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Implementation problems with the European Union's energy system regulations in Central East Europe

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IMPLEMENTATION PROBLEMS WITH THE EUROPEAN UNION'S ENERGY SYSTEM REGULATIONS IN CENTRAL EAST EUROPE

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A 30 credit units Master's thesis

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ABSTRACT

The 1992 Earth Summit in Rio de Janeiro spearheaded concerns about the environment and the future wellbeing of Earth and human civilization. It highlighted the importance of green energy and sustainable energy development. The European Union's Council progressed forward, spring boarding off of the environmental concerns and scientific knowledge, to establish and develop regulations, laws and tools to promote green and sustainable energy in Europe.

This analysis will focus on the regulations, laws, and directives of the European Union's primary energy market. It describes the background of the main European Council's (EC) energy sector regulation documents and analyzes the following: Directive 2006/32/EC on energy end-use efficiency and energy services, Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market and Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport. This work provides a general overview, highlights the main goals, and reports on the mechanisms, both proposed and in effect, used to reach these established goals. Lastly, this thesis will investigate the penalty system, or lack thereof, and discuss the difficulties in measuring its results.

The implementation of these directives is discussed for a representative sample of three Central Eastern Europe countries, specifically the Slovak Republic, the Czech Republic, and Poland. New European Union Member States have different markets, economical situations, energy sources, and supplies. This work will analyze the energy sector in terms of renewable energy, energy efficiency, and biofuels market. It shows the targets for each country and the forecasts concerning energy production. Finally, an overview of the energy policies needed to reach the goals will be presented, along with conclusions as to whether it will be possible or not to achieve the Directives' levels.

As a result of this work it is noted that the Slovak Republic and the Czech Republic, both with very young but solid renewable energy policies, have and will have huge problems with achieving their set goals. The main problem in these countries is the lack of investors, capital, and experience within the renewable energy sector. In Poland however, despite the appearance of ineffective green energy policy compared to other countries, production of electricity from renewable energy sources and energy efficiency policies have taken effect.

This thesis considers the implementation of EC's directives by analyzing the energy systems, energy policy, and goals set by these countries. It will show the difficulties in reaching the objectives set by the European Council's directives and inaccuracies in the implementation of these tools.

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1 INTRODUCTION – STATEMENT OF PURPOSE

When the United Nations convened the first conference on the environment in Stockholm in 1972, the United Nations Conference on the Human Environment, it gave the fledgling international environmental movement a legitimacy it had lacked. When it convened the Earth Summit in Rio de Janeiro in 1992, its principal product was Agenda 21, a blueprint for sustainable development (Brown, Eco – economy).

National sustainable development strategies are needed to provide a framework and focus for debate on sustainable development and processes of negotiation, mediation, and to plan and carry out actions to change technologies and energy markets with respect to priority issues and environmental aspects. Strategic initiatives, such as national development plans, national conservation strategies, environmental action plans or sector strategies, could be components of national sustainable development strategies. Existing strategies have already resulted in improved organizations, procedures, legislation, public awareness and consensus on issues (Carew Prescott Bass, Strategies).

The European Union (here and after referred to as "the EU") is working to reduce the effects of climate change and establish a common energy policy. The European Council agreed in March 2007 on binding targets to increase the share of renewable energy, which is supposed to be 20% of the EU's final consumption by 2020 and was only 8.5% in 2005. Also by 2020 10% of transport fuel must come from biofuels. It is necessary that every Member State increases its production and use of renewable energy in electricity, heating and cooling and transport. It is therefore estimated that renewable power must increase from its current level of 15% to around 34–35% in 2020 if the goal is to be achieved (Schaefer Oliver). It means that in a short period renewable energy shares have to increase, which will require a complete restructuring of European energy systems and policy to make that goal achievable.

When considering free energy markets, one must take note of the fact that in most cases renewable energy cannot compete with traditional fossil fuel energy. Markets do not respect sustainable yield and balances of nature. For most economists, a rise in carbon dioxide levels is of little concern. For an ecologist, such a rise caused by the use of fossil fuels is a signal to shift to other energy sources in order to avoid rising temperatures, melting ice, and rising sea levels (Brown, Eco–economy). To regulate energy markets with respect to sustainable development and growth of green energy, the European Council created laws which are being implemented in various Member States. However, different countries have different conditions, potential and possibilities for the implementation of these laws. In this work I will consider central Eastern Europe's energy market, using the examples of the Slovak Republic, the Czech Republic and Poland.

It is important to remember that when considering green energy policy and implementation in the European Union, Member States are setting their own renewable energy policies, with their own goals, support systems, incentives etc. Politicians and experts have to remember that while they are making decisions their policy will be inevitably influenced, to some degree, by European legislation, policy and activities. National policies may be influenced by requirements to meet targets in European directives and there may be a desire not to duplicate, but to appropriately support activities at the European level. It is important to remember that during developing energy policy it is necessary to consider European energy policy.

The energy markets of the Slovak Republic, the Czech Republic and Poland are different. Poland is a much bigger country than the two others, with more experience in dealing with European regulations. On the other hand, the Czech Republic has better procedures for implementing investments in the market and much more "investor friendly" laws. Slovakia however has bigger potential for renewable energy and some experience in its usage.

