INOGATE Textbook

REGULATORY IMPLICATIONS OF ENERGY EFFICIENCY POLICIES

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Textbook developed for the INOGATE Programme
"Capacity Building for Sustainable Energy Regulation in Eastern Europe and Central Asia"

by the

Energy Regulators Regional Association (ERRA)

ENERGY REGULATORS
REGIONAL ASSOCIATION

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PROGRAMME
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ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES

PREFACE

Dear Colleagues:

I am honoured to present to you a series of regulatory textbooks prepared by the Energy Regulators Regional Association (ERRA) within the frame of its INOGATE project called "Capacity Building for Sustainable Energy Regulation in Eastern Europe and Central Asia" – funded by the European Commission. The project embraces energy regulators, ministry officials and other relevant energy industry stakeholders from Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan and Ukraine. The key objective of the textbooks is to strengthen the institutional memory of the project by recording the expertise accumulated during the activities of the project. The regulatory experience and knowledge on important topics, while extensively covered in the workshops, also calls for a written approach that provides the ability to analyze the issues in a more complex and in-depth manner.

The textbooks extensively rely on the different project programmes organised on four main themes: (1) ***Renewable Energy Regulation, (2) Regulatory Implication of Energy Efficiency Policies, (3) Vulnerable Customers and Possible Support Schemes, (4) Regulatory Implication of District Heating.*** The aim of the textbooks is to present a good overview of the relevant policies of the European Union (regulation, directives and targets), national action plans, and case studies if available – together with applicable policy instruments. In particular, the text tends to focus on possible regulatory concepts and regulatory tools. The information in the textbooks attempts to present not only the role of the regulators but also the role of utilities in the above four main areas and the benefits of the available policies to consumers and utilities. The publications strive to focus on the possible barriers when implementing these policies in countries with transition economies and on the potentials for removing these barriers. They are based on relevant international and European regulatory good practices while taking into considerations the current state-of-play and the opportunities of the Inogate Partner Countries, and done by coupling these factors with recommendations for good regulatory practices.

I would like to draw your attention to the possible overlapping topics between these four publications. Although, we tried to avoid any possible overlaps, since the issues are so interrelated it is impossible not to cite the same directives, policies, practices and sometimes even to draw the same conclusions. We attempted to cross-reference the textbooks in these overlapping areas but I would like to suggest that you read all four publications in order to have a complete picture.

This particular publication focuses on ***<u>Regulatory Implications of Energy Efficiency Policies</u>***. One of the major challenges (energy) governments and regulatory authorities are facing is to create legal and regulatory framework meeting the challenges of climate change. Beside local environmental clean-up the energy efficiency (EE) measures have major possibility in this field (reducing pollutant emission through less usage of primary energy). All of the potential efforts have implications for the costs, prices and technological development on energy markets and appliances. These developments could shape the future of energy markets and will most probably have lasting impacts on investments, technology choice of distribution/transmission facilities and the way transmission and distribution networks are operated in the electricity, district heating and gas sectors. While energy efficiency and energy savings policies are not within the direct authority of energy regulators but regulators have good reasons to integrate EE issues into the scope of their activities. The proposal for a new Directive on Energy Efficiency in the European Union is to maintain a high level of liberalization, and simultaneously, reinforce a ‘command and control’ strategy for the involvement of utilities into demand side EE improvements.. If the new directive is implemented, national regulators of Member States will have important new responsibilities in the EE area. There are several reasons why this tendency could be followed by the Inogate Partner Countries.

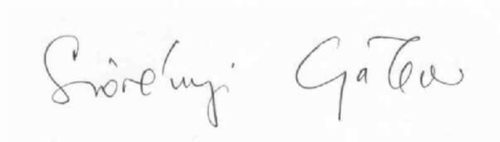
The aim of this publication is to provide a clear view on the complex benefits of energy efficiency measures and the complex picture on the climate change policies and energy efficiency policy instruments (worldwide and special focus on relevant EU policies). The Inogate Partner Countries could find and choose those measures for implementation, which better meet their political goal and national and regional circumstances.

I am personally very proud of these four publications and I am convinced that they will be useful and relevant not only for the purposes of Inogate Partner Countries but for many other regulators and government officials from countries with emerging economies. ERRA will do its best to promote the publications to this audience and present these textbooks to future stakeholders of ERRA.

I am also very pleased with the work of the authors. The list of authors represents internationally acknowledged experts of the specific themes, many of them are practising or former regulators which brings a special value to the textbooks. Most of the authors were involved in all of the meetings, workshops and training courses implemented under the umbrella of the project. Their participation enabled them to learn about the main regulatory features and policies of the Inogate Partner Countries. In addition, I am proud of our expert team verifying the content of these textbooks. ERRA has invited the Hungarian, the Polish, the Romanian and the Turkish regulators to appoint experts in order to make sure that the publications truly represent the current regulatory situation of the listed countries and of Europe in general. In the case of the textbook on District Heating we were fortunate to have the Finish utility, Fortum to evaluate the content. The piece on Vulnerable Customers was read and commented by select staff persons of the Energy Community. I am particularly grateful for the dedication and voluntary work of all these experts.

Finally, I would like to take this opportunity and thank the European Commission for supporting this initiative and contributing to the birth of these basic publications. I look forward to other successful joint initiatives in the future.

Sincerely:



dr. Gábor Szörényi
Chairman
ERRA

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LIST OF ACRONYMS

CHP:	Combined Heat and Power Generation
DH:	District Heating
DRM:	Demand Response Management
DRMPs:	Demand Response Management Programs
DSM:	Demand Side Management
DSO:	Distribution System Operator
ECO:	Energy Company Obligations
EE:	energy efficiency
ESCO:	Energy Service Company
ESD:	Energy Services Directive
ETS:	Emission Trading System
EU:	The European Union
EuPs:	Energy-using Products
FIT:	Feed in Tariff
GDP /Toe:	Tons of oil equivalent
GHG:	Green House Gas
GO:	Governmental Organization
ICER:	International Confederation of Energy Regulators
IEA:	International Energy Agency
IPCC:	Intergovernmental Panel on Climate Change
M&T:	Monitoring and Targeting
MS:	Member State
NGO:	Non-Governmental Organization
NRA:	National Regulatory Authority
REEP:	Renewable Energy and Energy Efficiency Partnership
TGC:	Tradable Green Certificates
TSO:	Transmission System Operator
TWC:	Tradable White Certificate

FOREWORD

Climate change is the greatest challenge Humanity has faced. There is widespread political commitment across the globe for mitigating climate change. One of the most efficient ways to reduce the causes of climate change (i.e. greenhouse gas emissions), is to increase efficiency in energy production, transmission/distribution and consumption. Consistently, more governments are realizing the advantages of energy efficiency (EE) measures. The benefits are: lower energy bills for consumers, lower environmental impacts, a decrease in energy import dependency, and higher economic development.

The European Commission has issued an ambitious new Energy Efficiency Plan. In the course of this effort a proposal for a new Energy Efficiency Directive was published. If it is adopted by EU institutions, it will provide strong guidance and mandate requirements for EU Member States.

Based on an earlier benchmarking analysis of ICER[1], the National Regulatory Authorities for energy (NRA) are largely not responsible for enforcing energy efficiency (EE) measures. This is true for the "INOGATE Partner Countries,"[2] despite the application of some energy efficiency technologies, like combined heat and power production and district heating, which are traditionally established in these countries.

Countries, which have committed government institutions, and involve their energy regulators in energy efficiency policy development and implementation, will be successful in reducing energy demand.. Chapter 3 explains it is the end-users, who deserve special attention, however, their capabilities to act for improving EE is limited. The end-user is essential. The utilities, (suppliers/traders and distribution companies) operating under regulatory control, can reach end-users, thus involving them in EE efforts. With Demand Side Management (DSM) and Demand Response Management (DRM) programs the end-users can take part in active system management, resulting in more efficient system operation and lower energy bills.

The progress with developing and implementing EE programs is different in the INOGATE Partner Countries. Huge energy saving potential exists in most countries, especially in the building sector. Despite this potential, the legal background and regulatory tools for improving EE are not deployed. No doubt, policy makers of these countries need information on the international practice of regulatory implications of energy efficiency policies, with a special focus on the practice of countries in the European Union and of the EU itself. This textbook provides the necessary information to begin the educational process, and demonstrates the significant energy and cost savings for governments, companies and citizens.

[1] ICER: International Confederation of Energy Regulators
[2] See introduction of the INOGATE Program in Chapter 1.

1 INTRODUCTION

The INOGATE Program[3] is an international energy co-operation program between the European Union and the Partner Countries of Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. They have agreed to work together toward achieving the following four major objectives:

1. Converging energy markets on the basis of the principles of the EU internal energy market taking into account the particularities of the involved countries.
2. Enhancing energy security by addressing the issues of energy exports/imports, supply diversification, energy transit and energy demand.
3. Supporting sustainable energy development, including the development of energy efficiency, renewable energy and demand side management.
4. Attracting investment towards energy projects of common and regional interest.

The INOGATE Program, among other initiatives, develops and runs projects, which support energy policy cooperation in the INOGATE partner countries. The projects are funded by the EU. One of the projects is "Capacity Building for Sustainable Energy Regulation in Eastern Europe and Central Asia." This project intends to develop the capacities of energy policy makers and regulators in the field of sustainable energies. The main focus areas are:

- energy efficiency
- renewable energies
- district heating and
- social aspects of energy.

In all of the above areas conferences were held and textbooks were published. The present material is the textbook for the energy efficiency focus area. It is recommended that the readers of this book collect information from the above other areas, too. We refer, among others, to textbooks (6), (7), and (8), given in Chapter "Materials proposed for further reading".

Energy is needed everywhere in our modern civilized life. We rely on energy services, such as heating, lighting, transportation; and require material goods, which contain embodied energy. The energy demand of a society is influenced by the lifestyle of the people and by the energy technologies the society applies. Achieving a high level of energy efficiency is not an easy task. The lifestyles of people have to be changed and more efficient technologies have to be utilized. Energy efficiency is definitely in the interest of all societies; still it is not always understood by the individual members of the societies. The individuals may not be willing to act or make sacrifices for the common societal goal. It is the energy policy makers and regulators of nations, which are mandated to represent the interests of the societies against any particular interests.

This textbook is compiled mainly for the use of energy ministry officials, regulators and other governmental agencies responsible for EE. They take the responsibility to work out and implement EE for their nations.

[3] See www.inogate.org.

Within the given size limitations, this textbook gives in its first part a brief summary of energy efficiency theory, and then reviews the measures and instruments energy authorities can use in order to improve energy efficiency.
The textbook pays special attention in its second part to the practice of the European Union, which gives very high priority to energy efficiency in its energy and environmental policies. The instruments used in the EU to promote energy efficiency can serve as a case study how measures could be implemented in practice.

PART ONE: THE GENERAL CONTEXT FOR ENERGY EFFICIENCY

2 ENERGY EFFICIENCY AND SUSTAINABLE DEVELOPMENT

2.1 The concept of sustainable development

The Earth provides the environment for human existence. We all depend on nature and on the ecosystem for a decent, healthy, and secure life.

Man's impact on ecosystems has grown tremendously in recent decades to meet exponentially growing requirements for resource based services and goods. All these services are provided on the basis of natural resources, like water, energy, biomass, and minerals.

The current pace of development cannot be maintained. It is not sustainable because it damages the natural environment that the Earth's ecosystem survival depends on. The unsustainability of present development is demonstrated by the extinction of species, depletion of natural resources, pollution of the environment and increasing social tensions. The effects of climate change are the most threatening consequence of unsustainable development. This poses a risk to human life on Earth.

Sustainable development is, according to the Brundtland Report[4], development that **meets the needs of the present without compromising the ability of future generations to meet their own needs**. There are other definitions, too, with all of them referring to the need of a sustainable level of development in the world, instead of the present unsustainable one, which is threatening to overshooting, leading to significant changes and the degrading of the Earth's ecosystem.

Sustainable development, as analysed in the literature, requires major change in the relationship between Man and Nature, as well as between Man and Man. Man is responsible for the current tendencies of today; and Man could also change these tendencies.

If the present, unsustainable development continues, it is only a matter of time until a healthy and a secure life is no longer possible for the growing human population. The population and the level of materialistic services will decrease. It is difficult to predict how the reductions will happen and how they will end.

2.2 The precautionary principle

The significant risk of global climate catastrophe is unquestionable; however, science has not clarified completely its content, timing, and occurrence. This is when the precautionary principle has to be applied. Policies have to be introduced, which probably help the mitigation of

[4] The Brundtland Report, officially "Our Common Future" was published in 1987 by the United Nations World Commission on Environment and Development (WCED).

climate change, and are not harmful, even if they are not effective in the control of climate change.

Principle #15 of the Rio Declaration[5] notes:

"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

Unfortunately, there is no effective world governance structure that could lead a concerted effort by nations to stop environmental destruction. Climate mitigation initiatives of individual countries and world organizations, such as the IPCC[6], do help. The question is, whether the present level of action is enough to avoid disastrous climate change.

The strategies of sustainable development are known, such as conservation of energy, material, natural resources; closing material cycles, social equity, etc. Committed action needs to occur strategically, based on the awareness of the consequences. The question is what is necessary to cause proper action by humanity. Are education and smaller signs of unsustainability enough or are global catastrophes required to impose effective measures?

2.3 Energy and sustainable development

2.3.1 Threats to sustainable development

Unsustainable development results in many threats, including:

- deterioration of ecological systems
- depletion and deterioration of natural resources
- overpopulation
- exponentially growing human impact on Earths natural systems
- social inequality
- vulnerable financial markets etc.

The Earth is the source of energy, and the sink of the wastes of energy production. Out of the many threats, energy usage is the one that will have a major impact on the development of the world.

5 The Rio Declaration on Environment and Development, often shortened to Rio Declaration, was a short document produced at the 1992 United Nations "Conference on Environment and Development" (UNCED), informally known as the Earth Summit. The Rio Declaration consisted of 27 principles intended to guide future sustainable development around the world.

6 The Intergovernmental Panel on Climate Change (IPCC, www.ipcc.ch) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC. The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters.

2.3.2 *Supply side: the depletion of fossil energy sources*

More than 80% of the world's primary energy demand is met by fossil fuel sources, and no significant change is expected within the next two decades. Oil is, and will be, according to the so called reference scenarios, the largest fuel in the fossil energy mix. Consumption-based models envisage that oil demand of 85 million barrels per day in 2008 will go up to 105 million barrels per day by 2030.

There is no proof that present levels of oil production can be increased by a quarter within 20 years. On the contrary: independent experts warn that the production of conventional oil, a finite resource, will peak, and subsequently decline. After the peak there will still be plenty of oil available, however, the daily market needs will not be fully met. The exploration of unconventional oil resources such as oil sands will even be more disastrous for the environment.

Peak oil will probably cause a global energy crisis, and trigger some kind of collapse. There is no common understanding on the timing and consequences of the impact from peak oil. However, no serious experts question that it is coming; only the paid optimists believe a transformation of the world to an "after the peak oil" state is possible without major pain.

As the International Energy Agency (IEA, www.iea.org) announced, based on their future energy mix analysis "the golden age of gas" will come in the next decade, because the impact of EE measures and renewable support schemes (together with the necessary network development for embedded generation) cannot be realized soon.

2.3.3 *Emission side: the climate change*

Climate change is 80% caused by the use of fossil fuels. Climate change is here, according to the best scientists of the world who work on mathematical models that predict the evolution and impacts of climate change. If the dynamics of the process is more or less in line with the models, immediate drastic action is necessary. Most climate mitigation plans, such as the Roadmap of the EU, include an 80% cut of GHG (Green House Gas) emissions by 2050.[7]

2.4 Energy efficiency as the most important sustainability strategy

Energy efficiency (EE) is the most important sustainability strategy. From societal perspective it

- reduces GHG emissions, helps mitigate climate change;
- slows down the depletion of conventional energy sources, gives more time to build another energy system;
- slows down the depletion of other natural resources, such as iron and rare metals, which are extensively used in energy infrastructure.

On the local level EE helps increase the social welfare and the competitiveness of the economy through reduced energy bills and creates job opportunities. It is worth to remember that saving a unit of energy through insulation of buildings, optimization or upgrading of end-use energy systems cost less but requires more labour, than producing an additional unit of en-

[7] See: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions „A Roadmap for moving to a competitive low carbon economy in 2050". /*COM/2011/0112*/

ergy. Decreased energy production also leads to reduced environmental impact, with less air pollution and water use.

Many countries in the world, including some INOGATE Partner Countries, are net importers of energy. For them EE reduces import dependency, and helps address winter energy shortages. The countries, which have growing electricity and gas demands, EE offers opportunities to fix system capacity shortages until new generation facilities or import potentials are created or built. EE can even postpone or make unnecessary costly capacity expansions.

From the perspective of the electric and gas systems EE reduces demand in general, and can also shift demand. Lower demand means lower load on the infrastructure, on the generation capacities, the transmission, and distribution networks. Thus, on a growing market, EE can postpone costly infrastructure developments. It is a resource of the energy sectors. Investments into EE, especially into end-use EE, may be more cost-effective than investments into the supply infrastructure.

