light bulbs, solar-powered water heaters, bioclimatic architecture, high-efficiency refrigerators, power-saving computers, etc.

Several exploratory studies have shown that if the developing countries can use the best techniques available today (technically and economically), their energy use could be well below that of the Western European countries for the same level of economic development.

Efforts are being made by several developing countries in this field, in particular, the establishing of agencies in charge of energy efficiency promotion such as the Tunisian Agency for Energy Management presented in Box 2.

Box 2
AME

The Agency for Energy Management (AME) of Tunisia was established in 1986.
AME is directed by a Board of Directors including several Ministries (one representative of the Prime Minister's Office, one from Finance, two from Industry, one from Economic Development, one from Transportation, one from Equipment and Housing), a representative of the State Secretary for Scientific Research, a representative of the Directorate of Credit at the Central Bank of Tunisia, and two members selected on the basis of their competence in the energy field.
The Chairman of the Board is the Director General of the Agency, who has under his control six departments or directorates as well as the National Energy Observatory (ONE) which is in charge of national balances and forecasting.
The total staff of AME is 73 – of which 52% are executives.

AME is in charge of implementing the State's policy in the field of energy management. Its activities cover studying, planning, promoting and coordinating rational energy use and renewable energy development programmes. AME manages the national system of mandatory audits for large consumers, offers advice and surveys, finances energy studies, implements demonstration programmes, supports Research and Development actions and technological transfers. It also assists in the design of standards and regulation.
AME is funded by the State budget, external financing and grants from bilateral and multilateral cooperation.
It has a strong international role: coordinating bilateral or multilateral cooperation programmes in Tunisia and, more recently, experience-sharing programmes.

Contact: AME – Tunis, Tunisia. Phone: 216.1.787.700 / Fax: 216.1.784.624

CHAPTER II

Institutions and partners

Summary

The key feature of an energy efficiency strategy is that it extends over all economic and social activities. Its sphere of activity is not confined to the energy sector proper, nor to industry alone; its purpose is to contribute to the construction and development of an economy that is aware of and complies with consumers' interests, social needs and the quality of the environment. It thus influences a very broad range of activities, often almost imperceptibly when taken individually, but very appreciably when taken as a whole.

The success of an energy efficiency policy lies in the interaction between government action (energy prices, legislative and regulatory framework, institutions, incentives), the mobilisation of partners and economic agents, and efficient market operation.

Energy efficiency programmes will be successful only if they are designed and executed with the full agreement of all the economic agents directly or indirectly involved in these programmes. The implementation of projects to improve the efficiency of energy use is a decentralised and diversified activity: responsibility for it lies with enterprises – either in the control of their energy use, or in the manufacture or sale of advanced equipment – local authorities, government services, firms in the services sector and households.

To motivate this network of partners, to define with them an energy efficiency strategy and then promote, stimulate and facilitate the decentralised implementation of these guidelines by all economic agents, there is a need for specific entities: this public service, of a new type compared with the traditional role of government services or regional and local administrations, must be entrusted to competent institutions.

In many countries, political and administrative organisation is largely decentralised, and the provinces, regions or cities can, by setting up local teams or institutions, implement an integrated energy efficiency policy taking full account of local development and environmental protection concerns.

At the national level, any institution established to bear responsibility for the energy efficiency programme should have small but high quality staff, be endowed with full legitimacy, broad autonomy and suitable human and financial resources to carry out its task. It should not be the task of this institution to carry out projects itself, but to create suitable conditions for projects to be executed by the decentralised agents and to ensure that they have maximum impact in terms of technical, economic, social and environmental efficiency.

Lastly, international cooperation must emphasise the establishment or strengthening of "local capacities", since this is in the interest both of the partner countries, which will then acquire greater decision-making autonomy, and of the cooperating organisations, which will thus be able to rely on the competence of their partners in the definition and implementation of energy efficiency programmes.

Institutions and partners

1

The need for government involvement

It is often in the countries which have the strongest need for an energy efficiency policy that it is argued that economic and social activities must become energy-efficient by the sole pressure of market forces in a market economy. The advocates of non-intervention by government maintain that everything can and must be regulated by the consumer price levels of energy products.

It is true that matching energy consumer prices with the true costs of production and supply, before taxes are added, is a prerequisite for the energy system to function efficiently. This certainly avoids interventions and subsidies to the energy sector which in many countries are a heavy burden on public finance. This is by no means enough, however, to ensure an optimal level of efficiency: government involvement is necessary to ensure the interest of the collectivity and to defend the position of the consumers. Moreover, the manner in which the technological energy system affects the environment provides a strong and positive rationale for various forms of government action on the energy system.

All countries have institutions, organisms, and powerful enterprises which are in charge of energy production and supply. In the energy field, even where the enterprises are private, the State plays an important regulatory role, keeping an eye on prices, investments and international negotiations – a reflection of the central place of energy supply in a country's economic and social development strategy.

This concern with collective strategic responsibility, in which environmental issues are increasingly prominent, must be further developed for energy end use efficiency. But whereas the definition and coordination of a supply policy, involving only a few dozen major players, generally close to government, is relatively easy, the same cannot be said of the demand side, which is the result of investment decisions and decentralised behaviour at all levels in society.

Nevertheless, such vital orientations, particularly for the long term, cannot be left only to market forces, especially those of an international market over which most countries have no influence. Each country can take the initiative at national level to launch an energy efficiency strategy, the first stage of which should involve looking at how energy prices reflect economic costs and (to the extent possible) social and environmental "external costs". Governments must, however, play a more active role in planning the "optimal energy pathway" of the country.

Beyond that of setting energy tariffs, implementing an energy end use efficiency policy requires a wide and diverse set of tasks:

- establishing an integrated energy planning which takes into account energy demand and supply on an equal footing;
- establishing a legislative, regulatory, institutional and incentive framework;
- studying and understanding the behaviours of consumers and decision-makers;
- establishing coherent programmes, promoting them and creating the conditions for their implementation;
- informing, training, developing a network of partners and economic agents;
- monitoring and evaluating the actions implemented.

The secret of success of an energy efficiency policy lies in the appropriate structuring between the action of the public authorities (energy prices, legislative and regulatory framework, institutions, incentives, information, training), the mobilisation of partners and economic agents and the efficient operation of the market.

1.1 CONSUMER ENERGY PRICES

The price of energy products for the consumer results, partly from international markets and production costs – which are closely tied in with the level of investment in the energy sector – and partly from the fiscal policy of a country.

1.1.1 Reflecting production costs

For social policy reasons, energy prices are subsidised by governments in many countries. Dissociating the price of energy from its real production and supply costs with subsidies hinders the efficient management and operation of energy companies. It also increases government expenditure and significantly reduces the effectiveness of energy efficiency policies, as the consumer is not encouraged to save inexpensive products or services.

Subsidising energy prices, for industrial or social reasons, almost unavoidably leads to over-consumption of energy, cancelling the gains obtained through energy efficiency policies and increasing the impact of the energy system on the environment. Such aims can be better obtained through specific subsidies, such as incentives for industrial modernisation or housing allowances for low-income families.

To encourage the efficient operation of energy companies and to improve their management, to reduce government expenditure and to assist the economy to operate efficiently, it is essential that energy prices reflect energy costs. Many countries are making the effort to match prices with costs, despite the difficulties and the social or political obstacles. However, consumers should not have to pay the economic cost of an obsolete and inefficient production system. For instance, it is only when a district heating network has reached a relatively high level of efficiency that the consumer can be asked to pay the full price of the heat. It is the same for electricity: prices should ideally reflect the cost of a high-quality service and not that of inefficient over-capacity.

During the period of price adjustment, the State may continue to subsidise energy producers, enterprises or local authorities in order to keep them afloat. In this case, it is not the end user but the State itself which has a direct interest in saving energy and thus in implementing energy efficiency programmes. These programmes will reduce the burden on the public treasury and "prepare the ground" for realistic price increases acceptable to the consumer.

The impact of increasing energy prices and the impact of energy efficiency actions are indissociable and complementary. A sharp price increase will have a short-term effect, essentially by affecting behaviour, which may restrict demand (but not affect efficiency). This short-term effect is often reversible (this is very clear in the case of the use of private cars, for example), especially in the absence of an energy efficiency policy which uses incentives other than price. A durable signal of high or relatively high prices for energy will have a long-term effect of encouraging the adaptation and modernisation of techniques and improvements in technology. Manufacturers will take energy efficiency into account in their new models.

1.1.2 Taking into account external costs

From a collective point of view, energy prices based on production and distribution costs alone do not reflect the full costs of energy supply; it is increasingly important that "external costs" are incorporated into energy prices, in particular in terms of environmental and health hazards caused by energy systems (at both the production and consumption stages).

In practice, external costs can only be calculated if clean-up technologies or direct compensations are used. More often, it is quite impossible to evaluate them with any precision, and therefore, taxes on energy products appear to be the main means of internalising external costs.

Specific attention should be given to the transportation sector. In almost all industrialised countries, the State receives important financial benefits from taxes on petrol (see Table 10). These taxes are generally driven by budgetary considerations, rarely by an explicit will to take into account the external costs linked to the development of road transportation.

Quite often, gasoil, used in particular by professional transporters, is much less taxed than petrol. Nevertheless, if all the costs generated by the development of road transportation are taken into account (extending infrastructure, maintenance, land occupation, accidents, etc.), currently, the highest levels of taxes (case of the European countries) barely cover the public expenses for the use of private cars in inter-city transportation. The cost of inter-city goods transportation and urban travel is two to three times higher than the revenue from the current taxes.

It is thus quite legitimate to devote special attention to fuel taxes, given that these will have a strong impact on inter-modal transfers (towards collective transportation, railroads, boats or combined modes). A fiscal incentive will, however, only have a large influence if an appropriate offer of alternative means of transportation exists.

TABLE 10: LEVEL OF TAX ON THE PRICE OF A LITRE OF PETROL IN SOME OECD COUNTRIES (1994)

The United States	34 %	United Kingdom	74 %
Canada	50 %	Italy	76 %
Japan	50 %	Sweden	77 %
Spain	69 %	France	80 %

Source: IEA – International Energy Agency

1.1.3 Energy / CO_2 taxes

In the last few years, the discussions on taxes applied to energy products have focused on the use of a tax (an energy or CO_2 tax) to efficiently combat the greenhouse effect. Before any comments on this discussion, it should be recalled that classical taxes on energy products, and notably oil products, the objective of which is to increase the State's income (and not energy end use efficiency) are by far more important than the so-called energy or CO_2 taxes. Furthermore, the countries which have established CO_2 taxes in the past few years do not have energy product tax levels greater than those which did not.

In 1992, the European Commission proposed the progressive implementation (over ten years) of an "Ecotax": a levy on energy products (around US $ 10 per barrel of oil equivalent at term), with a significant part (50%) based on the CO_2 content of the product. To avoid raising the overall level of taxes on energy, a fiscal redistribution is required, the modalities of which are left up to each government.

In December 1994, the European Commission abandoned its plan to levy a universal tax on CO_2 emissions. (The ratification of the United States and Japan was considered a prerequisite to the adoption of this measure.)

In principle, the Ecotax is an attractive measure: everyone recognises that curbing emissions will be difficult if energy prices remain low or constantly fluctuate. Consumers are not encouraged to save or substitute energies, as has been shown over the last few years and industrial operators have no reason to place energy efficiency among their priorities. The main advantage of an Ecotax is thus to create a price signal, stable at medium and long term, and capable of orienting technical progress towards more energy efficiency.

However, after further thought, it is not that simple. Firstly, many evaluations show that, if not accompanied by other types of actions, the direct results of the Ecotax are minimal, particularly in the sector which raises the most problems: transportation. Secondly, an Ecotax which would be implemented in the most wealthy industrial countries (OECD) would not bring about any response to the main challenge, i.e. energy efficiency in developing countries and countries "in economic transition". Moreover, in its current definition, the Ecotax implies that environmental risks related to CO_2 are more alarming than other risks related to energy. Considering our current knowledge, there is nothing to justify privileging the combat against CO_2 over the fight against other dangerous long-term energy-related risks, and notably radioactive waste from nuclear power plants.

Box 3

THE DANISH FUND FOR ELECTRICITY SAVINGS

To support electricity consumption management efforts and to reduce CO_2 emissions, the Danish Government adopted in December 1996 a decree for the creation of an electricity saving fund. Several studies in Denmark have shown that investments in electricity savings were more cost-effective than investments in the electricity generation system, both in economic and environmental terms.

The aim of this fund is to finance electricity saving initiatives in the public and domestic sectors. The main objective is to promote the substitution of electric heating by district or natural gas heating. Part of the financial resources will also be devoted to developing, introducing and disseminating efficient domestic equipment on the market.

The electricity saving fund will be supplied by a tax of 0.006 Danish crowns (0.001 US $) on the kilowatt.hour, i.e. around 2 % of the cost of electricity production, collected from the consumers in the public and domestic sectors.The fund will amount to a total of 90 million Danish crowns (around 16 million dollars) per year.

This fund is managed by an autonomous Board of Administration, composed of representatives of the consumers, the professional groups concerned, the electricity utilities and energy efficiency experts.

Electricity utilities, district heating or natural gas suppliers can participate in calls for tenders organised by the fund or can propose, on their own initiative, electricity saving projects

Contact: Danish Energy Agency – Copenhagen, Denmark. Fax : 45.33.11.47.43

As the starting point of any discussion on an energy tax, it must be admitted that this tax will only be efficient if the greater part of the income generated is allocated to programmes and actions permitting to develop energy efficiency and renewable energy. Moreover, part of the income generated by such a tax should be allocated to cooperation programmes with developing countries or countries in transition since environmental protection in these countries also calls for, in priority, the search for a higher energy efficiency.

We also consider that if a levy is established, it should concern final energy consumption in order to concentrate the efforts on end use energy efficiency. The decision to allocate the income generated by a levy to energy efficiency programmes and actions permits significant results with initially low tax levels, e.g. around 1% of the price of the final energy consumed. The aim of the tax is not to increase prices sharply to prompt energy saving or substitution but to:

- indicate to the economic agents the new public priorities by a durable price signal of a small value;

- collect funds which will prompt these agents to implement innovations and investments.

Such a decision can be taken by any country unilaterally, without waiting for a unanimous international decision.

1.2 BARRIERS TO THE IMPLEMENTATION OF AN ENERGY EFFICIENCY STRATEGY

Beyond the question of energy prices, there are a number of other obstacles to energy efficiency, more so in developing countries and the countries in transition, but also in industrialised countries. Even when a consistent energy price structure exists, most energy saving opportunities are not taken, even when the cost of the energy saved is well below the cost of producing the same amount of energy. There is thus a large potential for reducing both direct energy costs and environmental impacts.

For consumers

Theoretically, consumers should take decisions according to the global cost of meeting energy needs which comprises an initial investment, the energy bills and maintenance over the lifetime of the equipment. Consumers have to balance between investment today and operation costs tomorrow. In practice, it appears that:

- Consumer behaviour reveals a strong "preference for the present" which means an inclination to limit present investments and accept increased future operation costs. At the level of the community, this means that energy efficiency investments with a high rate of return are not made and the resulting extra energy needs are met through less cost-effective supply investments. This implies a serious imbalance between supply and demand investments with unnecessary costs for consumers, the society and the environment.

- Frequently, investment capacity limitations lead consumers to prefer the lowest initial cost solution. This is for example the case of a family financing the construction of a new house through a loan. Banks use debt income ratios to assess loans, but traditionally do not include reduced energy costs due to extra investment in energy efficiency in their calculations.

- Moreover, self-financing capacities and loan facilities are far superior for energy producers than for energy consumers, in terms of both interest rates and terms of reimbursement.

• Lastly, those who make the investment decisions are not always those who pay the operating costs (the owner of a house makes the investment and the tenant pays the electricity bill for example). Likewise, the consumers' choices are quite often determined by the territorial development policies adopted by the authorities (the existence of a high-quality urban transport system, for example).

Therefore, there is a disparity between the supply side and the demand side that should be removed if the conditions for a normal market approach to energy efficiency are to be created.

Hence, while the price issue is fundamental to orient market operation, cost effective energy efficiency policies or measures are needed to reduce the market imperfections mentioned above. This is where government has an important role to play.

For the community

The perception of the national or international interests is not the responsibility of the final user. In his economic choices, the consumer, whether an enterprise, town, or household, is not sensitive to the costs in hard currency of an energy expense, nor to the consequences that an energy consumption increase in the industrialised countries could have on the developing countries. The interests of the national community (and even less of the international community) are not directly reflected in the interests of the final user. This justifies public intervention.

The market is short-sighted; it is incapable of taking into account the medium and long term and anticipating with enough advance the rarefaction of resources, geopolitical risks or low-probability catastrophes. The public authority is thus responsible for these issues.

There is a lack of information and economic training of policy-makers, business leaders, elected representatives at the national and regional level, local authority planners and technical staff, as well as consumers, as to the potential and the ways of implementing energy efficiency measures, especially as regards the use of advanced equipment. Often, the most basic information, such as the energy consumption of various activities, is not well known, even in industry.

There are not enough engineering and consultancy firms at the national and local level capable of implementing projects; there is a shortage of measuring instruments and metering devices; energy-efficient equipment is often hard to find on the market and may be relatively expensive or pose maintenance and replacement problems.

The general shortage of capital for new investments is amplified by energy policy decisions which have almost always favoured supply side measures, even when funds from international cooperation is involved. The financial means allotted to energy end use efficiency are not sufficient.

One important obstacle is the manner itself in which energy efficiency policy is perceived, especially by decision-makers: energy efficiency suffers the major handicap, from the perspective of policy-makers, of being neither immediately visible nor spectacular. When a major energy efficiency programme has been successfully implemented and thousands of tonnes of hydrocarbons have been saved, there is no grand opening of a new power station or motorway. Energy savings are generally counted as relatively small increments. It is crucial, therefore, that politicians are convinced of the real value of energy efficiency and on its immense potential on the medium and long term.

1.3 THE REACTION OF THE INDUSTRIALISED COUNTRIES TO THE OIL SHOCKS OF THE 1970s

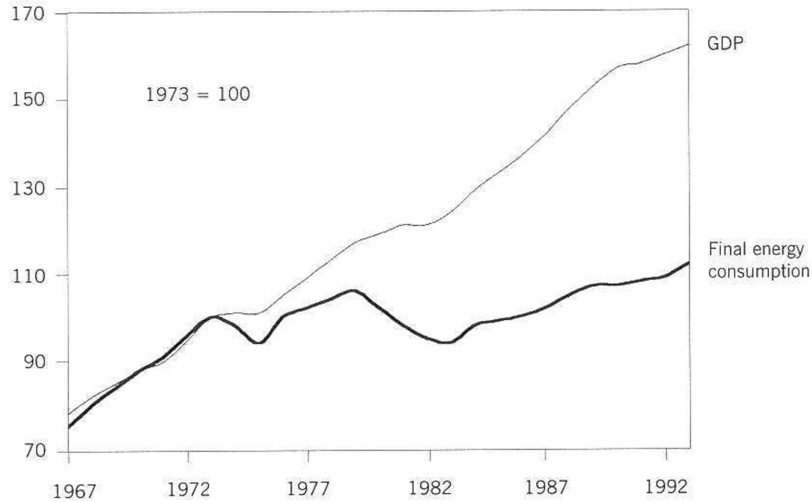
The first confirmation that concerted government action can improve energy efficiency came in the wake of the sharp oil price increase of 1973-74. Western industrial countries responded with vigorous energy efficiency policies to which they devoted substantial resources and continued their economic development despite the price rises.

Over the subsequent fifteen years, per capita energy use in the OECD countries virtually stabilised while their gross domestic product increased by around 30 per cent. (If the energy intensity of OECD countries had remained at its 1973 level, energy consumption in 1987 would have been 1 200 Mtoe higher – Mtoe = millions of toe, tons of oil equivalent.)

The energy price increase was the factor which triggered these energy efficiency policies. However, they did not develop spontaneously as a result of market forces, but by means of detailed institutional, technical and economic organisation.

In a context of fierce international competition, the major energy-intensive industries (steel, aluminium, chemicals, cement, paper, etc.) can only survive if they adopt energy efficient production processes. In this situation, these industries have incentives to launch energy efficiency programmes, without public aid. However, government support is often provided in the OECD countries to speed up the modernisation process and to increase the competitiveness of national firms.

TABLE 11: GROSS DOMESTIC PRODUCT AND ENERGY CONSUMPTION OF THE OECD COUNTRIES



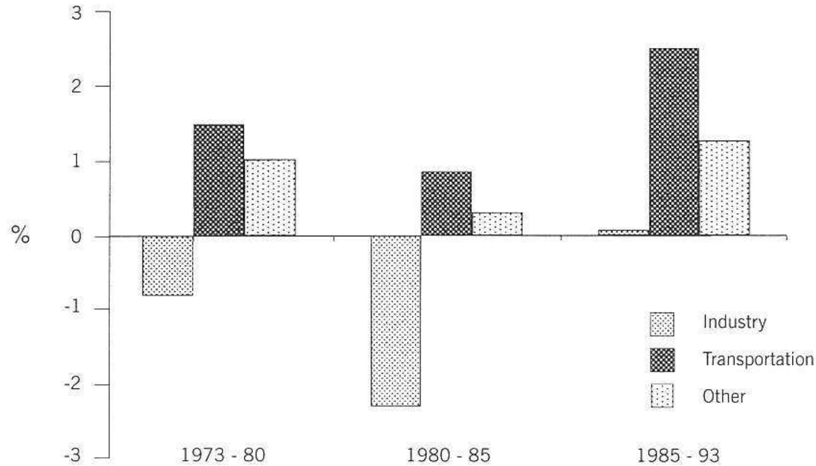
In other sectors, including other branches of industry, energy expenditure is not generally high enough to oblige the consumer to take immediate action. If the price is higher than what the consumer can afford, the short-term response will perhaps be a reduction in consumption, in other words a reduction in the service rendered, which is not a sign of greater energy efficiency.

The fundamental problem is that while the energy bill represents a substantial financial burden for the community, the price signal is not enough to push consumers to take independent action. Moreover, even when a consumer wishes to implement an energy efficiency operation, he often cannot if the appropriate means are not provided.

A range of publicly funded programmes implemented since the mid-1970s in Western Europe, Japan and the United States illustrates how the concerted action of governments, local authorities, industrial groups and consumer associations can shape consumer behaviour and demonstrate the economic value and the technical feasibility of schemes which encourage efficient practices and equipment. These programmes include:

- research and development programmes to improve industrial processes, building techniques and materials, electrical motors and appliances, etc.;

TABLE 12: AVERAGE ANNUAL EVOLUTION OF ENERGY DEMAND BY ACTIVITY SECTOR IN THE OECD COUNTRIES



Source: ENERDATA

- regulations on energy use, particularly for buildings, but also in some cases for cars and electrical appliances; standards and labels; compulsory energy audits for large consumers (industry, services, transportation);
- information programmes for consumers and training programmes for technicians and managers;
- financial incentives (subsidies, soft loans, tax breaks) to encourage innovation, demonstration or energy efficiency investments;
- creation of institutions, organisations and service enterprises for the design and implementation of energy efficiency programmes and projects.

Thanks to these programmes, the economies of the OECD countries are currently more efficient. Nevertheless, the global decoupling between the increase of GDP and the increase of energy consumption conceals significant dissimilarities in the evolution of each activity sector (see Table 12).

1.4 EXAMPLES OF THE EVOLUTION OF ENERGY CONSUMPTION AND ENERGY EFFICIENCY OPERATIONS IN THE LARGE CONSUMER SECTORS

The four following examples illustrate the evolution of energy consumption in the Western industrialised countries, and the complementarity between public intervention and the market.

1.4.1 The residential sector

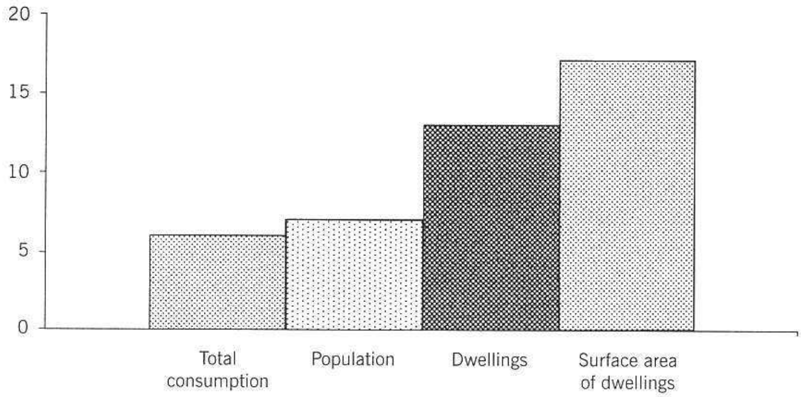
In the residential sector, final consumption is based upon:
- the potential final demand for services requiring energy (which depends on the number of dwellings, the unitary volumes heated, the number and type of appliances, etc.);
- the frequency or level at which these services are used (which depends on the heating temperature, the number of lights on at the same time, etc.);
- the energy efficiency of the equipment used.

The energy consumption increase observed in this sector masks the combination of two trends which point in opposite directions: a consumption decrease linked to energy efficiency improvements and an increase of this consumption, linked to an improvement in comfort.

Table 13 shows that, for all of the IEA (International Energy Agency) countries, the total energy consumption increase in the residential sector occured at a slower rate than the increase of the population, the decrease of cohabitation (the number of dwellings increases faster than the population) and the improvement of comfort and quality of life which is illustrated by the increase in apartment surfaces.

The gains in final energy efficiency have thus exceeded the new needs of services. In fact, it is in this field that most of the energy efficiency efforts have been made in the residential sector since 1974, bringing about a reduction of 20 to 30% of energy intensity in the OECD countries.
These gains are mainly due to a noted improvement in the quality of construction of new buildings. Most of the OECD countries have progressively enforced thermal regulations which permitted the reduction of heating and hot water consumption in new buildings by 40 to 60%, compared to those built before the oil shocks. This was possible without prohibitive extra costs through the evolution of building methods, the use of new materials, etc. In existing buildings, large efforts were also made (insulation, rehabilitation of the heating

TABLE 13: THE RESIDENTIAL SECTOR: COMPARATIVE GROWTH RATES (%) OF A NUMBER OF INDICATORS – IEA COUNTRIES (1980-1988)



Source: IEA

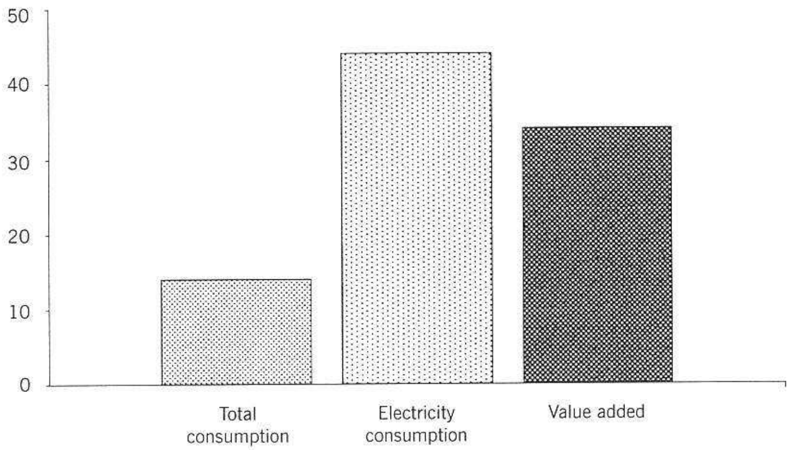
systems, etc.) but the evolution is less marked since the implementation of improvement operations meets with more technical, financial and institutional difficulties.

1.4.2 The service sector

Table 14 illustrates a similar trend in the total energy consumptions of the service sector: the increase of the total consumption over the 1980-1988 period is less than that of the value added (which is the indicator used to measure the demand in final service of this sector). We can observe, here again, an improvement of the sector's final energy intensity, measured by the ration energy consumed / value added. However, there is a decrease in the electricity intensity of the service sector, i.e. electricity consumption increased more rapidly than the value added produced.

The three main explanations for this phenomenon are:
- a strong increase in specific electricity demand, essentially linked to the development of computer technology;
- substituting fossil fuels by electricity for heating;
- the increase in air-conditioning.

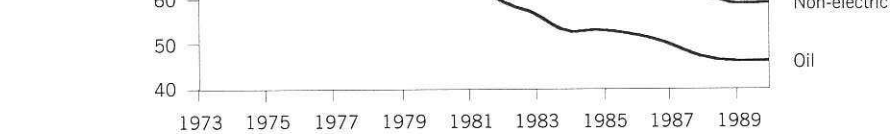
TABLE 14: THE SERVICE SECTOR: COMPARATIVE GROWTH RATES (%) OF A NUMBER OF INDICATORS – IEA COUNTRIES (1980-1988)



Source: IEA

TABLE 15: FINAL INDUSTRIAL SECTOR ENERGY INTENSITY IN THE OECD (1973-1990)

TOTAL FINAL CONSUMPTION (TFC) IN MTOE DIVIDED BY INDUSTRIAL PRODUCTION INDEX



Source: IEA, Energy Balances of OECD Countries.

TABLE 16: INDUSTRIAL SECTOR CONSUMPTION BY TYPE OF ENERGY (%) – OECD

	Oil products	Natural gas	Electricity	Coal	Other solid fuels
1973	44	21	13	19	3
1991	35	25	19	15	6

Source: IEA, Energy Balances of OECD countries

1.4.3 The industrial sector

Industry accounts for about 30% of final energy demand in the OECD countries. As a proportion of final energy demand, industrial energy consumption fell by 5% in the OECD countries in the 1970s and 1980s. Final energy intensity (i.e. the ratio of final energy demand to value-added in real terms) fell by 35% over twenty years (see Table 15).

This overall trend nonetheless conceals significant variations between the different forms of final energy (see Table 16). Overall energy demand per unit of output has fallen, but at the same time electricity and natural gas have often replaced oil and sometimes coal.

This substitution of oil products largely contributed to reducing the energy intensity of this sector, electricity being much more efficient than traditional fuels in some processes. Structural changes within the industrial sector – i.e. the shift towards product lines which require less energy per unit of value added – have also widely contributed to reducing energy intensity.

However, the main factor which decreased energy intensity in the different subsectors of industry is a more efficient final use of energy, whether this comes from a net reduction in energy consumption by an industrial process or the substitution of one form of energy by a another (see Table 17).

TABLE 17 : AVERAGE ENERGY SAVINGS IN THE INDUSTRIAL SECTOR IN THE EUROPEAN UNION (1975 -1990)

- Steel making: from 24 Giga Joule (GJ) to 20 GJ per tonne, approximately a 15% savings;
- Tile making: from 3.6 to 2.7 GJ per tonne, a saving of more than 20%;
- Cement making: a 20% reduction since 1975;
- Chemical industry: from 41 to 34 GJ per ton of ammonia produced over ten years, i.e. a savings of nearly 20%;
- Agro-food industry: a 30% reduction since 1975;
- Paper and cardboard industry: around 15% savings since 1978 in integrated plants producing pulp and board.

Source: European Commission

In many Western industrialised countries, energy saving activities have focused particularly on the industrial sector. There are a number of reasons for this:
- even if potential energy savings are less than in other sectors, for example private households, these savings can be achieved at a relatively low cost – on average, at a third of those in the household sector – with a return on investment of often less than three years;
- energy saving measures can often play a significant role in the modernisation of industry and in improving its competitivenes;
- energy accounting and the understanding of the cost of energy are more familiar issues in the industrial sector than in other activities.

Four types of measures were taken to generate these efficiency gains:
- better management, operating and maintenance practices, generally linked to the companies' efforts to improve energy metering and accounting;
- simple moves such as control systems and insulation, which generally require low outlay and often have pay-back times of less than one year;
- equipment renovation, add-on technologies, energy substitutions and other investments requiring higher outlay;
- new industrial processes, which may or may not be connected to energy substitutions.

Since the mid-1970s, all the OECD countries have introduced programmes and measures aimed at broadening the choice of technologies available, motivating industries and speeding the decision-making process. The most widespread measures (see Table 18) are promoting energy audits, financial and fiscal instruments to support investments (for example,

Table 18: Public Sector Activity to Improve End Use Efficiency in the Industrial Sector

Country	Equipment Appliance Labelling	Equipment Appliance Standards	Building Standards Audits	Financial Incentives	Audits
Australia	X	X			X
Austria				X	X
Belgium				X	X
Canada		X		X	X
Denmark				X	X
Finland				X	X
France	X			X	X
Germany				X	
Greece				X	
Ireland					X
Italy				X	X
Japan		X		X	X
Luxemburg				X	X
The Netherlands		X		X	X
New Zealand				X	X
Norway				X	X
Portugal				X	X
Spain				X	X
Sweden				X	X
Switzerland	X				
Turkey				X	X
United Kingdom			X	X	X
United States	X	X		X	X

Source: OECD, Paris

special grant or loan schemes for energy efficiency investments, third party financing, allowing companies to reduce the period of depreciation of the energy efficiency investments they make, etc.), public-sector support for research and development to trigger larger R&D investments by the private sector through attractive formulae, labelling and standards, technology dissemination, information and training.

Industry is using an increasing amount of electricity, a tendency which is expected to grow further. Electricity utilities thus have a growing influence over energy efficiency in the industrial sector and they tend to play an increasing role in energy conservation through Demand Side Management (DSM) programmes. The range of services provided by utilities is about the same as mentioned above (audits, information, aid to decision making, funding, etc.); utilities appear to be well-positioned to implement effective programmes.

The industrial sector is interested in energy efficiency not only as an energy consumer but more and more in terms of producing efficient equipment and appliances which save energy and/or protect the environment in all activity sectors.
Energy efficiency represents a new source of employment in the industrial sector.

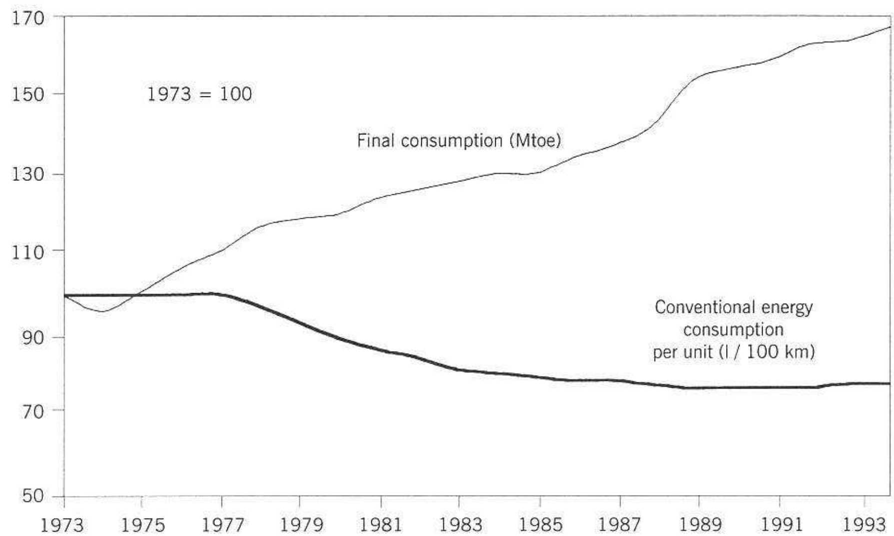
1.4.4 The transportation sector

Whereas the transportation sector is characterised by a strong dependence on oil and represents on average 30% of the final consumption of the OECD countries, the energy efficiency policies implemented in the industrialised countries after the oil shocks have been unable to curb the energy consumption increase in this sector. The result is that contrary to what took place in the sectors mentioned above, the energy consumption of the transportation sector in the OECD countries has increased steadily since 1975 and with increasing speed since the first oil countershock of 1986.

The main efforts were focused on improving the specific consumption of vehicles, and few of them concerned global traffic flows. Furthermore, as shown in Table 19, the decrease in the conventional specific consumption is insufficient to compensate for the deterioration of traffic conditions, the modal transfers from rail to road (in particular for goods transportation due to the development of "just in time management").

Transportation is a sector where the individual consumer currently has little choice, for there is often no alternative to private cars: when little or no public transportation is available or when it is unadapted to the various needs of mobility; when the various economic activities

TABLE 19: ENERGY IN THE TRANSPORTATION SECTOR IN THE OECD COUNTRIES



Source: Ademe, Paris

(work, domestic life, service and commercial activities, etc.) are situated in separate zones of a city, a situation which entails increased traffic.

In response to this situation, new trends are emerging: some cities are succeeding in developing various and complementary alternatives (for example, by developing park and ride systems, bicycle rentals in town centres). The example of the TGV in France shows that even in a context where road travel is preponderant, developing and improving the convenience of rail travel makes modal transfers possible. In the case of the "Atlantic TGV" which links Paris to the West of France, the number of passengers increased from 10 to 22 million from 1990 to 1992. This rise corresponds to a traffic increase of around 3.5 billion passengers.km, of which 60% is due to the transfer from road or plane to rail (and the other 40% due to an increase in demand). The corresponding energy saved reaches 40 000 toe per year.