While the human society as a whole is fundamentally interested in EE, certain influential stakeholders are not interested. Energy is one of the largest businesses in the world, and the short term interest of the profit-oriented private energy industries is to keep energy demand high. It is the responsibility of governments and independent regulators to represent the interests of society against any particular interests and to give incentives for the energy industry to operate in harmony with societal interests.

3 THEORETICAL BASIS OF ENERGY EFFICIENCY

3.1 The concept of the energy chain

We do not need energy itself, but energy services and material goods. Heating, lighting, air conditioning, mobility are classic examples of energy services, as they are done with the help of energy. All production processes require energy, too; therefore, consumption of material goods is consumption of energy. Since the Industrial Revolution the use of fossil fuels has increased to dominate the energy supply, leading to a rapid growth of carbon dioxide emissions.

Energy is made available for the end-user in the form of electricity, fuel (gas, oil, motive fuel, etc.) or another energy carrier (district heating or cooling medium, compressed air, etc.). The concept of the **energy chain** helps to understand the complex systems that provide energy for the end-users. The energy chain includes a number of processes which convert a natural energy resource, step by step, into a final energy service.

The following figure shows a typical energy chain that provides lighting, as an end-use energy service from coal, a natural resource.

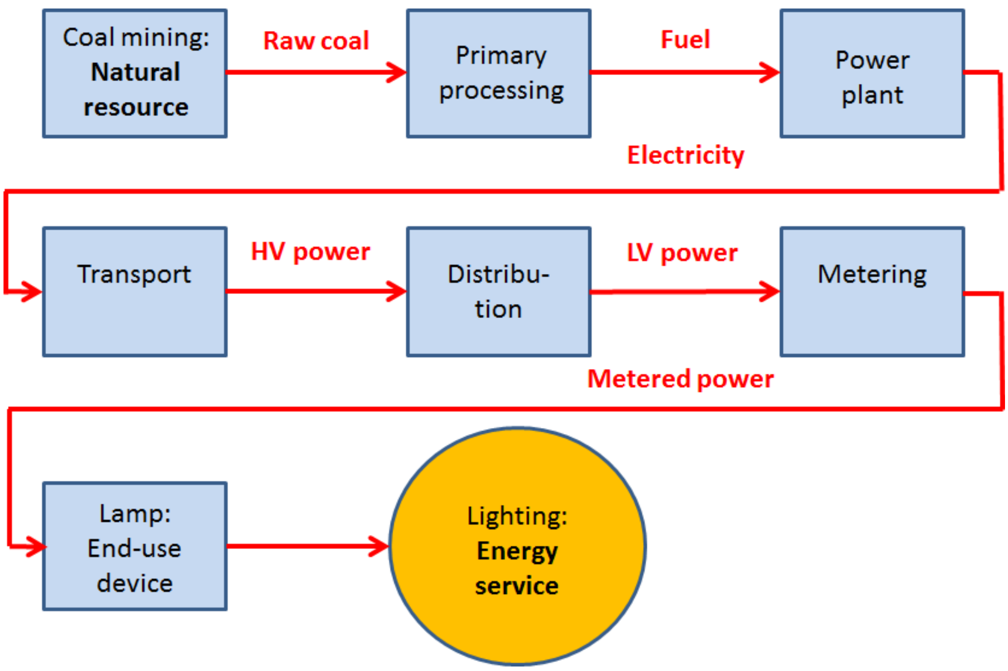


Figure 1. Energy chain

Energy loss occurs in each transformation process or step. The quotient of the net useful energy output of a transformation step and the gross input energy is called the efficiency, or η.

$\eta = E_{out} / E_{in}$

Energy can be understood both as energy in classical term, expressed in MJ or kWh, or in capacity, expressed in MW. The overall efficiency of the chain is the product of the individual transformation efficiencies.

$\eta_{overall} = \eta_1 \, \eta_2 \ldots \, \eta_n$

The input capacity demand of a, or a number of connected transformation units decreases with increasing efficiency.

$E_{in} = E_{out} / \eta$ [MW]

The environmental impact and the use of the natural resources are in correlation with the input energy E_{in}. Resource conservation expectations and the demand for minimizing environmental impacts call for maximizing the overall efficiency of the energy supply chain. It can be achieved by the improvement of any of the transformation steps. A 10% improvement of power plant efficiency, for example and an equal increase in end-use efficiency has the same result on overall efficiency. There is, however, an important difference. If the efficiency is improved at the end-use, the capacity demand in the preceding transformation steps is decreased.

This is an important point for the electricity, gas, and district heating systems, which rely on costly infrastructure, including generation capacities, transmission and distribution networks. The lower the capacity demand of the end-users is, the lower the capacity of the infrastructure can be. Lower capacity infrastructure means lower capital costs and reduced losses in absolute terms. It explains why the improvement of end-use energy efficiency has an outstanding role in EE policies.

Energy efficiency measures are often cost effective and sometimes cost money. Measures implemented at the end-use, may have, however, negative costs on the system level, what is caused by the decrease of capacity demand upstream of the intervention.

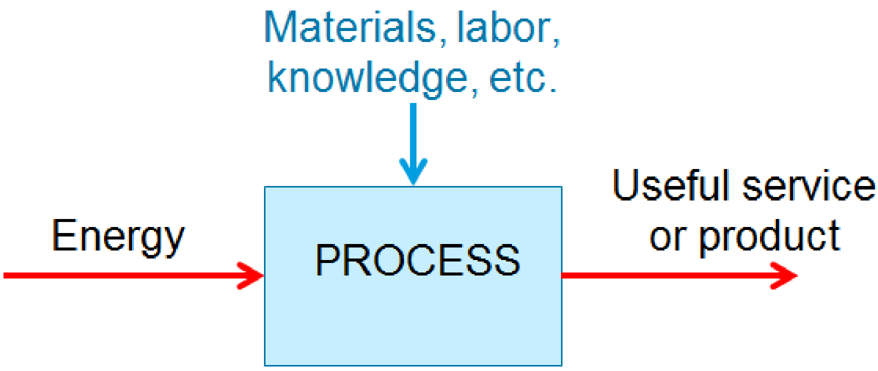
The main challenge of effective EE strategies and implementing measures is to create incentives for both end-user and energy infrastructure side.

EE in the electric, gas, and district heating systems reduces resource use and peak demand. **Demand response strategies,** explained in Paragraph 0 of this textbook, largely reduces only the peak demand.

3.2 Definitions and indicators of energy efficiency

3.2.1 Technical definition of energy efficiency

Physical, chemical, biological, production, etc. processes are associated with the transformation of energy. In order to maintain a process, energy is required.



The useful service produced by a unit of energy input determines the efficiency of the process. The more service we get, the higher the efficiency is.

Energy efficiency is relatively simple to define for technical processes. For "pure" energy transformation processes, for example, it is the quotient of the output and input energies. Power plants use indicators expressed in $kWh_{electricity\ produced}/GJ_{fuel\ input}$ or $kWh_{electricity\ produced}/ton_{fuel\ input}$. The energy efficiency of buildings can be expressed in $MJ_{annual\ heating\ demand}/m^2$. Of course, this indicator should be calculated under standard conditions. The energy efficiency of vehicles is expressed with the mileage, which shows how many km can be driven with one litre of fuel. All the industrial processes have their energy efficiency indicators, such as $ton_{product}/MWh_{electricity}$ or $m^3{}_{gas}$. Biomass fuel production is evaluated on the basis of the so called "fossil ratio" which tells us, how much fossil energy use is required to get a unit of renewable fuel. Biomass based motive fuels are sometimes criticized for having high fossil fuel ratios, while wood chip for power plant use has a fairly low fossil content and is therefore a more energy efficient transformation.

3.2.2 *Financial definition of energy efficiency*

In order to provide a more global overview over a complex of processes, energy efficiency can be defined in financial terms, as well. Statistics keep track of the GDP/Toe (tons of oil equivalent) indicator of nations, which expresses how much $ or € of GDP is produced[8] using a unit of primary energy. Similar indicators are used for industrial companies, which compare production value with the energy purchase.

3.2.3 *Societal definition of energy efficiency*

Human societies, from local communities to nations, seek happiness; a decent, healthy, and secure life. Some require more, others require less non-renewable energy to achieve it. Societal energy efficiency means **to get along with less traditional energy**.

Therefore energy efficiency in the societal definition requires

- rationalizing demand for energy services (behavioural and lifestyle changes),
- deployment of energy efficiency technologies, and
- replacing conventional energies with renewables.

3.3 Energy efficiency measures

Energy efficiency measures are interventions which translate into energy savings. The scope of measures includes:

a) behavioural changes resulting in reduced demand for energy services or material goods;
b) more efficient operation of (existing) energy systems or equipment;
c) upgrading (existing) infrastructure for better energy efficiency;
d) replacing, upgrading or retrofitting equipment or technology for better energy efficiency.

Type a) measures include lifestyle changes with lower mobility, less material consumption, more modest housing, etc. If lower demand for materialistic services goes together with higher respect for other values, low energy lifestyles may be liveable and enjoyable. Strictly speaking a behavioural change is not an energy efficiency measure as it does not generate the same output for less energy, but reduces the desired energy output.

The consumer society, with all its communication power, suggests that the material and energy intensive lifestyles are superior, so behavioural changes need strong incentives to occur. Behavioural changes can be encouraged through greater awareness. If energy consumers understand the relationship between energy/material use and environmental problems, they may behave differently. Some behavioural changes such as turning down the lights, when they are not necessary, need no sacrifice. Other changes may go together with smaller or bigger sacrifices. Good education, awareness campaigns, and the actions of environmental groups may help induce behavioural changes.

[8] We have to be careful with this ratio, if the value of our products on the market is low (because of different reasons, like advertisement, quality, beauty … the indicator could be misleading).

There are many examples of rational **type b) measures**, which result in improved EE without any or significant investment. Overheating of buildings or idling of industrial equipment can be avoided, for example, by better controls. Rational scheduling of work, sound management of energy demand, energy-aware dispatching of vehicle fleets are additional examples of this type of measure. Big industrial companies with complex energy systems can profit from the introduction of so called energy management systems, such as monitoring and targeting (M&T).

The basic principle behind energy management systems is to follow energy use, and give feedback to the consumer, which can influence it. If the consumer is informed about the desirable energy consumption, has the possibility to intervene, and is motivated, the chances of success are good. Annual reading of electricity or gas meters, for example, is surely not a good way to provide feedback to the customers. Frequent readings are better; however, the best solution is the use of smart metering systems, which can facilitate prompt and intelligent information for the customer about energy use and potential savings.

The method called monitoring and targeting (M&T) relies on the use of a mathematical model which predicts the "target" energy use on the basis of several influencing variables. Energy consumption of complex systems depends on a number of such variables, for example, the level of production, weather conditions, quality of feedstock material, mode of operation, etc. If the model gives the precise target energy consumption figures, and if the operators have chance to evaluate and intervene, energy saving may occur without major investments into the energy infrastructure.

Type c) and d) measures involve investment type interventions. A simple intervention is the replacement of an incandescent bulb for a compact fluorescent lamp or replacement of a conventional gas boiler for a condensing one. More complicated (i.e. time and money) interventions are the energy upgrades of buildings with thermal insulation and replacement of windows, the retrofits of energy supply networks, or the efficiency upgrades of public lighting systems. The investment type measures are implemented, at least theoretically, if they are technically feasible and economically rational.

Some end users have no expertise to prepare detailed cost-benefit analyses on EE measures. So the EE campaigns and some financial support schemes can convince consumers to act.

There is a special strategy that can improve the EE of electricity networks, this is **distributed generation**. In conventional electricity systems the electricity is generated in big central power plants. The power generated by several hundred or thousand MW capacity plants is transported to the regions with demand, and then distributed. Prior to transportation the electricity is transformed up to a high voltage level, then, prior to distribution it is transformed down to medium and low voltage levels. Each transformation, transportation, and distribution operation is accompanied by losses. The losses can be reduced if small, decentralized power generation units are involved in the system, close to the consumption.

Decentralized generators, usually connected to the distribution network, typically apply combined heat and power generation (CHP) or some kind of renewable technology. The capacity of such CHP and renewable plants spreads from a couple of kWs (micro generation) to a couple of **ten MWs** (industrial or municipal generation). Units with higher capacity, such as big wind farms and large hydro plants, are connected to the transmission networks.

Decentralized generators may reduce transmission and distribution energy losses. However, the positive effects of lower technical losses could be reduced by the higher unit cost of distributed generators compared to the large units.

It may be a challenge for the operators of transmission and distribution systems to integrate decentralized generators. The electricity networks were designed for uni-directional flow of energy from central plants to small end-users. Appearance of different capacity, unreliable generators in various points of the networks can cause voltage level instabilities and system regulation challenges. Maintaining high quality of energy supply may require costly interventions in the networks, which imposes an additional burden on the ratepayers. There is much to do for the distribution system operators (DSOs) and the regulators to develop the optimum practice of integrating small generators into electricity networks.

More or less the same is true for the gas systems, when they are expected to receive gas from decentralized biogas plants. Injection of green methane into gas distribution networks may cause fluctuations in the composition and pressure of the supplied gas. This technical challenge should be solved.

District heating (DH) networks are also designed, generally, for transporting centrally produced heat to a multiplicity of end-users. There is a growing demand, however, that the DH systems should receive energy from distributed generators, such as CHP plants or waste heat producers. Depending on the capacity, temperature level, production schedule, and other characteristics of the distributed generators, engineering solutions are available for integration. Heating the return line fluid, formulation of separated islands within big systems, injecting the decentrally produced heat into the main heat sources, are examples. Some solutions may have, however, prohibitively high costs. It is up to the operators of the DH systems and their regulators to determine which distributed generators can be integrated into the DH systems.

There are many mature efficiency technologies which are not widespread. Chapter 3.7 will analyse the reasons for inadequate market penetration.

Investment measures represent technological solutions. Politicians and technology-oriented stakeholders tend to claim that when it comes to EE or climate change, the answer is technology.

Is it? The roadmap to climate mitigation involves an 80% cut of carbon emissions by 2050 in the EU. It is easy to prove that with a slightly growing world population and GDP, technology alone will not be able to offset the impacts of growing energy demand. The proper handling of the climate issue requires the adoption of other strategies as well, like at the global level fighting overpopulation, lifestyle changes, or, in general, giving priority to "development" instead of "growth".

3.4 Methods to evaluate the behaviour of market players in different market structures and operational models

Energy efficiency requires that "things should be done in a different way." In market economies, the players (participants) are not directly influenced in their decisions. The scope of players in this regard includes individuals, as well, as organizations, companies, municipalities, etc. The 'rational market player' is a well-informed social planner guided by the criterion of economic efficiency. A player implements an energy efficiency measure if the benefits exceed the costs. He or she uses financial indicators to see if an energy efficiency measure is rational. The player may, for example, calculate a payback time, which is

PBT = investment cost / annual energy cost savings.

If the PBT is below a certain level, which is determined by the financial environment, the intervention is worth to implement.

Larger interventions of market players, such as investment type EE measures (introduced in Chapter 3.3) are evaluated by more sophisticated methods. For example, the net present value method calculates the net (discounted present) values of costs and revenues, and qualifies the intervention cost effectiveness, if the net revenues exceed the net costs. In more complicated cases dynamic financial models are applied, which can take into account all known influencing factors. The typical inputs into these models are

- scenarios for energy prices, interest rates, and inflation rates;
- investment costs of the EE measure (in time);
- energy savings;
- financial costs;
- changes in operational and maintenance costs.

Theoretically, an energy efficiency measure gets implemented, if the measure is technically feasible (proven technology is available) and economically rational. However, the real market players' decisions are influenced by a number of other factors, as well. Social expectations, trends, behaviour of others, and the notion about the future are examples of influencing factors. The behaviour of the market players is influenced by the structure and operational model of the energy sectors, too.

There is evidence suggesting that the market players' actual investment in EE is less than it would be if it were acting in a rational economical manner. This phenomenon is called the 'efficiency gap' and is caused by market barriers, which are analysed in Chapter 3.7. **Incentives** are applied to overcome the market barriers. There are two categories of incentives. The first category incentives discourage energy use or wasting, while the second category ones encourage EE actions. The incentives are also **called support schemes**, and are referred to as **policy instruments**, when applied by policy making bodies, government organisations (GOs). Other actors, such as non-governmental organisations (NGOs) can work out incentives, too. Environmental groups, industry associations are examples.

In developed market economies an abundance of technologies, products, and services are available for the market players from efficient appliances to assistance from professional service providers, called energy service companies (ESCOs).

In less developed, transient market economies access to EE products and services may be limited. If improvement of EE is high on the agenda of the society, the role of more direct actions by energy authorities is important.

A critical issue is the behaviour of the end-users. They are on the demand side of the meter, and the utility programs targeted at them are called **demand side management (DSM) programs**.

In the market structure (operational model) with vertical integration, which still exists in some cases, a uni-dimensional product, called retail electric service is provided by the utilities for the customers. The price of this product is regulated either by state agencies (in the centrally controlled economies) or by independent regulatory authorities (in market economies). In this scheme it is relatively easy to organize ratepayer-funded utility energy efficiency programs. The utilities, in order to meet government or regulator expectations, develop DSM programs, which are then implemented by them, and the costs are accounted in the rate-making process. The final customers either 'let the utilities do the job', or use the opportunities, which are offered by the programs. They, for example, let the utilities replace the inefficient bulbs; or purchase energy efficient refrigerators, and ask for a rebate from the utilities.

Some decades ago the **deregulation** of the electricity and gas markets began, and **unbundling** of generation, transmission, distribution and supply/trade started.

In most of transient economies, including most of the INOGATE partner countries, the opening of the electricity market began by allowing private investment into generation. While competition was created on the generation side, the transmission and distribution remained in the hands of state-controlled transmission system operators (TSOs) and DSOs, which are monopolies in the case of developed countries as well. In such cases the state can rule the distribution companies to implement obligatory DSM programs, and the state can determine the contents of the programs.

In fully liberalized and unbundled energy markets, it is more difficult to implement obligatory DSM programs. DSM can be performed by the players, who are in contact with the final customers; the retail suppliers or the distribution system operators (DSOs). The retail suppliers are in competition with each other, and offer DSM for their customers only, if it produces some kind of benefits for them. The DSOs are under strict regulatory control and involvement of DSM costs in the ratemaking process usually requires sophisticated methods. Some of the INOGATE partner countries have advanced in the deregulation of their energy sectors and apply market tools in introducing DSM.

The EU has recognized that in spite of the mentioned difficulties, the utilities' role in improving end-user EE remains important on the liberalized energy markets, too. This is reflected by the proposal for new EE Directive, which is in the approval process[9].

3.5 The rebound effect

The EU has recognized that in spite of the mentioned difficulties, the utilities' role in improving end-user EE remains important on the liberalized energy markets too. This is reflected by the proposal for a new EE Directive, which is in the approval process[10].

The so called "rebound effect" may offset the beneficial effect of EE measures. Historical experience suggests that societies which had the possibility to deploy advanced EE technologies, could not achieve significant energy savings. On the contrary: energy efficiency went together with growing energy demands. The phenomenon was scientifically analysed, and today there is significant scientific literature on the rebound effect. The most essential observation is that if the end-users apply EE measures, they save money which is then spent on additional energy services or material consumption. The owners of efficient cars, for example, drive more, or the residents of insulated homes keep rooms at a higher temperature.

[9] See chapter 10
[10] See chapter 10

The rebound effect warns us that the application of energy efficiency technologies alone will not properly improve the EE on the societal level. The education of the end-users and development of their awareness is equally important.

3.6 The role of energy authorities and energy regulators

As it was introduced in the previous chapters, improvement of EE is vital for the sustainable development of the human society. EE measures have to be implemented by members of society, including individuals, communities, industries, etc. The major part of the measures requires investment. In market economies **energy cost savings motivates market players to invest into EE**. Environmental considerations could also motivate action for EE; however, the environmental awareness of the players is typically poor. It is disappointing, but true; environmental considerations hardly play a role in influencing people to take EE measures (only among very limited group of end users). If the major motivating force remains cost saving, a perfect market with true energy prices could do at least a large portion of the job. Unfortunately, the market is not perfect and the energies are not properly priced in most cases (especially regarding costs of externalities).

Let us see the price issue first. In usual cases the prices are determined on the basis of direct production costs for the supplier, or in case of market conditions, the demand-supply balance determined commodity prices. Material (commodity), labour, capital and operation costs fall into this scope and they are called the **internal costs** of energy supply. There are, however, other costs, too, the so called **external costs**. The supplier is not directly faced with this type of costs. The external costs of energy supply occur because of the environmental and health effects of energy production, or because access to energy requires the use of power or extra expenses in maintaining the foreign trade balance of the country. See more about external costs in Peter Kederják's paper (4).

If the external costs are not internalized, as is the case in general, it does not send the right signal to the market players. Subsequently, investment into EE will be lower than optimal levels.

We have to note that in many countries energy prices are influenced by social policy (mainly in the case of domestic/household supply). Based on the principle that energy should be available to everyone as a basic commodity, energy is under-priced, and even the internal costs are not accounted for fully involved. Prices are kept low by subsidies from other taxes or through cross-financing by other market participants. Subsidized energy prices do not motivate market players to invest in EE measures.

Improper pricing of energy resources is one of the reasons why the market, without policy measures, cannot do the "job" alone. The market players always optimize their action among given conditions. In case these conditions do not give them incentives, they will focus on prompt maximization among the required service quality requirements. It would not be fair to expect that private energy companies (instead of governments, tax payers and end users) sacrifice their profit for political/social/climate change goals. The big energy corporations have the tendency to focus on short term maximization of profits. They have to produce dividends for their shareholders each year; and only the most farsighted companies are prepared to sacrifice short term profits for longer term issues. Beside this general attitude there are, still, some energy companies which are taking care of the future expectation and climate change goals as well.

As energy resources are often under-priced, the market does not take into account longer term issues, and only a smaller amount of EE investments seems rational by market players on the so called the micro economic level. And even this lower potential is not utilized. It has been observed that investment into EE is lower than it would be rational for the market players themselves. There is a gap, called the efficiency gap between the 'rational level' and the 'real investment level' for EE. Advanced societies apply policy measures to overcome the presented market imperfections. The policy measures represent an intervention into the market in the interest of society. This textbook intends to address the issue of efficiency gap by analysing the causes of the gap and introducing strategies which help reduce it. See Chapter 3.7.

As it was introduced in Chapter 3.1, improving EE in any parts of the energy supply chain is useful but EE measures at the end-use is of greatest importance. The end-users, who are the customers of the energy utilities, are, however, not well-prepared for action. They need help. The utilities, which are both technically and financially well prepared, and are in close contact with the customers, are in the best position to help.

If we accept that spending investment money on EE measures, which would not be implemented otherwise by the end-users themselves, is worthwhile, the question is

- how much money should be spent
- who should spend the money
- on what interventions and
- who should finance the EE expenditures.

It is the responsibility of governments to answer these questions when they design the national EE programs. The basic principle is that the benefits shall exceed the costs; and if money is allocated for EE programs, it shall be spent on the highest possible efficiency. If public money is involved, the spending shall be transparent and the programs shall be monitored for achieving specified goals.

Below this chapter addresses the **role of regulators**. The regulators operate as independent authorities, and have good reasons to integrate EE issues into the scope of their activities.

In market economies it is the end-users who (ought to) implement most of the demand side EE measures. The source of money for EE measures initiated on the societal level can be:

a) taxpayers' money or
b) ratepayers' money.

If it is taxpayers' money, the regulators have only a minor role. They may, for example, offer expert help in designing the government initiated programs, or assist in program evaluation. In some cases the energy regulators also have a role in the administration or oversight of the programs.

The role of the regulator is essential if ratepayers' money is involved. As presented in later chapters, several kinds of EE programs, on both sides of the meter, are financed from the small fees on the bills of ratepayers. The regulators have to control the spending in order that ratepayers' money is most effectively utilized. Much of the regulators' role depends on the structure of the energy sector and the status of liberalization. At this point, we have to note that regulators' responsibility is targeted at the monopolistic activities of the electric, gas, and district heating companies. The more advanced market liberalization is, the smaller the scope of monopolistic activities will be.

With vertically integrated utilities, all activities, including generation, transmission or distribution and supply, fall under the control of the regulators. They can develop, prescribe, or simply allow EE measures at any elements of the supply chain. When a measure is allowed by the regulator, it means that the costs of it can be approved in the ratemaking process and, ultimately, the ratepayers will cover the costs.

Liberalization of the energy sectors usually starts with opening the market for competing generators. Generators, not part of vertically integrated utilities, are excluded from direct control of regulators, who in this case, have no role in improving generation efficiency.

In the most advanced stage of market liberalization the scope of monopolistic activities covers only

- transmission and distribution, as technical monopolies, and
- tariff setting for domestic (household) customers (vulnerable customers only).

As the liberalization progresses on a market, the role of the regulators gets more insignificant, regarding end-user tariff setting, but remains regarding network and system charges.

According to a comprehensive study of ICER (2) "Competencies of Energy Regulators in terms of energy efficiency vary from country to country and States or Provinces in federal countries such as the US and Canada. Many regulators seem to have at least some competencies, especially with regards to end-use measures, roll out of smart meters, setting demand-side management and administration of energy efficiency programs, although their elaboration of such programs and of underpinning energy efficiency legislation usually rests with governments. Most European Energy Regulators don't have any competences on main energy efficiency matters; these rest mainly with the government and ad hoc governmental agencies. Some Energy Regulators play a role in the management of market-based schemes (white certificates schemes and tenders) and/or roll-out of smart meters. In all European countries transmission and distribution tariffs, set or approved by Energy Regulators, are cost reflective and therefore don't include any incentives to increase the volume of transported energy. Some Energy Regulators regulate energy bills and therefore require that bills contain all the elements necessary to ensure that the customer has a complete and clear understanding of the bill. Moreover, in some cases they participate to information dissemination activities to raise public awareness on energy-saving practices."

The European situation can change with recent developments in European energy policy. The proposal for a new Directive on EE, introduced in Chapter 10, is to maintain a high level of liberalization, and simultaneously, reinforce a 'command and control' strategy for the involvement of utilities into demand side EE improvements which are already covered by Directive 2006/32/EC. If the new directive is implemented, national regulators of Member States will have important new responsibilities in the EE area.

EE can result in more cost effective generation, transmission and distribution, which ultimately, decreases the rates. When a regulator permits EE investment on the supply side, he or she has to be sure, that the investment will reduce the cost on ratepayers' bills. This may not be true in the first years, but at least should occur over the long term.

Why do regulators allow or even expect that regulated utilities implement EE measures on the demand side? The answer is simple. An electric, gas, or district heating system with efficient end-users can more easily comply with the expectation of 'reliability and affordability'. Lower energy demand can postpone or make unnecessary costly supply side capacity expansion and it can reduce transmission and distribution losses. EE can help balance the systems with lower reserve capacity, and avoid costly interventions in critical situations. We can remember, for example, that some countries, exposed to gas supply disturbances in winter, have to use expensive fuel oil instead of cheaper gas. These arguments work mostly with vertically integrated utilities. In case of unbundled energy industry the additional cost and the benefit occurs at different companies. That means, the regulator should find tailor made incentives for the different regulated entities reaching EE goals.

So EE, if properly applied, decreases the cost basis of ratemaking and can contribute to lowering the end-user rates. However, the network charges can increase, because of two reasons:

- additional EE regulated cost on DSO side,
- reduced load reduces the income of DSOs.

The beneficial effects of capacity conservation do not appear on energy markets with negative growth. In many countries the energy markets shrank after the 2008 worldwide financial crisis. Supply capacities have been available in excess. In such situations demand side EE measures cannot be justified with the argument of supply side capacity conservation.

At the conclusion of the chapter about the role of regulators, it has to be noted that the role of the energy authorities and the regulators can be clearly distinguished.

Energy authorities have the responsibility of designing, financing, implementing, overseeing, and monitoring national EE programs. They include the relevant ministry, the energy committee of the parliament, and in some countries the EE or environmental government agencies. They channel taxpayers' money to EE programs and have the responsibility of developing primary legislation. They are responsible also for keeping contacts with stakeholder organizations, such as environmental groups and industry associations. The energy authorities have to take into account issues outside of the energy sector, too, such as climate change, economic development, or national security.

The regulators focus on the regulated players, like transmission system operators, distributors, storage companies, and in some cases regulated utilities. The idea of "utility" and the scope of regulated players vary country by country. The INOGATE partner countries follow different paths in restructuring their energy markets. Some of them maintain an important role for central control and plan to have state ownership on the long run. Others are in various stages of market liberalization. The regulation policies have to be designed according to the individual characteristics of the given market.

We can summarize that the opening of the monopolistic electricity and gas markets has started worldwide, and in most market economies this process is still in progress. The aim is the creation of effective energy markets, which provide secure, cost-effective energy to the end-users. **With the liberalization of the energy markets, regulation has been limited mainly to monopolistic activities, like transmission and distribution.** In this situation, the possibility of enforcing EE policies by means of regulation has become narrower, but is still very important. Examples are the supervision of compulsory take-over, implementation of feed-in-tariffs, white certificates, access to the grid by renewable generators, etc. Later chapters will present more details on these issues.

3.7 Barriers to efficiency measures

Historical experience supports that the market players' investment into EE is lower than it would be in the players' own interest. This 'efficiency gap' is caused by the so called 'market barriers'. It is of great importance to identify and tackle the market barriers, because they prevent socially desirable levels of investment in EE.

The market barriers to EE can be more easily understood on the basis of the market players' interests, possibilities, constraints, and behaviour. The following barriers can be identified in developed market economies:

- Financial barrier: However attractive an EE measure may look like, the player will not be able to implement it, if he or she cannot finance the investment. The financing barrier, sometimes called the liquidity constraint, refers to restrictions on own capital availability or borrowed money.
- Risks of action: Even if the market player has access to capital, he or she may be worried about potential risks. If the measure is not based on proven and demonstrated technology, the player will opt for being cautious.
- Lack of information: The market player may be simply unaware of the possible energy efficiency measures. He or she may not find energy efficiency an important issue at all.
- Lack of managerial capacity: The market player may not be prepared to manage complicated energy efficiency interventions.
- Social environment: In addition to rational factors, the behaviour of the market player is influenced by the social environment, too. The majority of people prefer to behave according to trends, which he or she believes to be widely accepted. The social environment affects the player psychologically.
- Misplaced, or split incentives: In specific cases the benefits of energy conservation are not enjoyed by the player who made the conservation efforts. The term 'misplaced incentive' is used to describe certain classes of relationships, primarily in the real estate industry between landlords and tenants. When the tenant pays for the energy bills, it is in the landlord's interest to provide least-first-cost equipment rather than more efficient equipment for a given level of desired service. There is little or no incentive for the landlord to increase his or her own expense to acquire efficient equipment (e.g., refrigerators, heaters, and light bulbs) because the landlord does not bear the burden of the operating costs and will not reap the benefits of reducing those costs.

On the less developed markets of the transient economies additional barriers are present:

⇒ Under-pricing of energies: Subsidized energy prices do not encourage investment into EE, because with low prices the savings will be low, too.

⇒ Flat energy fees: In some transient economies, the practice of flat energy fees is still present. It means, that certain energy services, such as the heating, or cooking gas supply are made available at a constant monthly fee. The fee is not related to real consumption; this way there is no incentive for the customer to save on energy.

⇒ Improper ratio of fixed and variable energy charges: Energy suppliers may apply two-element tariffs, including fixed and variable charges. The revenues from collecting the two kinds of charges are supposed to cover all the costs of the suppliers. In other terms the overall costs of the suppliers are split to fix and variable costs, which appear in the fix and variable charges. Usual EE measures can only influence the variable charges. If the fixed charges are too high, the customer's interest to improve EE is low. It is important to see that the suppliers' interest is to increase fix charges.

⇒ Limited access to EE technology: In some transient economies access to most advanced EE technologies may be limited or prohibitively expensive. This is explained by the small size of the efficiency technologies in these countries.

⇒ Low awareness about the importance of EE: With all the difficulties of the transition, people in the transition economies may have lower awareness about environmental issues, including the issue of EE.

⇒ Short term planning: The transition, taking place in many former centrally controlled economies, includes drastic social, political, and economic changes. Not enough stability is present in such societies. Amidst all the changes the market players are faced with, they may not be able to accurately plan over the long term, while EE measures would require long term planning.

4 ENERGY EFFICIENCY SUPPORT MEASURES

4.1 Introductory remarks

Energy authorities of the world have shown great creativity in developing support measures for EE. Today, a large number of energy policy instruments are in use. The policy instruments always have to be designed with regards to the modes of governance and the culture in each country, as well as the business models in the energy sector (electricity, gas, district heating, etc.). Different instruments should be selected for highly developed market economies, liberalized energy markets and for emerging economies with transitional energy markets.

The following chapters introduce several widely applied policy instruments for EE. The instruments are categorized for better understanding. A more detailed introduction of the policy instruments can be found in the literature, such as in (2) and (3).

The incentives are always designed on the principle that "energy consumption shall be made expensive, and efficiency improvement shall be made cheap and trendy." It means that a part of the incentives is to discourage or prohibit wasteful energy usage, while most of them, called support schemes, motivate energy conservation.

Each instrument

- has a **target group**;
- has a **goal**;
- is **established by some kind of legislation**;
- is **funded** somehow;
- is **administered and managed** by someone; and
- is **monitored and evaluated**.

The efficiency of the policy instruments is usually judged on the basis of energy (or CO_2 emission) savings compared to the amount of public money (taxpayers' or ratepayers' money) spent.

4.2 Legal and regulatory instruments

Legal and regulatory instruments are based on the power of legislation. They apply the 'command and control' strategy. A command is issued for a scope of market players (utilities, end-users, manufacturers of appliances, etc.), and then the execution is controlled by an authority (typically the regulator or some government agency).

4.2.1 Instruments applied in the regulation of vertically integrated utilities, DSM and DR programs

The energy supply chain is split between supply side and demand side at the location of the meter. Originally, the vertically integrated utilities on the demand side were expected to satisfy any demands on one side of the meter. The utilities got prepared to comply with the highest demand of their customers, called peak demand, and the regulators approved the related costs.