2

Promotion and leadership institutions and structures

Energy efficiency policies apply to all economic or social human activities. To be implemented, action programmes must be designed and carried out in harmony with the economic agents directly or indirectly concerned.

All the partners concerned by such a strategy – end users, standards authorities, designers and builders, public partners (such as local authorities) and private partners – must be involved in the very first stages of its preparation in the same manner they would be associated with its implementation and with its evaluation.

Public institutions are needed to carry out public sector functions for energy end use efficiency: organisation of the network of partners; elaboration, coordination and launching of programmes; follow-up and assessment of projects and measures.

2.1 THE ROLE AND NATURE OF ENERGY END USE EFFICIENCY INSTITUTIONS

With varying positions and status, public bodies charged with promoting, facilitating and implementing energy end use efficiency strategies exist in most OECD countries (see European examples in Box 4) at the national or regional level (in some regions of Italy, France and Spain for example). This is also true for some developing countries which have launched energy efficiency programmes (Tunisia, South Korea, Thailand, etc.) and some Central and Eastern European countries (Romania, Hungary, Ukraine, Russia, etc.).

The implementation of projects to improve the efficiency of energy use is a decentralised and diversified activity. Responsibility for it lies with enterprises – either through the control of their energy use or through the manufacture or sale of advanced equipment – local authorities, central government services, service sector firms and households.

The task of an institution charged with developing a national energy efficiency programme is not to carry out the energy efficiency projects themself, but to create the conditions which permit projects to be executed and have a maximum impact in terms of technical, economic, social and environmental efficiency. Such an institution should promote, support and facilitate the introduction of more energy efficient technologies and management in all economic sectors: this is indeed a public service activity of a new nature compared to the traditional role of the State or regional and local administrations. It is a role which requires considerable skills in leadership, dialogue, prompt intervention and assessment of the problems and constraints which affect a very wide range of partners. In particular, as decentralisation of decision-making is a prerequisite for the success of an energy efficiency strategy, the institution must be skilled at empowering others to make decisions.

The experience of several countries suggests the following approach:

Decentralised teams or offices can be created – especially in the case of larger countries – at regional level or covering large urban areas or industrial centres. The virtue of having local teams or offices is that they are close to consumers, have a concrete knowledge of the field and can thus develop programmes geared both to the orientations of the national programme and to the specific regional or local requirements. In accordance with national administrative organisation or structure, these teams may be attached to the regional or local authorities or to the national energy use control organisation. The first option is generally preferable since it respects the spirit of the decentralisation of initiatives and avoids making the national structure too cumbersome.

A national body could be empowered to:
- integrate the objectives of energy efficiency into the economic, industrial, R&D and energy policy of the country;
- design a national energy efficiency programme;
- propose national decisions regarding regulations and standards;
- give impetus to and coordinate energy efficiency research, development and innovation programmes;
- organise and promote national energy audit programmes, demonstration operations, and programmes for the dissemination of efficient techniques;

- organise and coordinate national aids and financial incentives;
- participate in international cooperation.

These bodies, at both the local or regional and national level, must be light structures with highly-qualified staff.

To avoid starting off on the wrong foot or creating ambiguities, the status of the national body in charge of energy end use efficiency must be well-defined. A certain number of pre-requisites must be fulfiled to ensure its maximum efficiency:

- If it is to be successful, the national body should have sufficient legitimacy and authority to mobilise the public and private partners in a coherent endeavour, including the other government ministries and administrations involved. To that end, the institution should have a clear mandate and government support at the highest level in the framework of a clearly defined policy. Though small in size, the institution should have highly skilled staff capable of carrying out diversified and complementary tasks, in particular dialogue and negotiation with the partners, in the fields of technology, economy, the environment, training and information. This staff must be carefully selected, mobile, correctly paid and continuously trained.

- The institution should have broad management autonomy and the ability to take prompt action. As a promotion and leadership body, it should be separate from traditional administration and should not be restrained by the classical state apparatus, the objective of which is completely different. If it is located within or on the outskirts of the administration for reasons linked to structural choices, it should have exceptional leeway in management and activity.

- The institution must have sufficient financial resources to:

– meet its own expenditure for staff and equipment, economic studies, communication and information purposes, training requirements, and participation in international activities;
– give direct financial incentives (subsidies) for some operations (energy audits, preliminary studies, demonstration operations, innovation aids, aids for diffusion of advanced equipment).

These financial means can be provided for by central government funds, special national or regional energy efficiency funds, private capital (especially when combined with government underwriting) and by international cooperation in the case of developing countries and the countries in transition.

If these conditions are fulfilled, and if the human resources allow it, one approach which might be suitable for many countries is to set up an "Energy Efficiency Agency" or "Centre", which would be an autonomous (financial and administrative) public body under government responsibility. The "position" of the Agency (or Centre) is important: it would be more effective if it were not under the sole responsibility of the Minister of Energy, as is often the case, but directly under the authority of the Prime Minister or the Minister of Economy (or Planning in some countries) since energy end use efficiency addresses all sectors of activity.

In cases – particularly in small countries – where human and financial resources are limited, the best solution may not be an Agency, since there is a risk that it would not attain "critical mass" and would not have the authority, competence and funds needed. In this case, the mobilisation of the partners and the tasks which we have described could be organised from within the government apparatus, while still respecting the conditions set out above. For this purpose, a "unit" directly responsible to an important minister (the Prime Minister or Minister of Economic Affairs) could be established to serve as a "headquarters", with responsibility for the integration of energy management into general policy, the design of a national energy use control programme, the promotion and incentives policy, and leadership of the network of partners. This unit would mobilise and be supported by the services and directorates of the various ministries concerned (economy, industry, transportation, construction, agriculture, environment, etc.), and particularly the energy department, whose operational capacity must be strengthened in the field of energy management. This arrangement will make it easier to galvanise energy producers and distributors. An organisation of this type could be a transitional stage on the way to creating a fully-fledged Agency.

The great advantages of building permanent and specific institutions devoted to energy efficiency are coherence of approach and the capacity to follow through and implement an energy efficiency strategy. The prerequisites are political will at the highest government level, freedom of action and autonomy of management, and the employment of high-quality human and financial resources.

2.2 THE ORGANISATION AND THE MISSIONS OF ENERGY END USE EFFICIENCY INSTITUTIONS

The organisation and tasks of an institution in charge of implementing the energy efficiency policy depend on the human and financial resources available in each country. We outline in the following paragraphs what may be considered an optimal case. This outline assumes that the "institutional model" can be implemented in a decentralised fashion, if the tasks are clearly assigned.

The general tasks include communication, organisation of training activities, economic studies, formulation of regulations, and financial engineering.

The objective of communication is to explain the importance of energy efficiency, to inform the partners and to increase the awareness of the programmes, their achievements and the role of the Agency. This covers a broad range of activities:
- keeping the Agency's own staff informed of its objectives and programmes;
- informing the partners involved: decision-makers, enterprises, local communities, government services, households. There are various means of providing this information: books, brochures, newsletters, audiovisual presentations, exhibitions, media and public relations activities;
- establishing a documentation centre.

Energy efficiency is a new discipline which applies to most activities and proccesses and can be used by many different people. Engineers, technicians, economists and managers must all keep abreast of energy efficiency techniques and methods. In addition, it is essential to the implementation of an energy efficiency strategy that training needs be clearly identified: training bodies should be mobilised in all fields starting with schools and universities; special training courses should be organised with all partners.

The economic studies cover a very broad field, from the global assessment of energy management (macro-economic assessments) to assessing the profitability of specific projects: energy demand analysis (the Agency should be the source of reference on such matters); forecasting trends in energy demand; integrated action programmes; evaluating the energy saving potential by sector; economic and environmental evaluation of projects and programmes (an ongoing evaluation from the outset of a project is of great importance).

Regulatory action is a powerful instrument of an energy efficiency policy. While a variety of government ministry levels are in charge of enacting and monitoring regulations, it should be the task of the Agency to propose the most appropriate regulations, discuss them with its partners and create the conditions for their application.

One of the main objectives of the Agency is to enable consumers (enterprises, local communities, households) to invest in energy end use management under the best possible conditions. The Agency's direct financial resources will rarely be sufficient for it to provide significant financial incentives for capital investments; it must therefore be able to set up attractive financial arrangements with funding agencies and banks and to propose them to its partners. Even if the Agency's financial resources are not matched to its needs, it is essential that it has financial competence (both national and international).

The technical tasks consist in organising the technical support needed by the consumer to execute efficiency projects and in developing the production, importation and use of new and efficient equipment and facilities.

These tasks cover a wide range of fields and types of activities:

- mobilising and encouraging partners in research and technological development of energy efficient facilities and equipment;
- drawing up, with partners in the industrial and commercial sectors, the criteria governing importation, the issue of licences and production authorisations for high efficiency equipment; developing national capacity in this field;
- organising demonstration operations;
- organisating energy audits, preliminary surveys and assisting consultancy and engineering bureaux to build up expertise in energy use management;
- organising, with economists and financial institutions, the most appropriate incentive systems for the various partners;
- developing expertise on the environmental impacts of energy efficiency measures.

Where regional teams exist, they should work in direct contact with consumers; the objective is to create a dynamic symbiosis between decentralised local projects and national programmes.

Activities which are mainly technical should generally be organised on a sectoral basis in the light of the techniques to be applied, and also of the partners involved: industry, housing and services, agriculture (and fisheries in some countries). But care should be taken to ensure that a sectoral breakdown does not mask the value of "grouped" projects aimed at specific targets: action programmes such as "energy efficiency in towns and cities" and "energy efficiency in the rural environment" should be given very high priority.

Box 4 shows how various national institutions of the European Union (and Norway) have organised a network to promote energy efficiency.

BOX 4

EXAMPLES OF NATIONAL INSTITUTIONS IN EUROPEAN COUNTRIES TO PROMOTE ENERGY EFFICIENCY: THE "EnR CLUB"

The EnR Club, or "European Energy Network", is an organisation bringing together the expertise of fifteen national agencies or organisations (in May 1996) in European countries, active in the field of energy efficiency. Among their activities, these institutions have four basic activities in common:
- formulating energy strategies;
- stimulating and coordinating research and development programmes;
- implementing demonstration programmes;
- disseminating and promoting energy efficiency methods and techniques.

Most of these organisations are also in charge of developing renewable energies and efficient technologies. Many of them also play a part in environmental protection.

In May 1996, the members of the Club were: Ademe (France), AEL (Luxemburg), CCE (Portugal), CRES (Greece), DEA (Denmark), ENEA (Italy), ETSU (United Kingdom), EVA (Austria), FORBAIRT (Ireland), IDAE (Spain), IFE (Norway), KFA-BEO (Germany), NOVEM (Netherlands), NUTEK (Sweden) and TEKES (Finland).

ADEME: AGENCY FOR THE ENVIRONMENT AND ENERGY MANAGEMENT, IN FRANCE

A public body responsible to three ministries: Environment, Industry (with responsibility for Energy) and Research, Ademe replaced the French Agency for Energy Management (AFME) in 1992, in the field of energy efficiency and renewable energies.
The Agency has three national centres and 26 regional delegations, with a staff of about 600.
It draws up and coordinates research and development programmes and innovation and demonstration projects, and offers advice to consumers (enterprises, local authorities, households) in the fields of rational energy use, renewable energy development, air pollution and waste recovery and use.
Its regional action programmes are conducted in cooperation with the elected Regional Councils (Regional Energy Management Funds).

Contact: Phone: 33.1.47.65.24.77 / Fax: 33.1.47.65.22.29

AEL: AGENCY FOR ENERGY OF LUXEMBURG

A private company created in 1991 by the Ministry of Energy, CEGEDEL – the electricity utility of Luxemburg – and SEO – the national importer and producer of electricity.
AEL promotes the rational use of energy sources, renewable and "soft" energies, decentralised energy production, etc.

Decisions are taken by the Governing Board (5 members), the general orientation is defined by the Steering Committee (3 members) and implementation is ensured by a task force (3 members).

Contact: Phone: 352.40.65.64 / Fax: 352.40.87.68

CCE: Centre for Energy Conservation, in Portugal

CCE is an association, under the authority of the Ministry of Industry and Energy, of the major public research and development institutes, and public enterprises in the energy and industry fields.
It focuses on energy efficiency and renewable energy development.
The Centre is located in Lisbon, and has a staff of about 50 (1996).
Its budget is funded by contracts with the energy administration (Directorate General for Energy), public utilities (for example, the Portuguese Electricity Company), associations and the European Commission (notably THERMIE programme).

Contact: Phone: 351.1.471.14.54 / Fax: 351.1.471.13.16

CRES: Centre for Renewable Energy Sources, in Greece

A public body responsible to the the Ministry for Industry, Energy and Technology.
Its task is to promote the use of renewable energy resources and energy efficiency.
It is funded by the government, by participation in public and private sector projects and by European Commission projects (for example, THERMIE programme).
It employs a staff of about 100.

Contact: Phone: 30.1.60.39.900 / Fax: 30.1.60.39.904 / 5

DEA: Danish Energy Agency, in Denmark

A public body and operational arm of the Energy Ministry.
Its tasks are to implement the energy policy (the Danish Government's "Energy 2000" action plan), particularly with regard to energy efficiency and renewable energies, to administer legislation on energy matters, and to advise the government. It employs a staff of about 250, specialising in technical, legal and economic areas.

Contact: Phone: 45.33.92.67.00 / Fax: 45.33.11.47.43

ENEA: National Agency for New Technologies, Energy and the Environment, in Italy

Directly responsible to the Ministry of Industry, Commerce and the Crafts, ENEA is a public body acting on the government's behalf in the field of energy research, studies and statistics and in implementing the government policy on energy efficiency and renewable energy (National Energy Plan, 1988).

It has a total staff of about 5 000, working in several research centres and technology diffusion centres. Approximately 600 people work in renewable energy sources and energy efficiency development.

Contact: Phone: 39.6.30.48.34.32 / Fax: 39.6.30.48.39.30

ETSU: Energy Technology Support Unit, in the United Kingdom

A national energy technology centre in charge of promoting energy efficiency in industry and commerce and of stimulating the development and use of renewable energy sources.
ETSU carries out work for the Department of Energy, the Department of the Environment, the Department of Trade and Industry, the European Commission, electricity companies, etc.
It employs about 140 specialists in energy efficiency, "clean" technologies and renewable energy.

Contact: Phone: 44.1.235.43.67.47 / Fax: 44.1.235.43.30.66

EVA: Austrian Energy Agency, in Austria

The task of EVA is to promote rational energy use and renewable energy. In this context, it is responsible for preparing the National Energy Plan, drawing up energy efficiency strategies for viable development, carrying out economic analyses of energy systems, and promoting and disseminating efficient methods and techniques.
It is a (non-profit making) federative association whose administrative council consists of the Federal Chancellor, the Minister for Economic Affairs and the President of the Conference of Regional Governors. Its members are the federal and regional administrations and about thirty energy institutions and companies.
It provides a forum for the exchange of information and for cooperation.
It employs a permanent staff of about 20.

Contact: Phone: 43.1.586.15.24 / Fax: 43.1.586.94.88

FORBAIRT (an Irish word for development), in Ireland

A new national agency, established on January 1st 1994, funded by the central government, with responsibility for developing Irish business enterprise and the technology needs of industry. It brings together the functions of EOLAS (Irish Science and Technology Agency) and the Industrial Development Authority (IDA).
FORBAIRT manages the technological R&D programmes financed by the Ministry for Science and Technology, promotes and coordinates Irish participation in European Union Programmes, and provides scientific expertise and technical, financial, management and marketing support for entreprises.
FORBAIRT has a total staff of about 800, working in 13 centres around the country. Twenty-one permanent staff are employed on the energy programme, plus temporary and external staff.

Contact: Phone: 353.1.837.01.01 / Fax: 353.1.837.28.48

IDAE: Institute for Diversification and Energy Savings, in Spain

An autonomous private firm linked to the public sector through supervision by the Minstry for Industry, Commerce and Tourism.
It invests in energy efficiency, cogeneration and renewable energy projects, using government funds.
It also performs service activities for the Spanish Government, the European Commission (notably the THERMIE programme) and private sector companies.
It employs about 100 persons.

Contact: Phone: 34.1.556.84.15 / Fax: 34.1.555.13.89

IFE: Technical Energy Institute, in Norway

A public sector R&D and promotion body working mainly for the Ministry for Oil and Energy, the Norwegian Royal Council for Scientific and Industrial Research, and the Departments of Water and Energy.
Out of a total staff of 560, 50 are employed in the Energy Efficiency Department.
IFE has three main activities in this field:
- the "Energy in Industry" programme of demonstration projects;
- the "Energy Efficiency Information Centre";
- the programme of state subsidies for energy efficiency investments in industry and in public and private buildings.

Contact: Phone: 47.63.80.60.00 / Fax: 47.63.81.29.05

KFA-BEO: Biology-Energy-Ecology Department of the KFA Institute, in Germany

KFA is a research centre at Jülich, the largest such centre in Germany, employing a staff of over 4 000.
BEO, is the Biology-Energy-Ecology Department within KFA and has a staff of about 180.
Its activities include the preparation of research programmes, the assessment of project proposals, recommendations for their funding by the federal budget, monitoring of projects and evaluation of their results.
In the energy field, these activities extend over the entire Federal Research Ministry research programme, apart from nuclear energy and a few other sectors dealt with elsewhere (such as energy efficiency in transportation).

Contact: Phone: 49.24.61.61.38.83 / Fax: 49.24.61.61.58.37

NOVEM: The Netherlands Agency for Energy and the Environment, in the Netherlands

A public body financed by contracts, mainly with the Department of Economic Affairs, NOVEM organises and coordinates government programmes in the field of energy efficiency, new technologies (especially renewable energies) and the environment.

It seeks to stimulate R&D and promotes energy efficiency techniques in the industrial and building sectors.
It employs a staff of some 250 in three centres and five regional offices.

Contact: Phone: 31.464.202.202 / Fax: 31.46.528.260

NUTEK: Swedish National Board for Industrial and Technical Development, in Sweden

NUTEK was established in 1991 as the legal arm of the Swedish Ministry of Industry and Commerce. Its two most important duties are to promote the growth and regeneration of Swedish industry and to promote long-term changes in the country's energy system. It manages the national energy research programme, promotes and introduces renewables on the market, carries out analysis and energy economic studies, ensures energy planning and coordination, surveys the operators of the deregulated electricity market, implements strong programmes on More Efficient Use of Energy and manages the programme for an Environmental Adapted Energy System in the Baltic States and Eastern Europe.
It employs a permanent staff of approximately 410 specialists in technical, legal and economic areas.

Contact: Phone: 46.8.681.91.00 / Fax: 46.8.19.68.26

TEKES: Technology Development Centre in Finland

Established in 1983 by the Ministry of Trade and Industry, TEKES coordinates and finances applied technical and industrial R&D.
Among its programmes, in the field of energy, TEKES covers rational energy use, renewable energies, fossil and fusion topics through 11 energy technology programmes, in particular a renewable energy technology programme, two energy and the environment programmes and five energy end use programmes.
TEKES employs a staff of 200 in all with a staff of 10 in the energy division.

Contact: Phone: 358.0.69.36.74.73 / Fax: 358.0.69.36.77.93

3

The network of partners and economic agents

Energy efficiency measures are ultimately carried out at the level of the end user: industrial and commercial enterprises, local communities, government services, transportation firms, households.

The large number of economic agents involved is one of the greatest difficulties in implementing these measures. Another difficulty is that in many cases the final decision does not rest with the end user. In the case of housing, for example, there may be a difference of interest between owner and tenant. An owner may prefer to install cheap appliances, even though their running costs are higher for the tenant. The tenant has little motivation for undertaking long-term improvements to his rented accommodation. Furthermore, consumers do not have a clear perception of their energy bill because of a lack of information regarding the benefits of rational energy use (and the lack of energy consumption metering in many countries).

Energy producers and distributors

Producers and distributors of energy products are the best organised and most powerful players on the energy scene and enjoy a monopoly situation in many countries, especially in the case of electricity. They also very often receive state subsidies. Despite their public service obligations, their management criteria have traditionally been based on increasing their sales volume. Thus, producers and distributors may have a limited interest in promoting rational energy use, and may even be hostile to it.

If energy efficiency programmes are to work, however, the power companies must be involved, for they know the market well, have frequent contact with the consumers of their products and, especially in the case of electricity distributors, have a large workforce deployed in the field.

The attitude of energy companies towards energy efficiency is beginning to change in many areas: a number of energy companies are aware of the value of energy use management for consumers, for the nation as a whole and for themselves. They are realising that:

- their real task is to provide the consumer with the best service possible at the lowest cost;
- more rational use will allow them to provide more services for the same quantity of delivered energy;
- a curbing of the growth in demand will allow them to stagger their investments better;
- managing demand, not only at peak periods, can bring them substantial money savings.

SUPPLIERS OF ENERGY-RELATED EQUIPMENT AND SERVICES

Suppliers of energy-related equipment and services are quite numerous: building designers and construction firms, manufacturers or importers and retailers of cars, domestic electrical appliances, light bulbs, engines,etc. On the services side, it includes the distribution networks, consultancy and engineering firms, financial service providers, training bodies, research centres, technical centres, and repair shops. Lastly, "energy service companies", for example heat supply companies, are becoming more and more widespread in Western countries.

For these suppliers and service providers, energy use is often a side issue and the selling point of their product often rests on unrelated criteria, above all price. Their main motivation for energy efficiency is the desire to win or increase their market share by the sale of innovative, competitive and lower-cost equipment. Their role is a key one in a market economy. Part of an energy efficiency policy will be to examine with these professionals approaches for bringing the most energy-efficient processes and appliances to the market. The regulatory, incentive and promotional measures of the energy efficiency policy will have a strong impact on this category.

INSTITUTIONAL BODIES

Institutional bodies also have an important role to play: centralised and decentralised government technical services, technical centres and local or regional development bodies. This category is very important in the designing, launching, monitoring and supervision of programmes.

IMPORTANCE OF PARTNERSHIP

Energy efficency programmes will be successful only if they are designed and executed with the agreement of the economic agents directly or indirectly participating. All the actors we have mentioned are concerned but each of them has his own rationale in terms of profitablility, his own financial resources and technical competencies.

This implies that a specific effort is required to mobilise the various actors. Such partnership is necessary to mobilise and establish links and dialogue between the state departments, regions, cities and other administrative bodies and to make enterprises and other users more aware of the collective interest of this approach. Moreover, numerous tasks linked to "immaterial" investments (promotion, market expansion) can only be performed in the frame of a wide partnership, equally necessary to serve as a relay for the dissemination of efficient techniques and the replication of successful operations.

Whether to guarantee the coherence and continuity of a national policy or to ensure the full effectiveness of international cooperation, the pooling of the human, technical and financial resources of each of the partners is imperative in any coherent and durable programme. It is all the more important for developing countries and the countries in transition, for which international cooperation can play a decisive role. It is vital that these countries draw up and carry out their own programmes through a consistent approach and not in the form of a series of dispersed projects lacking continuity.

4

Decentralised projects and programmes: energy efficiency in the provinces and regions, cities and towns, and the rural world

Energy efficiency measures can be implemented in all sectors of activity at the level of the end use of an energy product. Some changes in energy-use habits and techniques can be obtained by means of national or international guidelines and decisions (European Union regulations, for example), but, unlike energy production, efficient energy use has to be achieved through a whole range of measures widely dispersed in sectoral and geographical terms: a centralised initiative is necessary but not sufficient.

The success of an energy efficiency strategy in the service of sustainable development is very closely linked to the decentralisation of efforts to draw up and implement action programmes.

Centralised planning has led to dramatic failures in terms of energy efficiency, as demonstrated by the the present situation in the Central and Eastern European countries. The success of energy efficiency policies in other countries, by contrast, has highlighted the importance of involving the citizens in the energy policy-making process, of decentralising responsibilities and involving partners in the implementation of programmes.

The success of energy efficiency policies also requires that the action programmes be matched to the state of development and the local economic, cultural and social characteristics, which often vary widely from one region to another even within one country.

While the methods of government involvement and intervention in the industry, transportation, domestic and service sectors are general in nature, it should be remembered that they need to be tailored to each specific context in which they are applied.

An issue frequently raised is the interface between national programmes or international ones (in the case of the European Union, for instance), and regional or local programmes. How can the convergence, compatibility and coherence of these policies and programmes be guaranteed?
Let us first note that the risk of a dysfunction between these various levels is much lower for energy efficiency than for other areas, particularly for energy production. There is nevertheless still a need for overall coherence. The most operational method could be linking organisations responsible for implementing the national policy and those developing local policies by contractual relations requiring joint discussion, formulation and negotiation of programmes.

We shall now examine some aspects of projects in areas of application with specific features: the regions, towns and cities, and the rural environment and its particular productive sector, agriculture.

4.1 PROVINCES AND REGIONS OR STATES

In many countries the political and administrative organisation of society is largely decentralised: the regions (in Russia, Germany or Spain, for example) or the states (in the United States, India or Brazil) have elected local authorities vested with substantial control over economic policy. Energy issues, because of their major impact on economic activity, employment, the quality of life, and the environment, are regarded by these authorities as of the greatest concern, both from a political point of view (reflecting the will of their citizens) and from a regional development point of view. In these regions, where there is a high degree of autonomy, drawing up an integrated demand-side energy policy and implementing an energy efficiency policy have the same role as in a country.

These policies may vary widely from one region to another, as is the case in the United States, with the development of efficient electricity use policies by California and the North-Western and North-Eastern States. Similarly, it is at the level of the "Länders" in Germany, the "autonomous regions" in Spain and the "oblasts" in Russia that energy efficiency policies of varying intensities have been drawn up and implemented.

Even when they do not have this degree of autonomy in structural policy for geographical reasons, the regions and provinces have come into existence for geographical or historical reasons and thus usually constitute relatively homogeneous economic and social units where action programmes tailored to specific local needs and to the concerns of local inhabitants can be applied with success. Regions and provinces would thus constitute the appropriate geographical and economic framework for action programmes involving energy efficiency (which must be close to consumers) and the development of local and renewable energy resources.

The European Union has made much use of the potential for regionally based programmes. In the context of energy policy, the regional energy planning programme designed by the Directorate General for Energy encourages the drawing up of energy plans in each region of the States within the Union. Similarly, in the context of regional policy there is the use of the European Regional Economic Development Fund for energy efficiency projects. In several countries, specific regional programmes are also being developed as part of national policy, for example regional energy efficiency funds in France, and "Law 308" in Italy (as shown in Box 5).

Box 5
ITALY: OVERVIEW OF THE LAW 308 / 82

The Law 308 passed in 1982 established a public subsidy system for energy efficiency investments. This financial aid coming from the State budget was allocated at regional level (21 regions) on the basis of projects submitted either by enterprises, the regional or local authorities.
Over the 1985 - 1987 period, the global results of this actions were the following:
- number of projects awarded: 64 205
- total amount of susbsidies: 1 696 billion lire
- total amount of investments made: 5 814 billion lire
- amount of energy saved per year: 6.01 Mtoe

The public subsidy represents on average 29% of the investment. The average unitary cost of the investment per toe saved was 968 000 lire.
Most of the projects were in the industrial sector: these industrial projects represented an annual energy savings of 4.3 Mtoe (i.e. 14% of the total energy consumption of the industrial sector).
The programme was carried out in a very different manner from one region to another: the first six regions (Lombardia, Puglia, Emilia Romagna, Piemonte, Toscana and Veneto) counted for 81% of the total energy savings, of which 20% solely in Lombardia.

A new law (Law 10 - 91), passed in 1989 and prolonged until 1995 replaced Law 308 with larger budgets for energy efficiency projects and renewable energy development.

Remark: the financial amounts are expressed in 1983 lire (for 1983, 1US $ = 1 200 lire).

Contact: ENEA – Rome, Italy. Phone: 39.6.30.48.34. 20 / Fax: 39.6.30.48.39.30

The importance of the region as the appropriate arena for energy efficiency is acutely felt in the countries of Central and Eastern Europe, where it is reinforced by the desire to achieve genuine decentralisation, to discourage a possible return to centralised state power. This is reflected in the establishment of regional teams or agencies, as in Poland, of regional delegations of the national agency, as in Romania, of local energy efficiency teams or agencies at the level of republics, regions or large cities in the Russian Federation.

The key to defining and implementing an energy efficiency policy at the regional level is the creation of a specific local institution (see Box 6), which will play an active role in the regional development process. The experience of several countries shows that a multi-disciplinary regional team with a dozen or so members can achieve a great deal in terms of promotion and leadership in a region.

Islands form a special type of region. They are often at a disadvantage, especially if they are small, because of the high cost of energy resulting from transportation requirements (hydrocarbons) or the scale of production capacity (electricity). They are therefore especially suitable places to develop energy efficiency and renewable energies (wind and solar power, in particular). Here, too, the key to success is the establishment of a local team as part of the island's government, in charge of defining an integrated energy programme and formulating and implementing programmes and projects.

Box 6

FOUR EXAMPLES OF REGIONAL AGENCIES

GRAPE, GROMOSLASKA AGENCJA POSZANOWANIA ENERGEE, KATOWICE REGION, IN POLAND

GRAPE is in charge of the energy saving aspects of the regional economic policy programme being implemented by Katowice Voivodeship. GRAPE is a limited liability company, created in March 1993. It has 22 shareholders including the thermal power stations, the municipalities, the heating companies and one foreign institution (Malmö, Sweden). It has 8 permanent staff members.

Contact: Katowice, Poland. Phone: 48.32.587.722 / Fax: 48.32.586.823

ICAEN, Institut Catala d'Energia, Catalonia, in Spain

ICAEN is a public company forming one part of the Department of Industry and Energy of the Generalitat of Catalonia. It was created in 1991 with the task of promoting the efficient use of energy and contributing to adapting Catalan energy structures to new international market conditions. The Institut has a staff of 15.

Contact: Barcelona, Spain. Phone: 34.3.439.28.00 / Fax: 34.3.419.72.53

ENERGIEAGENTUR NRW, North Rhine-Westphalia, in Germany

The Energy Agency was set up in 1990 at the initiative of the Ministry of Economy and Technology of the North Rhine-Westphalia Region. It is a private limited company with a staff of 15. Its purpose is to inform companies and municipalities in the largest German federal state on the means available to promote more efficient use of energy and to provide consultation services. Advice to applicants for subsidies also falls within its responsibilities. The Agency provides free advice and information primarily to small and medium-sized companies, as well as to local authorities in towns and cities.

Contact: Wuppertal, Germany. Phone: 49.202.24.55.20 / Fax: 49.202.24.55.230

AREAM, Agencia Regional da Energia e Ambiente da Regiao Autonoma da Madeira, Madeira, in Portugal

AREAM, Agency for Energy and Environment of the Autonomous Region of Madeira, is a private non-profit association, created in 1993 on Madeira island with a staff of 6. Its main purpose is promoting rational energy use, renewable energies and environmental protection. It assists, both technically and scientifically, local and regional authorities and develops projects and studies in these areas, involving both energy users and producers. AREAM is an active member of ISNET, the "Island Network" created in 1993 with the support of the European Commission.

Contact: Madeira, Portugal. Phone: 351.91.226.266 / Fax: 351.91.225.129

4.2 CITIES AND TOWNS

4.2.1 A privileged initiator

The other fundamental arena for an energy efficiency policy is the city or town. Cities are the focal points of both dynamic development and its most glaring contradictions. From the large conurbation to the small or medium-sized town, urban areas are daily confronted with the problems of energy distribution (and in many cases energy production), transportation, waste, air and water pollution, public lighting, and the comfort and living (or survival) conditions of the inhabitants.

At city level, the issue is most often not to define an energy policy in the true sense, but to draw up a coherent programme of actions in those fields where energy and environmental problems interact (see Box 7).

The city, therefore, occupies a strategic position in the implementation of an energy efficiency and pollution control policy:

- it is often the producer and distributor of energy in its territory;
- it consumes energy (buildings, transportation, service and craft activities, industry, etc.);
- it is, in large measure, in charge of urban planning and regulations in the field of buildings and urban development;
- it also has an important role in providing incentives for the various socio-economic actors.

In all countries, cities are administered by a responsible authority, the municipality (almost always elected) and its technical services which deal with the day-to-day situation and can influence it.

The city is an entity with many features which qualify it to play an active role:

- it constitutes an administrative, financial and political unit, which makes homogeneous decision-making possible;
- it has responsibilities in various sectors which have a considerable influence on future energy consumption and on the environment (town planning, land use planning, transportation policy, etc.);
- it is a limited geographical area, which makes it possible to tailor policies to the local context and thus make them more effective.

From the perspective of sustainable development, cities must seek to improve the standard of living and well-being of their inhabitants, whilst respecting the constraint of pollution limits on both a local and global level. This inevitably involves a strategy to limit polluting

Box 7
Switzerland: "Energy in the City"

The "Energy in the City" Programme which was elaborated in the framework of the Energy 2000 Programme (which seeks to reduce energy consumption and CO_2 emissions in the Swiss Confederation) aims to convince cities of 5 000 to 60 000 inhabitants to implement energy policies which are favourable to the environment.
Some two-thirds of the Swiss population live in small and medium-sized towns, which thus have a particular role in attaining these objectives.

The "Energy in the City" programme seeks to exploit the experience of the most advanced communes and to encourage the others to introduce local environmentally-aware energy policies.

In the first phase, three pilot towns were selected. They listed and compared their experiences, then analysed the reasons for success or failure. The second phase will involve establishing working groups in these towns and creating a network for the exchange of experience.
Since 1995, certain pilot cities may obtain the "Energy city" label (as in the case of Neuchatel), if they respect certain conditions:

- to set energy management objectives;
- to plan investments;
- to monitor projects in order to obtain concrete results.

Contact: L'énergie dans la Cité – Cossonay-Ville, Switzerland.
Phone: 21.861.00.97 / Fax: 21.862.13.25

emissions, promote more efficient use of natural resources, including energy, and maximise waste recycling and use of local renewable resources.

Developing such a policy requires that a certain number of instruments are created to collect information and aid decision-making: the analysis of energy consumption and of the associated pollutant emissions; the analysis of the transportation scheme; an urban energy supply policy; methods for implementing demand side management.

4.2.2 A city can act on its assets (communal buildings, transport, etc.)

Even with few human and financial resources, a city can begin to set up simple and efficient management systems to monitor energy consumption in communal buildings. It is not necessary to postpone this inexpensive and indispensable action, which permits the identification of energy saving potentials in the city, until advanced tools are purchased and set up. Moreover, the energy saving actions which are identified by this method are in general simple, low-cost measures which often go along with improving municipal energy management.

Basic actions, such as rehabilitating equipment (boiler rooms, air conditioning systems, lighting, etc.) and regulating their consumption, monitoring and controlling the consumption in each building using computer equipment, etc., permits the comparison of technical and financial ratios and thus enables one to detect anomalies, to establish audits and hence to determine work programmes which incorporate the priorities of the city, the cost of the action and its expected savings. An annual energy balance is also useful for long-term comparisons.

Above all for a city as well as for a region, the key to success is the establishment of a permanent team, equipped with sufficient human and financial resources, in the form of an "energy-environment unit" at municipal authority level. For small cities, these units, which cover all sectors of activity and the various types of assets at city level, could be composed of no more than one person (this person can cover several small towns).

In the second stage, the management system can be improved by incorporating more buildings, by increasing precision and integrating remote control. These are more ambitious actions which require heavier investments, for example:

- energy diagnosis of the public buildings (precise study of the technical performances of buildings and of their equipment) which leads to a list of potential improvements, their cost, their expected savings in energy and the profitability of the investment (this diagnosis is a useful energy planning tool for a city);
- installation of an efficient remote control system to monitor and command the city's boiler rooms;
- substituting certain energy sources by new ones (natural gas) or exploiting local energy sources (solar energy, wood, waste);
- thermal rehabilitation of buildings;
- promoting combined heat and power production;
- remote control of the communal lighting system to ensure adequate lighting, to monitor consumption and reduce maintenance costs (by detecting failures and repairing them immediately); replacing traditional bulbs by efficient ones.

The energy consumption of a city is the sum of individual consumptions which result from a large number of isolated public or private decisions. The city authorities have an important role to play in encouraging energy savings by improving the profitability of their own investments, by training city employees in charge of asset management, by setting up relations between various agents and informing the population on the rational use of energy in households.

4.2.3 Urban development plans, a coherent development, network coordination and local energy resources

Many cities elaborate development plans, an opportune moment to address energy and environmental issues and transportation problems. At the first stages of defining new zones for development, new objectives should be adopted such as choosing a development which allows alternatives to the private car, using optimal and complementary energy networks (electricity, gas, heat, cold), using renewable and local energy sources, promoting bioclimatic architecture. To improve transportation, the authorities can chose to favour in priority projects which maintain domestic, professional and commercial activities in one area, or which build or improve housing developments with easy access to public transport systems.

For district heating, some cities have elaborated municipal plans to define neighborhoods where specific energy sources are used and others are limited. To implement such actions, accompanying measures are required which are the typical responsibility of a city: promotion, information and advice (to consumers, neigbourhood representatives, elected officials, heat and electricity suppliers and maintenance operators); subsidies to facilitate and accelerate the connection of the selected networks, etc.