Later it was recognized that the modification of consumer demand through financial incentives and education is cheaper than optimizing the supply side for peak demands. The modification **smoothed the load curve and reduced peak demand capacity** without influencing energy consumption. This strategy was named demand side management (DSM) or energy demand management. **The most well-known tools in DSM were time-of-use and interruptible tariffs.**

DSM with the main purpose of reducing peak demand may be called **"first generation DSM"**.

First generation DSM was based on the understanding that on growing electricity and gas markets energy conservation measures on the demand side can postpone or eliminate expensive developments on the supply side. Vertically integrated utilities run EE programs on the demand side to avoid supply side investments; but their efforts reduced energy consumption, too. The regulators approved the relevant costs when evidence was presented that the demand side EE interventions cost less than the investments would cost on the supply side.

The governing principle was to avoid supply side investments, and the "by-product" was energy conservation. The experience gained with classical DSM programs is utilized today to run **"second generation" DSM** programs with the main aim of **energy conservation**. These programs, called Energy Company Obligations or ECOs may also be able to reduce peak demand, however, the focus is on energy saving.

The ECOs work on the principle of 'command and control', determine obligations for the utilities to implement EE measures on the demand side. The "utility" is the player, which is in direct contact with the final customer. **In liberalized markets it is the DSO or the retail supplier. It can operate in regulated price regime without unbundling.** The scope of eligible measures is specified by the relevant legislation. It may be necessary for the utilities to get their projects qualified prior to implementation by the regulator. Following execution of the projects, verification and certification comes. The regulator checks if the related costs can be accounted in the **ratemaking process**. The utilities may also receive white certificates (WCs), which, in some countries can be traded. Some ECO schemes allow independent third parties to take part in the production of WCs. In WC schemes the utilities are obliged to procure a given number of WCs. The amount of WCs is usually determined proportionally to their energy sales. The ECO scheme is always backed by penalties; if the obligated parties fail to meet targets, they have to pay. Eoin Lees' presentation at the INOGATE Workshop "Regulatory Implications of Energy Efficiency Policies" gives an excellent summary of European ECO programs, see "Materials proposed for further reading" (3). He claims that ECO programs can be more cost-effective, save energy and/or reduce emissions more than other measures.

The Compendium of Best Practices of the Renewable Energy and Energy Efficiency Partnership (REEP) introduces similar efforts of states in the US, called Energy Efficiency Resource Standards (1).

In addition to ECOs there are other tools, too, applied in regulation of the utilities for EE. The following ones shall be listed here:

- Giving priority to generators of renewable and cogenerated power in the electricity networks.
- Roll-out of smart meters.
- Regulation of billing. Utilities can include more information than just energy consumption and the price for the billed period. Information can be given for consumption for the same period in the previous year, or the average consumption of a group of similar end-users.

After first and second generation DSM programs, today the Demand Response Management Programs (DRMPs) are seen as the proper tools to harmonize end-user demands with cost-effective generation possibilities. In DRMPs the end-users have an active role in balancing the system. DRM is an important element of the "smart grid" concept, which comprises many other elements, including intelligently controlled distributed generators.

The main driving force behind the first generation DSM programs and DRM programs is not EE, but the intention to operate the electricity networks cost-effectively. Still, these programs also have energy conservation effects. Reducing the peak demand means the need for switching on high marginal cost generation capacities (with high energy consumption) is decreased. On a liberalized energy market with unbundled players, DSM and DRM are more difficult to apply as the costs and benefits appear for different users.

4.2.2 Instruments targeted at the end-users

End-user targeted policy instruments help or force the end-users to use energy efficient appliances, buildings or products. Two strategies are applied:

- <u>Setting minimum efficiency standards.</u>

  Products with low efficiencies may not be produced or sold. This strategy is used in several countries of the world for certain electric devices and household boilers. For buildings, EE Codes are issued, which give the method of determining EE and sets minimum requirements.

- <u>Providing information for the consumers at the "sales point" about the EE of the products.</u>

  This is achieved by energy labelling. The scope of label information and the format of the label are specified by the legislation. Labels can only be introduced on big markets.

The European regulations on end-use efficiency are summarized by Luc Werring's presentation at the ERRA/INOGATE Workshop on "Regulatory Implications of EE Policies" (5) and will be extensively addressed in part two of this document.

The regulators do not have much competence in developing or overseeing policy instruments of the above categories.

4.3 Financial instruments

Rational EE measures are not implemented most often for financial problems. The market players do not have the capital to invest in EE or do not find the investments attractive enough. This is what the financial policy instruments tackle.

Lack of capital can be addressed by investment subsidies and soft loans. Both instruments improve the attractiveness of the investments.

Investment subsidy programs or grants reimburse a part of the investment cost or make EE equipment available at lower (subsidized) price.

The Member States of the EU apply sophisticated investment subsidy programs. The programs are designed by government institutions on the basis of national energy policy goals. The market players can access the subsidies through application. Strict rules are applied in the application processes to guarantee that the EE funds, the source of which is, ultimately, public money, are used transparently. The main rules are set by the EU, and the programs are closely monitored to verify the results.

Subsidy programs are very popular, what is partly explained by the notion of the market players that "the state should contribute to EE efforts."

The administration and management of investment subsidy programs is typically the responsibility of government agencies in Europe. In other parts of the world subsidy programs are mostly run by the utilities and overseen by the regulators. The reason is that these programs are financed by the ratepayers through small fees added to their bills, while the European programs get financing from the so called structural funds, which are set up using tax money.

Soft loan programs can address the liquidity constraint of the market players, and, at the same time, make EE investment more attractive. They spread out the costs over a period of time, and represent a better alternative to private lending agreements, as they offer lower interest rates and more favourable terms. Soft loans programs can be managed as revolving funds. As payments from borrowers are returned to the capital pool, the money can be lent to other borrowers again.

Governments may provide **tax incentives** to encourage investment in EE or development of EE services / technologies. The eligible enterprises, performing eligible activities may enjoy tax deduction (a portion of EE coupled costs are subtracted from the taxpayer's gross income), or tax credit (the costs are subtracted from the taxes owed).

Tax incentives may include the application of extra taxes or levies associated with energy use or emissions. Energy taxation is a proven strategy to internalize the external costs of energy use. For the market players energy taxes make energy consumption more expensive, what creates an incentive for them to improve EE. Péter Kaderják's presentation on the Minsk INOGATE Training gives an overview on the application of environmental policy tools in the energy sector (5).

4.4 Market type instruments

Improvement of EE is in the interest of the society and some EE measures are paid using public funds (from taxpayers or ratepayers). EE measures are "bought" by society, and it is of utmost importance to efficiently spend the money allocated for EE. This is why a market based approach is used, as the market is believed to allocate resources efficiently.

One of the most well-known market instruments for EE is the system of **Tradable White Certificates**. In this scheme selected market players, the energy utilities are obliged

a) either to execute EE measures, or
b) pay other players, who implement EE measures.

The performance of the players is expressed by White Certificates, which refer to the saved energy (GJs or kWhs) or avoided GHG emissions (tons of CO_2), reached as result of the measures.

If the White Certificates can be traded, we come to the Tradable White Certificates (TWC).

Fundamental elements of a TWC program are the following:

- Clear specification of the eligible measures.
- Clear specification of the methods, based on which the savings are calculated.
- Specification of the preliminary approval process: who is authorized to approve measures/projects and on what rules?
- Specification of the process to verify the achievements: who has the authority to perform verification and on what rules?
- The rules of issuing and accounting TWCs.
- Keeping record of the progress of the obliged players in producing/procuring TWCs.
- Penalties for non-performing players.

The TWC schemes are quite similar to the Tradable Green Certificate schemes applied in some EU Member States and some states of the US. Both tradable certificate schemes are based on the assumption that the EE or RE measures will be implemented by the most competitive players, who can generate energy savings at the lowest cost level. This way the money allocated by the society for EE is spent the most efficiently. We refer to further details presented by Eoin Lees (3).

The **emission quota trading** system applies the "cap and trade" principle. A cap (emission limit) is determined for a scope of market players. The emission allowances or quotas, the obligated participants have, can be traded. The emitters who would like to produce more energy need to buy quotas from participants who need fewer quotas. The latter can earn revenue by selling part of their quotas. The logical way of creating sellable quotas (not taking into account downscaling of business) is to improve EE. This is how the emission quota trading promotes EE activities. The quota owners would like to get the most income from their quota selling transactions, what gives them the incentive to apply the most cost-effective measures (see chapter 6.2 for more details on the EU Emission Trading System). Similar schemes, called Energy Efficiency Portfolio Standards, are in use by some US states.

Another typical market instrument is **tendering for EE**. Governments (if taxpayers' money is involved) or utilities (if ratepayers' money is involved) call for tenders to implement EE measures/projects. Usually

- the scope of eligible measures,
- the process of qualifying projects,

- the method of verification,
- the available budget, and
- the payment conditions

are specified in the call for tenders.

The participating parties, the so called tenderers, have freedom in designing the projects. As the tenders establish competition, it can be expected that the most cost-effective measures get implemented.

Finally, the **Energy Service Company** (ESCO) approach has to be mentioned as a market-type strategy for improving EE. The ESCOs offer complex services for energy consumers, from reviewing energy consumption (energy audit) to implementing EE measures and monitoring savings. The ESCOs can tackle a number of market barriers, such as the lack of information and managerial capacities, along with liquidity constraints. The ESCOs can be very effective with schools, hospitals, universities and other end-users, who do not have in-house energy expertise. The European Union has recognized the importance of the ESCOs and has committed itself to assist the development of the ESCO market. The assistance expands from capacity building to tax credits.

In some countries the ESCO market is developing below expectations, and it is, at least partly, explained by the bad reputation of some ESCOs. These ESCOs have not treated their partners fairly, and made extra profits by cheating them. When news spread about such cases, trust in the ESCO approach was questioned.

The EU intends to address this problem by working out sample contracts and introducing the qualification of the ESCOs.

4.5 Obligation to inform energy end-users

An end-user will take action for EE if he or she

- is motivated;
- has information (feedback) on his or her energy consumption and energy costs;
- has information about the possibilities to improve EE; and finally
- is not limited in action.

Motivation is provided by the end-user's intention to save on energy costs. The motivation works well if the energy price system sends proper signals to the end-users.

Feedback about energy consumption is to be provided by energy bills. It is a basic requirement that the bills should be based on metering and frequent readings of the meters. Flat fee energy supply contracts (see Paragraph 3.7) or real estate agreements with lump-sum energy services do not give feedback. Bills based on annual readings of the meters provide only poor feedback. The most advanced solution for giving sensitive and intelligent feedback for the end-users is smart metering. Smart meters can give real-time information for the end-user about his or her energy consumption and comparison is possible with consumptions of similar category end-users, or of similar periods of former years. Traditional energy bills can also help, if their content is well designed. This is what the regulators can do; prescribe the scope of billing information for the utilities, so that the consumers receive more information than the value of the monthly consumption.

Providing information about possibilities to improve EE is of fundamental importance, as most of the end-users are laymen, who lack expertise in energy matters. The right approach is to translate complicated technical information to simple messages, what the end-user can understand; and to involve experts, who can help the end-users.

An example for the simplification of information is **labelling of appliances**. The EE label put on electric and gas appliances gives information for the end-users about the energy efficiency of the appliances in a very simple form. The buyer of the appliance does not have to deal with the technical issues of appliance EE. See more about the European labelling systems in Part two.

End-users with more complicated facilities or systems can evaluate the energy efficiency of their facilities or systems with the help of **energy audits**. Energy audits are systematic reviews of the facilities, equipment, or systems in order to

- quantify energy consumptions and costs;
- determine factors, which influence energy consumption; and
- identify possibilities for improving EE.

The output of an energy audit is a report, which summarizes the findings of the experts and presents proposals. The proposals cover

a) behavioural changes, which reduce energy consumption by more energy-ware operation of the energy systems;
b) retrofit projects, which upgrade the facilities or equipment by the help of minor spending; and
c) investment type projects.

Government institutions responsible for energy may apply a variety of tools to encourage energy audits, such as

- building the capacities of energy audit experts / organizations;
- providing information about professionals who can offer energy audits (energy expert database);
- making audits obligatory for a selected scope of end-users;
- providing financial and methodological assistance for energy audits; and
- prescription of obligatory audits as eligibility criterion for getting investment support.

Summary of a successful audit program, the UNDP/GEF Full-sized Project “Hungary: Public Sector Energy Efficiency Program” is to be found in the Annex.

Energy utilities are also running end-user targeted EE information programs. They can do that either on their own interest (to postpone, for example, generation side investments), or in the framework of energy company obligation programs.

The governments or mandated organizations may organize complex information programs, too, which address a wider scope of end-users or measures. As an example, the Efficient Lighting Initiative of the Global Environmental Facility is introduced in the Annex.

4.6 Voluntary agreements

Market players or groups of market players can volunteer in implementing EE programs beyond their short term economic interests and beyond their obligations.

If they decide so, they can enter into voluntary agreements with their governments.

The market players, which show up as parties to voluntary EE agreements are typically industrial associations, representing companies of a specific industrial sector.

There are a number of reasons why the industrial companies make sacrifices to enhance EE:

→ They may have energy price scenarios, which makes EE cost-effective on the long term.
→ EE can help in meeting environmental targets.
→ EE can improve the image of "dirty" industries (steel, cement, brick, etc.), resulting in improved social acceptance.

Governments acknowledge the beneficial effects of the EE programs of industries and are ready to provide assistance, including positive communication about the involved industries, tax reliefs, help in designing and monitoring the programs, and even making grants or subsidies available.

A voluntary agreement defines the parties, determines the targets to be achieved, specifies the method of monitoring and evaluation, and sets the scope of assistance the government is obliged to provide.

The voluntary agreements work well only in politically and economically stable countries where industries are well organized and have the possibility to plan over the long term.

4.7 District heating

DH is not an efficiency technology in itself. The transmission and distribution of heat goes with unavoidable losses, and these losses are higher than the ones coupled to gas or electricity distribution.

The reason why DH is discussed in an EE textbook is that DH can provide the possibility of **efficient heat generation**. Another textbook of the INOGATE Program "Regulatory Implications of District Heating" elaborates on DH-related issues. Here we only refer to the efficient heat producing technologies, which can cooperate well with DH:

- fossil based combined heat and power production (cogeneration or CHP);
- biomass based heat production;
- biomass based cogeneration;
- waste incineration with heat recovery;
- geothermal heat production;
- large scale heat pumps.

DH can offer load shifting for cogeneration plants. Most cogeneration plants can be operated by different electricity-to-heat ratios. For example the ones, which apply back pressure steam cycles, can change the back pressure. With higher back pressures the heat production increases while the electricity generation decreases.

The driver for load shifting is to maximize revenues from power generation by shifting high electricity-to-heat operational periods to the peak hours of the electricity markets. Shifting is only possible if the DH network in itself, or through the installation of heat storage facilities, is able to store heat.

DH can only be recognized as an EE technology if it is operated efficiently. The major criteria for efficient operation are as follows:

- low distribution losses achieved by efficient thermal insulation of the pipelines;
- low forward and return temperatures to make cogeneration efficient;

– metering and controllability at the end-users, so that they consume only the amount of heat they really need; and finally
– heat pricing that incentivizes end-users to save energy.

See more about DH issues in (6).

4.8 Combined heat and power production incentives

The combined generation of heat and power is considered to be an EE technology. Combined generation results in fuel savings, as compared with separate generation of heat and power. This is true in most cases, however, with the advent of high efficiency heat (condensing gas boilers >100%) and power generation technologies (combined cycle gas turbine plants, CCGTs close to 60%) a more sensitive analysis is required.

No doubt, high efficiency CHP is better than usual heat and power generation. CHP is always better if biomass or other lower quality fuels are used. CHP is the right technology if large heat markets, such as district heating systems are serviced.

CHP is characterized by relatively high investment costs and the constraint that the production of heat and power must happen simultaneously. The heat-to-power ratio can be changed with most of the CHP technologies, but only within limits. It is impossible to operate a CHP plant according to both a heat and a power schedule. A further constraint with CHP is that the CHP plant has to be located close to the heat consumer(s). The unit capacity is limited according to the heat demand.

In spite of all these constraints, CHP is still the good choice in many cases. The EU, in its proposal for new EE Directive (which is in the proposal stage now), assigns a very important role to CHP. The profitability of CHP investment projects is evaluated by financial models. The inputs to the models are:

- production data (annual, monthly, weekly productions of electricity and heat, broken down to tariff zone periods);
- fuel consumption data;
- prices of fuel, electricity (in different tariff zones), and heat;
- capacity charges/fees for fuel, electricity, and heat;
- scenarios for inflation, price escalations, and exchange rates;
- investment and CAPEX costs (in time);
- maintenance and operation costs, including labour costs;
- costs of financing (equity-to-debt ratio, debt terms - loan period, grace period, interest rates, bank fees, ADSCR requirement, etc).

The outputs include:

- quarterly cash flows;
- debt service ability;
- dividends;
- profitability indicators (IRR, ROE, etc.).

4.9 Regulatory issues of CHP

Licensing and monitoring combined heat and power production on the regulated market raises a number of sensitive issues.