Depending on the legal context of the country, a city can organise the use of local energy sources such as heat recuperation from waste incineration, biogas from purification stations wood from communal forests, solar power. The networks permit the diversification of energy sources and are in general less polluting than individual installations; a city may then optimise its energy distribution and reduce its energy dependence.

4.2.4 The urban transportation policy

A city's transportation policy is not solely limited to managing communal vehicles, although analysing their consumption would point out badly tuned vehicles, lead to proper maintenance and driver training (see Box 34, Chapter IV - 2.1, "Reducing energy consumption in a bus fleet through training") and help optimise routes. All of these measures would reduce energy consumption, as well as pollution and noise.

In a broader perspective, by using its competency in the field of urban planning and development, a city can play an important role in reducing energy consumptions linked to transportation on its territory. In general, urban transportation plans aim to moderate the need for mobility, to facilitate the use of transportation modes other than cars (public transport, bicycles, walking) and to encourage an economic use of the soil. When a city applies various coordinated measures, it improves the quality of life both by reducing the time lost in commuting and by reducing traffic and its related nuisances and ensuring a balanced development of the city through a rationalisation of its organisation.

Considering that the use of private vehicles is often inadapted when social activities (professional, commercial, domestic, etc.) are situated in the same urban areas, a city can adopt urban development plans which encourage this proximity: mixed activity zones and reduced distances make bicycles, walking and public transport attractive alternatives in terms of time spent in transportation. Here are a few measures a city can apply:

• Limiting the development of large office buildings to areas where reliable public transport exists and limiting the number of parking spaces. The combination of these two measures should discourage employees from using their cars.

• As much as possible, the inhabitants' needs for services should be satisfied without necessarily leaving their residential area. In the same spirit, implanting malls and commercial zones alongside the highway and in peripheral areas which are only accessible to cars should be avoided.

• Promoting public transport: creating professional activity zones around the main stations and bus-stops, setting up separate infrastructure, adapting roadsigns (for example, setting up a system of traffic lights which gives priority to public transport vehicles), increasing the fleet, establishing a "park and ride" tariffication system, setting up convenient connections.

• Promoting the use of bicycles requires setting up safe, user-friendly and convenient infrastructure: separate and whenever possible unbroken lanes on large avenues; the possibility for bicycles to circulate in both directions on one way streets to reduce distances; special infrastructure and road signs; bicycle lots next to large urban transport stations.

• Restricting the use of cars: it has been observed that extending the road system often increases traffic. Instead of developing new roads which are supposed to make traffic more fluid, a city can choose to improve the use of the existing system: better traffic light coordination, building car parks in the close vicinity of urban transport stations. When the use of private cars is made inconvenient, urban transport becomes more competitive. A city can thus close some roads to traffic, create low speed zones, reduce the number of parking spaces and increase the price of parking in certain cases.

Some cities such as Groningen (170 000 inhabitants - The Netherlands) have been implementing these types of measures for over ten years, even cutting the city into four separate sectors which are only accessible to cars by using peripheral boulevards while urban transport and bicycles can go from one to the other. Despite an initial outcry, the project has been successful and there is discussion of completely closing the center of the city to traffic. The results of this city's policy are convincing: in 1996, the main mode of transportation was the bicycle (48%), ahead of the car (31%), walking (16%) and urban transport (5%). This success has led the regional authorities to reflect on the elaboration of a "regional mobility plan".

Contact: Gemeente Groningen. Fax: 31.50.672.376

Box 8

THE TRANSPORTATION POLICY IN THE URBAN COMMUNITY OF STRASBOURG (UCS)

In terms of transportation, the Urban Community of Strasbourg (UCS) is confronted with a double challenge:

• Facing the deep transportation problems linked with the constant increase of the mobility of the inhabitants (+ 2% per year) and the increasing rate of motorisation.

• Integrating in its transportation policy factors which are specifically linked to its strategical position: within the European Union – Strasbourg has an international role as headquarters of European Union institutions, within the zone of the Rhine, in the frame of which various cross-border cooperation activities take place, within the region and the area of influence of the Strasbourg activities area. This situation is reflected in the necessity to operate a complex set of infrastructures and transportation systems which are centered around the city: an international airport, a rail network, a main highway system (linked to the large French and European axes of communication), the autonomous port of Strasbourg, the river system.

To solve the problems of viability, practicality and environment which affect the conurbation, the UCS has elaborated a new "transportation plan" which provides for a global and multi-modal planning of urban transportation, with short and medium to long term (2010) objectives.

Strategic measures have been adopted:

• building a tramway network and the associated restructuring of the urban bus network;
• creating poles for intermodal connections to facilitate the passage from one mode to another;
• rehabilitating the space reserved to pedestrians;
• developing bicycle paths;
• moderating the use of cars.

Contact: UCS – Strasbourg, France. Phone: 33.3.88.60.90.80 / Fax: 33.3.88.60.93.83

4.3 THE RURAL WORLD AND AGRICULTURE

4.3.1 Energy and agriculture

Agriculture, considered as a specific sector of production, is often neglected in the formulation of energy policies and even in energy efficiency policies because it uses little energy compared with other sectors.

For the OECD as a whole, energy use in agriculture in fact accounts for only 2 per cent of total final energy consumption. In many (non-OECD) energy statistics, agriculture is not even separately identified but comes under the heading "other sectors", where its energy use is lumped together with the much larger use of the residential and services sector.

This attitude should be reviewed bearing in mind the following facts:

- the quantity of direct energy consumed in farms is indeed small in the national energy balance of industrialised countries, but in terms of value added, agriculture ranks about the same as all light industry as a whole. Although energy consumption is not generally speaking a major concern of farmers, any gains on their energy bill would certainly be welcome, as profit margins are often small;
- for some branches of agriculture – for example, greenhouse or battery farming – the energy system used and its cost are decisive factors in the viability of the enterprises;
- the intensive agriculture of industrialised countries uses twice as much energy indirectly as it does directly: energy in fertilisers, cattle feed, agricultural products and transportation. Furthermore, in the energy balance, this use is classified under the industry heading. Finally, energy use in the agri-foods industry is far from negligible;
- farmers' direct and indirect consumption of energy has a significant impact on the environment, especially as regards water and soil pollution: a number of energy efficiency improvements – particularly in livestock facilities – are justified by the environmental improvement they will bring.

The agriculture sector, therefore, like other sectors, can use energy efficiency measures to improve productivity and reduce its harmful environmental impact. However, this sector cannot be treated, in terms of energy efficiency actions, in the same manner as the industrial sector is, because it operates within a rural world in most countries with a quite different development pattern than that of the industrial sector. Therefore, energy efficiency actions in the farming sector cannot be separated from actions which target the other categories of rural activity.

4.3.2 Energy efficiency and rural development

In developing regions and countries, the rural environment and farming activities have a much greater economic and social importance than in most OECD countries. Energy is vital in these areas, both for productive activities (irrigation, for example) and to ensure the bare minimum of comfort for families (lighting, cooking facilities, etc.). In rural areas, energy problems imply an almost total absence of non-local energy sources – which are too expensive – and the gradual disappearance of traditional energy sources (fuelwood), with its almost unavoidable corollary: growing environmental degradation (deforestation for charcoal production, soil erosion, etc.).

The importance of the energy issue in the rural environment is thus much greater than one might have thought in the light of agriculture's relatively small share in the energy balance. Our attention should extend beyond the agricultural sector to the development of the rural world in general, which involves:

- the maintenance or creation of sufficient economic activity in the rural environment to discourage outmigration ("living and working in the hometown");

Box 9

ENERGY IN THE RURAL WORLD: ACTIONS FOR LOCAL DEVELOPMENT

Alentejo, in Portugal, is a wine region. Traditionally, after the dressing of the vines, wine-growers gather up the vine shoots by hand, pile them up at the edge of their property, and burn them to avoid the development of vine diseases.

Since 1988, this traditional method has been modified. The mayor of Redondo, a town of the region, decided to use this agricultural waste to heat communal buildings. He was supported in this project by the VALOREN programme of the European Commission.

A thermal audit was made of the school block. Old dwellings were insulated. A small district heating network was installed, to heat the school and its cafeteria. A furnace was built, specially adapted to use vine shoots as fuel. Finally, the mayor bought a trussing machine for vine shoots, which is lent to the wine cooperative. The latter, in exchange, delivers the vine shoot trusses free of charge to the communal district heating facility.

For the wine growers, the work is more rapid and much less laborious. The school is well heated, at almost no cost. This new system is also beneficial to the environment since the incineration of the vine shoots in a furnace produces less pollutants than in a traditional fire. Other towns of the region have already followed the example of Redondo.

Contact: Coordination Commission of the Alentejo Region, Portugal.
Phone: 351.66.740.300 / Fax: 351.66.265.62

- the improvement of living standards and socio-cultural services for the people concerned (education, health, leisure activities).

Energy is vital to the objective of sustainable development for the rural environment, it is essential to all activities and can constitute one of its main exportable products. Rational energy use and the exploitation of renewable energies can contribute to improving the economic and social situation, support existing activities (by improving productivity), give rise to new activities and generate new revenue. Although we shall not be discussing renewable energy sources in this document, it is important at this point to stress their essential role in the development of the rural world. Firstly, renewable resources are often the cheapest source of energy for the rural population, and, secondly, they can provide a substantial marketable resource, as shown in Box 9.

4.3.3 Overall approach, leadership, partnership

An energy efficiency strategy for rural areas should address all rural activities and be based on a comprehensive analysis of the development of the region, strong leadership and responsible partners.

A COMPREHENSIVE APPROACH

An energy efficiency measure, project or programme should not be evaluated strictly in the light of energy considerations alone. An operation with a broader development outlook including both economic and social dimensions is most likely to succeed. This requires:

- the permanent involvement of those in charge of local development. Too many projects which go well in the first phase of implementation subsequently fail, because of a lack of follow-up by a competent agent;
- the comprehensiveness of activities and criteria which means tackling, in the same programme, the whole range of activities and taking into account a wide range of factors (the economy, the environment, employment, quality of life, community stability, etc.).

The approach to or assessment of a project or programme must be based on several criteria which reflect its various objectives, i.e. consolidating economic activities, increasing disposable income through the savings made, creating new activities, improving the environment, etc.

Thus, integrated programmes are called for which incorporate all these aspects. Their economic evaluation should take the "global cost" into account and incorporate external costs and benefits, job creation, environmental improvement, etc.

Leadership and partnership

The search for synergies between various solutions or various activities calls for coordination between a number of partners: elected representatives, farmers, landowners, industrial operators, consumers, and others. In the rural environment, more than anywhere else, the dispersed nature of activities and wide range of partners means that getting a project off the ground requires strong leadership, to devise proposals and initiatives and to assemble the required expertise. With effective leadership, the rational use of energy, because it involves all rural activities, will generate momentum for all issues relating to development.

The main partner in the project is the project manager, who takes responsibility for the project and monitors progress. Unlike the case of enterprises (where management is responsible) or cities (where the municipal authority is responsible), it is hard to find suitable project partners in the rural environment. Ideally, projects should be the responsibility of elected representatives, supported by a technical team.

4.3.4 Energy efficiency action programmes

Energy efficiency action programmes in the rural environment mainly concern the following sectors:

Housing

- Renovation of existing housing: insulation, installation of space heating systems (use of wood); in some regions, installation of solar-powered water heaters;
- new buildings: development of bio-climatic housing;
- equipment: advanced (low-energy) cooking appliances, lighting and domestic electrical appliances.

Rural electrification

The cost of "commercial" energy (grid electricity and oil products) is generally very high in rural areas because of their poor accessibility and the dispersed nature of demand. The economic attractiveness of energy efficiency projects is usually much greater in rural than in urban environments, and electricity efficiency is a prime area for such a policy.
In rural areas, the development of decentralised electricity production using renewable energy sources (windpower, small-scale hydropower, photovoltaic power) should be accompanied by the dissemination of energy efficient equipment.

In addition to domestic uses, irrigation represents a major source of electricity use in many countries. Energy management in this field will encompass improving water management on the basis of an analysis of demand, sizing facilities to meet requirements and maintaining them, and choosing the most efficient equipment.

Farm buildings

Air conditioning is a very important issue for greenhouses and livestock buildings: in terms of ventilation, insulation, regulation, heating systems and the type of energy used. In the case of livestock buildings, the use of biogas combines energy efficiency and environmental protection. Lastly, significant progress has been made in drying and dehydration (see Box 10).

Agricultural machinery

Tractors and various other machines are the major consumers of energy (in the form of fuel) in the agriculture sector. The same types of action are called for here as in the transportation sector: choosing the proper vehicle or machine (with respect to power, in particular) according to proposed use; correct maintenance and upkeep; an economical style of driving.

Box 10

Energy and agriculture: an integrated approach

Several rabbit breeders in Bretagne (France) experienced extraordinarily high death rates among young rabbits. The veterinarian traced the cause to the poor thermal conditions in the breeding buildings. The breeders had premises audited with the additional objective of investigating possible energy savings. Following the audits, modifications were made to the buildings: the pre-heating division was insulated, the warm air distribution system was modified, a humidity control system for the summer months was installed. After these improvements, electricity demand decreased by 25%, the mortality rate by 7%. The pay back period was calculated at two and a half years.

Contact: Ademe – Bretagne Regional Delegation.
Phone: 33.2.99.85.87.00 / Fax: 33.2.99.31.44.06

4.4 DECENTRALISED COOPERATION NETWORKS

Another important means of stimulating and facilitating energy efficiency programmes and projects is to organise international networks for the exchange of information and experience. Networks of this type already exist at European and at OECD level. It is important that they be systematically extended to the countries of Central and Eastern Europe and to developing countries. The most active cities and regions and the European networks are in fact already focusing their attention on the countries of Central Europe (for example, Poland and Romania) and on the Mediterranean countries. Boxes 11 and 12 present the European networks of cities and regions for energy efficiency.

Box 11

THE EUROPEAN NETWORK OF CITIES FOR ENERGY MANAGEMENT AND THE ENVIRONMENT, ENERGY-CITIES

The European Union programme "Energy and the Urban Environment" was the starting point for the "European network of cities for energy efficiency and the environment", Energy-Cities.

A comparison of achievements in the field of urban energy policy between twelve European cities inspired them to form a city network to exchange information, experience and know-how. A Charter was drawn up: the signatory cities declare that they have an obligation to contribute actively to rational energy use, and thus to environmental improvement, and that these are achievable goals. The network, which in early 1996 had over 40 members, is open to any European city wishing to participate. Some Central and Eastern European cities are already members and others have asked to be associated with the network.

"Energy-Cities" is an association, the leading team of which is based in Besançon, France. This team coordinates meetings between the cities. It compiles a register of the activities of the European cities, the partners and the economic agents involved, and puts them in touch with one another and with cities that wish to conduct joint studies and projects.

Contact: Energy Cities – Besançon, France.
Phone: 33.3.81.65.36.80 / Fax: 33.3.81.50.73.51

Box 12
The European Network of regional Agencies: FEDARENE

FEDARENE is a European network of regional agencies, each with the task of setting up and directing regional energy management and environmental protection policies. Each regional agency, within the context of its own specific constraints, has developed specific solutions to similar problems. Their diversity provides a wealth of experience to be shared and developed while respecting the particular identity of each agency. FEDARENE is the forum for this exchange of experience and information between European regions. It is also particularly well-placed to act as the representative of its members in dealing with the European authorities and as a relay for the latter's policies. FEDARENE gathers 46 regions (1996).

Contact: FEDARENE – Brussels, Belgium.
Phone: 32.2.646.82.10 / Fax: 32.2.646.89.75

5

International cooperation

The first energy efficiency strategies were drawn up and carried out in the Western industrialised countries and Japan in response to the sharp oil price increases on the world market in the 1970s. During the 1980s, the concept of energy efficiency as an essential component of energy and development policy gradually broadened to reach all developing countries and, more recently, has come to be seen by most of the governments as a vital contributor to the reconstruction of the economies of the countries in transition in Central and Eastern Europe.

In parallel with this broadening dictated mainly by economic and political considerations, energy efficiency was given an added and marked boost by the growth in environmental concerns, both local (waste, pollution, risk of accidents) and global (waste, pollution, climate change, risk of major accidents).

International cooperation in the field of energy – technical assistance and financial aid – has thus been extended to cover energy efficiency, linked ever more closely with the environment. While this cooperation is still not sufficiently developed in view of the potentials and needs, it involves a large number of organisations.

Many institutions and organisations are active in international cooperation in the field of energy efficiency, some as their main activity, others as part of global cooperation programmes. We are presenting in the following paragraphs the main actors in this field, without pretending to cover the whole panorama which extends every day.

5.1 AT WORLD LEVEL: UNITED NATIONS ORGANISATION, DEVELOPMENT BANKS AND WORLD ASSOCIATIONS

5.1.1 The United Nations Organisation

INSTITUTIONS AIMED TO ORGANISE THE DEBATE

At world level, many inter-governmental and non-governmental organisations and associations are active in the energy field. The United Nations Organisation has set up several committees and organisations to ensure dialogue and cooperation between nations at world level:

• *The Commission on Sustainable Development*

The Commission on Sustainable Development is concerned by energy efficiency matters in two different domains:

– sustainable development: Energy matters are covered by chapter 9 of the Agenda 21 under the title: "Protection of the Atmosphere", sub-title: "Promoting sustainable development", sub-sub-title: "Energy development, efficiency and consumption".
– reduction of greenhouse gas emissions: This concern is over the long term and deals in particular with reducing the global CO_2 emissions to an acceptable threshold and stabilising the concentration of CO_2 gases in the atmosphere.

• *E 24 Committee*

The United Nations Committee on new and renewable energy and energy for the development (which we call the E 24 Committee, because there are 24 experts in this committee) was created as a follow-up of the Nairobi Plan of Action and the Committee on Natural Resources / Energy which both operated as inter-governmental panels (see Box 13).

COOPERATION PROGRAMMES AND SPECIALISED ORGANISATIONS

The United Nations have developed broad cooperation Programmes such as the United Nations Development Programme (UNDP - technical assistance) or the United Nations Environment Programme (UNEP), and have created specialised organisations such as the United Nations Industrial Development Organisation (UNIDO - general surveys, identification, preparation and evaluation of projects) which can take in charge energy efficiency in their domains.

Between technical assistance of a general nature and the funding of specific investments lies the Energy Sector Management Assistance Program (ESMAP) launched in 1983 jointly by

Box 13

United Nations Committee on new and renewable energies and energy for the development
Report of the Secretary General

Summary

In 1987, the World Commission on Environment and Development concluded that the best route to sustainable development of the energy system is a "low energy path", which means that nations should take the opportunities "to produce the same levels of energy services with as little as half the primary energy currently consumed". The improvement of energy efficiency, or the more rational use of energy, is generally viewed as the most important option in the near term to reduce greenhouse gas emissions and to reduce the negative impacts of the use of energy and/or fossil fuels.

There is growing awareness of the serious problems associated with the provision of sufficient energy to meet human needs and to fuel economic growth world-wide. This has pointed to the need for energy and material efficiency, which would reduce air, water and thermal pollution, as well as waste production. Increasing energy and material efficiency also have the benefits of increased employment, improved balance of imports and exports, increased security of energy supply and use of adopting environmentally advantageous energy supply.

Large potential exists for energy savings through energy and material efficiency improvements. Technologies will not now nor, in the foreseeable future, be the limiting factors with regard to the continuing energy efficiency improvements.

There are serious barriers to energy efficiency improvements, including unwillingness to invest, lack of available and accessible information, economic disincentives and organisational barriers. A wide range of policy instruments, as well as innovative approaches have been tried in some countries in order to achieve the desired energy efficiency improvements and hold promise to other countries.

These include regulations and guidelines, economic instruments and incentives, voluntary agreements and actions, information, education and training, and research, development and demonstration. An area that requires particular attention is that of improved international cooperation to develop policy instruments and technologies to meet the need of developing countries. Material efficiency has not received the attention that it deserves. Consequently, there is a dearth of data on the qualities and quantities of final consumption, thus making it difficult to formulate policies. Available data, however, suggest that there is a large potential in industrialised countries.

Contact: Department for Policy Coordination & Sustainable Development
Division for Sustainable Development - Energy & Natural Ressources
United Nations DC 2 - New York, NY, USA
Phone: 1.212.963.46.61 / Fax: 1.212.963.17.95

UNDP and the World Bank (and organised by the World Bank). ESMAP has implemented pre-feasibility and pre-investment studies and activities in over 60 countries.

Regional economic commissions

The United Nations have also set up regional economic commissions which are active at the level of the major regions of the world. We give hereafter two examples of these commissions particularly active in the energy field:

• The UN Economic Commission for Europe (UN-ECE) has supported an "Energy Efficiency 2000" programme, which was launched in 1991. The programme's main objective is to facilitate cooperation and information exchange in the field of energy efficient and environmentally sound management methods and technologies among European countries and particularly between the market economies and the countries in transition. Programme activities include the organising seminars, information exchanges, publishing a yearbook on energy efficiency techniques, partners and experts in European countries, and implementing a preliminary identification phase for major energy efficiency programmes covering large areas (towns and cities) proposed by the member countries, called "demonstration zones".

• The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is the most important regional organisation in this area, with 31 member countries, 28 of which are developing countries. It plays an active role in regional cooperation and in energy development. ESCAP activities in this field are focused on three areas: energy planning, energy efficiency and renewable energy development. Cooperation programmes such as the Regional Energy Development Programme and the Pacific Energy Development Programme are financed by UNDP.

Participation in other cooperation activities

Some programmes and organisations of the United Nations participate in worldwide activities with other international organisations. One of the most important of these actions is the Global Environment Facility (GEF), a fund set up by donor countries (foremost among them Germany and France) on an experimental basis for three years in 1991, and renewed in 1994. It aims to give financial assistance to developing countries for demonstration, technical assistance and investment projects which favour the global environment and clean technologies (see Box 14).

Box 14
The Global Environment Facility

1. Proposed by Germany and France in 1989, the GEF was created in 1991 to help the developing countries, through grants or loans, address four problems related to the global environment:
- global warming due to the increase of the greenhouse effect, itself caused by the increased emission of pollutant gases;
- the pollution of international waters;
- the destruction of biological diversity;
- the thinning of the ozone layer, caused by fluorocarbon emissions.

A three-year pilot phase of the GEF, endowed with 1.2 billion dollars, was undertaken in 1991. This first phase, under the common management of three United Nations Agencies – the UNEP, the UNDP and the World Bank – permitted the definition of the thematical priorities and the testing of the action modes and financial management.

2. In March 1994, at the end of the pilot phase, the GEF Member countries decided to undertake a second phase of this facility, endowed with 2 billion dollars.
Three authorities participated in the GEF decisions during this new phase:
- the Assembly, comprising the representatives of all the participating countries (94 in April 1994) is in charge of defining the overall orientations of the facility;
- the Council, comprising 14 members from the donating countries and 18 members from the beneficiary countries, is in charge of operational issues concerning the development of GEF programmes;
- the secretariat ensures the implementation of the Council's decisions.

The three United Nation's agencies cited above ensure the technical, administrative and financial management of the facility.

3. In the same spirit, France set up in 1994, the "French Global Environment Facility" (FFEM), endowed with 400 million francs over three years, on a bilateral basis, with the same themes and the same criteria as the GEF. It is under the responsibility of an Executive Committee composed of representatives of the concerned ministries (Treasury, Foreign Affairs, Cooperation, Environment, Research). The Caisse Française de Developpement is in charge of secretariat and administrative management.

Contact: GEF – Washington, DC, USA. Fax: 1.202.522.32.40
FFEM – Paris, France. Fax: 33.1.40.06.32.48

5.1.2 Development banks

In the United Nations system, the World Bank, through its regional divisions, carries out in-depth surveys of national energy situations and provides loans for energy sector development. Although the bulk of these loans still goes to production and transportation systems, energy efficiency has been receiving increasing emphasis in Bank policy papers, as presented in Box 15.

At the European level, two international development banks play an important role:
- the European Investment Bank (EIB) is part of the European Union structure and operates within and outside the European Union under financial protocols attached to European Commission cooperation agreements;
- the European Bank for Reconstruction and Development (EBRD), which was specifically set up to finance development projects in the countries of Central and Eastern Europe and the CIS. In September 1994, EBRD created an Energy Efficiency Unit to examine and support projects in this field under the Bank's rule (see Box 16).

Box 15

DEFINITION OF THE STRATEGY OF THE WORLD BANK ON ENERGY EFFICIENCY IN DEVELOPING COUNTRIES

Quotation from a "World Bank Policy Paper: Energy Efficiency and Conservation in the Developing World (1993)" (Chapter 7)
(...) The Bank will continue its efforts toward increased lending for components to improve energy efficiency and promote economically justified fuel switching. In addition, however, in taking advantage of the increased receptivity of many developing countries to efficiency issues, the Bank will sharpen its focus by undertaking the following four point programme:
– To gain greater country commitment, the Bank will better integrate energy efficiency issues into its country policy dialogue so that they can be addressed at an earlier stage. (...)
– The Bank will be more selective in lending to energy supply entreprises. (...)
– Approaches for addressing demand-side management and end use energy intermediation issues will be identified, supported, and given high-level in-country visibility. (...)
– The Bank will give greater attention to the transfer of more energy efficient and pollution-reducting technologies in its sector and projects work.

Contact: World Bank – Washington, D.C., USA.
Phone: 1.202.477.12.34 / Fax: 1.202.477.63.91

Box 16
EBRD's ENERGY POLICY

The European Bank for Reconstruction and Development published in March 1995 a document presenting its energy policy. The first of five operational principles is to "increase energy efficiency and cost effectiveness, in both energy supply and demand".

The document presents that this objective will be pursued through:
– direct investment projects and/or support to specialised financial intermediaries for industrial restructuring operations which include specific actions to improve energy efficiency (provided the industries involved are demonstrably economically viable after restructuring);
– specific energy supply and demand side efficiency in the power, gas, district heating, municipal activities and, in general, the public sector;
– supporting bankable projects to upgrade supply equipment;
– introducing more efficient technology when economically justified;
– supporting the development of ESCOs, leasing and third party financing companies;
– developing financing instruments which could allow the Bank to overcome barriers in financing small-scale energy efficiency projects.

In addition, to promote cost-effectiveness and energy efficiency, the EBRD will support selectively projects that are included in countries' long-term least-cost development plans for the sector and, to the extent possible, Integrated Resource Plans to ensure that supply-side and demand-side investments are considered on an equal footing.

Contact: EBRD, Energy Efficiency Unit – London, United Kingdom.
Phone: 44.171.338.70.79 / Fax: 44.171.338.69.42

Again, at the level of the major regions, it should be noted that the Asian Development Bank plays an important role in funding energy efficiency programmes, as also more recently does the African Development Bank and Inter-African Development Bank.

5.1.3 World Associations

In several countries or regions, and at world level, non governmental organisations and associations are active supporters of energy efficiency, in particular through information and lobbying (see Boxes 17 and 18). The World Energy Council (WEC), with about a hundred member countries , has integrated energy management and rational energy use in its agenda which covers all issues related to energy. Its most recent triennial congress which took place in Tokyo in 1995 was the occasion to present a certain number of studies, among which an important study on energy efficiency implementation.

Contact: WEC, Publications – London, United Kingdom. Phone: 44.171.930.3966 / Fax: 44.171.839.3285

All these parallel activities at world level and in the major economic regions of the world are the subject of a proposal for harmonisation in the context of Agenda 21 adopted at the Rio Conference in June 1992, the "Global Efficiency 21" programme.

Box 17

WEEA: World Energy Efficiency Association

The World Energy Efficiency Association was founded in June 1993 as a private, non-profit organisation composed of industrialised, in economic transition and developing country institutions and individuals charged with increasing energy use efficiency.

WEEA was formed to: (1) serve as a clearing-house for information on energy conservation programmes, technologies and measures, (2) disseminate this information worldwide, and (3) publicise international cooperation efforts in energy conservation.

WEEA members are drawn from both the private and the public sectors. Intergovernmental organisations, non-governmental organisations, non-profit corporations, and commercial organisations are all represented. Individuals and representatives of organisations and governments are also eligible for membership of WEEA.

The WEEA's By-Laws require that fifty percent of board members are from non-OECD countries. This assures strong participation from developing and re-industrialising countries in the formulation of WEEA's work programme. WEEA has established an Executive Committee, a Development Committee and a Plans and Budgets Committee.
WEEA regularly publishes the "international directory of energy efficiency institutions" with a very useful and accurate list of institutions presented per country. A data base on good practice projects is being elaborated. The first international event was organised mid 95 in Istanbul on "energy efficiency financing".

Contact: WEEA – Washington D.C. , USA.
Phone: 1.202.508.93.43 / Fax: 1.202.347.16.98

Box 18
ENERGY 21

Established in 1994, Energy 21 is a non profit, non governmental organisation based in France with a branch in the USA. It is affiliated with the Earth Council, an outgrowth of the Rio Earth Summit. It participates in the implementation of the Agenda 21, the global programme for sustainable development through the 21st Century which was adopted at Rio.

Energy 21 is dedicated to the promotion of sustainable energy as an element of sustainable development. Its activities focus on two areas:

- building awareness at the top: in most countries, decisions on energy developments are concentrated in the hands of relatively few people; Energy 21 works to inform top decision-makers on the availability of cost-effective alternatives to "business as usual" approaches;
- encouraging private investment: currently, most energy savings programmes and most renewable energy projects rely to a large degree on grant funds from multi-lateral or government agencies. This has generally limited renewables and efficiency to small-scale pilot projects, which in turn has engendered scepticism in the financial community and among many energy policy-makers. If renewables and energy efficiency are to achieve widespread implementation, they cannot remain so heavily dependent on subsidies or development bank loans. Energy 21 develops information and exchanges on methods to attract private capital to projects and companies in the fields of renewable energy and energy efficiency.

Contact: Energy 21 – Boulogne, France.
Phone: 33.1.46.04.68.50 / Fax: 33.1.46.04.80.99

5.2 THE ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD) AND THE INTERNATIONAL ENERGY AGENCY (IEA)

At OECD level, although the IEA does not provide financial support in the field of cooperation, it nevertheless plays a very significant role that extends well beyond its member countries. IEA activities include gathering energy statistics, reviewing national energy policies (including the countries in transition), energy forecasts, strategic surveys of energy efficiency and of the relations between energy and the environment, and cooperative R&D and information sharing programmes (see Box 25), including the GREENTIE programme focused on sharing technology information sources with Central and Eastern Europe, and developing nations.

IEA teams are particularly active in the countries in transition in the field of statistics and energy balances. They organise workshops in non-member countries on energy efficiency.

In the framework of the DSM - IEA agreement, the IEA cooperates with fourteen countries of Europe, North America and Asia on technologies and programmes for Demand Side Management. This agreement covers five tasks:

- international data base on demand side management technologies and programmes;
- communication technologies for demand side management;
- cooperative procurement of innovative technologies for demand side management;
- development of improved methods for integrating demand side options into resource planning;
- investigation of methods for implementation of demand side management technology in the marketplace.

A new task is programmed on DSM and energy efficiency in changing electricity business environments.

Within the OECD proper, the Group on Energy and Environment serves as a meeting place for the representatives of the member countries and conducts research and case studies on policies for the dissemination of efficient and environmentally sound technologies.

5.3 THE EUROPEAN COMMISSION

Energy efficiency is one of the focal points of the European Union's energy policy. Originally, initiatives promoting energy saving and exploiting local energy resources have been encouraged in the less developed regions of the European Community, with an aim to reinforce the social cohesion. Pilot projects have demonstrated that the savings made tend to be spent in the local economy. At present, two additional principles govern this option: increasing the security of supply, through the better use of scarce energy resources, and protecting the environment. The European Commission has developed several complementary instruments to improve energy end use efficiency. The programmes cover both technological and non technological aspects, institutional and operational levels, inside and outside the Union.

The characteristics of the main Commission programmes are as follows:

Specific energy efficiency programmes

- JOULE / THERMIE is a global programme with a practical orientation. The Commission financially supports the development of clean and efficient technologies and techniques at various stages, from R&D activities to marketing in the European Union. Some third countries (in Western Europe, Eastern Europe or the CIS) can participate in common research, demonstration and dissemination activities, through the INCO programme. Part of the budget of the INCO programme was attributed to JOULE / THERMIE to this aim.

Contact: Demonstration: DG XII – Science, R&D. Fax: 32.2.295.06.56. / 32.2.295.05.77
Dissemination: DG XVII – Energy. Fax: 32.2.296.60.16 / 32.2.295.61.18
INCO: DG XVII – Science, R&D. Fax: 32.2.295.27.16

• SAVE (Specific Action on Vigorous Energy Efficiency) focuses on non-technological aspects of energy savings. Its objectives are to develop and implement a consistent package of measures aimed at overcoming non-technical barriers to the rational use of energy. An essential part of SAVE consists in elaborating European Union level directives regulating the energy consumption of equipment (boilers) and electric appliances. In 1997, a pilot phase will associate countries from Central and Eastern Europe, when they have signed the protocol. SAVE also finances actions to support regional and local energy efficiency teams.

Contact SAVE: DG XVII – Energy. Fax: 32.2.296.42.54

SPECIFIC ENERGY PROGRAMMES FOR NON-MEMBER COUNTRIES

• The SYNERGY programme (1996 - 2000) stimulates cooperation between the European Union and non-member countries worldwide in the area of energy policy. Energy efficiency is a priority area. The objectives are to develop energy policy cooperation with non-EU countries by helping them elaborate, implement and evaluate energy policies which are in harmony with the European Union's objectives, and to initiate energy policy dialogue on a regional basis.

The target groups are governments, local authorities, utilities. The main activities are:
– providing high-level policy advice to decision makers;
– institution building or strengthening aimed at stimulating energy saving and renewable energy development;
– capacity building, in energy planning and management, project design, management and financing, through training courses, fellowships for postgraduate studies, twinning activities; information sharing through the organisation of conferences, targeted seminars, publication of reference material.

Contact SYNERGY: DG XVII – Energy. Fax: 32.2.295.98.16

• The ALURE Programme (Latin America Rational Energy Use) – (1995 - 1999) is a cooperation programme in the field of energy between the European Union and Latin America.

ALURE aims to contribute to economic growth and environmental protection in the Latin American countries through an efficiency development of the energy sector. The objective is to support the efforts of institutions and public, mixed capital and private energy companies in these countries to supply services adapted to the needs of the various consumers. This support can take several forms: training, experience exchange, executive staff exchange, twinnings, support to sub-regional energy integration, technology and equipment promotion, etc.

Contact ALURE: DG IB – External Affairs. Fax: 32.2.295.38.56

Cooperation programmes including energy

• The PHARE, TACIS and, in a near future, the MEDA programmes can undertake activities in the energy saving field, respectively in Central Europe, the Commonwealth of Independent States, and the Mediterranean region. These programmes, which correspond to the current regional priorities of the European Union, are managed by Directorate General for External Affairs (DG I), which also manages credit lines for Asia and Latin America; cooperation with Africa is managed by the Directorate General for Development (DG VIII). Being technical assistance programmes, they favour studies aimed at assessing the technical and economic feasibility of energy saving projects, but can also include training and promotion activities on a large scale, and, in some cases, participate in investments (supplementing the activities of the international development banks).

Contact PHARE: DG IA – External Affairs. Fax: 32.2.299.12.31
TACIS: DG IA – External Affairs. Fax: 32.2.231.04.41
MEDA: DG IB – External Affairs. Fax: 32.2.299.02.04

South and South East Asia: DG IB – External Affairs. Fax: 32.2.299.08.72
China and Far East: DG IB – External Affairs. Fax: 32.2.295.10.28
Africa: DG VIII – Development. Fax: 32.2.296.98.44
Latin America: DG IB – External Affairs. Fax: 32.2.295.38.56

Cooperation with the international financing institutions to set up appropriate financing schemes is an important element of these various cooperation programmes.

5.4 IMPROVING INTERNATIONAL COOPERATION

Despite the priority officially attached to energy efficiency as a strategy for sustainable development, international cooperation is still very limited in this field, in terms of resources and methods.

• As regards funding, a distinction must be made between technical assistance, which is often paid in full (international organisations, bilateral cooperation) and investments, which are financed by means of loans (development banks).

As regards capital funding, the procedures customarily applied by the financial organisations are, because of their past emphasis, best suited to large-scale projects and are not well adapted to the funding of most energy efficiency projects, which are typically small in scale. The notion of "project" needs to be replaced therefore by that of "programme": experience shows that if a sufficiently large-scale and clearly articulated programme is drawn up, development banks will be prepared to finance it if the government of the country considers it a priority (still too often, governments tend to favour energy production). It is up to the borrowing country to organise the management of the projects within the overall programme, bringing together technical expertise and financial management skills, and also to put forward a single interlocutor responsible for relations with the financing body.

• That leaves the issue of the definition of the programmes. It is essential for this to be done by the country itself if the programme is to take full account of local priorities and if it is to be carried out under local responsibility. A special body therefore needs to be set up, if it does not already exist, to take charge of the programme, endowed with the powers to define, promote and monitor it.