Regulation of the market is a policy instrument to help meeting energy policy goals. Each nation needs a national energy policy plan, and action plans for renewable energy supply and energy efficiency, including cogeneration. These plans specify the volume of cogenerated power to be produced in the planning period (called the target value). The energy policy plans are worked out by government institutions involved in energy; and it is the responsibility of these government units to apply policy instruments to implement the plans. With respect to CHP, in addition to the regulation of the electricity market, other instruments can be applied, such as investment subsidies, tax reliefs or subsidizing the production of the cogenerated heat.

The policy instruments are established by legislation. In connection with CHP the legislation has to regulate the following main points:

- Which market tools are to be used, the FIT (Feed in Tariff) system or the tradable certificate system for supporting CHP? The latter may include "green" or "cogeneration" certificates.
- What are the eligibility criteria for producers on the regulated market?
- Who are the eligible project owners/licensees? Possibilities: private companies, joint ventures, municipal companies, etc. Possible exclusions: private persons, companies with low capitalization, companies with former violations of energy legislation.
- What technical specifications apply for the eligible CHP plants in terms of
    - scope of technologies, such as steam cycle, gas engines, gas turbines, Organic Rankine Cycle, etc.
    - electric capacity minimum and maximum,
    - minimum electric efficiency in condensing operational mode (power generation only),
    - possible parameters of produced heat,
    - minimum overall efficiency,
    - technical requirements for grid connection.
- What are the criteria of eligible operation? Possibilities:
    - heat production shall serve socially useful purpose,
    - electricity shall be generated on schedule (in this case the rules of schedule making shall be specified),
    - electricity generation shall be subject to control of TSO (CHP plant may be interrupted or turned down),
    - overall efficiency shall be above a threshold level on annual and weekly basis.
- What rules apply for verification?

The regulator's responsibility is to **issue licenses** according to the legislation and **verify if the CHP plants comply with technical criteria of eligibility and are operated according to the license**.

Verification of power generation is not difficult. The generated power is exported to the public grid where the related technical and accounting procedures are well established. At the same time, the **verification of heat production** is a really sensitive issue both in technical terms and in terms of "social usefulness".

The technical verification of heat export of CHP plants can be solved by the application of credible meters and, if necessary, involvement of independent experts. The basic condition for the verification of social usefulness is the availability of proper definition in the legislation. In order to verify social usefulness, the regulator has to have the right to see the heat supply contracts. The regulator has to be convinced that the contracts are real, and the heat export happens according to the contracts. The regulators may apply their own proven methods, such as the involvement of independent experts, information exchange with other authorities, getting legally binding statements of the participants, etc., to be sure that the heat supply transactions serve real social demands.

Another sensitive issue is the **duration of the subsidized period in case of FIT**. The length of this period and the feed in tariff determine the economic attractiveness of the CHP business. Policy makers have to use an attractive FIT system as an instrument to achieve the policy goal (enhancing cogeneration). If the attractiveness is too good, too many investors may appear on the market and the cogeneration target can be overshot. The cogeneration support schemes usually provide preferential tariffs or tradable certificates until the end of the payback period of the investment. If the investment is paid back, the subsidizing is discontinued to avoid the generation of extra profits from public money. Gas based cogeneration (CHP) plants are faced with two categories of production costs:

a) operational costs (fuel, maintenance, labor, etc.) and

b) financial costs (debt service, return on equity, etc.).

Preferential tariffs, it is assumed, are needed only in the debt repayment period. After that the cost of production decreases (as costs of debt service do not occur), this way the CHP plants may work with lower (market) tariffs as well.

The situation is different with biomass CHP plants. Most of them cannot recover the operational cost, if they sell the generated electricity at a free market price level. If the continued operation of such plants is in the interest of the society, so called “brown” tariffs may be applied, which are lower than the green tariffs, but high enough to keep these plants running after the payback period.

In addition to economic attractiveness, a number of other factors influence the overall attractiveness of the CHP market. We can mention here the general investment environment of the given country, the political stability, the long term energy strategy issues, and the stability of the support schemes for the payback periods of investments. Licensing is definitely one of the matters that influences investor decisions. If licensing it too complicated, too bureaucratic, takes a long time, or licenses can be withdrawn or amended in the license period, investors will consider the high risks. CHP plants, as all power generation facilities, need a number of different licenses (permits), including construction, environmental, grid connection, fire protection, etc. licenses. According to a European study, the number of licenses for medium size CHP plants may reach 20 or even 30. The reason may be that the individual authorities do not harmonize their activities. It is better to nominate a lead authority, which is in contact with the investor, and harmonizes the activities of all the other authorities (one-stop-shop).

It is always a challenge to determine the proper tariff level for CHP. Benchmarking is difficult, because the electricity-to-heat ratio and the value of heat may vary project by project. Cost allocation between electricity and heat production may be problematic. The value of cogenerated heat may depend not only on the physical heat content of the produced heat carrier, but also on the temperature of it. The EU has defined the concept of “high efficiency cogeneration” and requires that the regulatory systems of the member states provide preferential schemes only for projects, which comply with the related specifications (see chapter 8).

4.10 Renewable power generation incentives

The generation of renewable power is encouraged by most of the governments by either Feed-in-Tariffs (FIT) or Tradable Green Certificates (TGC). Both schemes provide extra revenue for the generators of green power. The related extra costs are, ultimately, covered by the electricity end-users.

Proper actors of the sector (such as the transmission system operators, wholesalers or retail suppliers) are obliged

a) to take over at a regulated price all the green power generated in their service territory (in the FIT system); or

b) procure a prescribed amount of green certificates (in the system of tradable green certificates).

In addition to the above schemes the renewable power generators enjoy, in many countries, investment subsidies and tax credits, too. They also have priority access to the public grid.

The issues related to renewable energies, are discussed by another textbook of the INOGATE Program titled "Renewable Energy Regulation". http://www.erranet.org/Library/Search

4.11 Other and complex programs

Complex EE programs can be organized by governments, local authorities, international organizations, local or international non-governmental organizations, or stakeholder groups. There is a variety of possible goals, such as promoting climate mitigation, helping market penetration of selected technologies, or "greening" cities. Complex programs typically include awareness development and demonstration.

4.12 Leading by example: the role of the public sector

The scope of public sector activities comprises maintenance of buildings/facilities, operation of vehicle fleets, and provision of energy-intensive services. The state, regional, and local governments can play an exemplary role by running EE programs within the scope of their own activities. Both technologies and business approaches (like ESCOs) can be demonstrated.

Public sector EE efforts can be easy to design and implement because the relevant decision making bodies can directly command their own sub organizations. The public sector programs can positively motivate the end-users and the players of the private sector. The key issue is financing. The decision makers have to be sure the money spent is effectively spent on EE. Transparency and effective monitoring is a must with public sector programs.

PART TWO: ENERGY EFFICIENCY IN THE ENERGY POLICY OF THE EU

5 BACKGROUND

5.1 Global context of EU energy policy

As explained in the previous chapters the reason for worldwide promotion of energy efficiency is that it is the answer to two big global challenges:

- The difficulty to supply the world with enough energy[11]
- Climate change

Conventional oil supplies are currently reaching their peak and only by mobilising unconventional oil (e.g. shale oil), future global growing demand van be fulfilled. After the 2011 Japanese earthquake and the following nuclear disaster, further growth in nuclear energy is doubtful. Gas, including unconventional gas, will take over a part of the oil function and the share of renewables will also grow, but not enough to supply the world when energy efficiency is not deployed sufficiently. As an example for the great impact of energy efficiency on demand it can be demonstrated that if the EU had not decoupled the growth of energy consumption from the growth of the economy in the seventies, then it would consume now around 60% more energy.

Climate change, is long term, and posses an even greater problem, more so than failures in securing energy supply security. It will be a serious threat to the life and welfare of billions of people. It is clear that the earth's climate is changing. It is almost sure that disturbing the balance of greenhouse gases in the atmosphere by human activities is one of the main causes. It seems that the overall effect of climate change could make the planet a very unpleasant place to live. The EU wants to play a leading role in mitigation of global climate change. Common efforts are needed and energy efficiency is a no regret policy to combat climate change.

Energy efficiency is very often cost effective which in theory would mean that market forces would stimulate and create it. However, the invisible hand of the market is not working sufficiently in this area because of several market imperfections. Therefore it is the task and duty of governments to intervene and to lay down measures that repair these market imperfections.

5.2 EU legislative process and policy tools

Energy efficiency is a main policy of the EU as will be described hereunder. In order to understand the instruments that the EU could use to realize this policy it is useful to recap some of the basics about the functioning of the EU processes.

[11] Although fuel producing countries may like the idea of increasing fuel demand and therefore may have the tendency to be less interested in global energy efficiency, it is at least a good policy for themselves to reduce domestic energy use because this would leave more fuel available for export.

The EU (Brussels) is a complex of institutions which work together in a delicate balance of power.

The most important are:

- **European Council**[12] (heads of state or government) that meets 4 times a year to set political directions and priorities.
- **Council of the EU** (different settings of national ministers) to adopt legislative acts, in most cases together with EP
- **European Commission** (27 appointed Commissioners + EU's civil service) to propose legislation, to manage the money, safeguard Treaty and implement legal acts
- **European Parliament** (736 elected members +staff) to adopt legislative acts and budgetary provisions)
- **Court of Justice**[13] (27 judges +staff) to rule on cases related to EU law such as not correctly applying EU law

In short, the procedure to produce European legislation is that the Commission makes a proposal that is discussed and often amended by the appropriate Council of ministers (for instance the ministers of energy) and the European Parliament. When these two bodies come to an agreement the proposal is adopted and becomes EU law. This EU law very often has the format of a **Directive** addressed to the Member States that have a certain time to implement this Directive in their national law. The European Commission has the task to control if this implementation is done correctly. In case of failure of a Member State to implement a Directive, an infringement procedure is started which finally will be brought to the Court of Justice in Luxembourg.

Most of the legal instruments to realize energy policy in the EU are such Directives. In some cases another legal instrument is used which is called a **Regulation**. The decision making process of a Regulation is the same as for a Directive, but the difference is that a Regulation does not need to be transposed in national legislation as it is directly applicable in the format as it has been adopted.

5.3 The EU definition of energy efficiency

Energy efficiency in the strict sense means using less energy input for an equivalent level of economic activity.

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[12] Not to confuse with the **Council of Europe** which is an international organization in Strasbourg promoting co-operation between all countries of Europe in the areas of legal standards, human rights and democratic development and has nothing to do with the EU. The Council of Europe was founded in 1949, has 47 member states with some 800 million citizens, and unlike the EU, it cannot make binding laws

[13] Not to confuse with the **European Court of Human Rights** which is an international court set up in 1959. It rules on violations of the civil and political rights set out in the European Convention on Human Rights which is an international treaty of the Council of Europe.

As described in chapter 3, Energy efficiency is often measured by improvement of energy intensity (the amount of energy needed to produce a certain amount of product or per unit GDP). However there are autonomous developments that lead to less energy intensity like economic development, structural changes in the economy that make it difficult to use this indicator to measure progress or to set overall political targets. Therefore targets are more often expressed in energy savings.

Energy savings is an absolute decrease of the energy used and could be realized by energy efficiency but also by other events like declining economic activity and behavioural changes. Political targets in the EU are expressed as energy savings, but the clear aim is to reach these targets mainly by mobilizing the untapped potential of cost effective energy efficiency.

The main difficulty for an energy savings target is to define the baseline (business as usual) from which these savings are being calculated. It is possible that an energy savings target that was intended to be ambitious enough to realize a structural change in energy consumption, now appears to be rather easy because of an economical decline.

6 ENERGY EFFICIENCY POLICY

6.1 The EU climate and energy package of 2008

The EU wants to play a leading role in combating the climate change and at the same time is subject to a growing dependency on imports of fossil fuels. Moreover the EU wants to develop its global competiveness**.** This has led to the proposal of the EU climate and energy package including the so-called 20-20-20 targets.

The 20-20-20 targets were adopted in 2008, reconfirmed in later European Council meetings and implemented by legal acts proposed by the Commission and adopted by European parliament and Council of ministers. These targets imply:

- reducing greenhouse gas emissions by 20% compared to 1990 levels (binding target)
- increasing the share of renewables in final energy consumption to 20% (binding target)
- moving towards a 20% increase in energy efficiency (non-binding target) in national legislation

It is fair to say that the climate change may be the biggest global challenge but the security of supply appeared to be at least as important as a driver for EU targets in these fields.

6.2 Current legislation related to the 20-20-20 targets

The three targets are clearly interconnected. Achieving 20% less greenhouse gases implies a fuel switch to low carbon fuels like renewables and application of energy efficiency. If the overall consumption is reduced by energy efficiency then it is easier to achieve a 20% share of renewables in final consumption. Still the main operational legal policy instruments that were used until now to realize the 20-20-20 targets can easily be assigned to one of the three policy aims:

For the 20% reduction of greenhouse gases (GHG) (and indirectly the achievement of 20% renewables and 20% energy efficiency):

- Directive 2003/87/EC lastly amended by Directive 2009/29/EC on the European Emission Trading System (applicable for ETS sector)
- Decision 406/2009/EC on the effort sharing of Member States to reduce greenhouse gas emissions in the non-ETS sector.

For the achievement of 20% renewables (and indirectly the reduction of GHG):

- Directive 2009/28/EC on the promotion of the use of energy from renewable sources (replacing 2001/77/EC and 2003/30/EC)

For the achievement of 20% increase in energy efficiency (and indirectly the reduction of GHG):

Energy supply efficiency:

- Directive 2004/8/ EC on cogeneration including later decisions on reference values and methodology

Energy end use efficiency:

- Directive 2010/30/EU on labelling of energy related products
- Regulation 1222/2009 on labelling of tyres
- Regulation (EC) No 2422/2001 on a Community energy-efficiency labelling programme for office equipment (energy star)
- Directive 2009/125/EU on eco design of energy related products
- Directive 2002/91/EC on the energy performance of buildings to be repealed on 9 .2.2013 by its recast Directive:
- Directive 2010/31/EU on energy performance of buildings
- Directive 2006/32/EU on energy end use efficiency and energy services

The two instruments for achieving the 20% reduction in GHG emissions by 2020 cover in principle all emissions of the EU divided in two sectors: the ETS sector and the non-ETS sector.

The EU emission trading system (ETS) is a market based policy tool to reduce the emissions of greenhouse gases (GHG) and includes around 10,000 installations (about 45% of all GHG emissions in the EU) that have to render emission allowances for every ton of CO_2 and two other greenhouse gases that they emit. The total amount of allowances in the system is limited and will gradually be reduced. Allowances can be traded, so those emitters with insufficient allowances will have to buy them from those that are willing to sell their spare emission allowances. This generates a market price for the allowances and should motivate companies to reduce emissions by efficiency measures and low carbon production methods in the sector. Theoretically the market forces will take care of the reduction in the ETS sector as the price of an allowance will go up when emissions approach the ceiling as set in the Directive. However, in the latest energy efficiency action plan published in 2011 the Commission seems to be unsure to rely only on the ETS as it considers from 2013 binding efficiency targets and mandatory application of BAT for authorization of new permits and permit updates for installations that fall under the ETS sector.

For all GHG emissions that are **not** covered by the ETS system (e.g. small combustion, land and sea transport, agriculture) every Member state was given a separate target in the effort share Decision. These targets vary from a reduction of 20% compared to the emissions in 2005 to an allowed small increase in case of countries that still have to build up their industry, but the total reduction in this sector for all Member States together is 10% compared to 2005.

As stated before, energy efficiency is the main contributor to reducing GHG and the legislation that will be discussed hereunder contributes to the achievement of the GHG reduction target in the ETS sector (e.g. deployment of CHP, reducing use of electricity) and/or in the non ETS sector (e.g. energy performance of buildings, better boilers, better tyres).

The target on renewable energy has no direct influence on energy efficiency policy but it has the same impact: using less fossil fuels, therefore results in less emissions and less dependency on imports (renewable energy policy will be addressed in the following chapter). Furthermore cogeneration will be discussed separately as the main current policy on supply efficiency and finally the list of Directives and regulations that address energy end use efficiency. The last chapter is on the recent proposal of the Commission for an overall Directive on energy efficiency.

7 RENEWABLE ENERGY POLICY

7.1 Introduction

Renewable sources of energy – wind power, solar power (thermal, photovoltaic and concentrated), hydro-electric power, tidal power, geothermal energy and biomass – are essential alternatives to fossil fuels. Their use reduces our greenhouse gas emissions, diversifies our energy supply and reduces our dependence on volatile fossil fuel markets (in particular oil and gas). The growth of renewable energy sources also stimulates employment, the creation of new technologies and improves the trade balance. Renewable energy industries have great potential for creating jobs for equipment manufacturers, installers, technicians, builders and engineers. The industry currently employs, in the EU, over 1.5 million people and by 2020 could employ nearly 3 million more, according to recent studies.

In the EU the development of renewable energy has been an active policy since the mid-nineties but only in the last decade concrete legal instruments were developed to support policy implementation.

In 1997, the European Commission proposed that the EU should aim to reach a 12% share of renewable energy by 2010. The first two Directives were adopted for the electricity sector in 2001 and on transport (biofuels) in 2003. In these two areas the EU established **indicative, non-binding targets for 2010 for two sectors**: **electricity adding up to 21% electricity from renewable sources and a share of 5.75% in transport fuels**.