Emphasis must also be placed on developing the ability of existing economic agents in the country concerned – enterprises, towns, consultancy bureau, etc. – to take charge of and implement projects. Technical assistance will then have to be used not just for the implementation of the surveys, energy audits, and projects, but also, and above all, to strengthen the local capacity to perform these activities.

• Experience shows that the main thrust of international cooperation should be directed at establishing and supporting bodies and teams at the national, regional and local level in each country, which can draw up and carry out an energy efficiency policy. These teams must be in contact with consumers and very close to decision-makers if their proposals and actions are to be taken into proper account in general economic and energy policy. The efficiency of the national and local teams can be improved markedly by the establishment of international centres for exchanges and collaboration within the major geographical regions (for example, the Danube basin countries, the Black Sea region, the countries of West Africa, the Maghreb, the Middle East) on topics such as energy planning, energy efficiency programmes, the arrangement and monitoring of projects, and financing systems. By way of example, the UNDP-World Bank programme of energy planning in Arab and European countries in the late 1980s proved to be very valuable (among others, the survey of integrated planning for the "Altuma" region of Algeria, Tunisia and Morocco).

Another important element is the establishment and leadership of international networks involving the partners (national agencies, regions, towns and cities) in the Western industrialised nations, the countries in transition and the developing countries (see Boxes 4, 11, 12, 19) or for example, the Mediterranean countries. Such networks can be very useful: they must be financed by international means so as to allow real coordination and exchanges of staff, which are keys to the success of cooperation.

In summary, the primary objective of international cooperation must be to set up or strengthen "local capacities". This is in the interest of the countries concerned, because it will enable them to acquire decision-making and management independence in this field more rapidly. It is also in the interest of the multilateral or bilateral cooperation organisations because it gives them the guarantee that the programmes correspond to national needs and will be implemented and monitored by interested parties.

Box 19

IEI: THE INTERNATIONAL ENERGY INITIATIVE

Established on September 5, 1991, IEI is:
– A Southern-led, South-North partnership;
– A small, independent, international non-governmental public purpose organisation;
– An organisation that networks with groups and institutions concerned with energy.

• IEI's objective

To promote - initiate, strengthen and advance - the efficient production and use of energy for sustainable development.

• IEI's mission

Information, Training, Analysis, Advocacy and Action (INTAAACT).
– Information for decision-makers and users;
– Training through collaboration with institutions, groups and potential trainers;
– Analysis to support advocacy, action and training functions;
– Advocacy to expose key decision-makers to an energy efficiency approach in which the efficient production and use of energy is the core of energy strategies for sustainable development;
– Action to assist with designing and implementing, responding to requests from decision-makers in developing countries.

• IEI - Status and Progress

IEI has been formally incorporated as a non-profit organisation.
IEI has established operations in Bangalore (India) and Sao Paulo (Brazil) and will work through Regional Energy Initiatives (REI's) in Latin America, Africa and Asia.

IEI publishes a bi-monthly journal in English: "Energy for sustainable development", directed to all actors involved in the planning, decision-making, financing, establishing, managing, operating and using of energy systems in developing countries.

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CHAPTER III

The preparation of programmes

SUMMARY

The energy efficiency strategy is implemented in concrete terms in all sectors of economic and social activity at the level of the final consumer. Consequently, the mode of implementation varies considerably according to the sector of activity, the economic agents concerned and those involved in the programmes of action.

An energy efficiency policy is a dynamic process for the far-reaching modification of economic and social practices towards greater care in energy use and improved respect for the environment.

The formulation and implementation of the programmes are guided by two major concerns: first the continuity of actions and their basis in time; secondly the distinction between "corrective" actions and those which prepare the way for the future.

In certain activities, improving the performance of systems in current use is not enough, and must be dealt with as part of the major development choices: from the standpoint of the environment and the quality of life, decisions concerned with land-use planning, urban planning and changes in the rural world are of crucial importance. The value of the predictive analyses carried out in connection with energy efficiency is, compared with these activities, that they highlight the importance of these choices and place them in a multi-disciplinary and multi-criterion context.

The implementation of this kind of strategy thus demands a great variety of actions: R&D to develop the most effective techniques and methods, production, promotion and dissemination of the most advanced systems and, in many cases, changes in the attitudes and practices of decision-makers and users.

This chapter reviews the main guidelines of elaborating and preparing energy efficiency programmes, on one hand, following the path which goes from Research and Development to the dissemination of efficient equipment; on the other, following the path of the elaboration of global or sectoral programmes based on energy demand analysis and forecast and the economic evaluation of projects.

The preparation of programmes

1

Main guidelines

An energy efficiency strategy is applied quite differently according to the sector, the economic agents concerned and those involved in the programme. A great variety of actions are needed to implement such a strategy: R&D to develop the most efficient techniques and methods, production, promotion and dissemination of the most advanced systems and, in many cases, changes in the attitudes and conduct of decision-makers and users.
The choices involved in an energy efficiency investment are governed by many criteria: that of economic viability, but also criteria which relate to improvements in productivity and environmental protection.

The formulation and implementation of energy efficiency programmes are guided by two major concerns: first, the continuity and durability of the actions taken; and second, the distinction between "corrective" actions and those which modify future development patterns.

An important feature of energy efficiency, unlike conventional energy sector activities, is that projects are widely scattered and affect all sectors of activity and all sites (industrial areas, cities, rural areas, etc.). Because of this dispersal, implementing programmes is a complex task (when compared to the centralised manner in which supply-side actions are taken), but it has the tremendous advantage that it lends itself to decentralised decision-making, to the local needs and resources.

1.1 CONTINUITY AND DURABILITY

Energy efficiency programmes produces results in the short-term (the next few years), in the medium-term (the coming decade) and in the long term (at least the next half century). Because of this time factor, they will only be truly effective if they are implemented on a continuous basis, with a continuity of ways and means and political will. Nothing is more prejudicial to this type of action than the "stop and go" approach which characterised the efforts of most industrialised countries in the last twenty years. Whenever international oil prices have gone up – even incidentally or owing to fluctuating exchange rates – governments have introduced energy efficiency policies and provided them with resources, only to take away these funds shortly after the oil prices fell again. These short-sighted policies – which no one could call strategies – did not exploit the energy efficiency potential and in fact discouraged many economic agents and consumers who had been ready to commit themselves to long-term action.

It is true that a number of energy efficiency measures are virtually irreversible (for example, regulations governing new buildings, if they are actually implemented and enforced); but most need to be pursued over a longer period – research, training and education, the marketing of new systems, or incentives to the consumer to be environmentally conscious.

It is necessary to grasp that the positive effects of many energy efficiency actions are fragile and easily reversed, particularly as regards attitudes and conduct – those of the decision-makers as well as those of consumers.

Energy efficiency is not a marginal correction to the energy system which can be made in the space of a few years under the automatic influence of market forces against a background of realistic prices. On the contrary, it is a dynamic process leading both to swift significant results and to far-reaching changes in economic and social attitudes towards energy use and the environment, essential components of a sustainable development.

Action programmes aimed at correcting the energy consumption system are guided by three main objectives:

- renovating installations for greater energy efficiency;
- introducing more energy-efficient and environmentally-friendly processes and systems in new installations;
- redirecting certain activities and changing the way they are carried out with a view to consuming less energy and respecting the environment.

1.2 CORRECTIVE ACTIONS

Renovating existing installations covers:

- improving dwellings by means of insulation, rehabilitation or replacement of heating systems, replacing lighting equipment or domestic appliances by other, more effective models;

- actions in commercial and industrial buildings and in factories after staging "energy audits" including personnel training, measuring energy consumption, installation maintenance and overhaul, recovering heat losses, replacing certain machines or choosing new methods and technologies in the production process;
- the maintenance and inspection of vehicles, improving driving, rationalising journeys and loads, managing vehicle fleets and commuter movements.

As regards the existing situation, two actions of a general nature are essential to accompany the various energy efficiency initiatives:
- providing consumers with information to enable them to perceive the importance of modifying their attitudes and conduct and to have knowledge of the energy efficiency techniques and methods available on the market;
- training technicians and managers: substantial benefits can be obtained at low cost by improving management, and installation maintenance and overhaul.

1.3 PREPARING A SUSTAINABLE FUTURE

In the medium and long term, the greatest potential for energy efficiency is in new installations and systems, whether dwellings and buildings in general, domestic appliances, factories and workshops, or means of transportation. This is particularly true when economic growth is higher, when equipment is renewed more frequently and new factories, offices and dwellings are erected. These "future-oriented" actions are of the greatest importance for developing countries and those in transition.

The scope for action in this field is tremendous, including setting up and stimulating resources for research and innovation, information, promotion and regulation for the manufacture or importation and marketing of systems and machines which consume less energy and produce less pollution: automobiles and trucks which consume less fuel, domestic electrical appliances which consume less electricity, more efficient industrial machines, new manufacturing processes. For example, a great deal of energy is consumed at present in households and workplaces to produce comfortable living and working conditions, for heating and air-conditionning and in specific uses of electricity (notably lighting). In 1994, China built 958 million square metres of new dwellings and more than 1 billion in 1996: this represents both a short term stake related to the size of the energy sector investments and a long term stake related to the energy consumptions which will permit to ensure the comfort of these dwellings, over their entire lifetime.

Over the last 20 years, considerable progress has been made in architecture, in building regulations and materials, and in intelligently combining solar energy, insulation and energy consuming systems. These methods and techniques can be generalised. More energy efficient buildings do not necessarily cost more and certainly pay back any incremental costs over their lifetime: here again, appropriate information on available techniques must be provided and its dissemination ensured.

For certain activities it is not enough to simply improve the performance of systems already in use: they need to be reorganised or run differently in order to consume less energy.

The sector calling for the most urgent action of this kind is that of transportation, which causes a global and general increase in energy consumption (mainly oil products), creating significant environmental problems (pollution, noise and congestion of urban areas) and responsible for high numbers of deaths and injuries due to accidents. The argument for energy efficiency reinforces the other factors which militate for the expansion of public transportation in urban areas and inter-city transportation by rail for both passengers and goods. Solving the transportation and (growing) automobile dependence problem is emerging as probably the largest and most difficult challenge for the future.

Actions aimed at gradually bringing about sustainable development are not limited to transportation, nor to energy efficiency alone in the technical sense of the term. Decisions on land-use planning, town planning and changes in the rural environment are of crucial importance to the quality of life in general. Predictive analysis in the field of energy efficiency is also valuable in highlighting the importance of these choices and placing them against a multidisciplinary and multi-criteria background. One of the most important elements of predictive analysis as a tool for political debate is to show "what will happen if the right choice is not made".

1.4 TYPES OF ACTION PROGRAMMES

Action programmes, whether general or sectoral, consist of a series of ways and means adapted to the sector, the equipment and the partner. An example of a general action programme is presented in Box 20.

These ways and means may be divided into a number of groups:

- Actions in research, development and innovation are aimed at inventing, developing and testing techniques and methods which improve energy efficiency. The partners involved are public and private laboratories and research centres, universities, technical institutions and industry.

• When a product or system turns out to be efficient and competitively attractive to existing technologies, a phase begins which should lead to the product being placed on the market and distributed as widely as possible. Demonstration operations are arranged to test the product in actual conditions of use (technical, economic and social testing).

• At the stage of the distribution of energy-efficient methods and techniques, whether specifically organised or resulting from normal market forces, there is a convergence of interests between the operations aimed at developing and promoting effective products and those aimed at creating the conditions to ensure that the consumer invests in energy efficiency.

• The distribution of efficient systems and the generalisation of energy efficient practices are widely helped, sometimes decisively, by legal or regulatory action: government decisions encouraging energy efficiency and technology improvements through certain types of equipment, introducing quality labels and standards, publishing consumption figures, formulating building regulations, etc.

• The general actions aimed at directly involving consumers and all those taking part in the implementation of programmes are information and training: technical and economic information for decision-makers and the different types of consumers; training programmes in energy efficiency methods and techniques for engineers and technicians, managers, architects and town planners, consultancy bureaux, etc.

• Aids to decision-making and advice on the choice of products and investments cover several kinds of actions:

- energy audits covering factories, buildings, transportation fleets and farms, to accurately determine the energy situation of the installation and formulate a programme of action (covering technical, economic and financial aspects) in order to reduce the energy, economic and environmental costs;
- the establishment or strengthening of consultancy and engineering bureaux capable of performing energy audits, and conceiving and carrying out energy efficiency projects;
- advice on financial arrangements.

• Financial support for investment:

- financial incentives for investment from public authorities, special funds, banks and/or international cooperation in various forms: grants, preferential loans, tax allowances, etc.;

– use of the financial markets with methods appropriate to energy efficiency: leasing, third party financing, etc.

Investment assistance is generally aimed at the consumer wishing to carry out a project to make his installation more efficient, but in certain cases, it can also concern the manufacturer of energy efficient systems who needs initial help either to develop output or to penetrate the market.

This crucial question of funding energy efficiency investment is developed in Chapter V.

Box 20
BEST PRACTICE PROGRAMME – U.K.

"Best Practice" is a major Energy Efficiency Office (EEO) programme, launched in April 1989. EEO is part of the Department of the Environment of the United Kingdom (similar to a "Ministry of the Environment").
The aim of this programme is to promote and disseminate ways of improving the efficiency of energy use in the UK.
Through Best Practice, the EEO collaborates with energy consumers and with those who offer consumer advice, services and techniques to help improve energy efficiency. Best Practice covers the use of energy in buildings and industrial processes.
Best Practice has been structured to help energy consumers and decision makers regardless of their current level of energy efficiency.

The four elements of the programme are:

- **Energy Consumption Guides**

Energy Consumption Guides provide data on the way in which energy is currently used in specific processes, operations, plant and building types. The guides provide organisations with sufficient information to compare their current energy usage with others in their sector or with others occupying similar buildings.

- **Good Practice**

Good Practice promotes examples of proven techniques which are already enabling energy users to be more energy efficient. The literature produced ranges from simple case studies to detailed guidance notes for the implementation of energy efficient methods and the installation of equipment.

- **New Practice**

New Practice monitors and promotes first commercial applications of new energy efficient measures in order to obtain unbiased expert evaluations of them.

- **Future Practice: Research and Development**

Future Practice supports joint ventures into new energy efficiency techniques. Funding is available for basic R&D on new measures which could form the good practice of the future. Projects should gather several entities with one organisation taking the lead and acting as project proposer.

Best Practice is managed for the EEO by the Energy Technology Support Unit (ETSU) at Harwell Laboratory and the Building Research Energy Conservation Support Unit (BRECSU) at the Building Research Establishment, Watford.

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2

Research and Development, innovation, demonstration

2.1 THE ORIENTATION OF RESEARCH

Energy-efficient systems currently available on the market give outstanding results compared with efficient technologies of the 1970s or even 1980s. Consumers and decision-makers only became aware of the importance of energy efficiency some twenty years ago and research initiatives since then have been increasingly fruitful. Energy efficiency is likely to become a basic criterion in many technical innovations and it is expected that R&D can still make considerable progress.

A major problem in formulating R&D programmes and orientating government action is that of ensuring that the products of research will pass through the stage of industrial development and reach the market (see Box 21).

2.1.1 Technological research

Since the development of environmental concern in the Western industrialised countries, the search for improved energy efficiency is increasingly related to the control of pollution created by economic and social activity, using an approach aimed at establishing the basis of a viable world. In concrete terms, this means that the technical system must evolve to greater energy efficiency and a greater respect of the environment. Technological research must play a major role in a development which is necessarily set in the long-term, bearing in mind the lifetime of the principal systems involved: transportation, households and industry. The choices available to the decision-makers are broadened both by improvements in existing techniques and by the emergence of new ones, particularly those developed to meet environmental concerns (see Box 22).

Box 21
THE STM NETWORK

The "STM networks" (Science-Technology-Market) developed in France for energy-related programmes has proved very useful in terms of helping efficient technologies and practices reach the market. For each product, process or method, the "network" describes the sequence from scientific discovery to the market place, which involves research laboratories, technical research centres, industrial enterprises, financing institutions, consumers, public authorities. This permits to identify the barriers to the development of efficient products and processes and to determine the most effective mode of action in the frame of a research and development policy.

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To establish the basis for development, priority will be given to R&D activities aimed at developing and promoting energy efficient and clean techniques in all sectors of the economy.

High priority must be given to research related to the transportation sector. In fact, the current trend, a rapid increase in energy consumption, shows that action is needed on three determining factors: choices related to technical, organisational and behavioural issues.
As regards technology, the principal actions are to:
- improve the performance of all vehicles and modes of transportation;
- develop traffic control systems;
- develop transportation systems which pollute less and consume less energy (combined rail-road transportation, railways, river transportation).

Certain communication needs should be satisfied other than by transportation (video conferencing, networking, etc.), which can bring about a reduction in the number of journeys made.

In industry, the evolution towards processes using less energy and fewer raw materials (hence, producing less waste) is at the very heart of the problems of ensuring sustainable economic growth. The most rational approach is to redesign processes so as to eliminate, at the various stages of production, energy wastage and the degradation and loss of material which necessitate pollution control and therefore induce additional costs.

The priority research topics in industry can be grouped into two main categories:

Box 22

THE JAPANESE NEW SUNSHINE R&D PROGRAMME

In 1993, the Japanese Ministry for International Trade and Industry (MITI) launched the "New Sunshine" R&D programme covering technologies for the environment and energy efficiency. Its objective is to develop innovative technology to foster sustainable growth while adequately addressing energy and environmental issues. The 1994 budget for the programme reached 52,7 billion yen (an increase from 1993).

The following are the main aspects of this technological development programme:

• **Energy efficiency:** energy efficient cities (extensive networks for energy use); gas turbines using ceramics; superconductivity in electricity generation; fuel cells; dispersed storage of energy.
• **Clean energy sources:** photovoltaic energy, hybrid solar energy systems, geothermal energy; coal gasification and liquefaction; use of hydrogen as an energy fluid.
• **Clean innovative technologies:** nitrogen oxide reduction processes for lean burn engines; fixation, storage and absorption of carbon dioxide.

* A hundred yen represents around 1 US $.

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• Improving the energy performance of industrial systems which are used in numerous sectors and have substantial energy saving potential: heat exchangers, boilers and furnaces, radiant energy systems, heat pumps and cooling systems, machines for drying and crushing.

• Improving existing industrial processes or developing new processes by acquiring fresh knowledge, through new combinations of techniques, adapting techniques from other sectors, and developing specific systems.

Upstream of the production apparatus, improvements in products and processes can be expected from process engineering, i.e. developing scientific and technological concepts, finding new approaches to the rational use of resources, the safety of installations, environmental protection and product quality. Closer links between process engineering and chemical engineering should lead to the development of new processes.

Research in the building sector covers developing tools for design, improving thermal insulation products and techniques, optimising heat-producing and heating control systems, improving domestic electrical appliances, etc.

The objectives and activities of a technological research programme in the building sector generally come under four headings:

- materials used for construction, components and insulation; developing insulating materials without CFCs, windows with variable transparency; improving soundproofing.
- developing and optimising systems: efficient and clean generators, ducted air and air conditioning systems, new control and regulation systems.
- acquiring basic knowledge essential to overcoming a number of technological obstacles in the field of heat transfer, climatology, combustion, well-being, ergonomics, and so on.
- aids to decision-making (for government administrations, investors, bankers, consumers, etc.).

2.1.2 Socio-economic research

Considerable progress has been made in the technical field as regards the performance of systems, but there has been little advance in other equally important aspects of an energy efficiency strategy: relating to the economic, social and behavioral sciences. Indeed, although it is well-known today that many systems are technically reliable, consume less energy, pollute less and represent an overall saving for users and for the community, their dissemination and market penetration are limited.

Fields requiring further research include:

- Land-use planning, town planning, rural development, and major infrastructure development. Beyond the topic of the technical performance of systems, the decisions made regarding these major development and infrastructural issues will be decisive in bringing about sustainable economic growth. In most of these issues energy is a determining factor. The energy efficiency approach should therefore be incorporated into the overall strategy.

- Sociological and political issues on consumer behaviour and decision-making. Research into consumer behaviour is interesting and useful, but highly insufficient. It must be completed by knowledge and understanding of the attitudes and conduct of decision-makers whether these are governments, industrial leaders, local authority administrators or elected representatives. It is essential to deliver information tailored to their needs and culture and to present various alternatives. In any event, it is essential to develop ways and means of involving consumers in decision-making and programme formulation: an energy efficiency policy will not be implemented without them, and will be inapplicable when it doesn't act on their wishes.

• Economic and financial issues. Economic research is essential in order to grasp the macro-economic aspects of energy efficiency and to find new ways of exploring future energy demand. Research should also explore more precise ways of devising and evaluating projects, such as those aimed at controlling electricity demand (demand side management) or the practice of the integrated programming of resources (least cost planning).

An aspect which has been largely neglected in the research effort is financing. The ways of paying for energy efficiency actions are clearly not the same as those for the major projects to which the energy sector is accustomed. Of course, there have been innovations in this field, and progress has been made (third party financing, for example), but much remains to be done. It must be possible to offer the promoter of energy efficient systems and the consumer appropriate methods of financing. It is particularly interesting to examine these questions in political and economic contexts that are different from those of the Western industrialised countries: i.e. the developing countries (a highly disparate group) and the countries of Central and Eastern Europe.

• International cooperation between the industrialised countries and the developing countries or those in transition should itself be the subject of more research. With regard to methods of integrated energy planning, the formulation of an energy efficiency policy, research exchanges and the dissemination of advanced systems, we know little about how to make cooperation truly effective beyond the exportation of a development model or the sale of machines.

In terms of research on energy economy, some of the most advanced institutes in the European countries have gathered in a network called ENER (see Box 23).

2.2 FUNDING RESEARCH

Support by governments is essential to finance R&D programmes for energy efficiency. This support is justified by the strategic importance of the objectives, notably the expected beneficial impact on the environment.

Although most governments declare energy efficiency a priority of their overall strategy, these declarations are not necessarily reflected in the funds they actually make available.

Table 20 shows government R&D budgets in the energy sector and the amounts devoted to energy efficiency for the countries of the International Energy Agency.

Box 23

ENER: The European Network on Energy Economics Research

Created in 1985, the "European Network on Energy Economic Research" (ENER) connects (in 1996) ten European Centres involved in research on the economy of energy efficiency:

- CEEETA, Centro de Estudos en Economia da Energia dos Transportes e do Ambiente, Universidade Técnica de Lisboa, Portugal. Fax: 351.1.395.08.37
- ECN, Policy Studies Group of the Netherland Research Foundation, Petten, The Netherlands. Fax: 31.224.6.33.38
- FhG ISI, Fraunhofer Institut füra Systemtechnik und Innovationsforschung, Karlsruhe, Germany. Fax: 49.721.689.152
- GIEE, Grupo Interuniversitario de Estudios Energeticos, Universidad Politecnica, Madrid, Spain. Fax: 34.1.544.21.49
- IEFE, Instituto di Economia delle Fonti di Energia, Università Commerciale L. Bocconi, Milan, Italy. Fax: 39.2.58.36.23.15
- IEPE, Institut d'Economie et de Politique de l'Energie, Université des Sciences Sociales de Grenoble, France. Fax: 33.4.76.51.45.27
- LUND University, Lund Institute of Technology, Lund, Sweden. Fax: 46.46.222.86.44
- RISO, National Laboratory Systems Analysis Department, Roskild, Denmark. Fax: 45.46.75.71.01
- SPRU, Science Policy Research Unit, University of Sussex, United Kingdom. Fax: 44.1.273.68.58.65
- STEM, Studiecentrum Technologie Energie Milieu, Antwerp, Belgium. Fax: 32.3.271.14.24

ENER is supported by the European Commission. ENER organises joint studies, seminars and publishes a bi-annual bulletin; a copy can be obtained from IEFE.

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In 1993, the public funds allocated to R&D on energy efficiency programmes by governments of the IEA member countries amounted to US $ 651 million (1994 dollars), or approximately 7.5% of total R&D funding in the energy sector. Total energy efficiency funding peaked in 1980 when it was US $ 944 million (1993 dollars). There are great variations in the share of R&D for energy efficiency in total energy R&D between countries: for some, such as Austria, Belgium, Finland, The Netherlands, Norway, Sweden and the United Kingdom, this share is much higher than the average figure.

TABLE 20: GOVERNMENT RESEARCH AND DEVELOPMENT BUDGETS FOR IEA COUNTRIES IN 1993
(in millions of 1994 US $)

Countries	Total R&D budget for Energy Sector	R&D budget for Energy Efficiency	Share of energy efficiency R&D budget in energy sector R&D
Canada	232.6	25.7	11.1 %
United States	2 311.6	314	13.6 %
Japan	3 982.5	32.6	0.8 %
Australia	n.c.	n.c.	n.c.
New-Zealand	2.8	0.5	15.9 %
Austria	26	9.3	35.8 %
Belgium	15.2	6.1	39.8 %
Denmark	48.4	6.9	14.2 %
Finland	41	12.1	29.5 %
France	546	12.8	2.4 %
Germany	450.1	12.8	2.8 %
Greece	5.2	0.2	4.1 %
Irland	n.c.	n.c.	n.c.
Italy	284.3	51.6	18.2 %
Luxemburg	n.c.	n.c.	n.c.
Norway	52.3	12.8	24.6 %
Portugal	4.1	0.9	22.1 %
Spain	75	4.7	6.3 %
Sweden	73.1	23.9	32.7 %
Switzerland	166.6	27.2	16.3 %
The Netherlands	189.4	64.8	34.2 %
Turkey	3.0	1.0	34.0 %
United Kingdom	154.6	31.7	20.5 %
Total OECD	8 663.7	651.5	7.5 %

Iceland is not included in the IEA table.

Source: IEA, *Energy policies of IEA countries*, 1994 Review, Paris, 1995

However, these data and comparisons must be treated with great caution, for several reasons:

- The figures are supplied by governments and are prepared using rules that may differ from country to country; there is no uniform "grid" to guarantee that the data provided can be compared with that of another country.

- The mechanisms of government research incentives vary considerably between countries; in certain countries, public funds from the regions are taken into account, in others, assistance for industrial research comes under a heading different from energy efficiency, and so forth.

- R&D in the field of energy efficiency may be funded under research programmes in sectors other than that of energy, e.g. construction or transportation.

Even though an integrated energy efficiency strategy is regarded as a priority matter for the quality of the environment and the implementation of a world-wide sustainable growth strategy, the R&D budgets in this field remain relatively low compared with other energy research. A better balance between actions taken for the production of energy and those devoted to the efficiency of energy use should be established.

2.3 THE ORGANISATION OF RESEARCH PROGRAMMES

Energy efficiency R&D programmes must be carried out in a wide variety of settings. Effective coordination of the R&D effort by a competent authority is therefore crucial.
The authority in charge of implementing the energy efficiency policy needs to promote energy efficiency in both public and private research programmes, promote suitable research topics, coordinate and stimulate projects and evaluate the results.

It is extremely important that research programmes and their funding should be linked to other actions taken as part of an integrated strategy. For example:

- The drawing up of regulations on the thermal performance of new buildings should be accompanied by R&D in construction methods, construction materials and certain components (windows, for example).

- The publication of standards covering domestic electrical appliances goes hand-in-hand with efforts by the manufacturers of refrigerators, washing machines, office machines, etc. – possibly supported by government incentives – to develop and produce more efficient machines.

• The public authorities in certain countries have set target limits on the fuel consumption of motor vehicles: this approach should be paralleled by incentives to stimulate research and innovation by the motor vehicle manufacturers.

In most countries, government aid to research and public R&D programmes is largely concentrated on major projects (in the energy field, nuclear power is typical for several countries of the IEA and of the European Union). This approach:

• Ignores innovations that lie outside the present view of the "major project", but which can nevertheless represent substantial gains in energy efficiency, particularly as certain systems, for example refrigerators or microcomputers, are marketed in such large numbers.

• Disregards small and medium-sized enterprises which have the capacity for invention and innovation but not the funds to exploit them – a serious oversight because these firms are often active in producing everyday systems and appliances which consume energy.

Special attention should be paid to the links between R&D done by university organisations, research centres and institutes and the industries which manufacture the products and systems. Research activities and industrial activities are too often decoupled. On the other hand, Japan, for example, has shown an extraordinary capacity for bringing about cooperation between public research organisations and industry.

Government intervention to stimulate R&D in the field of energy efficiency must develop this form of cooperation: this can be achieved by the use of government contracts in which the research organisation and industry are linked from the moment the programme begins. In certain cases it will also be useful for a third partner, representing the potential users of the product or process covered by the research programme, to be involved from the outset.

Since financial resources are limited, it is important that research and development should be properly organised, monitored and assessed. This can be done:

- by setting up "scientific committees" to direct the programmes in the different disciplines and to monitor them with a critical eye;
- by making provision, in every contract for government aid to research programmes, for evaluation of the programmes by independent experts.

2.4 DEMONSTRATION AND PRE-MARKETING

One of the major difficulties in implementing an energy efficiency policy lies in bringing the most advanced techniques to the consumer, even when cost is not an obstacle. Scientists and engineers too often believe that the technical superiority of the machine or method they have developed will be sufficient to ensure market success – this is a simplistic notion which overlooks economic, financial and sociological reality. There are two essential links between innovation and market dissemination: they are demonstration and pre-marketing (see Boxes 24 and 25).

A demonstration project is the first use of an equipment or system at full scale, under realistic conditions of operation and in its socio-economic environment. The three criteria of the demonstration are technical feasibility, economic viability and social acceptability. It is essential to prepare a demonstration operation together with the users involved so that they can take responsibility for its monitoring and evaluating. Accurate technical, economic and social surveys after several years of operation are also important for evaluating long-term feasibility. The search for exemplarity may result in the same technique being applied in different industries or different geographical areas.

The aim of pre-marketing is to find a market for selected systems or processes according to an analysis of the potential market and a precise technical and economic assessment based on the results of a range of demonstrations.

Box 24

A MAJOR EUROPEAN UNION INNOVATION AND DEMONSTRATION PROGRAMME: JOULE / THERMIE

JOULE: "Joint Opportunities for Unconventional or Long-term Energy Supply"
THERMIE: "European Technologies for Energy Management"

This programme is a joint programme of DG XII - Research and DG XVII - Energy. Its duration is four years (1994-1998), with a budget of 967 million ECUS.

Objectives:

1. To finance R&D and demonstration activities in the field of clean and efficient energy technologies including development of techniques and processes for (I) the rational use of energy in the major end use sectors, (II) the non-polluting use of solid fuels and hydrocarbons and (III) the economic use of renewable energies.

2. To promote the development, dissemination and market penetration of the developed technologies.

The target groups are research institutes, universities, energy agencies, utilities, equipment suppliers, etc.

Contact: European Commission, Brussels, Belgium.
R&D and demonstration (DG XII) Fax: 32.2.295.06.56 / 32.2.295.05.77
Dissemination (DG XVII) Fax: 32.2.296.60.16 / 32.2.295.61.18

Box 25

INFORMATION SYSTEMS ON ENERGY END USE TECHNOLOGIES

CADDET (Centre for Analysis and Dissemination of Demonstrated Energy Technologies)

Organisation: • International Energy Agency (IEA); 14 participating countries and one associated participant (the Republic of Korea).

Contents: • Data collection on current and completed demonstration projects on energy efficient technologies. A specific annex has been created for renewable energy.

Information: • Technical and economic analyses, energy market monitoring, identification and communication of policy implications and market choices facing manufacturers, registers, and a quarterly newsletter.

Contact: NOVEM – Sittard, The Netherlands. Phone: 31.46.42.02.202 / Fax: 31.46.45.10.389

SESAME

Organisation: • European Commission.

Contents: • Documentary database containing descriptions of energy research and development projects, demonstration and hydrocarbon technology projects:
– research and technological development projects in the field of renewable energy resources, raw materials, environment (pollution, waste recycling);
– demonstration and innovation projects in the field of energy savings, solar energy, liquefaction and gasification of solid fuels, electricity and heat, alternative energy sources.

Information: • Administrative, financial, documentary (location, sector, results, aims).

Contact: EUROBASE – Brussels, Belgium. Fax: 32.2.296.06.24

ETDE

Organisation: • Consortium of 15 member countries. Exchange system established in 1987 with the support of the International Energy Agency (IEA).

Contents: • Scientific and technical database on energy. Significant literature on areas of international concern, such as global climate change.

Information: • Scientific and Technical Information. Bibliographic citations to energy-related literature published in the fifteen member countries.

Contact: Department of Energy, Department of Scientific and Technical Information
Oak Ridge, Tennessee, USA. Phone: 1.423.576.1272 / Fax: 1.423.576.2865

3

Planning, technical and economic studies, evaluation

The economic and technico-economic studies necessary to implement energy efficiency policies, programmes and projects cover a broad field:

- incorporating energy efficiency in overall energy and economic policy, based upon the analysis and forecasting of energy demand;
- evaluating the potential and economic characteristics of energy efficiency programmes in the various sectors of activity;
- reviewing the viability and funding of projects;
- evaluating completed projects and programmes.

3.1 FORMULATING ENERGY POLICY ON THE BASIS OF DEMAND

As we saw in Chapter I, an energy efficiency strategy implies an integrated energy planning exercise, placing action on energy consumption and action on energy production on the same footing. Against this background, the energy policy and, more specifically, the energy supply policy, will be formulated on the basis of knowledge, analysis and prospective study of energy demand, taking account of the potential for energy efficiency.

We shall examine the different stages of this "demand-based" planning approach which constitutes the backbone of an energy efficiency strategy.

FIRST STAGE

The first stage is conventional: drawing up the annual energy balance, which includes the following:

- the components of energy consumption, in other words, the distribution of final consumption by energy products (oil products, coal, wood, gas, electricity and heat) and by consumption sector (industry, transportation, households, the service and commercial sector and agriculture);
- the components of energy supply from the various energy sources: production, importation and exports, transformations (oil refining, electricity generation, centralised heat production or combined generation), transportation and distribution, up to the final energy stage, i.e. the distribution of energy products to the consumer.

To the newcomer, energy balance formulation often appears trivial. In fact, it is complicated and beset with difficulties and traps. These include:

- in the great majority of countries, including those of the OECD, renewable forms of energy – particularly wood – are often disregarded and systematically underestimated in national and international statistical studies;
- the question of quantifying electricity in kWh by a reference unit of energy (for example, the ton of oil equivalent) raises difficulties. The conversion ratio between kWh and toe used is not the same in each energy accounting system;
- as regards energy efficiency policies themselves, knowledge of energy consumption by sector is essential. However, in many countries consumption by the service sector is poorly identified and, in practice, often difficult to separate from the residential sector consumption.

In the countries of Central and Eastern Europe and countries such as China, consumption by the transportation sector always appears very low. This is partly due to the small number of automobiles, but also to the fact that in these countries' statistics, the transportation of goods is partly included in industry, and private motor vehicles under "population".

Second stage

The second, less conventional, stage involves drawing up the "map of energy consumption" (disaggregated sectoral energy consumption accounting) which covers:

- the consumption of final energy by product, by sector of activity and by end use (i.e. heat, motive power, electricity required, etc.);
- the factors which determine energy demand, i.e. the indicators which characterise energy consumption:
  - population, number of households, breakdown between urban and rural areas;
  - quantitative and qualitative characteristics of households and services;
  - household equipment (heating systems, electrical appliances, etc.);

- means of transportation, indicators such as ton.km, passenger.km or vehicle.km;
- industrial and agricultural output in physical terms (tons of products) or as added value;
- service and commercial activities (number of jobs, added value, occupied surface, etc.).

For each energy-consuming activity, it should be possible to work out a corresponding "specific consumption", which is the ratio of energy consumption to the value of the characteristic indicator of this activity (for example, the petrol consumption per passenger.km for private cars). These data are obtained from the country's economic statistics, supplemented – this is always necessary – by sectoral consumption surveys.

It would be illusory to look for a single indicator per sector. It is usually necessary to devise and monitor several indicators in order to understand trends, identify the decisive factors, and to plan policies and assess their impact. In the service sector, for example, energy consumption for the purposes of heating expressed in terms of floor area will not have the same meaning as when expressed in terms of economic activity – but both are useful. The indicators are calculated according to the availability and reliability of statistics. Knowledge of these indicators and specific consumption figures is important for planning energy efficiency actions since these will involve reducing specific consumption and possibly modifying certain factors which determine demand (for example, changing modes of transportation).

This description of the situation for a given reference year (the latest for which statistical data are available) should be supplemented by technical and economic analyses of trends in the determining factors and consumption figures of the past, in order to better understand the mechanisms of change in energy demand.

This information and analysis is not necessarily available in all countries. An effort should be made to gather it. However, this research should not postpone the launching of programmes under the excuse that more precise data is required. Gathering information and on-field action should be carried out simultaneously.

Third stage

The third stage involves "exploring future energy demand" within "scenarii" for social and economic trends in the country (or region, or city, depending on the area for which the plan is to be drawn up).

The scenarii consist of sets of coherent assumptions pertaining to trends in the factors determining energy demand: changes in population and the structure of households, in the stock of housing and service sector buildings, in industrial and agricultural production (and, within industry, evolution of the main branches), in the vehicle population, in the transportation of goods, and so on. One or more scenarii can be drawn up with the country's economic experts, the main difficulty being to maintain the coherence of the whole.

In order to determine the corresponding energy demand, the following steps must be taken:

• First, an analytical method is used to "monitor" trends in energy consumption in each sector and subsector throughout time (using the "technical-economic approach"), combined with a computer model which is simple and transparent but also comprehensive to facilitate the execution of several case studies – the MEDEE models (see Box 26) are now used in a large number of countries and appear in practice to be the most appropriate for this exercise.

• Secondly, energy efficiency programmes should be simulated, modifying the specific consumption figures or indicators by:
- changes in the price of energy products (including any additional taxes);
- technical advances and the introduction of improved systems and appliances;
- the introduction of regulations pertaining to energy consumption;
- financial incentives to energy efficiency actions.

In this way, the effects of an energy efficiency policy (or the lack of a policy) can be "explored" and the results assessed, for example over a period of 10 to 20 years. In schematic terms, the outcome will have two contrasting elements: one which corresponds to the continuation of current trends (in general, a not very rational use of energy), the other which corresponds to the application of a vigorous energy efficiency policy.

This forecasting exercise has a dual objective:
• to highlight the elements of an energy efficiency policy and to estimate its effects (and hence the potential) over a long period;
• to determine the needs for energy products which the supply system will have to meet, at the different time horizons of the exercise and for contrasting scenarii.
The factors of choice for the decision-makers will be determined by evaluating the costs of the different programmes affecting supply or demand.

This kind of demand-based energy planning comes into its own as an "aid to decision-making in energy policy", since it makes it possible to compare different development paths corres-

Box 26

THE MEDEE MODELS

The MEDEE models belong to the family of end use energy demand forecasting models. Their main objective is to evaluate the development of energy demand over the medium and long term (10-25 years) under alternative scenarii of economic development or energy policies.

Various versions of MEDEE models have been developed. The most recent software are MEDEE-N for European countries (i.e. with space-heating requirements), MEDEE-S and more recently MEDEE-A for developing countries. The models have been developed with the support of the European Commission (DG XII, DG XVII), Ademe / AFME in France, UN-ESCAP and the African Development Bank.

Contact: ENERDATA – Grenoble, France. Phone: 33.4.76.42.25.46 / Fax: 33.4.76.51.61.45

ponding to combinations of decisions to implement actions on energy demand (energy efficiency programmes) and on supply (investment in production, additional importation). For example, the cost of introducing compact fluorescent lamps, more efficient refrigerators or electronic speed variators for industrial motors can be compared to the cost of new electricity-generating facilities offering an amount of electricity equivalent to that saved by these new technologies.

The economic comparison of these different paths – different policies – should be accompanied by a comparison of impacts (improvement or deterioration) on the environment. It must nevertheless be pointed out that determining the environmental impacts of different energy paths is not straightforward and requires major resources for research and data, which will need to be kept up-to-date.

Box 27 gives an example of the MURE method (Model for Rational Energy Use), initially developed under the auspices of the European Commission (DG XII, then DG XVII). The example concerns electricity. MURE aims to describe the energy efficiency measures which are applicable to each consumption sector, to evaluate their potential and their costs, and their impacts on the energy balance: it is a precious tool for energy efficiency planning.

Important international cooperation programmes between research centres have been implemented on economic issues related to integrated energy planning and energy efficiency (see Box 28).

Box 27

THE MURE MODEL: MODEL FOR THE RATIONAL USE OF ENERGY

THE SPECIFIC USES OF ELECTRICITY

The aim of this particular application of the model is to describe the underlying evolution of specific electricity consumption and to measure the impacts of any "demand side management" actions on this evolution.

The model is made up of several data bases (socio-economic factors, technical characteristics of the equipment, behaviours of the consumers), of calculation rules and of several evaluation models:
- annual sales of appliances;
- annual investment generated by the purchase of each appliance;
- energy and raw material needed and volume of the waste generated by the production of the appliance;
- volume of the waste produced and of recyclable components at the end of the lifetime of the appliance;
- consumption of the equipment, other than energy (water, washing powder, etc.);
- electricity consumption and capacity of the appliances.

There are several ways the model can be used, depending on the objectives:
- a micro and macroeconomic use concerning the evolution of the appliance stocks, consumptions and costs;
- a "marketing" type use: current and future market shares which depend on consumer behaviour;
- an environmental and political use concerning demand side management. The model permits to quantify the impacts of the various options (technical improvements in terms of consumer behaviour, actions on the socioeconomic factors, on the power load or the use of the equipment).

Contact: INESTENE – Paris, France. Phone: 33.1.45.65.08.08 / Fax: 33.1.45.89.73.57

3.2 THE ECONOMIC EVALUATION OF ENERGY EFFICIENCY PROJECTS

The economic evaluation of energy efficiency projects and programmes will be made from different "points of view", whether the aim is to evaluate the benefit of measures or operations implemented or to be implemented for the national community, for the final consumer of for intermediary actors (cities, energy enterprises, energy service companies, etc.).

3.2.1. From the point of view of the community: costs of providing a service

From the point of view of the national community, as we have seen in Chapter I.2, determining the least costly energy strategy is based on the comparison of the cost of providing a service for various energy pathways, going from energy production to the service provided to the user.

Box 28
The COPED Centres

COPED, "Cooperative Programme on Energy and Development", is a network of research centres in Europe and developing countries for common research in energy economics. Since 1992, the common research activity has dealt with "the rational use of energy".

A number of papers were prepared by COPED for the Rio de Janeiro conference dealing with "strategies for the rational use of energy in developing countries" and several developing country case studies. COPED is supported by the European Commission.

The member Centres of COPED are:
- Asian Institute of Technology (AIT), Bangkok, Thailand.
- Instituto de Economia Industrial (IEI / UFRJ), Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.
- Environnement et Développement du Tiers-Monde (ENDA / TM), Dakar, Senegal.
- Instituto de Economía Energética, asociado a Fundación Bariloche (IDEF/FB), Bariloche, Argentina.
- Institut Economique et Politique de l'Energie (IEPE), Grenoble, France.
- Programa Universitario de Energia, Universidad Nacional Autonoma de Mexico (PUE/UNAM), Mexico.
- Institute of Nuclear Energy Technology (INET), Beijing, China.
- Science Policy Research Unit, Sussex University (SPRU), Brighton, United Kingdom.
- Tata Energy Research Institute (TERI), New Delhi, India.
- Energieonderzoek Centrum Nederland (ENC), Peten, The Netherlands (associated members).
- Energy for Development Research Centre (EDRC), University of Cape Town, Cape Town, South Africa (associated members).

Contact: IEPE – Grenoble, France. Phone: 33.4.76.42.45.84 / Fax: 33.4.76.51.45.27

The cost of providing a service is the sum of the values discounted over the period of use of the equipment costs (investment), the cost of use (upkeep and maintenance, operation) and the cost of the energy product consumed, calculated all along the energy pathway from the service provided to the primary energy.

The cost of providing a service is calculated with the discount rate, which is frequently used to compare large energy production investments.

Economic behaviours are most often characterised by a dynamic perspective in which actions on different timescales affect one with another. Consumers must decide how to distribute their resources between consumption and savings, i.e. between present consumption and future consumption. Likewise, the investments enterprises make today bring them profits tomorrow. The discounting method allows to compare revenue, consumption, gains or costs which take place at different dates.

To compare available gains or revenue or expenses to be made at different dates, they are converted into amounts payable today (i.e. at the date of the calculation): this operation is called discounting. In other words, the discounted value of a future expense or gain is the equivalent amount paid or received today.

The "discount rate" is used to determine this discounted value. In terms of loans, the discount rate is actually the interest rate at which the investor (whether the individual consumer or the community) considers he can lend or borrow money.

If Dt is a gain or expense to be received or paid at the date t (year t based on year 0 today), the discounted value of this gain or expense is the sum D, defined by: $D = Dt / (1 + a)^t$ where *a* is the annual discount rate.

More generally, the annual discount rate *a* is such that, for the economic agent considered, 1 US $ today is equal to $(1 + a)$ US $ in one year and $(1 + a)^{10}$ US $ in 10 years.

Discounting permits to compare flows of gains and expenses which take place at various times by converting them to a same date.

The discount rate reveals the preference of the economic agents for the present or the future, according to the interest rate net of inflation and the total duration of the investment. Discount rates vary according to the economic agents.

To calculate the discount rate, individuals can use the net interest rate: they know they can lend or borrow money at a certain rate. In fact, their choices often reveal a strong preference for the present: they may prefer to invest in low energy-efficiency equipment with a low initial cost but with a total cost (investment + operation over the lifetime of the equipment) much higher than if they had initially invested more for high efficiency equipment.

For the community, the discount rate is based on a reference interest rate which is different from that of private consumers. Generally, the rate used by the public authority varies between 8 and 10%, which favours medium and long term projects.

In the case of an energy policy, discounting permits to:

• compare means of production which have different "life rhythms", for instance for elec-

tricity, to compare hydropower plants (for which the cost of the kWh varies essentially with the level of investment) with thermal fuel-powered plants (where the cost of the kWh strongly depends on fuel costs);
- calculate the cost of providing a service by adding the discounted values of all the investments, operation costs, fuel costs, etc., which permit to provide the service and to compare the costs of providing a service for several energy pathways which integrate various means of production and consumption.

One can thus calculate the costs of providing:
- a "kWh of service" in the residential and service sector for the service rendered in space-heating, sanitary hot water or lighting;
- a passenger.km in the transportation sector for the service rendered for the transportation of one person over 1 km by various modes of transportation;
- a kWh of mechanical energy or process-heat in the industrial sector.

Take the example of the provision of space-heating. The economic interest of various options for the community can be evaluated. For instance, district heating and individual or collective gas heating can be compared (from the installation of equipment in the households to the upstream investment required for production, distribution, system management, etc.). This evaluation should also concern the political instruments which can be used according to the option chosen: tariff policy, regulations, etc.

Remark

A number of actions, essentially in the field of training, information and regulation, are difficult to evaluate, particularly if their target is very broad and their objective is to achieve lasting changes in behaviour, whether that of individual consumers or of companies. Nevertheless, even in these fields, when the programmes are specified, it is possible to evaluate the gains produced by operations which do not entail material investment. For example, once a factory exceeds a certain level of energy consumption, it is very important to designate an "energy manager" to supervise energy efficiency in all the factory's activities, ensure continuity and follow-up in this field, and investigate innovations or changes to improve the situation. The same applies to a city of sufficient size or a group of towns. It is possible to compare the costs of creating this position in the company, factory or city with the financial benefits accruing from the energy savings brought about. In the same way, it is possible to compare the cost of drawing up, implementing and monitoring certain regulations with the expected benefits of their application (in the case of new buildings, the results of this comparison are quite amazing).

3.2.2. From the point of view of the consumer or the investor: project evaluation

In the final resort, an energy efficiency policy enters the real world through the execution of projects – essentially through investments – at the level of the consumer or an external investor acting for the consumer. Hence, it is a question of determining the economic soundness of these investments by comparing them with the cost of the energy they save (not forgetting certain "external costs" notably linked to pollution).

Three main economic indicators are used to evaluate the viability of a project and to direct investment choice: the cost of the energy saved, the internal profitability rate and the simple payback period of the investment. The definition and the mode of calculation of these indicators are presented in Chapter V which covers investment financing. We will retain here that the aim of economic calculations on programmes and projects is to determine these indicators, or one of them regarded as the most significant for the operation being considered or the partner concerned (type of consumer, energy company, public organisation, etc.).

Since the comparisons are made over relatively long periods, changes in prices of energy products become important. The relevant assumptions must be made clear. The demonstration will be even more convincing if highly profitable operations can be highlighted even when energy prices are low. One of the advantages of the systematic character of this type of evaluation is that it shows up substantial potentials for energy efficiency at a very low cost. Moreover, the potentials obtained by this type of evaluation carried out at a given time often turn out inferior to the savings made or evaluated a few years later, primarily because technological progress is in general under-estimated in calculating potentials at medium and long term.

These various methods of calculation permit to establish the conditions of the economic profitability of a project. However, this demonstrated profitability does not in itself lead to the implementation of the project: in order for the energy efficiency investment to be made, sometimes a certain number of incentives must counterbalance the difference between the investment capacities of an average consumer (even an industrial operator) and that of an energy producer. Adapted financial mechanisms must also be designed and proposed to the consumer, or the latter must be relayed by special companies which can take his place as main investor.

Remarks

• For many countries – notably those whose currency is not convertible – it is important that the economic evaluation of an energy efficiency project should bring out the net foreign currency gain it produces. In fact, most countries are energy importers and this weighs heavily in their trade balance. To evaluate the net gain in foreign currency, two components must be considered:

- – the proportion of imported equipment, representing a loss of foreign currency;
- – the foreign currency gains induced by the energy savings made.

• This evaluation is particularly useful for investments based on public money. In fact the consumer, for example an industrial operator, who makes the investment, pays for the energy in local currency and is therefore not sensitive to foreign currency savings. On the other hand, it is a very important issue for a government. The evaluation of each project will therefore include the expected foreign currency gains, at the international price of the form of energy concerned (for example, dollars per barrel for oil), together with an estimate of how this price will change with time.

• The growing importance of environmental concerns and the major role of energy efficiency in reducing pollution related to energy consumption and production mean that the strictly economic evaluation of projects must be accompanied by an assessment of the environmental effects. At present, this evaluation is usually limited to air pollution. It is based on data on the emission factors of the main energy systems for pollutants such as SO_2, NO_X, CO_2, dust and grit.

Thus the evaluation of the energy saving made will be supplemented by the calculation of the pollution avoided by this saving, either directly at the place where the energy is consumed, or indirectly at the place it is produced (for example, reduced electricity consumption leads to less pollution from power stations). In the future it will be necessary to extend this evaluation of the positive environmental effects of energy efficiency projects to water pollution, soil pollution, waste production (notably radioactive waste), the risk of accidents, etc. Finally it will be necessary to take account of the savings made on other greenhouse gas emissions (methane, CFCs, CO, ozone, etc.).

3.3 INTEGRATED RESOURCE PLANNING AND DEMAND SIDE MANAGEMENT

Electricity use, and particularly low voltage electricity consumption in the residential and service sectors, is still often used as an indicator of economic health and of improvements in living standards. Few people are yet aware of the fact that the ratio between service needs and electricity consumption is, more than for other forms of energy, far from being a constant value. On the contrary, very important stakes in terms of energy saving and limiting environmental effects are involved in changing this ratio.

In fact, electricity generation and distribution have many harmful effects, both local and global, which have recently attracted much interest among scientists, politicians and the public, resulting in extensive and costly programmes aimed at reducing their impact. Rather paradoxically, the possibility of reducing these effects by adjusting demand is a concept which has had a difficult birth, even though in recent years it has been admitted in principle.

In the 1980's in the United States, particular progress was made under the pressure of environmental organisations, through the regulatory bodies. The overall concept of energy efficiency has evolved, generating new applications, especially in the field of electricity and gas consumption. Programme implementation concepts have developed, particularly that of Demand Side Management (DSM) and Integrated Resource Planning (IRP).

DSM includes a series of utility-initiated actions aimed at influencing customer load patterns and total consumption, in particular through load management and energy efficiency. For instance, replacing incandescent electric bulbs by compact fluorescent bulbs can lead to a delay in or avoidance of generating capacity (notably attractive in peak periods) and financial savings both for the consumer and the electricity utility. DSM is thus one element of the "demand" part of an energy policy based on the principle of least cost planning.

The concept of the "Negawatt" was formulated for the first time in the United States by Amory Lovins to describe the electricity generating capacity saved by adjusting demand, in the same way as the Megawatt defines the generating capacity produced. It found concrete expression in 1987 in the State of Michigan when the Lawrence Berkely Laboratory presented a programme to reduce the electricity consumption in a call for tender, in direct competition with a classical option to build a new power station.

As a rule, the electricity sector is structured around powerful public or private utilities enjoying a monopoly or virtual monopoly situation within the area allocated to them by the public authorities. In return, the latter generally exercise a tight regulatory function which covers, in particular, major investment decisions and price formation.

As far as the electricity company is concerned, financing programmes to save electricity means that the traditional options of increasing generating capacity, and the options of reducing electricity demand for the same service provided, are dealt with on an equal basis. The vocation of electricity enterprises which choose this approach is no longer simply to supply or sell power but to supply a service at the least cost in energy and environmental terms, by promoting more efficient management and user practices as well as appliances which consume less energy for a given purpose.

Under pressure from the authorities, a number of American electricity utilities have developed effective incentive mechanisms for saving electricity. It may be that electricity companies in every country will not show the same interest or dynamism. Nevertheless, the general rule appears to be:

- electricity companies are interested in encouraging electricity saving at peak times (when generation is expensive);
- electricity companies are interested in electricity saving when it is being sold at a loss, i.e. when the selling price is less than the cost (as it is in certain isolated areas or islands); this also applies to situations where there is structural under-pricing in countries with subsidised economies;
- the public authorities should encourage electricity saving, through the organisation in charge of implementing energy efficiency policy, for reasons of general interest: savings on investment and foreign currency for the country, reduction in electricity bills for consumers (in many countries, the price of electricity is very high compared with the purchasing power of households), and a reduction in the environmental effects of electricity generation and transmission.

INTEGRATED RESOURCE PLANNING

"Least Cost Utility Planning" (LCP) or "Integrated Resource Planning" (IRP) consist in comparing the cost of developing new electricity generating and distribution capacity (energy supply curves) within a given year with the cost of implementing demand side management programmes (saved energy supply curve). In doing so, it is assumed that the energy saving should be dealt with in the same way by the public authorities, the banks and the taxation authorities as would a new power station. The electricity companies are prompted by the supervisory authority (ministry or regulation committee) to invest only at the least cost to the community and the consumer. For some American utilities, the energy saved through current programmes costs one tenth of that produced by a new plant (more savings could be made at a higher cost but still below the cost of supply options). Similarly, for example, in Vancouver – Canada, the British Columbia-Hydro utility prefers to subsidise high performance systems rather than build a new dam. The rules imposed on the utilities by the supervisory authorities in some American states also include environmental concerns, for example, the introduction of damage factors or the quantification of environmental externalities.

The rationale is global and compares the actions taken by the supply side and the demand side from the standpoint of the community. Of course, the difficulty is that this is not always in the immediate interests of those involved: it may be necessary to adapt the regulation to incite the actors to implement programmes.

DEMAND SIDE MANAGEMENT

To achieve the "savings" part of the programme, the utilities therefore implement a series of incentives for their customers, including information and advice, audits and financing. The companies finance certain investments they recommend to the consumer, the latter possibly repaying the loan on his electricity bill. Demand side management has allowed American utilities to save on installations and their participating customers to pay less for the same service.

Electricity generating and distribution companies have always played an active part in the development and marketing of consumer appliances, for example by working together with appliance manufacturers to determine quality standards (particularly as regards safety) or by acting directly or through intermediaries to promote certain technologies in industry, agriculture or the residential and service sectors. In this way, they are very familiar with all the partners involved in the implementation of a demand side management policy, and appear to be essential participants in the implementation of an efficiency policy for the specific uses of electricity. Most of these utilities have developed modulations in the rate structure as a means to reflect the production cost structure. It also encourages consumers to manage their energy demand better, particularly by using off-peak power or investing in electricity savings.

Although tariff structure is an important element to guarantee the interest of the consumers in saving electricity, the implementation of DSM programmes is also based on a range of complementary instruments aimed at:
- helping the consumer to understand his electricity bill better;
- helping the consumer to detect the opportunities to make improvements, and advising him on possible options: personal audit and advice, wide-scale or targeted information campaigns, labelling, etc.;
- developing the skills of electricity-consuming equipment installers (training, handbooks, etc.);
- offering to consumers financial incentives in the form of rebates or loans (reimbursable credit on the electricity bill for example);
- accelerating the marketing of innovative equipment and promoting its dissemination.

Many countries are now progressively instituting least cost planning and demand side management programmes. Of course, each country has to redefine the objectives, procedures and the roles of those involved according to their own situation. But the North American experience has shown the possibility of interesting energy suppliers in a strategy which is optimised from the point of view of the community, and the effectiveness of being able to mobilise these suppliers towards controlling demand.

In Europe, Denmark, Sweden, the Netherlands and, to some extent, Germany are the most active in promoting DSM programmes. A European Commission directive on Utility Planning Principles incorporates the Integrated Resource Planning approach. However, the current changes in the regulation framework of the electricity sector and the development of competitive markets may lead to a decline in DSM efforts, or at least an evolution of the nature of demand management activities. Taking IRP and DSM concepts into account in the emerging regulatory framework will constitute a major stake for the coming decade.

The practice of Least Cost Utility Planning is based upon a collaborative process which involves all the people concerned by the elaboration of action proposals on energy demand and on energy supply. In parallel, implementing the programmes sometimes involves competitive bidding, whereby the energy suppliers can "subcontract" part of the programmes to energy service companies (ESCOs, see Chapter V.4.4).

The main attraction of the techniques of Least Cost Utility Planning and Demand Side Management is that they can simultaneously allow for more room for market forces and a public service approach:

- more room for market forces. The issue is to optimise the electricity supply system according to market forces: return on investment, matching supply to demand, eliminating non-flexibility in the production system, smoothing out market operation;
- a public service approach. The consumers pay less for the same service, while pollution is reduced, the countryside suffers less from high voltage lines or other infrastructure, and the local economy benefits from the investment when the investment creates more jobs.

CHAPTER IV

The means of action

Summary

The organisms and teams in charge of elaborating and implementing energy efficiency programmes must have a wide range of instruments and methods at their disposition – along with the human and financial means to use them – both to increase the scope of action of the decision-makers and consumers and to permit the implementation of concrete projects on a wide scale.

After having examined the main guidelines of programmes in the preceding chapter, we present here the means of action, which are:

- communication and information;
- training;
- voluntary approaches;
- regulatory instruments;
- financial incentives.

By applying these means to the building sector we illustrate their use in the case of a high energy-consuming sector.

The means of action

1

Communication and information

Communication and information constitute a delicate and complex task, since the energy efficiency message cannot be reduced to a few simplistic formulae and must explain the multi-criterion approach covering energy, the environment and development.

The energy efficiency message often comes up against the predominant argument which continues to view increases in energy consumption as an index of progress. This argument is supported by the energy producers who urge the user to consume but do not always provide the choice of rational energy consumption at the least cost for the service provided.

Communication and information involve entirely specific professions, methods and techniques: not everybody can be a good "communicator". In an energy sector dominated by engineers, the choice of people in charge of this activity is therefore very important.

Any programme of communication and information must be preceded by a precise analysis of the prevailing situation. This should cover three major areas: objectives, targets and resources.

1.1 OBJECTIVES

Communication has two main objectives:

• To provide information to all decision-makers, economic agents, intermediate organisations and consumers, enabling them to take an active and effective part in the implementation of energy efficiency programmes. The nature of the information is economic, technical, industrial, financial and commercial.

• To increase general awareness of the value of an energy efficiency policy by presenting arguments and methods in order to help orient economic and social development towards a more energy-efficient society which is more respectful of the environment. In a nutshell, communication on energy efficiency participates in the building of sustainable development.

It is clear that the field of communication is extremely broad. It must be based on a carefully prepared strategy adapted to the particular country, the sensitivity of the various categories of the public and their desire to become involved, the state of the market and the techniques available. Box 29 shows the example of a specific information action on energy efficiency, coordinated with public incentives.

1.2 TARGETS

The "targets" of communication are those to whom messages on energy efficiency are addressed, the intermediaries and relays involved in implementing programmes and the partners who will execute the actions. They can be classified into several categories:
• the consumers (individual users and households): the general public;

Box 29

MOTIVA: INFORMATION CENTRE FOR ENERGY EFFICIENCY

In September 1992, the Council of State of Finland approved the national "Programme on Energy Conservation", designed to achieve energy efficiency targets through information and technological improvement.
In approving the programme, the Government of Finland provided for the establishment of an Information Centre for Energy Efficiency.
This Centre was called MOTIVA and started operating in March 1993.
The main responsibilities of MOTIVA are information for increased energy conservation and awareness, and support for the market entry of more energy efficient technology.

MOTIVA targets all user groups and works in cooperation with industry, consumer organisations and individual consumers by establishing mutually financed projects for energy auditing, training or technology demonstration.

MOTIVA collects, processes and distributes information on energy efficiency and allocates funds to support energy conservation measures.

Contact: MOTIVA – Helsinki, Finland. Phone: 358.0.456.60.90 / Fax: 358.0.456.70.08

- professional circles: industrial firms and those in the service sector, professional organisations, local communities, etc.;
- the decision-makers: the government, the Parliament, regional and local elected representatives and executives, heads of government departments, etc.

1.2.1 Consumers in the general public

It is generally thought that the particular target of communication is the ultimate consumer, regarded as the "general public": this is the first notion that comes to mind and many governments have indeed launched "awareness campaigns" (often on television) to make users more conscious of energy savings.

The consumer can change his behaviour and make energy savings either by controlling his consumption (by turning off unwanted lights, driving his car smoothly, or buying appliances which use less energy), or by having his dwelling modified with a view to saving energy. At the same time, the consumer is an active member of society and hence is in a position to intervene in the city, through professional activities or political life.

However, the approach consisting in targeting the general public may not always be suited to a particular country, the market or the state of mind of the consumers. Moreover, their freedom to make choices must not be overestimated. In many cases the consumer is not in control of the most significant choices and can purchase only what is on the market: does the town have rapid public transportation which is frequent, comfortable and cheap? Are the dwellings well insulated? Are the heating systems efficient? Are the domestic electrical appliances sold in supermarkets of an advanced design? Are the commonest models of motor vehicles economical and low in pollution?

Communication with the public must therefore be used with care, particularly if the basic needs of the people involved are not being met, as is often the case in developing countries and in those in transition. The golden rule is to have "something to say": not to make speeches about energy efficiency, but to organise information campaigns with precise proposals referring to existing programmes which are now bearing fruit or programmes about to be launched and in which the consumers can become involved.

We shall examine the communication resources to be used in paragraph 1.3. Experience teaches three lessons:

- Messages aimed at the public must be positive: they should not forbid or restrict, particularly if the people concerned lack amenities and are living in difficult conditions. On the contrary, consumers must be shown that energy efficiency will increase their well-being and their purchasing power and reduce pollution. It is essential to appeal to the consumer's intelligence, as was done in a celebrated information campaign of the French Agency for Energy Management (AFME) in 1986 with the slogan "energy efficiency: a smart move" (a campaign which won a gold medal at the New York Advertising Festival).

• In general terms, communication intended to inform the public and prevent habits that lead to waste should be continuous and make use of the greatest possible variety of resources. Massive, expensive, "one-off" campaigns are usually not a good solution.

• The best communication activities are those which, by their design and application, involve the consumers themselves either directly or through consumer associations or local communities.

In this sense, it is useful to direct some of these activities at children and young people (see Box 30), who are likely to adopt, more easily than adults and in a more lasting manner, new patterns of consumer behaviour which are more respectful of the environment. Schools are an ideal location for communication and exchange, in association, of course, with the teaching staff.

Box 30
Wapiti Notebook for Children
"I save energy !"

A group of partners from associations and enterprises gathered their know-how and resources to desing an educative programme "Understanding and serving the environment".

This national programme targets 8 to 12 year old children and takes the form of a Wapiti Notebook for Children. The notebooks takes them on a discovery trail using various instruments (comic strips, individual and collective games, quizzes, investigations, etc.). A teachers' guidebook provides recommendations on the use of the Notebook and suggests additional activities.

This collection currently covers three topics:
- waste ("Waste Parade");
- energy ("I Save Energy");
- water ("Water for Everyone").

Over three years, this educational programme was delivered to 800 000 children throughout France.

Contact: Espace Naturel Régional – Lille, France. Phone: 33.3.20.12.89.12

1.2.2 Professional circles and economic agents

The professional world expects and is sensitive to high-quality, well-directed, technical, economic and financial information. Here it is not a matter necessarily of reaching the greatest possible number, but of having a continuous and deep link with well-targeted contacts, making maximum use of information "clearing houses" or intermediaries:
- chambers of commerce and industry;
- academic bodies and institutes;
- professional associations and trade unions;
- professional research centres;
- specialised press;
- consumer associations, learned societies, non-governmental organisations, etc.

It is extremely important that the information programme extend beyond the professional circles of engineers and technicians, to reach architects and town planners, firm or housing association managers and, in particular, city service departments, regional and local authorities. The information provided to the various organisations and individuals must be elaborated according to their specific needs to enable them to provide useful information to their members.

In addition, special communication programmes should be produced to publicise new techniques, pilot projects, pre-marketing or demonstration operations, as well as aids to decision-making and means of funding that facilitate investment.

1.2.3 Decision-makers

The economic and ecological importance of energy efficiency seems sufficiently well proven for the political decisions necessary to its implementation to be taken. Actually, in most countries, we still observe considerable hesitation, notably in political circles. There are complex reasons for this policy "delay", but it is due essentially to ignorance of the policy's economic value and pressure from energy producers. In the main, politicians only hear about energy from energy producers and distributors and are unaware of the growth potential generated by energy efficiency programmes, especially for the creation of new businesses and new jobs.

It is therefore essential to develop special information campaigns and public relations activities aimed at:
- government managers in charge of budgetary and financial questions, sectoral activities

Box 31

Combined Heat and Power Association (CHPA)

The British Combined Heat and Power Association (CHPA) groups together the economic agents who are favourable to the development of the combined generation of heat and power (energy suppliers, machine manufacturers, consulting engineers, installers and consumers) and is a powerful parliamentary lobbyist. It recently extended its activities to the European Union authorities in cooperation with associations in other European countries which pursue the same objective. It now organises discussions with members of the European Parliament and members of the Commission.
CHPA is a member of the European association "COGEN Europe" created in 1993 to promote combined heat and power at European level. This association currently gathers 103 members throughout 21 countries.

Contact: CHPA – London, United Kingdom. Phone: 44.171.828.40.77 / Fax: 44.171.828.03.10
COGEN Europe – Brussels, Belgium. Phone: 32.2.772.82.90 / Fax: 32.2.772.50.44

(industry, construction and land-use planning, transportation and agriculture) and environmental questions;
- the Parliament and particularly the committees responsible for finance and economy, industrial and energy issues (see Box 31);
- local and regional administrators and elected representatives.

1.3 RESOURCES

The resources that can be devoted to communication and information are clearly related to the available funds. But this is not the only factor: high grade communication is possible, even with limited resources, so long as a clear communication strategy is defined and then implemented by professionals.

1.3.1 Do, and let others do the talking...

This is the first adage of communication. It means that the role of the press, radio and TV is absolutely fundamental: they must be regularly informed on energy efficiency, its programmes and its progress – particularly the regional and professional press. Information visits should be organised for journalists to show them the most interesting developments and keep them abreast of technical progress. Press conferences must be held regularly, either on programmes and projects of a general nature, or on a particular technical development or incentive approach. Cooperation with the professional press must be developed before consideration is given to special publications on energy efficiency.

As far as decision-makers and politicians are concerned, an article in a major daily or weekly newspaper, or a television programme produced by independent and well-informed journalists, carries more weight than any number of bulky reports.

1.3.2 Some specific publications

• Two groups of partners can benefit from regular and specific information: enterprises and local communities. This can take the form, for example, of a quarterly newsletter (one for each target group) to keep the economic decision-makers up-to-date on the latest news and innovations in the technical field or on energy regulations by means of brief and well-documented reviews and articles.

• It is important to prepare leaflets on each research and development operation and each demonstration project. The leaflets should be drawn up in conjunction with the beneficiary of the operation and sent to the firms and communities directly concerned. An extension of this approach is to construct a computer database describing exemplary developments which can be consulted on-line.

• It might also be useful to distribute a small number of technical brochures reviewing the state-of-the-art in a particular sector or on a precise technical topic (see Box 32). The amount of detail these brochures provide can vary according to the target. For example, if the aim is to point out a few principles of good management to the operators of installations and to get them to ask the right questions – an important first step towards being aware of energy efficiency – then short, instructional notes are sufficient.

• Informing the general public is an important task, but one must be aware that it involves fairly considerable funding. Two particular approaches are interesting and complementary:
  - the production of widely distributed information sheets on topics such as the insulation of dwellings, domestic electrical appliances and vehicle maintenance;
  - the reply to telephone questions which are issued by the public.

These actions have greater impact when they are carried out at the level of a city or region to permit contact and exchange with the users and the understanding of local realities.

Box 32

THERMIE Programme technical brochures

When the European Commission finances projects in the framework of the THERMIE Programme, it asks for a report. The Directorate General for Energy (DG XVII) has thus published hundreds of technical brochures on energy savings in very precise activities, mostly in industry.

The main rubriques of this collection are: rational energy use in cities (district heating, steam distribution systems, architecture, lighting, etc.); buildings (bioclimatics, lighting, insulation and controls, etc.); industry (several fields, for example investment opportunities, diesel engines, energy saving in compressed air, energy maps of selected Community industries, improvements in rotating machinery, fish processing industry, car recycling, etc.); agrofood and drinks; boilers; cement industry; ceramics; chemicals; cogeneration; finance in industry; foundry; glass; heat pumps; iron and steel; metal; paper; textile; transportation (for passengers, goods, but also fuels, efficient vehicles, urban transport, information systems, rail, movement management, etc.).

Contact: European Commission, DG XVII – Energy, THERMIE – Brussels, Belgium.
Fax: 32.2.295.61.18

Seminars, conferences and exhibitions

1.3.3 Seminars, conferences and exhibitions

Seminars, conferences and exhibitions can be extremely useful but must not be overused nor considered as an objective by themselves. A few recommendations could be useful:

- make maximum use of general exhibitions into which the methods and techniques of energy efficiency can be incorporated (for example, exhibitions concerning housing);
- give preference to seminars and conferences with limited participation, ensuring detailed discussion between participants on precise, circumscribed topics;
- as regards overall political and economic orientations, on the other hand, organise conferences for the public with a broad international dimension.

In the field of information and communication, international exchanges of experience and know-how play a major role and should be further developed (see Box 33). However, one must be careful about large prestige events where every speaker recites his personal philosophy. These are costly and lead nowhere. Priority should be given to staff exchanges, training courses with technical teams in the field (city departments and industry) and working groups.

Box 33

ACEEE

The American Council for an Energy Efficient Economy (ACEEE) is a non-profit organisation which gathers, evaluates and disseminates information to stimulate greater energy efficiency. It conducts studies, publishes books and reports, provides expert testimony, and organises conferences to facilitate information exchange between individuals developing new techniques in energy efficiency and those who can put them to work.

Support for ACEEE work comes from a broad range of foundations, governmental organisations, research institutes, utilities and corporations.

The ACEEE series of publications has been designed to make information on energy conservation and energy policy more accessible to those interested in energy issues.

Contact: Research office – Washington, D.C., USA.
Phone: 1.202.429.88.73 / Fax: 1.202.429.22.48
Publication office – Berkeley, California, USA.
Phone: 1.510.549.99.14 / Fax: 1.510.549.99.84

ECEEE

The European Council for an Energy Efficient Economy (ECEEE) was established in 1992. Its goal is to play a prominent role in establishing the agenda for energy efficiency in Europe. The ECEEE defines itself as a responsible activist for energy efficiency issues in Europe following the tradition of its sister organisation in the United States, the ACEEE.

As a forum for presentation and discussion of applied research, the ECEEE convenes a Summer Study every second summer. The first two summer studies were conducted in Rungstedgard, near Copenhagen, Denmark (1993) and at Mandelieu, France (1995). The 1997 Summer Study took place at Spindleruv Mlyn in the Czech Republic.
The four day long conference brings together a broad group of professionals from Europe and other parts of the world to examine the technological, social and economic aspects of improving the efficiency of energy end use.
The ECEEE and the Summer Studies are sponsored by governmental and commercial organisations interested in promoting energy efficiency. The ECEEE Summer Study Secretariat rotates after each conference. The current Secretariat (1995-1997) is situated at the Danish Energy Agency.

Contact: DEA – Copenhagen, Denmark.
Phone: 45.33.92.67.00 / Fax: 45.33.11.47.43

☆

Organising information and communication is not an easy task. There are plenty of organisations and companies producing worthless (and occasionally ridiculous) brochures and advertising materials, usually very expensively. There are, however, others who do remarkable jobs and have years of experience in energy efficiency and who do not know how to make use of their capital and do not "communicate".

Energy efficiency implementation is primarily a question of methods and ways of tackling problems, of partnership and a joint search for the best solution for the consumer and the community. It is then a matter of passing on this know-how to all the economic agents and consumers.

One important point: the staff directly involved in implementing the energy efficiency policy must be well-informed, involved and immersed in the communication at the very outset of the preparation of a policy or programme. Communication is not a programme "add-on": it is an integral part of it.

As with any other activity, it is necessary to assess the impact of communication. This is not always easy, but it is only by knowing how the "targets" have reacted to a message that it is possible to correct and refine it and to meet the true needs of consumers and partners.