In the electricity sector, only seven out of 27 Member States have met these 2010 targets. In the transport sector, nine have met the 5.75% targets. The EU as a whole reached just over

18% for the share of renewable energy in the electricity in 2010 rather than the target of 21%. For transport, the EU reached 5.1% instead of 5.75%.

Therefore, in 2009 the Community agreed to a more ambitious renewable Directive that includes electricity, transport and heat with compulsory national targets for 2020. The result is a **legally binding overall target of 20% for renewable energy**. In doing so, the EU has provided the business community with the long term stability it needs to make rational investment decisions in the renewable energy sector. This enables the EU to develop a cleaner, more secure and more competitive energy system.

7.2 The new Directive on renewable energy

In the EU the Renewable Energy Directive adopted in 2009 sets **binding targets** for renewable energy. The new law focuses on achieving a **20% share of renewable** energy in the **overall energy mix by 2020**. Every Member State has to reach individual targets for the overall share of renewable energy in energy consumption. In addition, in the transport sector, all Member States have to reach the same target, a 10% share of renewable energy.

While Member States failed to reach their indicative 2010 targets for the share of renewable energy in the electricity and transport sectors, the new renewable energy Directive ensures that Member States take remedial action: Member States **National Renewable Energy Action Plans** are required to contain all the measures effectively designed to achieve the trajectory contained in the Directive. In following these trajectories, the failure to meet the 2010 targets will not hinder Member States from reaching their (legally binding) 2020 targets.

According to their national plans submitted in 2010, the **Member States will all meet their 2020 targets:**

Renewable energy %*			
	2005	**2009 (prov.)**	**2020 target**
Austria	23,3	29.2	34
Belgium	2,2	3.8	13
Bulgaria	9,4	11.5	16
Cyprus	2,9	3.8	13
Czech Rep	6,1	8.5	13
Denmark	17	19.7	30
Estonia	18	22.7	25
Finland	28,5	29.8	38
France	10,3	12.4	23
Germany	5,8	9.7	18
Greece	6,9	7.9	18
Hungary	4,3	9.5	13
Ireland	3,1	5.1	16
Italy	5,2	7.8	17
Latvia	32,6	36.8	40
Lithuania	15	16.9	23
Luxembourg	0,9	2.8	11
Malta	0	0.7	10

Netherlands	2,4	4.2	14
Poland	7,2	9.4	15
Portugal	20,5	25.7	31
Romania	17,8	21.6	24
Slovak Rep	6,7	10	14
Slovenia	16	17.5	25
Spain	8,7	13	20
Sweden	39,8	50.2	49
UK	1,3	2.9	15
EU27	**8,5**	**11.6**	**20**

**As a share of gross final energy consumption Source: Eurostat (with normalized hydro) & (for 2009) EurObserv'er 2009(www.eurobserv-er.org)*

In addition to the legislative targets as outlined above the new Directive contains the following important provisions:

Cooperation between Member States

Member States can "exchange" an amount of energy from renewable sources using a statistical transfer, and set up joint projects concerning the production of electricity and heating from renewable sources.

It is also possible to establish cooperation with third countries. The following conditions must be met:

- the electricity must be consumed in the Community;
- the electricity must be produced by a newly constructed installation (after June 2009);
- the quantity of electricity produced and exported must not benefit from any other support.

Guarantee of origin

Each Member State must be able to guarantee the origin of electricity, heating and cooling produced from renewable energy sources. The information contained in these guarantees of origin is normalized and should be recognized in all Member States. It may also be used to provide consumers with information on the composition of the different electricity sources.

Access to and operation of the grids

Member States should build the necessary infrastructures for energy from renewable sources in the transport sector. To this end, they should:

- ensure that operators guarantee the transport and distribution of electricity from renewable sources;
- provide for priority access for this type of energy.

Biofuels

The Directive takes into account energy from biofuels. The use of biofuels should contribute to a reduction of at least 35% of greenhouse gas emissions compared to fossil fuels in order to be taken into account. From 1 January 2017, this condition – as regards emissions savings, should be increased to 50%.

Biofuels are produced using raw materials which come from outside or within the Community. Biofuels should not be produced using raw materials from land with high biodiversity value or with high carbon stock. To benefit from financial support, they must be qualified as "sustainable" in accordance with the criteria of the Directive.

7.3 Additional actions to achieve the 20% renewable target

In addition to these EU regulations, it should be underlined that Member States, regional and local authorities have to make a significant contribution towards increasing the use of renewables. Member States will have to make further use of the range of policy instruments at their disposal, in compliance with the provisions of the EC Treaty.

Member States and/or local and regional authorities are in particular called upon to:

– ensure that authorization procedures are simple, rapid and fair with clear guidelines for authorization including as appropriate, appointing one-stop authorization agencies responsible for coordinating administrative procedures related to renewable energy sources;

– improve pre-planning mechanisms whereby regions and municipalities are required to assign suitable locations for renewable energies;

– integrate renewable energies in regional and local plans.

A wide range of different financial instruments are used in all Member States to help reduce renewable energy costs. These instruments include capital support: grants, loans and loan guarantees, equity funds, and production aid: feed in tariffs, premiums, quota/certificate schemes, fiscal incentives and tenders.

The Commission recommends further reforms of national renewable energy support schemes. Support schemes need to ensure the costs of renewable energy production continue to fall but they also need to provide a stable investment climate, without any retroactive changes to discourage investment.

8 COMBINED HEAT AND POWER GENERATION

8.1 Introduction

Cogeneration (CHP) is a technique to produce electricity and heat in one process. It ensures that electricity can be produced in a process where a very high part of the energy content of a fuel is utilised (high efficiency). When electricity is produced separately, around half of the energy within the fuel is lost. Cogeneration provides a process with two products: electricity and heat - or more specifically electricity and heat at conditions where the heat can be used either for industrial purposes or for heating of buildings. Cogeneration is not a specific technology since a number of different technologies fulfil the criteria of cogeneration. Cogeneration is not linked to one type of fuel - all kind of fuels can be used for cogeneration. However in the context of this chapter, cogeneration is connected to combustion of fossil fuels.

The promotion of cogeneration is part of the strategy for the efficient use of energy and is supplementary to the strategy of increased use of renewables. However, cogeneration is not a target in itself but can be an efficient tool to generate energy savings and to pursue the targets of reductions in CO2 emissions by replacing separate production of heat and electricity.

8.2 The current EU Directive on cogeneration

Already in the cogeneration strategy from 1997 the EU Commission identified the advantages and possibilities of an increased use of cogeneration in the EU. An overall indicative Community target of doubling the share of electricity production from cogeneration in total EU electricity production from 9% in 1994 to 18% by 2010 was put forward. Nevertheless, despite the promising potential for cogeneration, and the addition of new Member States - with high levels of district heating and cogeneration, no significant increase in the share of cogeneration was seen. Cogeneration was furthermore reiterated in several action plans and finally the Commission proposed the Directive on " the promotion of cogeneration based on a useful heat demand in the internal energy market" that was adopted by the Council and the European Parliament as Directive 2004/8/EC.

The three cornerstones of the Directive 2004/8/EC are:

- The relation to the internal energy market notably the electricity market.
- A harmonized definition of high efficiency cogeneration;
- A common understanding of the term "useful heat demand";

Where Directive 2003/54/EC defines the general rules for the internal electricity market, the Cogeneration Directive provides the necessary common concept of electricity from cogeneration, which is necessary because cogeneration is an energy efficient and environmental friendly technique, but not always economically viable and therefore needs to be financially supported in certain circumstances. In those cases where cogeneration is cost effective the market will stimulate it and no additional financial support is needed. However, there are circumstances where cogeneration would save energy, but would not be competitive enough compared to separate production of electricity and heat . When a producer of cogenerated electricity claims a certain amount of support it is important that "high efficiency cogenerated electricity" is clearly defined in order to avoid market distortions by support to cogeneration processes that do not provide for energy savings. Also the so-called “state aid” rules of the EU forbid government financial support to private enterprises when there are market distortions. A common definition of high efficiency cogeneration, in negotiations, was extremely difficult to develop. Reflecting this difficulty is the fact that the Directive contains two paths to qualify a given cogeneration process as high efficiency. It is an assessment of the cogeneration process that leads to the qualification.

The main road to qualification as 'high efficiency' cogeneration goes via a two-step procedure. Step one is to isolate the cogeneration process and identify the amount of electricity and heat coming from the cogeneration process. Step two is to calculate the primary energy savings obtained in comparison with a production of the same amount of heat and electricity in separate productions i.e. heat from a heat-only boiler and electricity from a conventional power-station according to agreed reference values. If the energy savings are above 10% then the cogeneration is qualified as “high efficiency”.

A common understanding of the term “useful heat demand” is linking together the production of heat and electricity, it is important to ensure that the produced electricity and heat meet real demands. The electricity can be transmitted into a market place and sold where it is needed, the heat however cannot easily be transported or stored and therefore the cogeneration process must be based in time and place on a real need for heat. The real need for useful heat is the cornerstone of efficient cogeneration, because if the produced heat is not meeting a real demand the advantages of cogeneration disappear. Furthermore, the promotion of cogeneration should not lead to encouragement of increased heat consumption.

9 END USE EFFICIENCY

9.1 The labelling Directives

The energy demand in households accounts for 25% of the final energy needs in the EU. Electricity used for domestic appliances in households show the sharpest increase. Higher standards of living and comfort, multiple purchases of electric appliances and the growing need for air-conditioning are key reasons for this prevailing trend. Energy consumption by consumer electronics and new media, via the Internet is also steadily growing.

The most common market failure that has to be addressed in order to achieve cost effective energy savings is a lack of information to consumers. To address this, the EU has three groups of labelling Directives:

1. **Directive 2010/30/EU on labelling of energy related products**

Energy labels are adopted by the European Commission on a product by product basis within the framework of the energy labelling Directive 2010/30/EU.
They include the following information:

- ranking of products according to their energy efficiency consumption on an A to G scale, the A class (green) being the most energy efficient appliances and the G class (red) the least. Once the majority of products in a certain category reach class A, up to three classes (A+/A++/A+++) may be added on top of class A (in that case, the colour of class A becomes yellow as green is always the colour of the best class).

- annual energy consumption or energy consumption per cycle
- other information which relates to the use of energy or other resources: e.g. water consumption, volume of the appliance etc.

Energy labels under this Directive are mandatory for all appliances placed on the EU market and must always be clearly displayed on each appliance at the point of sale.

The Directive defines energy-related products as those having an impact on energy consumption during use.

The Directive currently applies to the following types of household appliances, even where these are sold for non-household uses:

- refrigerators, freezers and their combinations;
- washing machines, dryers and their combinations;
- dishwashers;
- ovens;
- water heaters and hot-water storage appliances;
- lighting sources;
- air-conditioning appliances.

Obligations for the supplier:

The supplier must establish technical documentation sufficient to enable the accuracy of the information contained in the label and the fiche to be assessed. This documentation must include:

- a general description of the product;
- the results of design calculations, where necessary;
- test reports;
- where values are derived from those obtained for similar models, the same information for these models.

The supplier shall make this documentation available for inspection purposes for a period ending five years after the last product has been manufactured.

Suppliers must provide:

- a free label, to be attached to the appliance by the dealer in the appropriate position and in the appropriate language version;
- a product fiche, contained in all the brochures relating to the product or, where these are not provided, in all other literature provided with the appliance.

Suppliers are responsible for the accuracy of the information contained in the labels and fiches that they supply and are deemed to have given their consent to the publication of the information.

Member States must take the necessary measures to:

- ensure that all suppliers and dealers established in their territory fulfil their obligations under this Directive;
- prohibit the display of labels, marks, symbols or inscriptions relating to energy consumption which do not comply with the requirements of this Directive and which are likely to cause confusion, with the exception of Community or national environmental labels;
- launch educational and promotional information campaigns aimed at encouraging more responsible use of energy by private consumers.

2. The Regulation 1222/2009 on labelling of tyres

Today's technology makes it possible to significantly reduce the tyre share in vehicle fuel consumption allowing a driver to reduce his/her fuel bill by up to 10% between the best and the worst set of tyres available on the market. However, lack of reliable and comparable information on the performance of tyres makes it currently difficult for consumers to take these elements into account in their purchasing decision, in particular when the time comes to replace a used set of tyres. Therefore there exists a clear market failure arising from the lack of information for end-users on tyre fuel. This is especially true for the replacement market, constituting 78% of market share.

This market failure impacts:

- End-users (consumers, companies or local authorities owning small or larger fleets such as leasing companies, and road transport operators) who do not benefit from the net savings that they could obtain with fuel efficient tyres.
- Tyre producers who have more difficulties in obtaining a return on their investments in R&D (R&D is already instrumental in obtaining market share on the OE market as car producers have the know-how on tyres, but is less rewarding on the replacement market).
- Society as a whole, with potential social benefits exceeding consumer benefits due to transport externalities (reduced greenhouse gases (GHG) emissions, health effect from air pollution caused by vehicles' pollutant emissions (NOx, particulate matter, etc.) and increased security of supply (from increased fuel efficiency).

In order to repair this market failure the EU adopted on 25 November 2009 a Regulation imposing a compulsory labelling scheme for tyres.

By 1 November 2012, the **fuel efficiency, wet grip and external rolling noise performances** of tyres in the in the EU of C1, C2 and C3 tyres (i.e. tyres mainly fitted on passenger cars, light and heavy duty vehicles)will be displayed by means of a label for consumers and fleet managers. These tyre performances will be displayed at the point of sale and on technical promotional literature such as catalogues, leaflets or web marketing. The aim is to promote the market transformation towards more fuel-efficient, safer and low noise tyres beyond the standards already achieved. It will also pave the way for competition to run on tyre performances in addition to prices, which will in turn stimulate investments in Research and Development.

This legislation is expected to trigger, in the whole EU fuel savings from the increased use of fuel efficient tyres, savings between 2.4 and 6.6 Mtoe (million tonnes of oil equivalent) in 2020 depending on the speed of market transformation. This is more than the annual oil consumption of Hungary!

The CO2 savings from all vehicle types are expected to range from 1.5 million tonnes to 4 million tonnes per year depending on the speed of market transformation towards fuel efficient tyres.

Responsibilities of tyre suppliers

Suppliers shall ensure that C1 and C2 tyres, which are delivered to distributors or end-users, are equipped with a sticker on the tyre tread displaying a label indicating the fuel efficiency class, the external rolling noise class, Part C and, where applicable, the wet grip class. The format of the sticker and the label is harmonized for the EU. Suppliers shall state the fuel efficiency class, the external rolling noise class and measured value and, where applicable, the wet grip class, of C1, C2 and C3 tyres in technical promotional material, including on their websites. Finally suppliers shall make technical documentation available to the authorities of Member States on request, for a period ending five years after the last tyre of a given tyre type has been made available on the market. This technical documentation shall be sufficiently detailed as to allow the authorities to verify the accuracy of information provided on the label with regard to fuel efficiency, wet grip and external rolling noise.

Responsibilities of tyre distributors

Distributors shall ensure that tyres, at the point of sale, bear the sticker provided by suppliers or before the sale of the tyre, the is shown to the end-user and is clearly displayed in the immediate proximity of the tyre at the point of sale. Distributors shall provide end-users with information on the fuel efficiency class, wet grip class and external rolling noise class and measured value of those tyres. Finally distributors shall state the fuel efficiency class, the external rolling noise measured value and, where applicable, the wet grip class, on or with the bills delivered to end-users when they purchase tyres.

Responsibilities of vehicle suppliers and vehicle distributors

Where end users are offered a choice at the point of sale between different tyres to be fitted on a new vehicle which they are intending to acquire, vehicle suppliers and distributors shall, before the sale, provide them with information, for each of the tyres offered, on the fuel efficiency class, the external rolling noise class and measured value, and, where applicable, the wet grip class of C1, C2 and C3 tyres. That information shall be included at least in the technical promotional material.

3. The Regulation (EC) No 2422/2001 of the European Parliament and of the Council of 6 November 2001 on a Community energy efficiency labelling programme for office equipment (Energy Star)

The European Energy Star Programme is a **voluntary** energy labelling programme for office equipment. The Energy Star logo helps consumers identify office equipment products that save them money and help protect the environment by saving energy. Office information and communication technology equipment (computers, monitors, printers, fax machines, copiers, scanners and multifunction devices) is responsible for a growing share of electricity consumption in the EU.

Manufacturers, assemblers, exporters, importers and retailers are invited to register with the European Commission allowing them to place the Energy Star label on products that meet or exceed energy-efficiency guidelines. The participation in the programme is voluntary.

Office equipment is traded globally. Although the manufacturing base is increasingly moving to Asia, a large share of research and development, marketing, and even manufacturing facilities are located in the EU and the US. The trade in this market segment between the EU and the US is falling but remains substantial. The ENERGY STAR is a voluntary energy-efficiency labelling programme run by the US Environment Protection Agency .