2

Training

2.1 THE PRINCIPLES OF ACTION

Energy efficiency stems from technical knowledge which is generally conventional, and from new practices and methods of use and management. Hence, it is essential that all those whose activities include the use of energy should be trained in these practices so they may implement them accordingly. Organising training programmes is therefore an essential aspect of the implementation process. Programmes will address technicians and engineers, but also managers (of buildings, for example), economists, managers of industrial departments or of city technical departments, architects, etc. These training programmes should stress the transfer of experience and know-how.

Training in understanding, formulating and implementing an energy efficiency policy has the same features as the policy itself. It concerns all sectors of economic activity and must therefore address all the present and future professionals in these activities. It calls upon all skill levels; it is based on general knowledge, or even culture, but it also uses highly specialised skills in certain fields.

These few points illustrate the need for a properly structured training policy, characterised by the diverse people involved: professionals contributing their knowledge and experience; educators with teaching skills and methods; staff from government departments, institutions and other organisations which define and implement the programmes; and those who provide the funding.

The training strategy should be defined with regard to these different parameters and to the "time", the "level" and the "content" of the training. "Time" refers both to the present and the future: continuous training meets the immediate training requirements of active professionals, but it is equally essential to prepare for the future by acting in the field of education where tomorrow's professionals will be trained. "Level" refers to the skills to be introduced or improved, which should be applicable from the stage of designing products, processes and installations up to their industrial or trade completion, incorporating the operation, maintenance and monitoring of installations, etc. "Content" means that training should cover different fields: knowledge of basic disciplines (physics, geography, etc.), fundamental disciplines in higher technical education (heat engineering, thermodynamics, etc.) and economics (planning, price definition, etc.) or technological disciplines and specialised knowledge defined in accordance with the development of techniques in each activity.

The training activities should also be durable and continuous (see Box 34). Their success will depend in particular on:

- the formulation of a training strategy for the short, medium and long term with the competent institutions – ministries and national and local departments in charge of the education and professional training system – so that energy efficiency will be constantly taken into account by those who provide the training and define the programmes and resources;
- the establishment of permanent links and exchanges with the professional partners by involving them in determining the objectives to be attained, the funding and evaluation of the actions taken for their benefit in matters of energy efficiency.

It is possible to evaluate the benefits establishing objectives beforehand: this essential phase is too often forgotten.

Finally, special attention should be given to training the staff who are directly involved in preparing and coordinating energy efficiency programmes (for example, the staff of national or regional energy efficiency institutions described in chapter II). This is to ensure that they perfectly master the knowledge required in their day-to-day activities and above all that they systematically incorporate a training component in all the programmes they prepare or implement. It is extremely important for this group to be directly involved in the training activities by participating in seminars and working groups and preparing the brochures and manuals which serve as a basis for training.

As for communication, a note of caution is appropriate: training cannot be improvised. Contrary to the unanimous view, the training provider needs knowledge, methodology and special experience, and is much harder to find than an engineer. The managers of the training programmes in energy efficiency programmes should be recruited with the greatest care.

Box 34

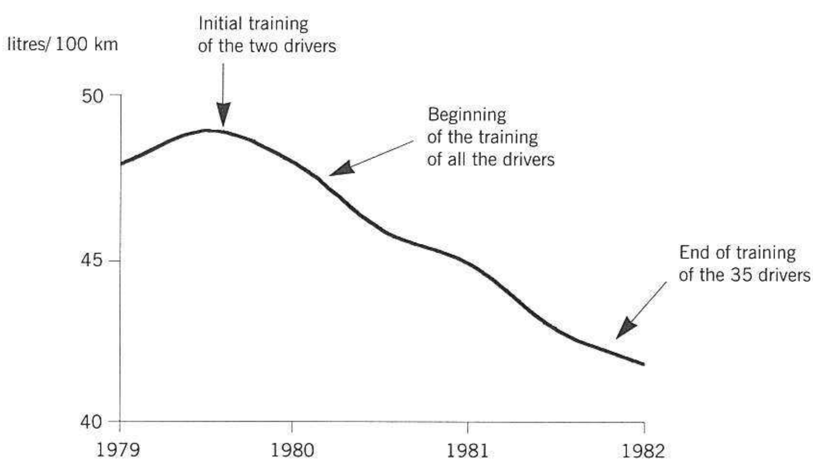
REDUCING ENERGY CONSUMPTION IN A BUS FLEET THROUGH TRAINING
THE CASE OF DIJON IN FRANCE

The city of Dijon had 95 buses and 325 drivers in 1979 when officials decided to launch a city transport energy saving plan.

Two drivers received special training and then trained their colleagues in economical driving techniques over a thirty-month period. The training programme led to a 13,5% reduction in diesel consumption.

These savings have been maintained, thanks to rigorous monitoring of consumption and the appointment of an energy manager.

Consumption curve after the implementation of a training programme in a city transport enterprise



Contact: Ademe – Regional Delegation Bourgogne, France.
Phone: 33.3.80.76.89.76 / Fax: 33.3.80.76.89.70

2.2 ORGANISATION

In the energy efficiency field, the basic principle of training is to build upon existing training structures by associating training modules to these structures. These modules accompany normal training activities or are specially designed for a well-defined and well-targeted public.

The first job in organising training is therefore to list the institutions and organisations which have training activities in fields related to energy consumption and, particularly, the university institutes or engineering colleges in the sectors of industry or construction. The prerequisites for setting up training programmes are a knowledge of training activities and the establishment of a network of partners.

Another important lesson drawn from experience is that training in energy efficiency should not be limited strictly to the professional areas concerned with energy consumption, but should be widened to a very large number of professions and activities. It should also be included, as soon as possible, in general education from primary school level.

Training should therefore be developed in three main directions:

- Including and explaining energy efficiency in traditional education.

- Producing teaching modules on energy efficiency in specialised courses for engineers, architects, managers, technicians, and so on.

- Establishing seminars or training courses on specific and usually very concrete subjects, providing training in particular techniques or methods or addressing a precise category of trainees.

Of course, some of the resources allocated to actions concerned with energy efficiency will have to be devoted to the implementation of broad-based training programmes. But it must be remembered that substantial funds are devoted in any case to training at national, regional and international levels – these must be listed and reviewed for their potential use in energy efficiency training.

2.3 RESOURCES

ASSISTANCE WITH TEACHING EQUIPMENT

One essential aspect of energy efficiency is measuring energy consumption. This is fundamental to technical sectoral activities, but is also certainly worth including in the curriculum of disciplines such as physics or heat engineering. In these disciplines, energy efficiency requires fairly refined methods of calculation, whether it is a question of the heat balance of a building or optimising an industrial process.

A good way of bringing energy efficiency into technical education is to assist the educational establishments in the acquisition of measuring instruments, computer hardware and software and the development of case studies relating to the implementation of typical energy efficiency projects.

THE DESIGN AND PRODUCTION OF TEACHING TOOLS

This involves providing those who dispense training (schools, institutes, consultancy bureaux) with teaching tools using the innovative techniques of microcomputing. An example is a set of teaching programmes on the thermal engineering of buildings: in such complex fields, the computer offers both the capacity for calculation and hence simulation, and the capacity to display the phenomena that are essential in order to understand them. It also allows each trainee to learn at his own pace. These teaching programmes are designed for higher education (engineers, senior technicians, architects).

Training activities should also be supported by the publication of manuals, teaching documentation for use by instructors and documentation describing concrete technical achievements to serve as a basis for case studies. It is important that these teaching tools be prepared in close cooperation with working groups including teachers, researchers and users.

SPECIALISED SEMINARS

This involves convening working groups for a period of about two to three weeks. The participants' level should be similar enough to enable them to work together and they should not exceed 12 to 15 to allow meaningful exchanges with training staff and managers.

Two key topics are well-adapted to the needs:

- planning energy efficiency actions based on analysing and forecasting energy consumption;
- designing, assessing, implementing and monitoring energy efficiency projects.

The first theme covers the concerns, methods and tools we dealt with in the chapter on planning and economic studies: the concept of integrated energy planning based upon demand analysis; databases on energy consumption and the factors determining energy demand; analysis of energy demand; methods of investigating possible trends in energy demand; formulating energy efficiency action programmes both generally and by sector on a macroeconomic basis; assessing the results of an energy efficiency policy, etc.

It is very important that these workshops should have an international dimension: first, in order to provide an understanding of the world energy situation and its constraints, notably geopolitical, economic and environmental; and second to determine "what is going on elsewhere" and to benefit from the experience of other countries. Hence, an attempt should be made to expand participation by experts and working professionals of different nationalities.

The second theme deals in a realistic manner with the way in which an actual energy efficiency project is implemented. These workshops should be based on case studies discussed with professionals who are familiar with these projects in the various economic sectors (industry, construction, cities, transportation, agriculture). Each project is comprehensively reviewed – formulation of the project and assessment of its economic and environmental importance; project funding; the stages of implementation and its organisation (distribution of tasks, scheduling); equipment necessary; measurement campaigns; project monitoring; project evaluation; related programmes of information and training, and so on.

Specialised seminars of shorter duration with a highly practical content will be organised, possibly in firms, on specific subjects such as:

- Building management; practical thermal analysis in buildings; the design of building types adapted to certain environments (tropical climates, for example).

- Practical energy analyses in industry; measuring energy consumption in industry; reviewing new industrial processes, etc.

- Energy audits of vehicle fleets; traffic problems in cities and their impact on energy consumption and the environment.

• Energy efficiency in agriculture, by types of activity: buildings used for raising livestock, agricultural machinery, rural dwellings, the use of different forms of agricultural and forestry biomass, and so on.

Each of these workshops will address a specialised and carefully chosen audience with a view to "train the trainers". This will serve to decentralise the action by making maximum use of professional organisations and consultancy bureaux as intermediaries.

INTERNSHIPS AND RESEARCH SCHOLARSHIPS

The link between research and training can be profitably reinforced through the development of research scholarships on topics concerned with the development of energy efficiency.

Training internships in a research laboratory, an industrial firm, a consultancy bureau, or a city's technical department concerned with energy efficiency are an extremely useful means of "in-service" training, particularly if the international dimension is added to the professional one. In many countries, internships in firms and research laboratories is a well-developed practice but courses in city departments and internships abroad (for example, at a national or regional agency in charge of implementing energy efficiency policies) are less frequent.

It is absolutely essential to expand international internships in this field, which implies coordination and funding by international organisations: the United Nations, the European Commission, etc.

3

Voluntary agreements

Beyond policies based on prices, financial incentives or regulations, many countries are currently developing voluntary-type approaches.

Their aim is still to improve the energy efficiency of products or processes, but they are more specifically focused on preparing the market of the future with various partners (public authorities, producers and consumers) by accelerating the introduction or the dissemination of efficient equipment using competitiveness and innovation, which are market ingredients and prospective analysis.

The voluntary methods we present have the advantage of being manageable for the industrial operators as well as for the administration and do not weigh heavily on public budgets. They are relatively flexible since the manufacturers are free to search for solutions adapted both to their specific case and the global objectives. Producers often participate in defining these same objectives. The methods are based on confidence or contracts between partners and further lead to public recognition for the participating enterprises. Moreover, manufacturers are receptive to these approaches focused on forecasting demand.

However, voluntary approaches require the involvement of public authorities to guide and stimulate them, often case by case: their definition, negotiation and evaluation are complex procedures. Governments often provide support for energy audits or technical development for enterprises which so desire, but they can also threaten to develop schemes based on regulations to be enforced if the voluntary approach fails. Voluntary approaches permit to improve energy efficiency and the competitiveness of enterprises while they reduce the impacts of products and their use on the environment.

3.1 AGREEMENTS ON EFFICIENT PRODUCTS

The advantage of agreements on efficient products, as they are most often envisaged, is that, starting with the expectations of the consumers, it is simultaneously possible for industrial operators to identify a market and define a product concept which not only integrates energy efficiency specifications but also all the various attributes which the future client would like to see in the new product.

The aim of such agreements is to improve the energy efficiency of products by encouraging producers to change their production schemes and consumers to demand more efficient products. The voluntary approaches which concern the energy efficiency of products and equipment can be subdivided into three categories: non mandatory labels and quality labels, target values and procurement.

3.1.1 Non-mandatory labels and quality labels

Introducing non-mandatory labels or quality labels (see Box 35) aims to separate:

- enterprises which voluntarily commit themselves to improving the energy efficiency of their products – according to the directives issued by the administration – and can highlight them by displaying a label;
- from those which do nothing, in a context where the consumer is informed of the possibility to purchase efficient products.

The "Energy Star" programme in the United States, launched by the Environmental Protection Agency is a quality label operation for office computers which have automatic standby modes. In this particular case, the manufacturers were motivated by a guaranteed demand since federal administrations could only purchase the efficient models after 1993. The second stage of the programme, beginning in 1993, intends to further reduce the specific consumption of the computers in the standby mode and to launch an identical programme for printers, copiers and fax machines.

With a similar approach, the Energy Policy Act (EPACT) adopted in the United States in 1992 proffers several quality labels for windows, lamps, etc. However, if the voluntary efforts are considered a failure after a three-year trial period, the Department of Energy maintains the right to impose mandatory federal standards.

task is costly and risky and industrial operators will only commit themselves when their market analyses clearly highlight an opportunity... and it is not always simple to know in detail the expectations of the consumer in terms of product evolution.

The idea of procurement originated form the hypothesis that a latent demand could exist on the market for new products, a demand which was not spontaneously organised and expressed and that industrial operators could not easily detect. Organising this demand would then permit to push manufacturers to design and commercialise new, more efficient products. The aim is to create a link between industrial operators and consumers.

Procurement or competitive procurement consists in prompting producers to manufacture efficient products after target characteristics have been set for the products based on the analysis of future demand. This incentive can be more or less formalised (extending to the organisation of calls for tender) but must always be carefully organised. The impact of procurement operations on technical change can be quite significant in certain sectors. Technological options which are known by the industrial operators but never exploited because they seem too risky, too costly or which do not seem to have sufficient markets, are thus enhanced (see Boxes 36 and 37).

In a first stage, the future buyers and users of the selected goods must be brought together. This buyer group evaluates the current and future needs in practical terms. The demand is thus defined as the characteristics and performance the future product should have, from the views of the consumer and also the opinion of the producer who is often already involved at this stage. The buyer group can be made up of electricity utilities who want to accelerate the dissemination of more efficient equipment in the frame of their DSM programmes (as was the case for the "Golden Carrot" programme in the United States) or future buyers and users. To genuinely influence the decisions of industrial operators in developing new products, the group must present one or both of the following characteristics:
- to represent important market shares;
- to have a certain notoriety or a place of leaders on certain markets for which these buyers define new references.

These characteristics then serve as terms of reference for a call for tenders launched by those in charge of the procurement programme. The public authority is in charge of coordinating the operation, from setting up a pertinent buyer group to eventually guaranteeing the purchase of a certain quantity of efficient products if the requested conditions are satisfied. A timetable sets the various stages of the operation: survey of the buyer group, call for tender, production of prototypes, analysis of the results and mass production.

Box 36

A "GOLDEN CARROT" EXAMPLE FOR REFRIGERATORS IN THE UNITED STATES

In the early 1990's, the context of the American market was not favourable to efficient equipment: the relatively low efficiency standards were not incentives for manufacturers; there was little demand for efficient equipment; many operations with bonuses for the purchase of efficient refrigerators were organised without any concertation by different electricity utilities and with few results...

Twenty four electricity utilities gathered around a "Golden Carrot" operation and launched the Super Efficient Refrigerator Programme. They organised a contest between refrigerator manufacturers to build a super efficient refrigerator. The stake (the carrot) was 30 million dollars awarded to the winner. Fourteen manufacturers entered the contest and were evaluated according to energy efficiency criteria, the price of the kWh saved, production and distribution capacities, the reliability of the enterprise and its resources in capital, etc. Whirlpool, the winner, committed itself to producing 250 000 refrigerators 30% more efficient than the level set by the 1993 American standards (i.e. which permit to save 392 to 407 kWh per year depending on the model) and with less expensive operating costs (US $ 55 per year).

The results of this programme are considerable: 1 billion kWh will be saved over the 15 years of the lifetime of the super efficient refrigerators; this represents a reduction in the CO_2 emissions by power plants of about 600 000 metric tons per year. The programme based on a bonus to manufacturers turned out more cost-effective than when bonuses are distributed to consumers; the market is influenced in the long term: manufacturers introduce energy efficient improvements on their standard models.

This programme demonstrated the effectiveness of partnerships between the public and private sectors, including electricity utilities and governmental energy and environment agencies. These actors created the Consortium for Energy Efficiency (CEE) with the aim of developing similar initiatives for other appliances, and stimulating transformations of the market.

Contact: CEE – Boston, USA. Phone: 1.617.330.9755 / Fax: 1.617.589.39.48

The winner of the competition is judged both on the solidity of his technical project and on the feasibility of the industrialisation and commercialisation strategies he proposes. The prize awarded to the winner is not attributed for the design of a project which could eventually reveal itself unsaleable, but under the condition of an effective commercialisation. Procurement offers, in exchange, a certain reduction of the risk taken by industrial operators: the existence of a large buyer group which commits itself to purchasing a certain amount of products guarantees a minimal depreciation of the research and production costs engaged. The product can then be marketed under more favourable economic conditions. This effect is reinforced in calls for tenders through the competition.

Box 37

A NUTEK PROCUREMENT OPERATION FOR WASHING AND DRYING MACHINES IN SWEDEN

In the framework of its programme for efficient energy use in buildings, office buildings, industry and the domestic sector, NUTEK launched in 1992 a procurement operation for washing and drying machines.
In Sweden, there are buildings equipped with common laundry rooms, serving 10 to 50 apartments depending on their size.
NUTEK selected a buyer group, composed of several owners of such buildings.

On the basis of a study which evaluated the consumption of existing installations at 2.6 kWh per kilogram of clean and dry laundry, and the requests of the buyer group (according to the experience of the owners, the caretakers and the tenants), NUTEK established detailed terms of reference with the objective of attaining a consumption of 1.35 kWh per kg of clean and dry laundry for conventional washing machines and 0.95 kWh per kg for tumble dryers with heat pumps. Issues related to environmental protection (water consumption, noise or high temperatures in the laundry rooms) were also covered in the terms of reference. For each criteria, NUTEK determined a minimum mandatory requirement and a desired requirement, more demanding.

To accompany this operation, NUTEK launched several activities:
• an incentive for the manufacturers in the form of a 200 000 SKr* bonus distributed to producers who responded to the call for tender and produced a prototype;
• the guarantee to order the machines to equip 100 laundry rooms of an average capacity of 10 kg of laundry for the winner (s) of the call for tender;
• the commitment of NUTEK to widely disseminate the results of the operation, in order to inform owners and potential buyers in Sweden and, more generally, in Scandinavian countries;
• the distribution of a 2 500 SKr bonus per kg of washing capacity to real estate owners who ordered approved washing and drying equipment and a 2 500 SKr bonus per kg of washing capacity to real estate owners who ordered drying equipment coupled with a heat pump.

In February 1994, the delivery of efficient equipment for the 100 laundry rooms took place with machines which were more efficient than the minimal level required: 1.2 kWh per kg of clean and dry laundry for the washing machines and 0.8 kWh for the tumble dryers with heat pumps. It is estimated that, compared to the most efficient technologies which existed before the launching of this operation, energy consumption was divided by 2 (a precise evaluation is under way).

*100 SKr (Swedish crowns) = about 16 US $

Contact: NUTEK – Stockholm, Sweden. Phone: 46.8.681.91.00 / Fax: 46.8.681.95.85

This relatively inexpensive mechanism stimulates innovation and competitiveness between enterprises while providing a fair image of future demand, since the efficiency criteria aimed for correspond to the needs determined by the buyers. The risks the manufacturers take are reduced and the energy efficiency of the products is improved.

One of the best examples of procurement is given by NUTEK (the National Swedish Board for Technical and Industrial Development) which organised this type of operation in the framework of its programme for efficient energy use in buildings, office buildings, industry and the domestic sector. Several contests were organised to improve the energy efficiency of refrigerators/freezers (+ 33%), to develop noise-reducing and energy efficient windows (+ 44%), high frequency electronic ballasts for fluorescent bulbs (+ 20%), washing and drying machines (+ 70%), ventilation (+ 50%), etc.

However, a formal order through a call for tenders emanating from the buyer group is not the only path possible. On the basis of the confidence obtained from certain industrial sectors thanks to previous successes, it is currently envisaged to cease this heavy approach and develop less formal meetings between a potential, but well expressed and defined, demand and the producers concerned. If such an approach succeeds, it would tend to prove that the task of identifying and expressing potential markets has as much, if not more, importance for industrial operators than the security provided by the bulk order. The risk of putting new products on the market could then be progressively handed back over to the producers.

3.2 AGREEMENTS ON EFFICIENT PROCESSES

Voluntary agreements on efficient processes aim to reduce the quantity of energy used to produce a given product: they target both the processes used and the global energy consumption of the enterprises. This approach is new from an organisational point of view because the objectives are negotiated with the industrial operators. It is less costly for the administration than the traditional approach which implies checking compliance with the regulatory standards, a task which is often quite demanding. However, this method is often presented to the industrial operators as a means to avoid regulations, which can always be applied if the operator does not respond progressively and positively to the energy efficiency requirements.

Voluntary agreements in industry can concern each specific enterprise or industrial branch (formal agreements with the administration). For the public authorities negotiating and supervising these agreements, they are a complementary instrument of an energy efficiency policy, along with taxes, labels, regulations, etc.

The participating enterprises are at the heart of the voluntary agreements: they decide on the appropriate means, the management and the internal regulations which should be adopted to reach the objectives, and use their own know-how to reach them.

Box 38
Long Term Agreements in industry in the Netherlands

The government of the Netherlands established a memorandum on the energy and environment policy in which one of the components concerns the reduction of carbon dioxide emissions by 3 to 5% by 2000. To reach this objective, the Netherlands set the target of reducing the unit consumptions of the industrial sector by 20% (reference year: 1989).

Adopting the national objective, a growing number of industries signed long-term voluntary agreements on energy efficiency with the Government, setting the conditions of a combined effort to reach the objectives of the National Environmental Policy Plan. Numerous other industrial branches have established declarations of intentions with the gouvernment which stipulate that they are preparing long term agreements: in 1996, twenty two agreements were signed. The chemical sector alone represents 60% of the energy savings envisaged.

The Ministry of Economic Affairs published a document in English titled "Energy efficiency in industry with long term agreements" which examines in detail the political aspects and the philosophy underlying energy efficiency in industry. A half-time evaluation undertaken by the ministry seems to confirm that the current rate of reduction of unit consumptions should permit, if it continues, to reach the objectives set by the agreements.

Contact: Energy Directorate of the Ministry of Economic Affairs – The Netherlands.
Fax: 31.70.379.79.05

4

Regulatory instruments

Establishing rules and standards relating to energy consumption and monitoring their application are matters for governments. It is up to the organisations and specific institutions in charge of implementing energy efficiency policies to prepare the regulations in such a way that they promote, not curb, energy efficiency. It is equally essential that the regulations be enforced. This implies that certain conditions are met which ensure the applicability of the regulations. This task largely falls upon the specialised agencies for energy efficiency, owing to their continuous contacts with all those involved in the policy. As a result, the objective is not only to define and promulgate appropriate regulations, but also to ensure that they are properly enforced – nothing is more counter-productive than regulations which are not applied. Regulations can thus be a useful tool but must be handled with care.

The introduction of new regulations must be preceded by a phase of explanation and discussion – and sometimes negotiation. This ensures that the regulations will be fully understood, their importance made clear and that the partners will see the benefits their application will bring. The authorities must not hesitate to use substantial resources to create favourable conditions for enforcing the regulations.
We present in the following paragraphs some of the most widely used regulations.

4.1 REGULATIONS FOR BUILDINGS

Thermal regulations relating to the construction of new dwellings. These regulations have been promulgated in nearly all OECD and are being drawn up in a number of developing countries (for example, in the Maghreb countries). These regulations have a considerable effect over a long period and are cost-effective given the technical progress made in building methods and the quality of materials (see IV – 6.4: "An example of a sectoral strategy: new buildings in France").

4.2 STANDARDS AND LABELS FOR APPLIANCES

Standards and labels do not affect the market in the same manner. While standards set a minimum value for energy efficiency and ban from the market appliances which consume too much energy, labels inform the consumer on the energy efficiency of a product and enable him to compare between the various models available.

Consumption standards can be set for systems and appliances which are widely used. This has been done in many countries with regard to the output of industrial boilers and the operating conditions of heating plants (presence of skilled personnel, compulsory monitoring devices, etc.).

Most countries tend to use the label method: no maximum consumption standards are laid down, however it is mandatory to label appliances to indicate their energy consumption and permit the comparison between the models offered by the various manufacturers. This approach relies on information and competition rather than on regulation.

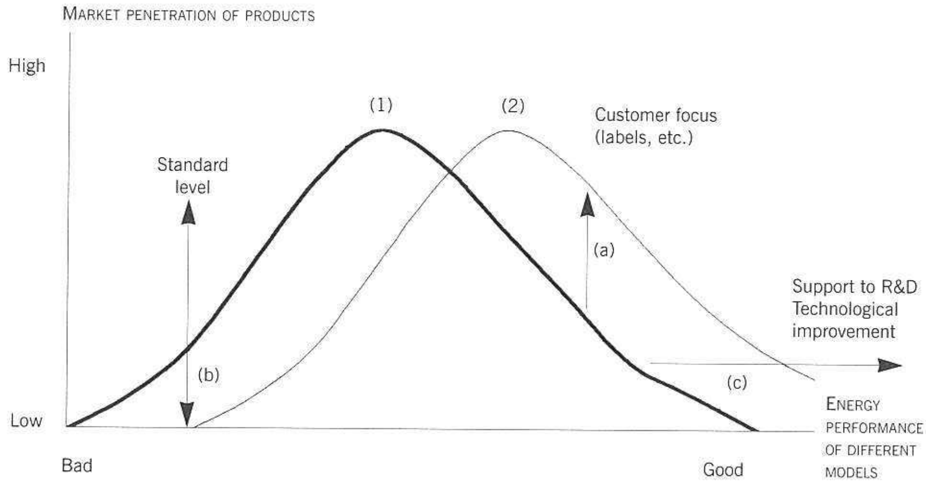
In the United States, Canada, the European Union and Japan, both standards and labels have been issued for domestic electrical appliances (see Box 39). Combining these two instruments in a complementary manner stimulates the market towards more efficient products (see Table 21).

This type of approach using standards or labels is most effective when it is accompanied by negotiation (and possibly by financial incentives) with the manufacturers or importers and distributors of the concerned appliances in order to help them modify their range to include more energy efficient products. In this case, the energy efficiency policy acts as a factor of modernisation in the supplying industries.

The introduction of a label must be accompanied by consumer information: consumers must be prepared to receive information on the energy efficiency of domestic equipment and must be able to understand this information. There must be a wide range of models in order for them to base their purchase decision on these new criteria.

The regulations should ban the importation of high energy-consuming products, for products which are imported in large quantities. This is often the case for products which come from industrialised countries, or are made under licence from firms in those countries. They are often less efficient than products sold in the exporting country itself. It is therefore important to check that the standards for systems imported or assembled in the country are respected.

TABLE 21: IMPACT OF A FEW INSTRUMENTS ON THE DISSEMINATION OF ENERGY EFFICIENT EQUIPMENT



1. Curve 1 represents, for a given appliance (such as a refrigerator), the initial distribution of market shares of the models on sale, in relation to their energy efficiency.
2. Curve 2 illustrates the distribution of market shares obtained, following the implementation of several instruments:

   a. Labels and other instruments of customer focus increase the market shares of efficient products, to the detriment of inefficient ones.

   b. Standards prevent the marketing of low-efficiency appliances. This process is facilitated on markets where labels have already reduced the market shares of these products.

   c. Finally, by supporting innovation and research and development new, more efficient, products are introduced on the market.

It would be equally interesting to take energy efficiency criteria into account in international calls for tender concerning the establishment of consumer goods production or assembly factories: this could be enforced by an international regulation.

Box 39

THE EUROPEAN LABEL ON ELECTRIC APPLIANCES

In 1992, the European Union adopted a directive which introduced a mandatory label for the main domestic electrical appliances.
The first application of this directive concerns domestic refrigeration equipment, for which it is mandatory to display the label at the sale point since 1994.
The European label indexes each product sold on the market according to an energy efficiency scale which goes from A (high efficiency) to G (poor efficiency). The label also informs the consumer on the noise level of the appliance, its annual consumption and its useful volume.

In 1995, a similar label was introduced for washing and drying machines. The same principle is used to index the appliances – from A (very good) to G (poor) – but the label also integrates the washing and spinning performances of the machines. The label will be extended in the next few years to dish-washing machines, light bulbs, air conditioners, ovens, water heaters, etc.
Moreover in 1996, the European Union introduced minimum energy efficiency standards as a complement to the labels for refrigerators and freezers.

Contact: European Commission, DG XVII, SAVE Programme – Brussels, Belgium.
Fax: 32.2.296.62.83

4.3 REGULATIONS IN THE TRANSPORTATION SECTOR

Several types of regulations can be adopted for the transportation sector. There are three main categories:

• Standards on the fuel consumption or CO_2 emissions of new vehicles are addressed to manufacturers and importers. In the European Union countries, the regulation only imposes that the normalised consumption of vehicles is publicised; however CO_2 emission standards are under discussion. In the USA, the CAFE (Corporate Average Fuel Economy) standards oblige manufacturers or importers to limit the average consumption of the vehicles sold (consumption of the various models ponderated by sales). Moreover, for existing vehicles, technical inspection has a positive effect on fuel saving and also helps to reduce accidents and pollution.

• Regulations concerning traffic and parking: taxes on fuel or the possession of vehicles, urban or highway speed limitations, incentives for car-pooling, limitation of traffic or parking in city centres, actions on territorial development (for example, banning the establishment of large shopping centres near highways when no collective transportation means exist), etc.

• Regulations which aim to encourage the diversification of goods transportation modes, for example the obligation to transport trucks by train over long distances.

4.4 MANDATORY REGULAR ENERGY AUDITS

In industrial installations, major service enterprises and transportation fleets, energy audits permit to identify the technical and financial measures necessary to achieve energy savings at the individual plant level. They make it possible to identify opportunities to reduce energy costs through projects which can serve as models for all the firms in a particular sector. This approach is effective so long as it is not merely an administrative inspection but leads to a policy establishing an energy saving programme, accompanied by technical advice and financial assistance for the necessary investment.

There are two stages to an audit: a preliminary and a detailed audit, both of which are essential, possibly followed by special feasibility studies.

The preliminary audit should preferably be mandatory and light, financed by the beneficiaries (factories, service sector firms, etc.) and supported by the public authorities. These audits consist in visiting the facilities for a few days. Their basic objective is to collect available data on consumption and production broken down by individual assembly shops, an inventory of machines and their characteristics, an analysis of materials, coolants and fuel flows. The aim of these audits is to heighten the awareness of decision-makers concerning two main elements: energy savings through good maintenance measures and investment opportunities for energy efficiency.

The good maintenance measures which permit to reach savings of 15 to 20% are the following:

- setting up an energy accounting system at each level of the enterprise;
- developing operation and maintenance actions;
- creating a service or an employee in charge of supervising and managing energy consumptions (in large enterprises, the gains in terms of energy saved easily cover the cost of this employee).

As shown in Box 40, utilities and agencies can help industrial operators in their efforts towards greater efficiency.

Box 40

The Irish Electrical Supply Board (ESB) conception of "monitoring and targeting"

Implementing a monitoring and targeting programme can help the industrial staff permanently capture and increase good housekeeping savings. Monitoring and targeting programmes permit to reduce electricity costs and equipment failure, to spot and rectify inefficient practices, to introduce accountability for electricity and information on energy use and costs, to assess the effectiveness of further investments to improve energy efficiency, and to develop an efficiency culture.

Monitoring includes: identifying scopes for energy savings, selecting production units where electricity consumption is related to output and both parameters can be easily measured; selecting meters to measure electricity consumption; selecting methods – possibly including software – to be used to take readings; analysing performance and reporting, review and follow-up procedures; deriving an accurate "standard" specific electricity consumption figure (for example kWh per unit output) for each unit; familiarising staff with reading and analysis procedures; monitoring energy consumption and output regularly and computing performance against the "standard" of each unit; issuing regular reports to the managers in charge of efficiency in each energy centre to highlight both efficiency performance and corrective actions needed.

When monitoring is well established, targeting consists in setting new target "standards" for the production units and continuously examining the potential to implement further energy-saving projects.

The last stage of a monitoring and targeting programme is to set up "energy systems management" which automatically monitor equipment energy consumption, operating conditions and can use this information to ensure that the equipment operates efficiently under varying conditions.

ESB has advised several companies on Energy System Management (ESM), with significant results.

One example of this is a £ 35 000 system, installed in 1992 as part of an energy efficiency programme in a large turbofan engine maintenance company to:
- monitor electricity;
- provide regular reports on energy consumption;
- control space heating and air handling units, hot water boilers, process ovens and lighting.

The results have been successful: space heating costs have been reduced by 10%, the winter week-day demand between 5.00 p.m. – 7.00 p.m. has been reduced by 200 kW, water consumption has been reduced by 50%.
The ESM has helped the company achieve an annual savings in electricity costs alone of an estimated £ 30 000.

Contact: ESB, Customer supply and marketing department – Dublin, Ireland.
Fax: 353.1.702.68.81

The identification of saving potentials pointed out by the audit permit to define the potential energy efficiency investments.

The mandatory character of these preliminary audits makes the decision-makers take a first step in an approach which they would not have otherwise adopted but which can rapidly interest them. Nevertheless, the public authorities must accompany this process through an agency for energy savings, a chamber of commerce, etc.

The preliminary audits can be followed by more detailed ones, which are not compulsory, with the aim of designing one or several investment projects. The detailed audit is concerned with the fundamental aspects of energy use: the problems associated with the manufacturing process and methods of production and organisation. The aims are:

• To determine, for the plant as a whole and for each production unit, the levels of material and energy use, a plan of energy flows and the associated methods of recording them as well as the current consumption ratios.

• To produce an action programme for the plant manager which identifies priorities, sets out training needs, analyses the options for using alternative energy.

• To assess, for each stage of the programme, all the economic and financial variables (cumulative investment, cumulative savings expected, financial indicators, etc.) and the indicators of return on investment, in order to identify the potential value of such investments to the firm, in terms of its individual financial and fiscal situation and resources and of the loans it might be able to secure.

• To produce an economic assessment of the programme's national impact, in terms of foreign exchange (savings on imported energy versus imports of foreign equipment or expertise), job creation and environmental improvement.

Such detailed audits also help to heighten employees awareness of issues relating to rational energy use. They provide an excellent opportunity to raise the issues involved at all technical and managerial levels. Employees should be as fully involved as possible in the process of collecting information to prepare them for the follow-up activities or for any changes in which they will be required to take part when the action programme is implemented.

4.5 REVIEW OF NEW PROJECTS

One important measure is to ensure that all new projects concerning the replacement, renovation or modernisation of high energy-consuming installations, and which require a licence or for which public financial support is sought, are reviewed from an energy efficiency perspective. Substantial energy savings, which will continue throughout the life of the installation, may thus be achieved, often without involving significant additional costs.

Review at the design stage is fundamental in developing countries where the greatest potential savings are to be found in new installations and systems. Here again, the energy efficiency organisation would not intervene merely to check and prohibit, but could advise the partner on the best alternative approach in terms of energy and economic efficiency for the whole project. The rationale should be the same for products to be made by a new factory.

Even in the absence of a thermal regulation, or in preparing its elaboration, the promoters of new industrial or service sector projects can be prompted to attach a thermal consultant to the architects or engineers in charge of the project.

5

Financial incentives

For a company to undergo a mandatory audit and thus identify a potential for energy savings does not automatically imply that it has the finances required to carry out the recommended operations, even if they are quite cost-effective.

Public authorities can assist the actors in financing energy efficiency operations by establishing an institutional context for energy efficiency investments using public and private relays to mobilise capital, create attractive financial instruments (see Box 41).

In this chapter, we focus exclusively on project and programme funding, i.e. instruments developed by the public authority to promote energy efficiency. Chapter V is entirely focused on the use of these financial instruments by the consumers.

5.1 THE VARIOUS FINANCIAL INSTRUMENTS

When reviewing the various means of funding energy efficiency actions, it is important to take into account the great variety of possible actions and partners.

Actions can be divided into two categories:

• Initiatives aimed at permitting the development or the marketing of advanced systems, efficient products or processes, which are technically mature but have a relatively high cost which curbs their dissemination. These actions target the designers, manufacturers, importers, distributors and retailers and aim to reduce the costs and/or widen the market. The community benefits from these initiatives when the market for this efficient equipment or process is mature enough to operate autonomously.