The increasing energy consumption of office equipment and the global nature of the ICT market provide a strong rationale for international regulatory cooperation in this domain. It is against this background that the EU and the US signed in 2000 the first Agreement on the coordination of energy-efficiency labelling programmes for office equipment. On the basis of the Agreement, the EPA and the Commission jointly manage the ENERGY STAR programme for office equipment. That includes cooperating on the development of product specifications and the mutual recognition of products registered in the EU and the US. The Agreement, which was renewed in 2006 for a second 5-year period. It is implemented in several other economies, including Japan, Canada and Australia, through agreements similar to that with the EU

On 15 January 2008 the EU adopted a regulation 1406/2008 that requires EU institutions and central Member State government authorities to use energy efficiency criteria no less demanding than those defined in the ENERGY STAR programme when purchasing office equipment.

9.2 The Eco-design Directive

There are two complementary ways of reducing the energy consumed by products: 1) labelling to raise awareness of consumers on the real energy used in order to influence their buying decisions (such as the above described labelling schemes for domestic appliances), and 2) energy efficiency requirements imposed on products from early stages in the design process.

The production, distribution, use and end-of-life management of energy-using products (EuPs) is associated with a considerable number of important impacts on the environment, namely the consequences of energy consumption, consumption of other materials/resources, waste generation and release of hazardous substances to the environment. It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product. Against this background, **Eco-design** aims to improve the environmental performance of products throughout the life-cycle by systematic integration of environmental aspects at a very early stage in the product design.

The EU adopted a very important Directive 2009/125/EU on establishing a framework for setting Eco-design requirements (such as energy efficiency requirements) for all energy using products in the residential, tertiary and industrial sectors. Coherent EU-wide rules for eco-design will ensure that disparities among national regulations do not become obstacles to intra-EU trade. The Directive does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting requirements regarding environmentally relevant product characteristics (such as energy consumption) and allows them to be improved quickly and efficiently.

The following implementing regulations containing Ecodesign requirements were until now adopted by the Commission:

- Commission Regulation (EU) No 1016/2010 with regard to ecodesign requirements for household dishwashers
- Commission Regulation (EU) No 1015/2010 with regard to ecodesign requirements for household washing machines
- Commission Regulation (EU) No 347/2010 with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps.
- Commission Regulation (EC) No 641/2009 with regard to ecodesign requirements for glandless standalone circulators and glandless circulators integrated in products
- Commission Regulation (EC) No 643/2009 of 22 July 2009 with regard to ecodesign requirements for household refrigerating appliances
- Commission Regulation (EC) No 642/2009 with regard to ecodesign requirements for televisions (Text with EEA relevance)
- Commission Regulation (EC) No 278/2009 of 6 April 2009 with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies
- Commission Regulation as regards the ecodesign requirements on ultraviolet radiation of non-directional household lamps
- Commission Regulation (EC) No 244/2009 of 18 March 2009 implementing with regard to ecodesign requirements for non-directional household lamps
- Commission Regulation (EC) No 107/2009 with regard to ecodesign requirements for simple set-top boxes
- Commission Regulation (EC) No 1275/2008 with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment

9.3 The Building Directive

On 18 May 2010 Directive 2010/31/EU on the energy performance of buildings was adopted. This new Directive is a recast of the previous Building Directive 2002/91/EC in order to strengthen the energy performance requirements and to clarify and streamline some of its provisions. This recast will replace the current Directive by implementation in the Member States as from 9 January 2013.

The energy consumption of buildings in the EU varies enormously; whilst new buildings usually need less than 3 to 5 litres of heating oil or equivalent per square meter floor area and per year, the existing buildings stock consumes, on average, about 25 litres per square meter, some buildings even up to 60 litres. Available construction products and installation technologies can drastically improve the building's energy performance – and so reduce its energy consumption– and create net benefits: the annual energy cost savings are exceeding the annual capital costs for the investments. The most efficient time for energy efficiency improvements is when buildings are constructed or when they are renovated.

The current Energy Performance of Buildings Directive 2002/91/EC establishes four basic requirements to be implemented by the Member States:

- Member States are required by the Directive to ensure the setting of minimum energy performance requirements. It is important in this context to note that the level of these requirements is left entirely up to the Member States. These minimum standards are to be set in a flexible and integrated way so that designers and builders are able to meet energy efficiency requirements in the most cost-effective way. The standards shall also take into account climatic differences and may allow a differentiation to be made between standards for new and for existing buildings.

- These standards have to be applied to most new buildings and to existing buildings larger than 1000 m² when larger renovations are undertaken. These standards are to be reviewed, at the most every 5 years, to update them to reflect new technologies and technical advances.

- Member States must ensure that when buildings are constructed, sold or rented out, an energy performance certificate will be made available to the owner or by the owner to the tenant or potential buyer. The certification shall also include advice on how to improve energy performance. Certificates provided should not be more than 10 years old when transactions take place. Member States may also choose to require larger public buildings to provide for the display of the current temperature and of the recommended indoor temperature, mainly as a means of increasing public awareness of inefficient and wasteful management of cooling and heating systems. This is, however, an optional measure.

- Finally the Directive lays down requirements for the regular inspection of heating and cooling systems, with the frequency of the inspections being based on the effective rated output of the boiler or air-conditioning system. A one-off inspection of the entire heating installation is required if the boiler is older than 15 years. This assessment will include advice on possible replacement or modifications of the boiler, including the use of alternative energy solutions.

The recast Directive that will come into force on 9 January 2013 will helps citizens to more effectively improve the energy efficiency of their houses and for the construction industry to build better quality buildings. The macroeconomic estimated impacts are also significant: 5-6% less energy will be used in the EU in 2020 (which equals the total current consumption of Belgium and Romania) and about 5% less CO_2 emissions will be emitted in the whole EU in 2020.

The new Directive contains the following extra provisions:

- The energy performance certificate becomes a real, active energy label of houses. For instance, the certificate has to be included in all advertisements for sales or renting. Also, the certificate with its energy saving recommendations has to be part of the sales and renting documents. Inspections of heating and air conditioning systems will advise consumers to use better appliances or improve their operation, even replacing if need be. Member States have to ensure the good quality of certificates and inspections.

- The scope of the Directive is broadened, from 2013 all existing buildings when they undergo a major renovation should meet certain efficiency levels and not only those buildings that are larger than 1000 m² .

- Member States are obliged to develop plans for increased numbers of low or zero energy and carbon buildings, such as passive houses. The public sector should show a leading example by investing in such buildings.

9.4 The energy efficiency and energy service Directive

Directive 2006/32/ on energy end-use efficiency and energy services includes an indicative energy savings target for Member States, obligations on national public authorities as regards energy savings and energy efficient procurement, and measures to promote energy efficiency and energy services. The objective of the Directive is to promote energy efficiency and energy services and to develop the markets for these as a means of contributing to environmental protection as well as to the security of energy supply. This Directive is designed to help remove informational, financial, institutional and other barriers that prevent the realization of the significant energy savings potential that exists in all the Member States. It does this by laying down the following provisions:

- **A general energy end-use savings target** for Member States of 1% per year for 9 years, covering the period from 1 January 2008 until 31 December 2016. The overall target of 9% is to be met by the 9th year and will include an intermediate target covering the third year of application of the Directive. The basis for the calculation of the energy savings is 1% of the average amount of energy consumed during the most recent five years for which statistics are available. The savings can be realized from the following sectors: households; agriculture; commercial and public sectors; transport and industry, with a few exemptions. All types of energy will be taken into account, from electricity and natural gas to district heating and cooling, heating fuel, transport fuels, coal and lignite, and biomass.

- **A public sector obligation.** Member State public sectors shall fulfil an exemplary role and fulfil a number of obligations to contribute to reaching the overall savings target. The public sector will need to ensure the availability and publication of public procurement guidelines that take into account energy efficiency. Alternatively, they may choose to use energy audits and apply the resulting recommendations or apply financial instruments such as energy performance contracting.

- **A supply-side obligation** concerning the offer of energy services and other energy efficiency measures to customers. Energy distributors and retail energy sales companies will have to ensure that their customers are offered competitively priced energy efficiency improvement measures or services when they are supplied with energy. These measures may, however, be implemented by any competent market actor such as energy service companies, installers and energy advisors. Alternatives in form of contributions to funds and voluntary agreements are also possible.

- **A harmonized method for calculating improvements in energy efficiency** will be developed by the Commission and a committee composed of Member State experts. The measurement system will include benchmarks, energy efficiency indicators and bottom-up measurements.

- **Member States will report regularly** on their progress in meeting targets, using national Energy Efficiency Action Plans. These plans will be assessed by the Commission and reported on. If insufficient progress is being made, additional measures will be proposed by the Commission. Examples of eligible energy services and energy efficiency improvement measures are set forth in the Directive.

This Directive is intended to serve as an "umbrella" to complement and improve the implementation of existing EU energy efficiency legislation, including the Energy Performance of

Buildings Directive, the Combined Heat & Power Directive and the Directives on the energy labelling of appliances.

However, the National Energy Efficiency Action Plans that were submitted by the Member States to the Commission on the basis of this Directive were considered to be disappointing, regarding ambition and achievements. Therefore a new proposal was brought forward to reinforce the efforts of Member States in the field of energy efficiency.

10 THE PROPOSAL FOR A NEW DIRECTIVE ON ENERGY EFFICIENCY

10.1 Introduction

The latest estimates made by the Commission, on the basis of the national energy efficiency targets for 2020 that Member States have set for themselves in the context of the Europe 2020 strategy, show that the EU will not be able to achieve its objective.

Therefore, the Commission has made on 22 June 2011 a legislative proposal for a Directive on energy efficiency which builds upon the existing Directives for Cogeneration and Energy Services[14] and merges them into one comprehensive legal instrument addressing energy efficiency in energy supply and in final energy consumption.

The Directive also foresees that the Commission will make in 2014 an assessment of the progress made towards the EU's 20% energy efficiency objective for 2020 and, if necessary, bring forward a further legislative proposal to set mandatory national energy efficiency targets.

The aim of the proposal is to save more energy and to reach the target the EU has set itself: By 2020, the EU wants to cut energy consumption by 20%. In absolute terms – calculated in million tons of oil equivalent (Mtoe)– this are 368 Mtoe in 2020 compared to projected consumption in that year of 1842 Mtoe. This needs to be achieved by the EU as a whole.

At the moment – with all the measures on EU and national level in place so far – the EU would only reach 1678 Mtoe, or 9% of savings.

[14] See chapters 7 and 9.4

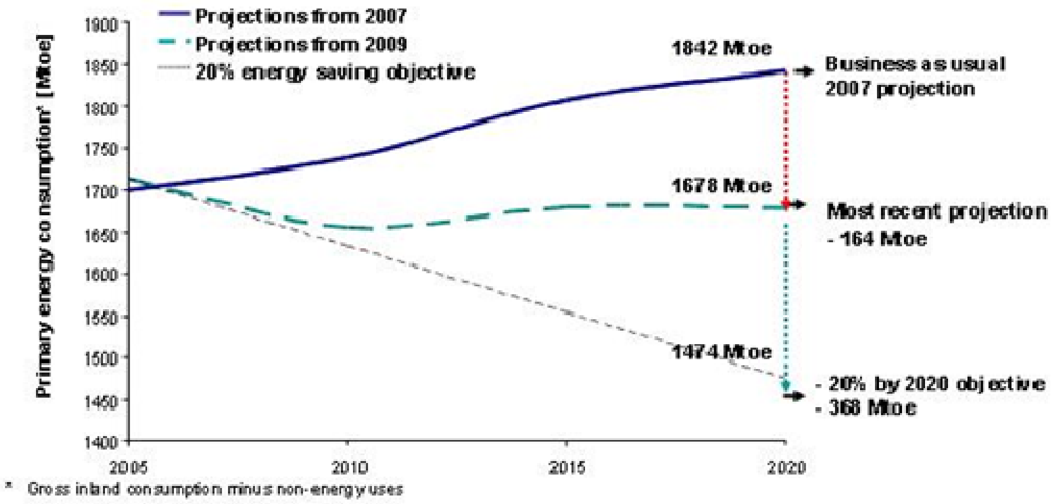

Figure 2: Projection of primary energy use for the EU by 2020

10.2 Key measures of the proposed Directive

- (Article 3) Member States have to set **national targets** for 2020 that should lead to the 20% efficiency target for the EU. These proposed targets are a follow up to the (9% saving targets for 2016 that were already established in the current Energy services Directive 2006/32/EC). Like in this current Directive these national targets **have no compulsory** character but by 30 June 2014, the Commission shall assess whether the Union is likely to achieve its target of 20% primary energy savings by 2020 and if necessary propose binding targets.

- (Article 4) From 1 January 2014, 3% of **public buildings** should be renovated each year, with the clear aim to save energy. Currently, the same percentage is renovated per year but in only half of the cases energy efficiency improvements are included (1. 5% energy related renovation rate. In many cases a cost optimal renovation can bring up to 60% energy savings. The benefit of this measure can be estimated to 6 Mtoe in 2020. This article is a new and very specific obligation to public sector.

- (Article 5) It will become a legal obligation for the public sector to **purchase energy efficient** buildings, products and services. This article is a stronger wording than in the similar Article 5 of the current Directive

- (Article 6) Member States have to set up an **energy efficiency obligation scheme**. This scheme shall ensure that either all energy distributors or all retail energy sales companies operating on the Member State's territory achieve annual energy savings equal to 1.5% of their energy sales, by volume, in the previous year in that Member State excluding energy used in transport. To achieve these savings the energy companies concerned would have to work with the final energy users (e.g. individual house owners, supermarkets, and hospitals) to implement energy savings. In order to allow for sufficient flexibility, Member States have also the possibility to propose alternative energy savings mechanisms that lead to the same results but are not based on obligation on energy companies. These could, for example, be funding programmes or voluntary agreements. It is expected that this legal obligation will reduce the EU's energy consumption by 6.4% in 2020 (or 108 to 118 Mtoe primary energy). The similar existing provisions in the current Directive (where such obligations are only one of the options provided to Member States to ensure that energy utilities achieve savings in end-use sectors) will by this proposal be reinforced.

- (Article 8) Member States shall ensure that final customers for electricity, natural gas, district heating or cooling and district-supplied domestic hot water are provided **with individual meters** that accurately measure and allow to make available their actual energy consumption and provide information on actual time of use. This should be done not later than 1 January 2015 for electricity, natural gas; hot water and centralized heat. In a longer term, this may require introduction of intelligent metering although in the shorter term, frequent billing can be based on self-reading of existing meters by the consumers themselves. The potential savings that could be reached through improved information provided through more adequate metering and billing are estimated at the level of around 80 Mtoe. This provision exists already in the current Directive (Article 13) but apparently was not enforced sufficiently.

- (Article 10) The proposes Directive requires that by 1 January 2014, the Member States have established **a national heating and cooling plan** as a basis for a sound planning of efficient heating and cooling infrastructures, for developing the potential for the application of high-efficiency cogeneration (CHP) and efficient district heating and cooling. Moreover, Member States shall ensure that all new thermal electricity generation installations with a total thermal input exceeding 20 MW are provided with equipment allowing for **the recovery of waste heat** by means of a high-efficiency cogeneration unit and are sited in a location where waste heat can be used by heat demand points. This proposed Article goes clearly further than the provisions in the current Directive 2004/8/EC where Member States are only invited to report on the potential of CHP in their territory.

10.3 Impacts on the ETS

Simulation models show that the implementation of the proposed Directive could have an important impact on the ETS price in the emission trading system. Some scenario's project a drop to zero of the ETS price in 2020 whereas others show a much lower impact (a reduction from €16.5/t to €14.2/t in 2020). This difference in projected ETS price impact until 2020 is explained among other things by the assumed share of modelled measures with GHG reductions materialising in non-ETS sectors, the full market foresight assumed and an unlimited ETS banking flexibility until 2050. In the implementation of the 20% energy efficiency target, the Commission will have to monitor carefully the impact of new measures on Directive 2003/87/EC establishing the EU's emissions trading directive (ETS) in order to maintain the incentives in the emissions trading system rewarding low carbon investments and preparing the ETS sectors for the innovations needed in the future. In this respect, appropriate measures will be considered, including recalibrating the emissions trading system by setting aside a corresponding number of allowances from the part to be auctioned during the period 2013 to 2020, should a corresponding political decision be taken.

10.4 Relation to the two existing Directives

The scope of two existing Directives: the Cogeneration Directive (2004/8/EC) and the Energy Services Directive (2006/32/EC, ESD) clearly overlap with this Proposal. Therefore, it is proposed that these two Directives are repealed when the new Directive enters into force, except for Articles 4(1) to (4) and Annexes I, III and IV to the ESD. These provisions concern the achievement by 2017 of an indicative energy saving target of 9% of the final energy consumption of each Member State in the 5 years before the implementation of the ESD. This target – albeit different in scope and level of ambition - contributes to the realisation of the EU's 20% energy efficiency target by 2020, and should therefore be maintained.

10.5 Timing and procedure for adoption of the proposal

As explained in chapter 5.2 a proposal of the Commission will only become European legislation after adoption of the European Parliament and the Council of (energy) Ministers of a compromise text.

Especially as regards the contents of the proposed Article 3 (targets), Article 6 (obligations for energy companies) and Article 10 (compulsory recovery waste heat) exist strong on-going discussions. In general, the EP is willing to go further than the Council. Therefore at this stage it is not possible to predict how much of the proposal of the Commission will be turned into EU law and at what stage it will happen.