Box 41

THE ENERGY SAVING TRUST

The Energy Saving Trust is an independent, non-profit-making organisation set up in 1992 by the United Kingdom Government, British Gas and the British public electricity suppliers. Set up as part of the commitment made by the Prime Minister at the Rio Earth Summit – to return UK carbon dioxide emissions to 1990 levels by the end of the century – it aims to stimulate the efficient use of energy by managing goverment subsidies for energy efficiency projects, promoting energy efficiency awareness in consumers and policy-makers and working in close collaboration with energy suppliers.

The Trust sets up and pilots 30 Local Energy Advice Centres (LEACs), run and partially financed by regional organisations, to provide consumer information. It coordinates various programmes in the domestic sector (Homes 2000 Programme, Energy Efficiency in Social Housing, Residential CHP Programme, etc.); evaluates schemes submitted by the Regional Electricity Companies to reach the electricity saving targets set by the Standards of Performance for Energy Efficiency in England and Wales by the Office of Electricity Regulation in April 1994.

The Energy Saving Trust currently searches to deploy its activities in the transportation, commercial and industrial sectors.

Contact: EST – London, United Kingdom.
Phone: 44.171.931.84.01 / Fax: 44.171.931.85.48

• Initiatives aimed at helping the consumer invest in energy end use efficiency: here the targets will be firms, communities, government departments and households. These actions are made necessary by market imperfections and distorsions in which:
 – the conditions of access to the capital required to finance these investments are more difficult for energy consumers than for energy producers; an intervention is then necessary to establish an equilibrium between the different actors in the access to capital and its cost;
 – the immediate interests of the consumer can be different from those of the community because the two have a different perception of the profitability of an energy efficiency investment. Various measures can influence consumer decisions by making these investments attractive. The expected benefits for the community must then be greater than the means provided to support these initiatives.

Financial incentives from the authorities can take different forms: subsidies, providing for soft loans, creating a favourable framework for leasing and third party financing, tax incentives and creating guarantee funds. The incentive needs to be adapted to the particular sector of activity, the type of equipment but most of all to the nature and the means of the partner.

SUBSIDIES

The OECD countries make wide use of direct grants. Grants can be used to finance or partially finance the various types of programmes:

- R&D programmes in new technologies, new products or new methods, and technology transfer programmes. These programmes may involve upstream organisations (public and private sector research institutes) or downstream players (equipment manufacturers and design offices). In the case of innovative projects, reimbursable grants can be provided. This procedure is often used in industry and offers the advantage of recuperating the subsidy in the case of success and thus permits an efficient use of the available funds.

- Energy audits, feasibility studies, demonstration operations and even investments at final consumer level in pre-dissemination operations, in order to accelerate the dissemination of proven technologies which have not yet broken through.

- Programmes of action conducted jointly with decentralised operators in the public or private sector.

When using subsidies, two key elements should be kept in mind. Firstly, fund management should be kept simple in terms of procedures. Secondly, grants are only efficient policy instruments if programme management is tight and if support organisations work closely with beneficiaries, which in turn helps limit procedural complexity.

A good idea is therefore to allocate an "operational budget" to a number of decentralised organisations (national or regional agencies, electricity utilities, banks, etc.) which would permit these organisations to implement, by delegation, sectoral subsidy programmes. One institution must however ensure overall coherence, administer, control, follow-up and evaluate the programmes.

PROVIDING FOR SOFT LOANS

Grants may be flexible and effective solutions in many cases, but they cannot be used to solve all project financing problems at both R&D and final consumer levels. Grants should be used to cover risks and guide economic decisions. They are too much of a drain on public resources if they are used as a large scale financing instrument. In addition, grants worth 10 or 30% of an investment solve nothing if the operator cannot find the remaining funds. Appropriate types of loans are therefore needed.

Appropriate types of loans should be worked out with lending institutions. Energy efficiency investments differ from some other types of investment in that they are paid back by reductions in operating costs. The criteria for approving a loan thus need to be reviewed: eligibility should be based not on estimated gains in revenue (as is the case of productive investments) but on estimated cost reductions.

The State may decide to encourage energy efficiency investments by offering consumers soft loans. Interest payable on these loans is a few percentage points lower than the going rate, and the capital required is mobilised by the banking system in ways that are conventional on the national market (e.g., bond issues) or on the international market (particularly refinancing by development banks).
If soft loans are offered, the authorities will need to cover the cost of the interest subsidy.

CREATING A FAVOURABLE FRAMEWORK FOR LEASING AND THIRD-PARTY FINANCING

We will examine in Chapter V the various financial instruments which can be used by an investor for energy efficiency projects. Our purpose here is to present the legislative or regulatory role of the public authority which is necessary for the correct operation of such instruments.

More sophisticated financing instruments such as leasing contracts or third-party financing can help build momentum in the energy efficiency market.

Leasing contracts on property, plant or equipment managed by financial service companies offer final users two main advantages: firstly, the final user does not carry the debt directly, so the energy efficiency operation is not in competition with other investments; and second, project financing can be spread over a longer period of time. On the other hand, leasing arrangements do not guarantee energy saving results: instalments on the lease have to be kept up even if the estimated savings are not made. Third-party financing can provide this kind of guarantee, but is more complicated to arrange and manage.

The two solutions are in fact complementary. How they will develop in the country depends first and foremost on legislative issues. Moreover, a number of related financial measures could also help these products emerge in the marketplace:

- Taxation on leasing and third-party financing companies: in several countries, leasing companies are exempted from income tax. The main argument in favour of this arrangement is not so much that it brings financial services companies tax-free status but that tax exemption makes methods of depreciation totally flexible. These companies can therefore select the most suitable solution for each operation, without being influenced by end-of-year reporting obligations.

• Equity capital, provided either directly or through venture capital companies, can help new operators become established and develop.

It is easier to intervene on the second point than on the first point which depends first and foremost on the State (to make it legally possible to set up these companies in a country, with special tax status if applicable).

Taxation

Tax incentives are also widely used to encourage energy efficiency investments. Some of the many possibilities are mentioned below:

- tax allowances in proportion to the investment made (mainly suitable for households);
- accelerated depreciation for energy efficiency investments (for companies);
- exemption of import tax or sales tax on selected products.

These measures generally have a cost for the State, since they lead to a decrease in fiscal revenue. However, to correctly estimate the budgetary cost of such an incentive, two elements must be taken into consideration:

- when a tax break leads consumers to prefer an energy-efficient appliance to a classical one, the loss in revenue linked to the reduction of the fiscal rate can be partially compensated by the increase in the average value of investments;
- the tax break can also be used to help a new product emerge on the market, which does not replace an existing product but provides a new service: insulation, heating or air conditioning regulations, cogeneration, depollution, etc. In this case, there is no loss in revenue for the State.

In general, tax breaks are transitional measures which make it possible to increase the market shares of innovative technologies. As markets develop for these new technologies, the old advantages can be suppressed and new ones introduced. A relatively stable fiscal framework is maintained and is therefore an incentive, accompanied by application lists which can periodically be adapted.

CREATION OF GUARANTEE FUNDS

A guarantee fund could be set up to support financial operators (leasing companies) by covering the risk on their receivables, against an insurance premium proportional to the value of the goods financed. This guarantee fund could also be used for conventional loans (as an alternative to personal guarantees, mortgages, etc.), thereby making them simpler to administer. Finally, the guarantee fund could be used to spread the intrinsic risks of certain operations (new product development, etc.).

5.2 A FUND FOR ENERGY EFFICIENCY

It is clear that all the financial means required cannot depend on the State budget alone. An Energy Efficiency Fund can be established, based on assured and perennial revenues guaranteed by legislation. One interesting solution is to supply this fund by a levy (1% for example) on all sales of energy products to the final consumer. Such a measure, which does not disadvantage the State and which creates stable revenues, has a large political advantage and can be easily explained to the consumer: each consumer participates, in proportion to his energy consumption, in financing actions which will help reduce the energy bill, in his own interest as well as in that of the national community.
Such Energy Efficiency Funds have been established by Law in several Regions of Russia.

Financial public involvement over several years in the form of an Energy Efficiency Fund could induce all the economic agents to integrate the energy efficiency approach into their strategies. The main role of the public body in charge of implementing the energy efficiency policy is to programme and orient available public funds towards this objective. It is obvious that the encouragements from the public authority should go towards developing specific financial schemes, which permit energy efficiency to be progresssively integrated in the normal operation of the market, in particular in terms of attracting private capital.

6

Example of a sectoral strategy: energy efficiency in buildings

We have seen that an energy efficiency plan should define a coherent set of measures and actions addressed to each sector, subsector and partner. The means of action which can be used by those in charge of elaborating and implementing these plans have been presented in the preceding chapters. It would be interesting to see how a set of measures could be used to define an action strategy in a particular sector. We will take the example of the building sector.

Building a sectoral energy efficiency strategy implies that the public authorities and the sectoral partners concerned develop a process of thinking in four stages:

• Identifying the targets in terms of technical potentials. In most cases, these potentials are easily identified and the means to reach them are known.

• Having an understanding of the subsectors and their structure: which and how many actors? their interests? do their interests converge or diverge? A good understanding of each subsector will make it possible to rank the actions to be taken, each action concentrating on a target sector.

• Then, since the aim is to make maximum use of the resources available for public action, a number of criteria should be applied for selecting target-action combinations. This process may result, to begin with, in withholding action in certain subsectors and concentrating available resources on a limited number of others.

• Finally, a combination of instruments adapted to each subsector must be outlined.

6.1 IDENTIFICATION OF THE SUBSECTORS

The building sector is a composite sector: new buildings can be distinguished from old ones, uses in dwellings vary from those in offices or businesses, the technical characteristics also vary according to the use. It is thus necessary to establish a typology to identify subsectors and build an adapted energy efficiency strategy (see Table 22).

TABLE 22: TYPICAL BREAKDOWN OF THE BUILDING SECTOR INTO ACTION SUBSECTORS

The residential sector

a. New dwellings
Old dwellings (it is possible to use several subsectors characterised by the date of construction)

b. Individual dwellings
- grouped (estates: technical uniformity)
- separate

Collective housing
- social housing (rented/ownership accessible)
- private sector
  - co-ownership (resident owners/leaseholders)
  - single owner per building (leaseholders)

The commercial and service sector

a. New buildings
Old buildings

b. Public and semi-public property
Private property

c. Sector of activity
- administration
- health
- leisure
- education
- commerce
- army

d. Size (area, number of people, added value, etc.) for example: small shops and supermarkets, large hospitals and health centres

6.2 CRITERIA FOR SELECTING PRIORITY TARGET-ACTION COMBINATIONS

Once the subsectors and the actors have been identified, the public and private partners and the concerned define the criteria for selecting the priority targets and actions which will make up the sectoral policy.

Energy and environmental efficiency

The criterion of energy and environmental efficiency refers to the potential gains in terms of final energy consumed, and of reducing environmental effects. It is therefore a question of evaluating, in macroeconomic terms, the potential for savings and for reducing pollution in each subsector. This assessment depends on the significance of the subsector concerned in the overall picture and the proportion of gains in efficiency that are identifiable in this subsector.

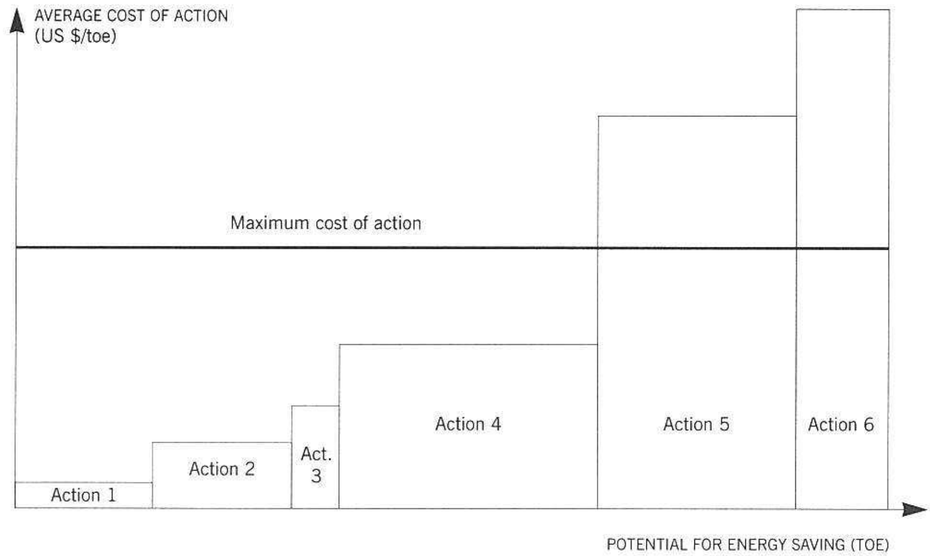
The economic efficiency of the proposed actions

The economic efficiency of the actions being considered is a basic but complex criterion. It is necessary first to consider the intrinsic economic effectiveness of the actions to be taken, i.e. the relationship between the investment costs of each action and the expected savings. It is then possible to rank these actions from the most viable to the least viable, and combine this information with that on the observed potential. Table 23 shows this combination: the x axis represents the actions which permit to obtain a gain in energy and environmental efficiency, ordered by increasing costs; the larger their base, the higher their efficiency potential.

The economic value can be assessed with reference to the pricing system in force, but can also be estimated from a collective point of view by taking account of non-monetised factors, notably environmental costs. This second approach can justify the implementation of actions that appear to be less highly "classified" according to the first criterion, but the effect of which may lead to gains – including financial gains for the state – from the collective point of view.

The economic effectiveness of actions must also be considered in the light of their costs in terms of the public budget; in other words, the cost to the community of using mandatory or incentive measures. This approach refers to the "public cost of implementing" a potential saving. If we take the example in the building sector of the "old dwellings – private rented accommodation" subsector: the owner will see no point in having work done to save

TABLE 23: SAVINGS POTENTIALS IN RELATION TO THE COST OF THEIR MOBILISATION



energy, if he cannot cover the investment by raising the rent, since it is the tenant who will reap the benefit. Similarly, the tenant will hesitate to pay for work to improve a dwelling that does not belong to him. This type of problem could be resolved by renegotiating the leases on an individual or collective basis; but this is not always easy since the level of rent is a sensitive element between the landlord and the tenant. If changes in the lease are not possible, one can of course imagine incentives such as tax allowances or grants in favour of one or the other of those involved. Unfortunately, these can prove very costly to the public purse and make such actions less attractive than cheaper options with lower intrinsic viability.

WHEN WILL THE POTENTIAL SAVING BE ACHIEVED ?

It is also important to consider the rate at which a potential saving is achieved. This determines how long it will take for a measure to produce appreciable macroeconomic results: it is important in relation to the objectives laid down (reducing a country's energy bill, reducing CO_2 emissions, etc.) but it is equally important in terms of the credibility of the action taken, and hence of the continuation of the effort.

THE DEMONSTRATION EFFECT

Consideration can also be given to the demonstration effect of the actions taken: the stock of social housing is usually a good reference point for the whole residential sector, as regards both construction and management. It is thus particularly interesting to undertake energy efficiency actions in the social housing sector. The same does not apply to the stock of public service buildings which are highly specific compared with the private service stock.

SATISFYING SEVERAL CRITERIA

Some programmes may also satisfy several criteria: for example, actions taken to support disadvantaged families who cannot invest in energy efficiency although, in terms of their purchasing power, reducing their energy bill is a real advantage. In some cases, and to avoid cutting off heating, gas or electricity supplies, social services pay these families' energy bills. In this case, it is then important to work with those services on devising and implementing suitable programmes.

6.3 THE CHOICE OF THE INSTRUMENTS

Regulations, certification, labelling, information, communication, training, Research and Development, demonstration, grants, loans, tax incentives, levies: the range of possible measures is wide and the most appropriate should be selected according to the various combinations of targets and actions decided upon.

EVALUATING THE INTEREST OF REGULATORY INSTRUMENTS

A first level of choice involves working out whether mandatory measures are worthwhile. These mandatory measures may appear attractive, since they are supposed to be inexpensive from the public standpoint, and by definition cover the entire field. However, regulations have been ineffective in many countries because they were not enforced. Hence, it is important, before launching this type of measure, to assess its pratical applicability rather than its theoretical impact.

First of all, a mandatory measure is generally based on the assumption that it is possible to define with precision a quality requirement applicable to a sufficiently large group of equipment: this is true of new buildings, for example, where those concerned must meet minimum standards of quality (strength, weatherproofing, safety, etc.). These rules can be supplemented by requirements as to thermal performance, or even minimum characteristics for space conditioning systems. Many countries have successfully implemented thermal regulations for new buildings.

However, it is not easy to define absolute requirements for the existing stock, which is too heterogeneous. All that can be done is to encourage relative improvements in quality, which are more difficult to regulate. Nevertheless some mandatory measures, different from those applied to new construction, can have a considerable effect. It is possible to make the regular maintenance of systems obligatory, and in high consumption buildings to require that a comprehensive audit of the building shell and the heating installations be carried out periodically (every 3 to 5 years), leading to a set of concrete proposals for improvement. Some countries, such as Denmark, have also formulated regulations under which the publication of a dwelling's annual operating cost, calculated on a standard basis according to the characteristics of the dwelling concerned, is compulsory, whether for sale or for rent. In the USA, a number of cities have adopted residential energy conservation ordinances where the seller of a home has to implement a precise list of energy efficiency measures before the city approves the transfer of ownership to the buyer.

Regulations have to reflect a compromise, acceptable to all concerned, between an enhanced quality requirement, technological feasibility, the know-how of the professionals and the cost of construction. As a result, regulations can only be transposed from one country to another with great care. Regulations should be drawn up in close cooperation with all concerned and provision made for an introductory period during which the accompanying measures (development and dissemination of innovative technologies, training and information) can be implemented. Hence, regulations generally have a temporary character and gradually evolve towards stricter requirements.

Finally, two other aspects will influence the application of a regulation: the uniformity of the subsector concerned (for this reason, it is initially easier to regulate dwellings than services), and the flexibility the designers have for meeting the requirements. There are two regulatory options: prescriptive standards where one must install a list of energy efficiency measures, and performance standards, where the consumer (or the designer) can install any measures they want as long as they do not exceed the energy consumption set for a given installation (building, factory, etc.).

If a policy is to be well-formulated and well-implemented, there must be a good understanding of the strategies and the interests of all concerned, with a distinction between the target actors (those who ultimately take the decision) and the intermediate actors who are able to influence the decision. As far as construction is concerned, the actors are numerous and their interests sometimes diverge. We have seen the problems of running costs in the case of rented housing; we could also mention the case of new construction where the owner and the property developer are not the same person.

Evaluating the interest of incentives

As regards incentive measures, a scrupulous analysis of the obstacles to a natural dissemination of efficient techniques is necessary.
It may prove effective to remove some or all of the taxes and duties from certain products, whether imported or domestically produced, so as to open up the market. If the supply of certain types of equipment is inadequate, it may be preferable, depending on the size of the potential market, to encourage imports, to support a technical partnership between domestic and foreign manufacturers, or to undertake an innovation project in conjunction with manufacturers.

Fiscal incentive measures often appear attractive, particularly for households, who are often more sensitive to the "symbolic" rather than the absolute value of the incentive. Bank funding should be adapted to energy saving investments which, by definition, should offset the loan repayments. The criteria for analysing loan applications are therefore different, and the government can support this supply of funding by promoting the reduction of interest rates, particularly in favour of social housing.

Non-mandatory programmes based on incentive measures may also be specifically designed to complement mandatory programmes (regulations or standards) and facilitate their enforcement. For example, demonstration programmes in conjunction with design assistance and training programmes can play an important role in testing and improving new technologies, as well as helping the designers and the building industry to adopt the new technologies.

The above discussion regarding regulations clearly shows the importance of combining complementary instruments for a single action (see Box 42): good public information and appropriate training of professionals on target products will lead to considerable and beneficial use of financial and fiscal instruments. On the other hand, a general and isolated communication campaign will have little effect. Financial incentives directed to large institutional builders (such as social housing institutions) during the preparation of new building codes may also be helpful to reduce the extra cost of new technologies by expanding their use, as shown in the example of new buildings in France presented in the following pages.

Box 42

THE ENERGY POLICY ACT OF 1992 (USA)

The Energy Policy Act of 1992 (EPACT) is probably the most significant energy legislation ever enacted in the United States.

In the building sector, EPACT extends the DOE's (Department of Energy) labeling programme to windows and window systems, commercial office equipment, and luminaires (lamp fixtures). In all three areas, the Department is directed to support industry efforts to create voluntary testing and information programmes and to monitor and evaluate these programmes. Three years after passage of EPACT, if any of these voluntary efforts is not successful, DOE is directed to march in with a mandatory Federal standards programme.

In another application of labels, the Department is directed to develop voluntary guidelines for Home Energy Rating Systems, or HERS, and to provide support to State and local organisations, encouraging them to adopt these HERS guidelines. Within three years from the passage of EPACT, the Department is to report to Congress on the feasibility of requiring minimum efficiency ratings for all homes purchased with Federally assisted, guaranteed, or insured mortgages – effectively establishing a minimum efficiency level for all US homes at the time of their sale or refinancing.

To eliminate a financial barrier to increased housing efficiency, EPACT directs Federal mortgage agencies to offer Energy Efficient Mortgages, or EEMs. In the past, the selection criteria for home loans did not recognise that the dollars saved in energy costs could be used to make higher mortgage payments, which created a first cost bias against efficiency. Home builders were wary of adding efficiency features for fear their additional costs would disqualify some potential buyers. EEMs eliminate this barrier. EEMs also allow the buyers of existing homes to include in their mortgages the funds required to make cost-effective energy saving improvements (the funds are placed in an escrow account to be used to pay the retrofit costs).

Contact: Efficiency and Renewable Energy Clearing House – DOE, U.S.A.
Phone: 1.703.287.83.91 / Fax: 1.703.893.04.00

6.4 NEW BUILDINGS: THE CASE OF FRANCE

A CONTRIBUTION BY MR. GILLES OLIVE, EXPERT ON BUILDING REGULATIONS

6.4.1 A progressive legal and regulatory frame

Following the first oil shock in 1974, the French public authorities began to establish an evolutional legal and regulatory frame:

• On one hand in 1974, a set of regulations concerning energy use in new and existing buildings in the residential and service sectors were introduced, which covered:
- energy control and distribution;
- limiting temperatures in the buildings;
- remuneration for heating exploitation;
- heat metering;
- insulating energy equipment.

• On the other hand, a set of thermal regulations for new buildings were successively established in 1974, 1982 and 1988.

In old dwellings, actions were simple and easy to generalise, such as insulating roof spaces, and replacing burners or control systems, but there were no new regulations. The fact that regulations governing new buildings permitted action to be taken on about 300,000 dwellings a year (the number of new dwellings built in France each year) argued in favour of making this approach a strategic priority.

These successive regulations on new buildings have made it possible to progressively reduce the minimum level of efficiency required:

• The 1974 thermal regulation concerning heating in domestic and service sector buildings permitted to reduce consumption for heating by about 20% compared to consumption in buildings constructed just before this regulation.

• The 1982 thermal regulation, which concerned heating in the domestic sector led to a reduction in consumption of another 25% for heating compared to buildings constructed under the 1974 law.

• Finally, the 1988 regulation concerning heating and sanitary hot water production in the domestic and service sector buildings introduced new requirement levels. For the domestic sector, this led to a 25% decrease in consumption for heating and hot water compared to buildings under the 1982 law. For service sector buildings, the regulation permitted to reduce consumption for heat and hot water by about 25% compared to new buildings constructed under the 1974 law.

There is currently, in 1997, discussion of raising the levels of energy efficiency required for new service sector buildings (to align their energy efficiency on that of the domestic sector) and to eventually raise the level of efficiency required in the domestic sector.

6.4.2 Why was this regulatory system effective ?

The main reason this regulatory system works is that it respects the following principle: to be enforced, a mandatory measure must be accepted by the market. If the actors concerned by such a measure cannot satisfy its requirements for socioeconomic reasons, the regulation will just not be applied. It is always detrimental when regulations are not respected. Consequently, in preparing a regulation, the question of its acceptability is crucial.

To ensure that the regulation was accepted and applied, the following choices were made: regulation based on performances; implication of the actors concerned; experimental anticipation of the regulation; a step by step enforcement; the use of a special energy efficiency fund.

PERFORMANCE-BASED REGULATIONS INSTEAD OF NORMATIVE ONES

A performance-based regulation imposes results, not methods. Consequently:
- this type of regulation allows actors to choose the means to reach the objectives; the market is thus free to evolve;
- this liberty has a price: this type of regulation must be accompanied by a standard procedure which may be used by the designer to justify that the expected result respects the regulatory requirement.

A RAPID INVOLVEMENT OF ALL THE ACTORS CONCERNED WAS ORGANISED

For a regulation to be correct, applicable and respected, its preparation must progressively, but as quickly as possible, involve all the actors concerned.

To simplify, the actors, together with the public authorities are the following:
- the "experts": research organisms and technical centres, building experts;
- the "operators": all the actors concerned by the order (developers, owners, financers), the design (architects, engineers, consultancy firms) and the implementation (industrial operators and distributors, contractors, inspectors and coordinators) as well as by the use (service providers, managers, users, insurance providers);
- the "political bodies": institutions which represent the building sector and user associations.

There are three stages in preparing the regulation to respect both the logical path in solving the problems encountered (definition of the requirements and elaboration of the regulation) and the logical progression of actor involvement:

• The first step is to gather the knowledge necessary to determine the regulatory requirements. This stage is initiated by the public authorities, who sollicit the "experts" and begin to sensitise the "operators" and the "political bodies" to the preparation of a regulation.

• The second step is to determine the desired requirements. This stage is coordinated by the public authorities, who sollicit the "experts" and continue to sensitise the "operators" and the "political bodies".

• The third step is to elaborate the regulation. This stage is guided by the public authorities, who sollicit the "political bodies" to complete the process preparation.

THE EXPERIMENTAL ANTICIPATION OF THE REGULATION

Two procedures must be implemented in parallel to ensure that a regulation is effective: the process of defining possible requirements and an experimental anticipation of the regulation.

This is how applicable requirements are defined:

• Determination of possible requirements (action *a*)
This process consists in carrying out technical and economic evaluations of the thermal and energy qualities of comfortable and energy efficient buildings. These evaluations then permit to identify the most pertinent regulatory criteria and the possible requirement levels to meet these criteria.

• Experimental anticipation of the regulation (action *b*)
This process is two-fold:
- organising an experimentation plan which permits to test certain technical sub-branches. This aims to convince the actors concerned of the effectiveness and the practicality of these sub-branches (in order for them to be incorporated in the planning phase by the developers, in the design phase by the architects and engineers, and in the implementation phase by the contractors and installers);
- an incentive for voluntary anticipated application of the quality requirements (so as to cover the range of possible regulations), such as a thermal and energy quality label for new buildings, to ensure that the market approves the future regulation, on a technical and economic level.

• Defining the desirable requirements:
Actions *a* and *b* allow the definition of the possible requirements (their nature and their

level) to evolve. At the beginning of action *a*, this definition is highly approximate. At the end of *b*, it is strongly validated. However, the levels of the possible requirements are necessarily more or less applicable; this applicability must then be evaluated. From the possible requirements emerge the desired requirements, i.e. those with the highest level of applicability. These desired requirements will then make up the final regulation.

THE REGULATION WAS ENFORCED STEP BY STEP

- The first step was the promulgation of an initial regulation with a low-level requirement which the market would automatically accept. At the same time, an ulterior reinforcement was announced.

- Following this, a final regulation with the optimum level requirement was enforced. The acceptibility of this requirement was verified through the experimental anticipation process.

This step by step implementation created a very favourable context for the experimental anticipation process:

- In the absence of an initial regulation, only a minority of the actors concerned would have the foresight to prepare for a stricter future regulation. Moreover, the references used in the experimental anticipation process would be imprecise: on one hand, the current practice (where the thermal and energy quality of buildings is not taken into account) and, on the other hand, an unknown future practice.

- With the implementation of an initial regulation and the notification of a future one, all the actors of the building sector are obliged to respect the first level of requirement and know that they will have to respect the second level ulteriorly. The interest of anticipating the regulation will be understood by more actors. In this case, the references of the experimental anticipation process are clear: the minimum level of the experimental anticipation corresponds to the practice required by the first regulation and the maximum level corresponds to the objectives of the second regulation.

THE USE OF A SPECIAL ENERGY EFFICIENCY FUND

The experimental anticipation operations of the regulation (action *b*) were not limited to a small number of demonstration operations. Even if these operations are replicable, one must not have too many illusions on their spontaneous reproduction.

The government permitted an in-depth process of integration by the market of a new quality requirement, in order to ensure the perenity of its demand, by measures aimed at supporting investments in energy efficiency operations in the building sector. These subsidies were awarded to owners which implemented energy efficiency operations, essentially to social housing organisations. This subsidy programme (1982-1986) was made possible thanks to the component aimed at supporting energy management investments (i.e. 6 billion francs of aid from 1982 to 1986) of a fund which had a wider scope, the Special Fund for Large Operations (FSGT) supplied by a loan reimbursed through a tax on oil products.

CHAPTER V

Financing investments

SUMMARY

A decisive factor in the success of the programmes is the introduction of specific financial products on the markets that are well suited to energy efficiency projects and to the different types of investors, in the various sectors of activities, institutional or private.

The more elaborate of these methods of financing will in particular allow customers to transfer to the finance organisation the risks related to unsatisfactory technical performance of the project, or to changes in energy prices.

This chapter deals with:

- the criteria of profitability of an investment used in the preparation and evaluation of energy efficiency projects;
- various conventional methods of financing (equity funds, loans, shares);
- new approaches: leasing, guaranteed results contracts (contracts with shared savings and energy service contracts), third party investment formulae.

Financing investments

1

Introduction

The energy price increases of the 1970s and the consequent energy management policies launched by the governments of the OECD countries drove investors to search for possibilities to reduce energy consumption for heating, air conditioning, lighting, transportation or industrial production. In this search, investors had to select the most appropriate energy efficiency method, taking into account its price and technical performance. If investors invest in energy saving systems using their own or borrowed funds, they assume the risk themselves of whether the system will actually reduce energy consumption and produce financial savings.

After increasing in the 1970s, oil prices dropped in the 1980s, thus reducing the economic savings expected by investors and pushing the idea of energy savings into the background. Local authorities, schools, hospitals, universities, business centres and industry – all with limited budgets – had to make choices. Their energy bills were still high, but it was necessary to repair the roads, increase teachers' salaries, modernise equipment to remain competitive, etc. Since energy was no longer the primary concern, many managers hesitated to use capital for energy saving investments the results of which were not guaranteed.

Thus, in the early 1980s, new financial schemes appeared which have the advantage of taking responsibility for the uncertain factors – such as the risk – in energy investment. These new instruments are often highly effective and innovative, however, there are cases for which they are not appropriate.

We have seen in chapter IV – 5 "Financial Incentives" how the public authorities can set up a certain number of instruments to create a favourable environment for energy efficiency investments. In the present chapter, we will again focus on these instruments, but from the point of view of the investor. The issue here is how to find the most appropriate financial scheme for a specific project.

There are numerous ways of funding an investment: paying cash, borrowing (loans or bonds), leasing, etc. Each of these options has advantages and drawbacks, and any of them could be the best approach in a particular situation, taking into account the skills and financial situation of the individual or institution involved and the extent, cost, risk and effectiveness of the improvements being envisaged.

In this chapter, we shall present the different ways of financing energy efficiency projects, pointing out some of the main factors in choosing and applying the best method for a particular situation.

Remark
Energy efficiency projects in industry are underscored by energy audits or diagnoses which provide a reading of the current situation and permit to elaborate a detailed action programme, accompanied by the cost of the actions envisaged. When the investor is the industrial operator himself, and has the means to invest, this approach is logical and justified: for the executives of the enterprise, the audit is an instrument for decision on the basis of which a financing scheme can be established. This method is equally appropriate when there are substantial financial incentives available for energy efficiency: the audit permits to elaborate the presentation of the project in order to obtain the corresponding financial assistance.

However, in many cases – notably in countries in economic transition and developing countries – the industrial operator does not have the means to invest, public subsidies are low and the enterprise is obliged to use a loan or sign a contract with a third party investment company. In this case, the main decision criterion of the loaner or third party investor will not be the technical quality of an energy audit, but the financial situation of the enterprise, its reimbursement capacities, its level of exportation, etc.

Often, the conditions required by the loaner or third party investor are not satisfied and the investment is not made. Hundreds of in-depth (and expensive) energy audits were thus financed by international organisms in developing countries and countries in economic transition and are now stacked on shelves, because the financial conditions of the investment were not studied before the energy audit.

In such cases, it is best to adopt a pragmatic approach which consists in selecting enterprises which are likely to implement energy efficiency operations, and to have a light audit carried out in them to provide a "rough idea" of possible programmes. Then, it is necessary to examine possible financial mechanisms with the management of the enterprise. Once certain financing possibilities have been made clear, or better yet, potential financers have made a commitment in principle, an in-depth energy audit can be carried out to outline the project. Once the financing has been acquired, the feasibility study on the actions pointed out by the audit will permit to define the project in detail. This rule of caution also applies to buildings and transportation, however, it is in industry that the gap between the audits carried out and the investments made has been the most significant.

2

Criteria of the profitability of an investment

Four economic indicators are used to evaluate, from the point of view of the investor, the profitability of an investment in an energy efficiency project. The investor can be the consumer himself or a third party which replaces the consumer in making the investment. If the investor contracts a loan, these indicators are indispensable to demonstrate the validity of the project or programme to the loan organism (in general, a bank).

These indicators are: the cost of the energy saved, the gross payback period, the cost over benefit ratio, the internal rate of return. The use of one or the other of these indicators depends on the nature of the project or the partner who makes the investment. We also discussed in Chapter III the "cost of providing a service". However, this indicator is used more as an optimisation criteria for energy pathways from the point of view of the community than as a critieria for the individual investor.

2.1 THE COST OF THE ENERGY SAVED

The cost of the energy saved is equivalent to the annual repayment on the hypothetical loan (at market rates) needed to make an investment designed to save energy, divided by the expected annual energy savings produced by this investment. It is generally assumed that the period of the loan equals the life of the investment (values often used are ten years for industrial projects and twenty years for domestic and service sector projects).

The evaluation of the cost of energy saved permits a direct comparison between investment in the rational use of energy and the consumer's expenditure on purchasing energy.

An investment in energy saving is, from a theoretical perspective, economically attractive to the consumer if the cost of energy saved by this investment is less than the cost of the energy he would have to use otherwise. However, various barriers most often prevent the consumer from following this rationale because the most important issue for him is his investment capacity.

2.2 THE GROSS PAYBACK PERIOD OF THE INVESTMENT

The gross payback period of the investment is the period after which the amount of the investment is compensated by the financial savings which stem from the energy savings induced by this investment. For instance, an investment of US $ 1,000 which permits saving US $ 500 per year is said to have a gross payback period of two years. For energy efficiency operations in industry, payback periods of less than two or three years are frequent.

2.3 THE COST OVER BENEFIT RATIO OF THE INVESTMENT

The cost over benefit ratio of an investment is the ratio between the amount invested in an equipment and the annual gain, over the lifetime of the equipment, resulting from the energy saved by this investment. For example, for a lifetime of five years, if a US $ 1,000 investment allows a US $ 500 saving per year, the cost over benefit ratio is 2,5.

Most investments do not produce the same profits each year. Moreover, the reference monetary unit will not have the same value in one or ten years. The future value of the money must thus be recalculated in order to be compared with its current value.

A calculation of the net present value, using the discount rate chosen by the investors (see Chapter III – 3.2: "Economic evaluation of energy efficiency programmes and projects"), over the lifetime of the equipment, converts the profits or benefits into an amount which can be compared to the costs. If the net present value of the benefits is greater than the costs, the investment is economically profitable.

2.4 THE INTERNAL RATE OF RETURN OF THE INVESTMENT

The internal rate of return is the discount rate at which the net present value of the benefits is equal to the discounted cost of the investment (initial investment + operation costs). In other words, it is the annual level of financial remuneration of the investment, calculated over the lifetime of the equipment.

An energy efficiency investment is justified if the internal rate of return of the investment is greater than the opportunity cost of capital (the internal rate of return which could be obtained by other investments) or greater than the access cost of capital (borrowing terms on the financial market).

The internal rates of return of several energy efficiency projects can be compared and the most profitable investment, i.e. the one which has the highest rate of return, will be financially preferable.

3

Classical methods of financing: with personal resources and with loans

With traditional financing, the borrower bears all the risk of the project, but receives all the benefits.

3.1 FINANCING WITH PERSONAL RESOURCES

Payment in cash is the simplest and most familiar method of funding energy efficiency systems. A manager may negotiate with a contractor to insulate a building, or a school may use its operating budget to increase its boiler capacity or to install a more suitable electrical system. All the costs and the benefits that accrue are the direct concern of the cash-paying manager.

Before investing funds in energy saving projects, the following should be considered: are the funds available and is it feasible to lock them up until they are repaid from the savings produced? Will the return on the investment exceed the savings and/or the income that could be obtained by investing the money in other systems or by alternative approaches? Is there much risk that the savings will be less than expected?

In general, measures with a payback period of less than a year should be paid for from the operating budget. Projects which have a longer payback period are usually financed in other ways.