The foreseen timing for adoption and implementation of the proposal is as follows:

- **Until December 2011**: Discussions in the Council working groups and in the relevant Committees of the European Parliament.
- **Jan-June 2012**: A political agreement between the European Parliament and Council on the basis of a proposal of the rapporteur of the European Parliament (Claude Turmes of the Green Party) and a political orientation in the Energy Council in November 2011
- **June –Dec 2012**: Finalization of the legislative text under the Presidency of Cyprus
- **End of 2012**: Entering into for force of Energy Efficiency Directive
- **June 2014**: Assessment of progress towards 20% saving objective

Until this proposed Directive is adopted the two current Directives 2004/8/EC and 2006/32/EC will remain in force and these give plenty of opportunities to those Member States that are willing to progress substantially in energy efficiency to move forward.

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ANNEX

Case study 1: UNDP/GEF Full-sized Project "Hungary: Public Sector Energy Efficiency Program"

(Excerpts from the Project Evaluation Report)

Brief description of the project

The UNDP/GEF Full-sized Project "Hungary: Public Sector Energy Efficiency Program" started in March 2001 and closed in June 2008. The project was funded in part by UNDP TRAC (USD 400 000) and the GEF (USD 4.1 million) with co-financing from Government and private sources. The project falls under the GEF Focal Area Climate Change (CC) and the GEF Operational Program OP5: Removal of barriers to energy efficiency and energy conservation.

The objective of the project was to help mitigate Hungary's greenhouse gas emissions by improving the energy efficiency in public sector buildings, and to help build the capacity in municipalities to improve energy efficiency through project implementation and improved energy management of existing buildings and infrastructure. The project was expected to result in significant and sustainable annual reductions of carbon emissions estimated at 300,000 tC over the 20-year lifetime of the investment projects.

The project aimed to achieve this overall objective by means of;

1. strengthened outreach to municipalities including setting up municipal networks and regional energy advice centres;
2. improving the knowledge base of municipal decision maker and energy managers through tools and training; and
3. supporting energy audits and feasibility studies to identify viable energy efficiency investment opportunities in municipal buildings and infrastructure.

The Project was executed by the Ministry of Economy and Transport of the Republic of Hungary and was implemented by the Energy Centre Hungary, a non-profit company set up in 1992 jointly by the Ministry of Economy and Transport, the Ministry of Environment and Water and the Hungarian Energy Office.

The primary advantage of the project was that it addressed the need in Hungary to improve Energy Efficiency with a combination of a clearly structured short-term support mechanism for EE implementation (audit and feasibility study fund) with capacity support at the municipal level to ensure long-term sustainability of results. The effectiveness of this solution is evident in the strong dynamic and enthusiasm observed among the municipalities to further identify and implement EE rehabilitation projects on their own.

Considering Hungarian national policies and priorities, and the opinions of public and private sector stakeholders, this UNDP/GEF project has been consistent with national priorities and has reflected the high priority put on public sector energy efficiency. The project was well designed, showed good stakeholder involvement and utilized a comprehensive but flexible strategy. In the period between the design of the project (2000) and its completion (2008) the relevance has increased. This and the increased capacity resulting from the project are already showing sustainable results. Key stakeholders and, in particular, the representatives of the municipalities interviewed were satisfied with the approach and the results of the project.

Significant delays (resulting in part from ambiguities in the chain-of-command and priorities with regards the Energy Centre Hungary mandate) during the first two years of project execution were identified and acted upon by UNDP CO and the Project Management structure. These early delays did result, essentially, in a project re-start in 2003 and, subsequently, in project extensions totalling some 27 months. Within the shifted implementation period (2003-2008), project execution proceeded timely and effectively. In this respect, the project team is commended for their organization and efforts. The project was well managed and the involvement of the different stakeholders well structured. Communication between the Steering Committee, the Project Board, the Energy Centre and UNDP/GEF was well structured and implementation modalities were effectively applied. Stakeholder recommendations and suggestions were well integrated.

The shifted implementation period (2003-2008) coincided well with partnership programs for financing of EE measures in municipalities (in particular, EU structural funds available through KIOP, 2004-2006 and KEOP, 2008-2013) and these have been well exploited in the project implementation (the Energy Centre Hungary staff continues to manage these funds and monitor results.) Within the project, a fund totalling USD 1.5 million to finance Audits and Feasibility studies was created and managed. According to data from the M&E unit in the Energy Centre Hungary, 209 Audits and 53 Feasibility Studies were prepared with this fund. From these 130 municipal EE rehabilitation projects are either realized or underway at project close resulting in a total lifecycle benefit of 305 095 tCO2 emission reduction. Substantial additional (indirect) CO2 emission reduction benefits are expected to result from the project dynamic and the increased capacity evident at the municipal level.

Despite delays and extensions in project implementation, the project retained a surplus of GEF funding of USD 120 000. Government co-financing (USD 3.14 million) was somewhat higher than originally planned and private sector investment (USD 19.3 million) in realized EE projects was double that estimated in the project document.

Recommendations of the Project Evaluation team

1) The Energy Centre Hungary would benefit from a broader focus to maintain and strengthen its role with respect to the municipalities and to the central government. In particular, it is recommended that the Energy Centre Hungary assume the following mandates:
   - Strengthening of international co-operation within the framework of EU projects Final Evaluation of Public Sector Energy Efficiency Program – Hungary
   - Development and implementation of new local Energy Efficiency master plans in co-operation with municipalities. The core function of the Energy Centre Hungary in this activity should be the dissemination of base knowledge for EE investment implementation and the promotion of Energy Efficiency program and best practice.
   - Collecting and processing of data and establishing a comprehensive EE database as a basis for development of governmental energy strategies.
2) The Energy Centre Hungary should be further integrated within the Ministry of Transport, Telecommunication and Energy with a clear definition of its role and mandate.

3) A broader range of financing strategies for municipal EE project implementation should be explored. By providing information for a broader range of financing models, the Energy Centre Hungary and the Regional Advice Centers can further promote municipal EE project implementation. From interviews it is clear that such networking and support would provide much desired guidance for municipalities in strategic planning of EE projects.
4) The good relationship which was established between the Chamber of Engineers and the Energy Centre Hungary during the development of the Energy Audits and Building Energy Passports should be utilized. These organizations should continue to work together to further disseminate / promote Energy Efficiency among engineers, architects and auditors.
5) It is recommended to update the one-stop-shop website established within the project. The webpage remains a useful source of base knowledge for municipalities. This webpage should be integrated in the Energy Centre Hungary and updated on a regular basis.
6) For similar projects in planning or implementation, it is recommended that a broader range of financing models be explored and promoted to realize actual EE investments.

Lessons learned

1) A particularly successful aspect with regard to project replication and sustainability is the high level of capacity, knowledge and enthusiasm observed in the municipalities some 8 months after project closure. Local energy managers have been trained or hired and a general mandate to improve energy efficiency has been expressed by municipal officials.
2) In addition, municipalities have begun to develop their own Energy Efficiency master plans or complete series of EE rehabilitation projects for implementation based on the success of EE investments realized in the project.
3) Municipalities are also exploring other financing models on their own including commercial co-financing or ESCOs. These positive developments contribute decisively to the overall success of the project.
4) The co-operation of UNDP and the Energy Centre Hungary was excellent. This relationship constituted a major factor towards the success of the project
5) The effectiveness and the sustainability of the project benefited from the shifted implementation period (2003-2008). Partnership programs (KIOP and KEOP) available for municipalities in this period provided key opportunities for actual EE implementation based on the Audits and Feasibility Studies funded by the project. In addition, the mandate and capacity of the Energy Centre Hungary has been strengthened by the project Final Evaluation of Public Sector Energy Efficiency Program – Hungary

Case study 2: Efficient Lighting Initiative of the Global Environmental Facility

ELI-Hungary Program Profile

The IFC/GEF Efficient Lighting Initiative (ELI) was a three-year, $15 million programme designed by the International Finance Corporation (IFC), a member of the World Bank Group, and funded by the Global Environment Facility (GEF). ELI sought to reduce greenhouse-gas emissions by accelerating the penetration of energy-efficient lighting technologies into emerging markets in developing countries. ELI worked to lower market barriers to efficient lighting in Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines and South Africa through a set of multi-country initiatives, local and global partnerships, and interventions tailored to individual countries' conditions.

Figure 1 The ELI logo

The ELI-Hungary program design was based on the finding, from ELI's market research, that a significant part of lighting upgrades is economically feasible. ELI-Hungary contained the following elements:

1. Awareness development, improving consumer confidence in efficient lighting technologies.
2. Many-sided assistance to the market players, with special emphasis on Energy Service Companies (ESCOs) and lighting professionals.
3. Investment subsidies on a limited basis.

The total budget for the ELI Hungarian program was USD 1.25 million, of which $ 856,393 was actually spent. ELI-Hungary ran from spring 2000 until the end of 2003. Program impacts (energy and capacity savings, reductions in GHG emissions) were achieved through two major outcomes:

- increase in awareness of and demand for quality CFLs in the residential sector;
- increase in awareness of and demand for energy efficient lighting in existing buildings, particularly public buildings.

Activities in the residential sector

To address market barriers, a residential CFL campaign was launched by ELI-Hungary in co-operation with manufacturers, retailers, wholesalers and NGOs. The Program had to face the following main communication challenges:

- diffusing and counterbalancing the psychological barrier of high first cost;
- changing old lighting purchase habits;
- explaining the economic benefits of CFLs;
- emphasizing the difference between high and low quality CFLs.

Advertising was used to a limited extent in the national level media, but much greater emphasis was placed on the distribution of pamphlets, point-of-sale information and materials, public relations events and direct actions. Detailed information brochures and leaflets were distributed directly to households, and at point-of-sale events. The print materials have helped consumers distinguish between low and high quality CFLs, and provide consumers with a list of suggestions for CFL usage. Television information spots were developed for broadcasting on local cable and public television channels, and for use in schools. Considerable use was made of advertising in local newspapers and radio stations. NGOs, manufacturers, distributors, local utility and retailers were involved in the implementation of the campaigns.

Figure 2 ELI banner in a department store's lighting department

Figure 3 Shelves in a department store's lighting department decorated with ELI creative materials

Figure 4   Big size electrometer display placed in a department store

While the ELI logo was used on all materials and visuals, it did not play a central role and was not identified specifically with high quality CFLs. Manufacturers with ELI approved CFLs had the possibility to use the ELI logo.

Figure 5   ELI logo used in a GE organised sales promotion contest (in Hungary, GE uses the name Tungsram)

Activities in the non-residential sector

The professional awareness, education and marketing program addressed the awareness, knowledge and information barrier amongst suppliers (professional designers, ESCOs) and end-users (building owners/operators), and the barrier of limited access to financing for building owners.

This program item covered the following activities:

- lighting design training and certification for professional designers;
- lighting design training and certification for ESCOs, and training in financial management and project specific coaching; and
- ESCO transactional support including model contracts and supporting material;
- training for building owners/operators to increase awareness of and demand for energy efficient lighting and lighting retrofit projects (Lighting Day conference);
- dissemination of information and communication with the help of newsletters and a Hungarian website.

Awareness development of public building owners

The owners of the public buildings were approached, within the scope of ELI's awareness development program, by an optimum mix of information channels. The awareness development program of ELI-Hungary had three phases.

(1) Information was disseminated about the importance of efficient lighting in public buildings, and news was spread about a forthcoming major event, the Lighting Day. More than 3,500 decision makers were approached and invited to the Lighting Day. The invitation packages contained a booklet on efficient lighting.

(2) Targeted at public building owners/operators, a national, one-day mini-conference was organized, including lectures by reputable speakers, exhibitions of lighting technologies, introduction of ELI-certified professionals and ESCOs, and announcement of ELI and other financing opportunities.

(3) In the third phase, the public building owners worked directly with the market players introduced during the Lighting Day and listed in the ELI database. Their project development activities were supported by ELI's ESCO Transaction Support Fund (ESCO TSF). ELI, in co-operation with the Hungarian Lighting Society, also runs a general phone advice service to help the end-user institutions solve every day and long-term problems, to establish contact between them and the ELI certified professionals and ESCOs.

In addition, newsletters were issued and sent to more than 2,500 addresses (amongst them were public building owners, professionals, authorities, entrepreneurs, NGOs, ESCOs, etc.) as a reminder of the importance of lighting upgrades and as a source of information dissemination regarding lighting.

Professional awareness, education and marketing trainings

Training of ESCOs

The objective of the ESCO training course was to catalyse the establishment of new lighting ESCOs and develop their capabilities as well as that of other existing participant ESCOs. ESCOs are more likely to offer a comprehensive service including auditing, financing, procurement, installation and evaluation.

An exam was held at the conclusion of the training. The names of those who obtained an ELI ESCO Training Certificate were put into a database which has been made available for a wide scope of potential project owners on the ELI website.

A number of different follow-up activities helped the ELI certified ESCOs to

- make contact with financial institutions;
- obtain information about project owners looking for partners to reconstruct their obsolete indoor lighting systems;
- obtain a forum to introduce themselves to the potential clients;
- place information made available by them on the ELI website.

Training of professionals

The main target group of the training program was the group of – ca. 500 – engineers with a so-called "0.4 kV license" who are supposed to work on major lighting projects. Most of them have never received lighting education or only to a very limited extent. Mostly they have learnt via their own experience, and as a result, many of them have gained a good knowledge of energy efficiency lighting. The target group was supplemented with the decision-makers of the technical departments at public institutions.

ESCO Transaction Support Fund

ELI-Hungary established an ESCO Transaction Support Fund (ESCO TSF). Its objective was to assist ESCOs and potential ESCO clients to overcome the barriers of the ESCO business.

The Fund had two windows:

- the “Project Development Window” covered a part of the “soft” transaction costs of the applicants; and
- the “Demonstration Window” covered a part of the “hard” investment costs of projects with outstanding demonstrative value.

The Fund provided support on a competitive basis. The scope of eligible applicants included all the already active and to be ESCOs, all the companies, professionals, experts and entrepreneurs active in the lighting sector.

Summary of program achievements

The most important things that ELI achieved in Hungary are as follows:

- The implementation process of ELI, the different program elements and the developed structure of the whole program helped to strengthen the existing coalition of lighting professionals (experts, manufacturers, etc.)
- The ELI residential campaign gave useful – sustainable – education tools for local NGOs to promote amongst pupils and citizens the importance and the possible measures to achieve energy and cost savings in lighting systems.
- Demand for up-to-date lighting engineering knowledge was developed amongst electric professionals who are generally involved in the design and implementation of the reconstruction of existing and also newly built lighting systems, but have very limited knowledge about lighting design.
- Increased CFL sales and the rising proportion of the quality CFLs within the number of CFLs sold.

The following program elements proved to be the most effective in reducing barriers to increase penetration of efficient lighting:

- public education in the form of residential CFL campaigns;
- professional and ESCO trainings;
- ELI acted as an unbiased program (”organization”) irrespectively of the business interest of the involved – professional – parties. This approach was well accepted by the main actors (manufacturers) of the lighting industry, therefore they were ready to work in co-operation with each-other while earlier –some of them mainly due to business reasons (typically due to international companies’ business policies) – tried / had to avoid working together.

Contrary to the above listed activities there were activities which were not effective enough or were less accepted by the target groups, such as:

- The “ESCO Transaction Support Fund” did not get the expected attention (which could be measured by the number of applications).
- The foreseen effect of one of the campaign elements of the 2002-2003 nation-wide residential CFL campaign was overestimated. It was the so-called “WestEnd” project, where the number of clients requiring advise was below expectations; the CFL sales weren’t successful, etc.

Figure 6 A giant CFL, information and selling counter and the ELI stage in a shopping centre before Christmas

Figure 7 A CFL Balloon in a shopping centre before Christmas

- Amongst the preliminary goals of ELI was the strong cooperation with and the involvement in the program implementation of the electric utilities. After the first reassuring positive replies of the utilities and the active participation of one of the stakeholders in the area on the regional residential CFL campaign, ELI received negative responses from the utilities, who decided not to cooperate with or participate in ELI's activities. The electricity suppliers, more precisely their Western owners (RWE, EdF, E.ON) are generally not interested in participating in any DSM activities, and this does not relate to whether they are hostile to the programme or not. One of the reasons for this behaviour is that there is no legal obligation / reason for them to deal with DSM type activities. As industrial energy consumption has fallen dramatically with the closure of the industrial facilities and free capacities are available, the electricity suppliers want to sell the surplus energy and one of the potential consumers is the residential population.

It is possible to state that sustainable changes have been observed on the lighting market, which are as follows:

- In the residential sector the picture is much nicer. The penetration of CFLs in the residential sector was high (60%) and the market surveys shows it to be a steady status. Now the main goal on this market is to change the composition so that the bulk of the CFLs used and sold in this sector are the more reliable, longer lifetime, quality ones. Thus it is important to explain the benefits of using quality CFLs, help people realize the difference amongst the various CFLs available in the market and last but not least to increase CFL penetration.
- As basically the manufacturers found ELI useful, they decided to continue their (common) activities following the closure of ELI to disseminate information, advertise and communicate the quality issue of the CFLs.