3.2 FINANCING WITH LOANS

In fact, very few projects are paid in cash. In most cases, at least part of the cost is borrowed. The loan allows the purchaser to combine the reimbursement of the loan (monthly reimbursements over a period defined beforehand) with the benefit generated by the use of the efficient equipement. The two main ways of borrowing money are obtaining loans or issuing shares. These two mechanisms are examined hereafter.

Loans

Managers typically use a loan to finance larger projects. As a rule, a number of guarantees are needed to obtain a loan. For example, the lender may require the borrower to put out, from his own resources, 10, 20 or even 40% of the cost to limit the risks. The ratio of the amount borrowed to the capital invested by the borrower is known as the debt/capital ratio. A debt much higher than the capital invested by the borrower indicates a high degree of indebtedness.

There are other important parameters such as the term of the loan, the rate of interest and the transaction charges. For example, a 10-year loan may be concluded with an interest rate of 10% with an additional 0.5% to cover financial charges. In general, a high risk loan will have a limited debt proportion, a high interest rate and a short repayment time.

Lenders often request additional guarantees that the loan will be repaid. If the repayments are guaranteed by goods or assets, the credit establishment will simply work out the borrower's repayment capability and then link finance charges to the credit assessment. When a firm is involved, the lender will often turn to specialised agencies.

It can be profitable to borrow money to finance energy efficiency investments when the annual costs of the loan are covered by the resulting savings. The manager not only benefits from reduced taxation related to depreciation and tax credits on the system installed, but also from deductible interest charges.

Emitting shares

Local authorities, and public or private service enterprises can obtain money for specific projects by issuing shares or bonds. A bond is a pledge to reimburse the lender at a certain interest rate at the end of an agreed period. Instead of borrowing the money from a bank, the authority concerned issues shares to thousands of shareholders. The entire debt can be funded from this issue. In this case, the advantage is that the money obtained is integrated into the equity and does not appear as a debt in the balance. Since this procedure is complex and the transactions involved are costly, it is used only for large scale projects. The dividends paid on the shares issued can benefit from tax advantages.

4

New financing formulae: leasing, guaranteed results contracts, third party financing

In some cases, borrowing and/or cash payment are not satisfactory financing methods because the investor assumes too much risk. Consequently other approaches, specially adapted to investment in energy efficiency, have emerged with the aim of redistributing the risk and reducing the financial liability of the manager.

These financial instruments can be classified in three categories:
- leasing contracts;
- guaranteed results contracts;
- third party finance contracts.

To be complete, the financial approach of an important project should analyse these possibilities.

4.1 LEASING CONTRACTS

Under a leasing contract, it is primarily the equipment itself which is borrowed and not the money. Leasing is a widespread practice in business. For example, photocopying machines and computer equipment are often leased rather than purchased. With a leasing arrangement, the lessee passes on any problems of obsolete equipment or malfunction to the supplier. For his part, the lessor can achieve economies of scale when purchasing the equipment in bulk or organising the funding. The leasing option is increasingly used by municipalities and public enterprises.

An energy efficiency system leasing arrangement should guarantee that the monthly payments are less than the expected savings. For example, the lessor may ask for a monthly payment of US $ 500 for a system that should reduce the energy bill by US $ 1,000 a month. The lessor installs, maintains and remains owner of the equipment. If the system does not operate as well as provided for in the leasing contract, the customer is entitled to break the contract. The lessor will then have to remove the installation at his own expense.

The legislation and rules which govern the leasing of equipment are complicated and vary from country to country. Leases mostly cover removable systems which do not form an integral part of the structure of a building. (The various regulations governing leasing are too complicated to be explained here.)

Leasing contracts are often used because they have the advantage of reducing risks to the lessee and saving time. The lessee has no worries, because if the equipment does not function correctly, the lessor is responsible and must resolve the problem. In addition, the "customer" does not lose time in the first place by examining all the existing systems in order to choose the one which best meets his needs. He simply rents one, sees if it operates and how it operates, and then is free to choose another more suitable technology. However, all this has a cost which is reflected in the interest rate of the leasing.

4.2 GUARANTEED RESULTS CONTRACTS

In this procedure, an energy user negociates a general contract covering the financing and risks of the energy efficiency investment. The guaranteed results contract is particularly well suited to cases where the manager has neither the time nor the analytical data necessary and cannot or will not cover the cost of the project. Although leasing contracts do have a number of advantages, their application is limited to circumstances where the need for a specific energy system is well defined. Larger projects require a more complex combination of services, equipment and controls. In these cases, service contracts in which the manager brings in one or more contractors to take care of some or all energy installations should be considered.

There are two types of service contract: shared savings contracts and energy services contracts. The services and systems can be the same in both cases, the only difference being the way in which the payments are determined. In each case, a contractor finances and installs the energy efficiency systems in the customer's premises. The latter pays nothing for the equipment which remains the property of the contractor, who assumes all the risks. The system can be sold to the client when the contract expires at the salvage value of the equipment according to the specific laws and tax system of the country. The consumer's monthly energy consumption can be then compared with what it would have been without the installed systems. This calculation is based on methods carefully analysed and accepted by all parties to the contract. The difference between the two numbers is the energy savings produced by the new system.

In shared savings contracts, the money value of the measured energy savings is distributed according to contractual formulae accepted by the parties. In other words, each party takes a share of the savings made. If there are no savings, the customer simply pays his energy bill and owes the contractor nothing.

In an energy services contract, the customer pays a fixed amount each month to the energy services company for all the energy requirements covered by the contract. If the energy costs are less than the monthly payment, the contractor keeps the difference. On the other hand, if the energy bill exceeds this amount, the contractor pays the difference.
The following are a few simple examples:

Shared savings contracts

An energy services company installs a number of energy efficiency systems, at its own cost, on its customer's premises, in exchange for 80% of the savings these systems produce. In the first month, the energy bill is US $ 1,000 less than that paid before the systems were installed. This saving is shared (80/20) between the energy services company and the customer. Thus, the customer saves US $ 1,000 on his energy bill and pays US $ 800 to the energy service company. The customer gains US $ 200 and the energy service company receives US $ 800 to cover the costs of its investment and other expenses.

Energy services contracts

The energy service company audits the installations and identifies where improvements can be made. The company offers to install systems, at its own cost, and to pay the energy bills for 5 years for example. In return, the customer agrees to pay the energy services company a monthly sum equal to 80% of what the bills would have been without the modified installations. Hence the customer can only gain. The energy service company can make a profit if the installations result in the energy bill falling by more than 20%.

Let us assume, for example, that the normal monthly energy bill is US $ 1,000. The customer agrees to pay the service company 80% of the US $ 1,000, or US $ 800 a month, which means a guaranteed savings of US $ 200 a month for the customer. Let us suppose that the contractor reduces the existing energy bill to US $ 600. He thus gains US $ 200 a month. If the contractor cannot reduce the energy costs below US $ 800, he will not make a profit. Whatever happens, the customer will pay US $ 800 a month.

4.3 THIRD PARTY FINANCING

A new concept, which appeared in 1984, called third party financing, is proposed by specific investment companies who are only interested in developing energy efficiency projects with no financial interest in selling equipment or operating the system.

Under this arrangement, the third party investment company finances and executes the project aimed at making operational savings, and is repaid up to the amount of the savings actually made each year over a limited period. Hence the company provides a three-fold service covering financing, technical execution and guaranteed result.

This guaranteed result, reflected in the fact that the investment is repaid pro rata from operational savings, is the most original feature of the arrangement. It ensures that the customer benefits from a net reduction in operating costs, whatever the performance of the systems installed. In the extreme case, if no savings are made, there are no repayments: the customer has a new system without having paid for it.

BENEFITS TO THE CUSTOMERS

As far as the customers are concerned, these contracts have a three-fold benefit:
- financial: the customer invests in his energy systems without having to pay; the repayments are based on sharing the operational savings, ensuring a net gain;
- technical: the third party investor takes care of the whole process, actually carrying out the work under his own responsibility and guaranteeing the supply of an adequate system;
- economic: because of the method of repayment used, the customer is not only insured against technical contingencies but also against fluctuations in energy prices. The procedure actually guarantees a payback period, whereas an ordinary investor faces the risk of seeing the expected payback period extended as a result of unexpected changes in energy prices.

TYPES OF CONTRACTS

Third party investment contracts fall into two categories:

- contracts with public authorities under which the third party investor finances the investment with around six years of gross return, repayments being annual payments equal to 85% of the savings made over an average period of twelve years. Under these contracts, the third party investor is never the owner of the systems installed and is therefore his customer's creditor, this appearing as a capital asset;
- contracts with industries under which the third party investor finances the investment with around three years of gross return, the repayment being made by annual payments of 85 to 100% of the savings over an average period of six years. Under these contracts, the third party investor retains ownership of the systems installed which therefore show up as tangible assets in his accounts.

The effect of these two types of contract from the accounting point of view is clearly very different. In the second case in particular, writing down the asset, when this is allowed for energy systems, means that the profits can be distributed in time.

THE MANAGEMENT OF RISK

Under third party investment contracts, the funding provided is repaid in proportion to the operational savings made over a limited period. This means that in theory it is possible that the savings will be insufficient to repay the financing, with a consequent risk of loss for the third party investor. One of the main tasks of the latter is therefore to minimise the risks undertaken in the operation.

There are various complementary approaches to managing the risks of technical performance:

- guarantee limited by contract: all the contracts set minimum levels in the calculation of repayments;
- stringent and prudent review of the predicted energy savings before work begins;
- involving subcontractors in the guarantee: payments to consultancy bureaux and even to subcontractors usually depend partly on the results obtained after one year of operation;
- involving the maintenance and operating companies: in many cases, the third party investor negotiates operating contracts for his customers (flat rate or result-based) under which the operating companies guarantee the energy savings in volume;
- technical measures to limit risk: whenever he can, the third party investor selects dual energy systems, and, within one same contract, spreads out the risks by diversifying techniques and types of energy between the different sites;

- preference for grouped contracts: master contracts covering several operations allow for considerable reductions in technical and pricing risks by sharing the liability (i.e. for n operations, the individual risk is divided by n).

Pricing contingencies are managed in two main ways:
- by diversification and risk-sharing: under different contracts, the third party investor carries out diversified operations on which changes in energy prices have opposite effects. For example, if the same guarantee covers a fuel substitution operation (coal for gas) and a gas saving operation, it is obvious that a rise in the gas price will make the substitution less attractive but the savings more so;
- by a return guarantee from the energy distributors: certain substantial operations involving energy substitution do not lend themselves this risk sharing. The third party investor must then seek pricing commitments from the energy distributors.

The third party investor should act only when he is certain that he is able to manage the two kinds of technical and economic risks and, hence, to limit the differences between the predicted energy savings and those which are actually achieved.

Also, since contract periods are always longer (by some two to four years) than the normal repayment period, a reduction of 10 to 15% in the savings merely extends the repayment period without any loss of capital or interest. In this way, the third party investor has a margin on the guarantee.

TABLE 24: THIRD PARTY FINANCING
A THEORETICAL EXAMPLE

Let us consider a programme of work the total cost of which is US $ 1,000 (inclusive of taxes) and for which the payback period (investment inclusive of taxes/annual savings inclusive of taxes), is five years.

The third party investor offers a contract for a maximum period of twelve years, during which the maximum repayment is 85% of the savings in energy consumption.

Year	Saving on energy consumption ($ including taxes)	REPAYMENT INCLUDING TAXES			Net Gain
		Capital	Interest	Total	
1	200	75	95	170	30
2	200	82	88	170	30
3	200	90	80	170	30
4	200	99	71	170	30
5	200	108	62	170	30
6	200	119	51	170	30
7	200	130	40	170	30
8	200	142	28	170	30
9	200	155	15	170	30
beyond	200	0	0	0	200
		(total 1,000)			

The interest rate in this example is 9.50%

IF THERE ARE NO ENERGY SAVINGS, THE GUARANTEE IS INVOKED. THEREFORE, THE REIMBURSEMENT SCHEME CHANGES.

TABLE 24 (continued)

Let us assume that the actual energy consumption savings are not US $ 200 but US $ 150 (inclusive of taxes) owing to lower performance or changes in price, then the repayment schedule becomes as follows:

Year	Saving on energy consumption ($ including taxes)	REPAYMENT INCLUDING TAXES			Net Gain
		Capital	Interest	Total	
1	150	33	95	128	22
2	150	36	92	128	22
3	150	39	89	128	22
4	150	43	85	128	22
5	150	47	81	128	22
6	150	51	77	128	22
7	150	56	72	128	22
8	150	62	66	128	22
9	150	68	60	128	22
10	150	74	54	128	22
11	150	81	47	128	22
12	150	89	39	128	22
beyond	150	0	0	0	150
		(total 6,790)			

The third party investor is owed the rest of the capital: 1,000 - 679 = 321 US $

Box 43

European Bank for Reconstruction and Development
Press Release (extract)
December 15th 1995

EBRD to help boost energy conservation in Hungary

A US $ 5 million (ECU 3.8 million) loan from the European Bank for Reconstruction and Development (EBRD), signed today in London, will allow the Hungarian joint-stock company Prometheus Rt. to finance its ongoing energy saving activities and will support the development and growth of Energy Service Companies (ESCOs) in the energy conservation field.

At the signing, Jacques de Larosière, President of EBRD, said: "The EBRD recognises the need for demand-side energy savings. This first loan contributes significantly to the transition process in Hungary: it helps develop a new sector, to reduce energy consumption and to increase the efficiency and competitiveness of local public and private sector entities. The use of ESCOs is one of the most efficient ways for the EBRD to foster investment in small and medium-sized energy efficiency projects."

The EBRD loan to Prometheus will enable the company to invest in energy-saving equipment. The company will use the loan proceeds for renovations, new parts and safety devices, and the operation and maintenance of energy installations in private sector businesses or public sector enterprises operating in Hungary.

ESCOs are industrial companies which, because of their extensive expertise and experience in energy conservation, are able to purchase, install and maintain for their clients (at their own initial expense) the equipment needed to generate significant energy savings, and to accept the risk of being reimbursed proportionally to the real savings obtained. ESCOs are paid through contractual arrangements that convert the customer's savings from reduced energy costs into revenue. ESCOs, which use a "Third Party Financing" concept, were previously unknown in the EBRD's countries of operations.

This type of project enables private and public sector entities (such as schools, hospitals, barracks and other public buildings) to realise energy conservation potential. The EBRD is the first international financial institution to lend for such an activity.

This project will strengthen Prometheus's business and provide long-term cost savings for its clients through reduced energy consumption, and reduced operation and maintenance costs. Reduced energy consumption will also benefit the environment by lessening pollution due to fuel combustion. Macroeconomic benefits will arise from reduced energy imports (...).

Contact: EBRD Energy Efficiency Unit – London, United Kingdom.
Phone: 44.171.338.70.79 / Fax: 44.171.338.69.42

4.4 ENERGY SERVICE COMPANIES (ESCOs)

Certain companies – known as Energy Service Companies (ESCOs) – offer to carry through the energy efficiency projects on a turnkey basis, using the three approaches described above. They audit energy use to identify possible energy savings, then install the recommended systems, maintain them, and bear the costs of the whole operation. In return, they receive part of the savings made. Box 43 presents the first creation of an ESCO in Central Europe.

4.5 ELABORATING FINANCING OPERATIONS

Contracts with shared savings, energy services and third party investment appear to be very suitable ways of reducing energy bills without significant financial cost and risk to the energy user. The customer must give up some of the savings made, but saves nonetheless. These processes permit the customer to avoid direct investment in energy efficiency and thus allow him to make other investments elsewhere. Moreover, in the case of third party investment schemes, at the end of the contract he is sole owner of the systems installed and from then on benefits from all the savings.

The customer should take great care in choosing the service contractor with whom he will work. Preparation of the contract and the execution of the programme can take longer than one might think, particularly in institutional arrangements where decisions have to be approved by a large number of departments. Furthermore, the transaction cost may be higher than expected. A good working relationship between the customer and service provider will help the process run smoothly.

The claim that guaranteed results contracts cost nothing is a myth. Since these operations are complicated and have to be adapted to the special features of each installation, a significant amount of time must be spent on them. Moreover, since this kind of arrangement emerged only recently, its supporters often have to convince the decision-makers that it really does work.

The procedure for selecting contractors, negociating the contract and monitoring the project through to completion is described below.

The first step is to determine whether the potential for energy saving is sufficient to interest an energy service company. The length of time needed to set up these projects is such that energy services companies will only consider projects for which the annual potential savings exceed US $ 50,000 or even US $ 100,000 a year. Assuming that a 20% reduction in the energy bill is possible, this would mean that potential customers have energy costs of over US $ 250,000 a year. An initial audit of the installations should identify what savings are feasible, and give the different parties a first idea of the possibilities. In this way, the audit should show the customer what simple modifications to his installations can be applied immediately and cheaply without recourse to a burdensome financing procedure.

Following this initial stage, if there remains sufficient potential for savings, a guaranteed results contract may be considered. Occasionally, the customer may have to ignore inexpensive modifications in order to interest an energy services company in the project.

To have a virtually risk-free guaranteed results contract, the costs, benefits and risks of all the other options of funding the project have to be compared with a view to making 10 to 50% savings. If the contract still appears attractive, the next question is whether staff are available to take charge of the process of selecting contractors, negotiating contracts and setting up the project. This requires legal, accounting and technical capabilities. Finally, one must be certain that the people who will have to approve the project give their full support. Without top-level cooperation and confidence, this kind of project can easily collapse at any of the stages.

If the preliminary review shows that large savings can be made, that adequate staff are available and that the management is ready to back the project, the procedure of selecting the contractor can then start. A customer draws up the specifications of an operation and issues a call for tenders. Unlike standard contracts, most guaranteed results contracts are not easy to compare in a call for tender procedure. For example, one contractor may claim that a particular item of equipment will lead to an energy saving of US $ 10,000 per month and propose to retain half of the savings. Another company claims that its installation will save US $ 15,000 per month and requests 60% of the gains. In examining tenders, the customer may find it difficult to judge which of these predictions is the fairest. In theory, he will save more with the second bid (US $ 6,000 against US $ 5,000), even if the energy services company retains a larger share of the savings. However, if the second bid appears more risky or optimistic, and without detailed technical assessment of the bids, it is difficult to decide between them.

The decision must not be taken simply on the financial aspects of a bid. It is important to review the reputation of contractors, their experience and references, the complexity of the project and the technical risks involved.

One way of identifying companies interested in the project is to issue a call for expressions of interest. Contractors reply with a brief description of their competency and their experience in the field. It is then possible to select one or several contractor(s) to negotiate solely on the basis of qualifications. This process is often used to produce a short-list of candidates who are then asked for a detailed technical and financial bid.

This procedure is more costly and takes more time. However, it is a sensible approach in cases where the size and complexity of the project justify detailed analysis. The proposals may often include energy saving ideas or management proposals that the customer had not thought of.

The customer must take certain steps to verify whether the bids received meet his requirements. The first is to prepare a brief description of the energy installations. The call for tenders can also include a summary of the services expected, the framework, the persons to be contacted and should explain how the bids will be assessed. The following should also be requested: a detailed energy audit, the methods of calculating energy savings; details of installation, construction, management, maintenance and control; financing of the project; and a schedule for the completion of each stage.

From the outset, the customer should know which clauses he wishes to incorporate and emphasise in the contract and should request that applicants address them specifically. Items to be considered should include responsibilities in the event of faulty operation or accidents, the ways in which benefits will be distributed in the event of a sudden increase in energy prices, and the terms under which the customer may purchase the equipment during or at the end of the contract.

The procedures used for calculating energy savings constitute the core of guaranteed results contracts or third party investment contracts. They determine the amount which will be shared. The contractors consulted should clearly explain the methods, data and assumptions used in their calculations. Examples of similar projects should be presented.

The customer should request references from companies and examine these with care. The company must clearly demonstrate that it is capable of funding and installing the systems as planned, that the contract complies with the law, and that the company is stable and will continue in business throughout the contract.

Once the contractor has been selected, the customer signs a preliminary agreement. The service providing company should then begin a detailed energy audit, recommend certain items of equipment, estimate the costs as well as the savings that will accrue, and propose the financial terms of the contract. If substantial differences between the preliminary review and the results of the detailed study exist, it should be possible to renegotiate the terms of the contract. Before signing the final contract, the customer again examines in detail the legal, technical and financial aspects of the proposal in order to ensure that they do in fact meet his requirements. The customer's responsibility does not stop with the signature of the contract. The time between the signing of the contractual agreement and the execution of the contract may be long and necessitate patience and perseverance from all contracting parties. There should be a specific contract for each operation; however, model contracts may be proposed as a basis for negotiation.

The customer should then appoint a team to manage the project and check that the different stages are carried out satisfactorily.

The contract should include a clause for cancellation without penalties, in the event that the service provider does not abide by the completion schedule. When the installation is completed, the customer must ensure that regular maintenance is carried out and verify the contractor's invoices. Most importantly, the customer must double-check that the methods used to calculate energy savings are those provided for in the contract. If all is satisfactory, the customer may then content himself with minimal daily checks. The customer's role may be limited to that of light monitoring, but he should be ready to take a more active part in the event of problems.

The financing formulae we have analysed above are thorough and effective instruments. However it must be remembered that:

• They require a first-class guarantee of the quality of the contractual links between the service company and its client. In particular, it is often difficult to evaluate the savings actually made (notably if a modification is made to the output of a factory, or in the occupancy rate of a hotel).

• These procedures are not cost-free to the customer, who has to pay the service company for the service provided (and, in particular, assume some of the risk). This cost, which is partly independent of the scale of the operation, will be amortised so long as the savings are sufficient. These formulae are usually best suited to large operators.

Bibliography

To present in 1997 a bibliography on "Energy Efficiency" is not an easy task: from a few books and articles in the 1970's, the amount of litterature on the subject considerabily increased in the 1980's, and even more in the 1990's, with the growing importance of energy efficiency in reducing environmental problems.

The bibliography presented here is, of course, not exhaustive. It tries to cover the historical evolution of energy efficiency issues through a review of selected books presented in chronological order and also to enable the reader to find books, reports or articles fairly easily by supplying the fax and phone numbers of the main periodicals and organisations which regularly publish on energy efficiency.

Since this book is published in English and in French, we have as a general rule limited ourselves to publications in those two languages. If this book were to be translated, the bibliography should include publications in other languages.

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Performance contracting for energy and environment systems.

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Energy and environmental strategies for the 1990's.

Plant engineers and managers guide to energy conservation.

Innovative energy and environmental applications.

ADB
ASIAN DEVELOPMENT BANK

Manila, The Philippines
Phone: 63.2.632.44.44 / Fax: 63.2.636.24.40

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AIT
ASIAN INSTITUTE OF TECHNOLOGY

Bangkok, Thailand
Phone: 662. 524.54.16 / Fax: 662.524.54.
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ENERDATA S.A.

Grenoble, France
Phone: 33.4.76.42.25.46 / Fax: 33.4.76.51.61.45

Training seminar on demand oriented energy policies (Papers) – Seminar organised by ENERDATA S.A. with the support of the SYNERGY Programme (EC / DG XVII) and Ademe.

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EUROPEAN COMMISSION

Directorate general for energy (DG XVII)

Brussels, Belgium
Phone: 32.2.295.28.79 / Fax: 32.2.235.01.50

Energy in Europe:
Quarterly in english, with translations into French, German or Spanish of articles in the preceding issue.

- *A view to the future,* September 1992.
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Report on activities of the Cooperative Programme on Energy and Development (COPED).

Regional and Urban Energy Management Programme, "maps brochures" and case studies.

THERMIE Programme:

- *THERMIE promotion of energy technologies for Europe – Information activities.*
- *Flag brochures and final reports on rational use of energy.*
- *THERMIE sectoral catalogues on energy saving in building and in transport technical projects.*
- *Technologies énergétiques au service de l'environnement, rapport annuel 1991-1992.*

Hundreds of high level reports and books have been published, in the frame of the THERMIE programme, on rational use of energy, whether general or on very precise technological topics.

SYNERGY Programme:
- *Energy indicators for the countries of Europe and the CIS.*
- *Synergy newsletter.*

SAVE et PACE Programmes:
- *Study on energy efficiency standards for domestic refrigeration appliances,* March 1993.
- *Energy efficient technologies in Europe (OTEEE),* January 1994.
- *Study of measures to promote energy efficient lighting in the commercial sector in Europe,* 1994.

Directorate general for science, research and development (DG XII)

Brussels, Belgium
Phone: 32.2.295.36.67 / Fax: 32.2.295.37.01

JOULE Programme (Joint Opportunities for Unconventional or Longer-term Energies)
- Catalogue of contracts, in particular on "Models for energy and environment" and "Rational use of energy, conservation in end use sectors".
- Energy technologies, environmental policy and competitiveness, Final report for JOULE II Programme.

IEPE
INSTITUT D'ECONOMIE ET DE POLITIQUE DE L'ENERGIE

Grenoble, France
Phone: 33.4.76.42.45.84 / Fax: 33.4.76.51.45.27

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IEPF
INSTITUT DE L'ENERGIE DES PAYS AYANT EN COMMUN L'USAGE DU FRANÇAIS
Agence de coopération culturelle et technique

Québec, Canada
Phone: 1.418.692.57.27 / Fax: 1.418.692.56.44

Collection "PRISME" (PRogramme International de Soutien à la Maîtrise de l'Energie)
- *Session de suivi et d'évaluation du premier atelier régional sur la maîtrise de l'énergie dans les bâtiments,* n° 6, 1994.
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IIEC
INTERNATIONAL INSTITUTE FOR ENERGY CONSERVATION

IIEC North America: Washington D.C., USA
Phone: 1.202.842.33.88 / Fax: 1.202.842.15.65
IIEC Europe: London, United Kingdom
Phone: 44.171.704.67.37 / Fax: 44.171.704.87.57
IIEC Asia: Bangkok, Thailand
Phone: 66.2.381.08.14 / Fax: 66.2.381.08.15
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Phone: 56.2.236.92.32 / Fax: 56.2.236.9233

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"E - Notes": quarterly newsletter: energy efficiency issues in developing countries.

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LAWRENCE BERKELEY LABORATORY

Berkeley, California, USA
Phone: 1.510.486.7489 / Fax: 1.510.486.6996

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OECD AND IEA
Organisation for Economic Cooperation and Development
International Energy Agency

Paris, France
OECD – Phone: 33.1.45.24.82.00 / Fax: 33.1.45.24.85.00
IEA – Phone: 33.1.40.57.65.00 / Fax: 33.1.40.57.65.09

Regular publications

Energy policies of IEA countries.

World energy outlook.

The role of IEA Governments in energy.

Energy policies in ...:
Series of country reports, last publications: Poland 1990 survey (1991) and 1994 survey (1995), Hungary 1991 survey (1992) and 1994 survey (1995), The Czech and Slovak Federal Republic 1994 survey (1995), Romania 1993 survey (1993), Republic of Korea 1994 survey (1995), Russian Federation 1995 Review (1996), Ukraine (1996).

Recent publications

Long term efficiency targets: a technical and economic analysis: dishwashers, washing machines, driers, DSM technology procurement: group for efficient appliances, 1995.

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- *Effets sur l'environnement des systèmes énergétiques,* 1983.
- *Effets sur l'environnement de la production d'électricité,* 1985.
- *Incidences sur l'environnement des transports automobiles,* 1986.
- *Incidences sur l'environnement des énergies renouvelables,* 1988.

Urban transport and the environment, 1979.

La production de l'énergie et l'environnement, 1977.

IEA Newsletters

Energy efficiency update (every 4 months)

Energy technology newsletter (every 6 months)

ETSAP News: the newsletter of the Energy Technologies Systems Analysis Project

ROCKY MOUNTAIN INSTITUTE

Snowmass, Colorado, USA
Phone: 1.970.927.3851 / Fax: 1.970.927.3420

Homemade money: how to save energy and dollars in your home, 1995.

A primer on sustainable building, 1995.

Greening the building and the bottom line: increasing productivity through energy-efficient design, 1995.

Lean and clean management: how to boost profits and productivity by reducing pollution, 1995.

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RMI publishes a tri-annual newsletter.

TERI
TATA ENERGY RESEARCH INSTITUTE

New Delhi, India
Fax: 91.11.46.217.70

TIDE: TERI Information Digest on Energy (quarterly in English).

ASSET: digest (quarterly in English), with the UNU, University of the United Nations, Tokyo.

PAJE: Pacific and Asian Journal on Energy (quarterly in English).

UNITED NATIONS (UN)

Habitat II: Sustainable energy in human settlements: dialogue for the 21st century, Conference proceedings, Energy 21, 1996.

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• IE / PAC: Industry and Environment Programme Activity Centre

Phone: 33.1.44.37.14.50 / Fax: 33.1.44.37.14.74, Paris, France.

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UN / Economic Commission for Europe

Geneva, Switzerland
Phone: 41.22.917.2407 / Fax: 41.22.917.0227

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- *Energy efficient design,* n° 9, 1991.
- *Sustainable energy development in Europe and North America,* n° 6, 1991.
- *Energy efficiency in European industry,* n° 1, 1989.

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Manual on business planning: how to construct a business plan for energy efficiency projects, 1994.

Energy conservation policies and prospects for cooperation in the ECE region, 1992.

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UN / Economic and Social Commission for Asia and the Pacific

Bangkok, Thailand
Phone: 662.288.1547 / Fax: 662.288.1000

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Policies for rational use of energy, 1989.

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UN / Economic and Social Commission for Western Asia

Amman, Jordan
Phone: 962.6.606.847 / Fax: 962.6.694.981

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Optimization of energy use in oil refining, 1993.

Issues of rural energy in the ESCWA Region, 1992.

Energy audits for selected energy-intensive industries in the ESCWA region, 1989.

WORLD BANK

Washington D.C., USA. Phone: 1.202.477.1234 / Fax: 1.202.477.6391
European Office, Paris, France. Phone: 33.1.40.69.30.00 / Fax: 33.1.40.69.30.66
Tokyo Office, Tokyo, Japan. Phone: 81.3.3214.5001 / Fax: 81.3.3214.3657

Annual *World Development Report.*

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Energy demand in five major Asian developing countries: structure and prospects, 1995.

Capacity building requirements for global environmental protection, 1995.

What makes people cook with improved biomass stoves? A comparative international review of stove programs, 1994.

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4

Examples of selected recent publications of some energy efficiency agencies

ADEME
AGENCY FOR THE ENVIRONMENT AND ENERGY MANAGEMENT

Paris, France
Phone: 33.1.47.65.20.00 / Fax: 33.1.46.45.52.36

Three collections

Dossiers et références : data collection, legislative and regulatory texts, monographs, studies, surveys...

Connaître pour agir : products and processes (technical leaflets, catalogues...); technical guidebooks.

Rencontres et journées techniques : workshops and seminars.

Publications

Bâtiments à hautes performances énergétiques : de la conception à la gestion : six books, co-edited with PYC Editions, AICVF, 1992-1996:
- *Hôtels, restaurants*
- *Etablissements de santé*
- *Immeubles de bureaux*
- *Etablissements d'enseignement*
- *Sports*
- *Agriculture*

Energie et environnement : aide-mémoire des financements européens, with "La cellule entreprises-marché unique", 1995.

Le financement des équipements liés à l'énergie, guide pratique à l'usage des PME-PMI, co-edited with the European Commission DG XVII, 1995.

Confort d'été : rafraîchissement ou climatisation des bâtiments ; ventilation des bâtiments : état des lieux et perspectives, Proceedings of technical sessions, September and October 1995.

Maîtrise de l'énergie en chiffres, 1973-1993, 1994.

Echangeurs thermiques : enjeux, marchés, technologie et politique d'innovation, 1994.

L'énergie en Afrique, with IEPE and ENDA, Ed. Karthala, 1994.

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Electrification rurale en France, COLOMBIER M., 1993.

Les déplacements urbains en province, pratiques et opinions, 1993.

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Gisement des économies d'énergie du parc européen des appareils électroménagers obtenues par une réglementation des performances énergétiques, LEBOT B. *et al.*, 1991.

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Maîtrise des usages spécifiques de l'électricité dans l'habitat et le tertiaire, Proceedings – AFME – 1990.

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BEW
SWISS FEDERAL ENERGY BUREAU

Berne, Switzerland
Phone: 41.31.322.56.11 / Fax: 41.31.382.43.07

Le programme "Energie 2000", Federal Department for Transportation, Communication and Energy, 1991.

Véhicules électriques, guide à l'usage des intéressés, 1990.

Economies de chauffage à la maison, 1986.

Economie d'énergie et logements, 1986.

Information "Solutions Exemplaires", information on rational use of energy targeted towards local authorities, property owners, etc.

DEA
DANISH ENERGY AGENCY

Copenhage, Denmark
Phone: 45.33.92.67.00 / Fax: 45.33.11.47.43

Small-scale combined heat and power in Denmark, 1993.

Energy 2000: follow up – Responsible and forward looking energy policy, 1993.

Energy 2000: follow up – Assumptions and analysis, 1993.

District heating, research and technological development in Denmark, 1993.

Energy efficiency in Denmark, 1992.

See also: the National Building Agency
Denmark uses energy better: information sheets on the latest energy conservation know-how, with the Energy Conservation Industry's Information Committee.

EMC
ENERGY MANAGEMENT CENTRE

An autonomous organisation under the Ministry of power, Government of India
New Delhi, India
Fax: 91.11.686.8914

Energy conservation measures in the domestic sector in India.

Load management in HT industries in India.

Review of different financing schemes for energy conservation in India.

Institutional framework and infrastructural set up for energy conservation.

ENEA
NATIONAL AGENCY FOR THE NEW TECHNOLOGIES, ENERGY AND THE ENVIRONMENT

Rome, Italy
Phone: 39.6.30.48.34.20 / Fax: 39.6.30.48.39.30

The italian approach to the rational use of energy: the role of ENEA, MARTINI M.

An overview of energy issues and options, MALLONE M.

Energy efficiency technologies and experiences in industrial plant, DI BARTOLOMEO M., PALAZZI G.

ENEA activities and experience in the diffusion of energy efficiency, MEBANE W., FUNARO G.

Data analysis, diagnostics, monitoring and control systems to support plant efficiency and rational use of energy in industrial plant, DI BARTOLOMEO M., FEDERICO A.G.

Public intervention in the promotion of energy conservation and in the development of renewable energy resources: the Italian experience, D'ANGELO E., ROMERIO R.

The MePER methodology: methods and instruments for regional energy planning, GIUFFRIDA L.G., CATONI P.G.

Technologies for rational use of energy in the private sector in Italy, MALOSTI D. *et al.*

ETSU: ENERGY TECHNOLOGY SUPPORT UNIT (ETSU)
BRECSU: BUILDING RESEARCH ENERGY CONSERVATION SUPPORT UNIT

ETSU: Harwell, Oxon, United Kingdom
Phone: 44.1235.43.34.59 / Fax: 44.1235.43.31.31

BRECSU: Garston, Watford, United Kingdom
Phone: 44.923.66.42.58 / Fax: 44.923.66.47.87

Best Practice Publications

- 131 case studies
- 121 guides
- 30 leaflets
- 39 R&D reports
- 18 fuel efficiency books

ETSU is also in charge of the edition of "ODA Energy Efficiency" (twice yearly), a newsletter of the British Overseas Development Administration (Fax: 44.1235.43.37.27).

EVA
AUSTRIAN ENERGY AGENCY

Vienna, Austria
Phone: 43.1.586.15.24 / Fax: 43.1.586.94.88

Proceeding of a SAVE / SYNERGY workshop in Bratislava: *energy policy in the European Union,* 1996.

Proceeding of a SAVE workshop: *European workshop on least-cost planning,* 1994.

Proceeding of a SAVE Conference in Prague: *overcomming barriers to energy efficiency,* 1994.

Opportunities to improve energy efficiency in the Czech and Slovac Republics, 1994.

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Strategies for the reduction of CO_2 emissions, 1993.

Technologically oriented measures for the reduction of CO_2, 1993.

Subsidies in Austria for investments aiming at energy efficiency and the use of renewable energies, 1993.

FORBAIRT

Dublin, Ireland
Phone: 353.1.837.0101 / Fax: 353.1.837.2848

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Powerful savings for industry – brochure of the electricity supply board, 1993.

Potential for energy improvements in rotating machinery, 1992.

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IDAE
INSTITUTE FOR DIVERSIFICATION AND ENERGY SAVINGS

Madrid, Spain
Phone: 34.1.556.84.15 / Fax: 34.1.555.13.89
The main publications are in Spanish

European seminar on energy saving and diversification in urban public transport, December 1993.

Efficient energy technologies for the incineration of solid urban waste in mediterranean countries – European seminar, March 1992.

IFE
TECHNICAL ENERGY INSTITUTE

Kjeller, Norway
Phone: 47.63.80.60.00 / Fax: 47.63.81.09.20

Methodology to sustainable knowledge in energy efficiency in Eastern Europe, European conference and exhibition "Energy and environment" in Marseille, 1995.

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Heat pumps R&D programs in Norway, 1989.

Encouraging household energy conservation, 1986.

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The Netherlands Agency for energy and the environment.

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