This work will present a general overview of the energy sector with current green energy share, energy efficiency progress and the situation of the biofuels market. It is also necessary to know the trends and forecasts concerning energy production. Is it possible that the goals which were set by the Europeans Council will be achieved? Is the renewable energy potential sufficient for that purpose? How does energy policy look in terms of reaching indicative targets? And are the energy policies of each country developed and applied in the proper way? It is possible that even if green energy policy is well constructed there are some problems with implementing them in the market. Sometimes it is because of a lack of supplies or potential. However, sometimes problems lie in a procedure of changing legal status and getting building permissions that is too complex and long lasting. The procedure for obtaining zoning plans can be time consuming. The same thing is true of the environmental analysis necessary for investments. In a free market, green energy cannot compete with traditional technologies, such as fossil fuels plants, combined cycle plants based on natural gas, efficient coal-fired combined heat and power plants. Moreover there can be a problem with strong fossil fuel lobbying. In some cases there is no interest in the market and these financial supports are not effective. In terms of new Member States there can also be problems from a lack of investors and their interest in investments in green energy. Finally, the financial situation of investors is unlike the situation in "western" European Union countries. There can also be some legislative problems. But it seems that renewable energy can be an interesting and profitable market for investors from other countries.

2 BACKGROUND OF EUROPEAN COUNCIL'S ENERGY SECTOR REGULATION DOCUMENTS

2.1 Green Paper on Energy from 1996

Green Papers are documents published by the European Commission to stimulate discussion on given topics at the European level. They invite the relevant parties (bodies or individuals) to participate in a consultation process and debate on the basis of the proposals they put forward. Green Papers may give rise to legislative developments that are then outlined in White Papers (Commission, Green Paper 1996).

Green Papers on entrepreneurship in Europe (2003), on demographic change and a new solidarity between the generations (2005) or, more recently on a European strategy for sustainable, competitive and secure energy (2006) are examples of topics discussed (Europa.eu).

An EU Green Paper on energy was published in 1996, with 3 major priority policy objectives:

- Security of supply
- Improving the competitiveness of European business
- Taking environmental aspects into account, with an emphasis on the "energy dimension of climate change"

It concluded that the role of the European Community in relation to renewable energy policy was to support research, stimulate cooperation, introduce appropriate equipments standard and establish a Community framework for national fiscal and other incentives (Thornley, BioEnergy).

This applies especially to taxation, fiscal incentives and low VAT on environmentally friendly products, which is the promotion of criteria led ecolabels and green public procurement. If applied they may form a powerful set of tools for a push and pull approach, to improve the environmental performance of products. The concept of benefit or tax incentive refers to everything that the law sets as the tax benefit, depending on sectors or regions, through exemptions, tax base or reduction of rates. The use of tax incentives is designed to compensate for market failures, in order to stimulate private investment by reducing the marginal cost of additional expenditure. However, in practice the actual range of applied instruments might be much smaller if the Commission fails to develop internal consensus, leadership and orientation and if governments continue to block progress in a common approach towards environmental taxation. So there is the risk that only the voluntary, informational and consensual instruments will survive (The European Environmental Bureau).

2.2 White Paper on Renewable Energy from 1997

Commission White Papers are documents containing proposals for Community action in a specific area. In some cases they follow a Green Paper published to launch a consultation process at the European level. When a White Paper is favourably received by the Council it can lead to an action programme for the Union in the area concerned.

Examples are the White Papers on Completion of the Internal Market (1985), on Growth, Competitiveness, Employment (1993) and on European Governance (2001). More recently, the White Paper on Services of General Interest (2004) and that on a European Communication Policy (2006) have also moulded the development of Community policies (Europa.eu).

This work reviews the background of renewable energy in Europe, considers potential technical contributions sector by sector and defines a strategy and action plan to promote the market penetration of renewable energy sources, with an overall target of doubling their use of renewable energy by 2010 (from 6% in 1996 to 12% in 2010). The plans and actions being carried out by Members States are reviewed and the shares of renewable energy sources (RES) in their current energy budgets are estimated, as well as projected RES contributions by 2010 (Commission, White Paper 1997).

2.3 Renewable Energy Sources Directive from 2001

In 2001 the first ever evidence piece of European legislation aimed at promoting the production of energy from renewable sources was introduced (Directive 2001/77/EC). This European Renewable Energy Sources Directive aimed to increase the share of green electricity from 14 to 22% of consumption by 2010 and to double the share of renewable energy from 6% to 12% of gross energy consumption in the same period. The directive required all Member States to set indicative targets for the consumption of electricity from renewable sources by 2010. The Directive does not propose a harmonised Community support system for green electricity, but does undertake the assessment of support measures implemented by Member States, with the intention of possibly proposing a community support framework if that were considered necessary in the future.

This directive will be widely discus in following chapters.

2.4 Directive on Promotion of Biofuels from 2003

This directive required member states to set national targets for the minimum level of bio or other renewable transport fuels in their markets. The reference levels recommended in the Directive were 2% by 2005 and 5.75% by 2010 (Directive 2003/30/EC).

This directive will be widely discus in the following chapters.

2.5 Communication on share of renewable energy in the European Union from 2004

In 2004 the European Commission issued a communication evaluating progress towards the targets set in the 2001 RES directive. It noted that with existing national policies and measures the EU would achieve only 18-19% of renewable energies as shares of total electricity consumption instead of the 2010 target of 22% (Commission of EC 26/05/2004). Regarding the target of 12% share of renewable in overall energy consumption by 2010 the Commission believed that, even with full application of the biofuels directive and other existing legislation only 10% would be achieved (Thornley, BioEnergy).

2.6 Communication from the Commission on "The Support of Electricity from Renewable Energy Sources" from 2005

In 2005 the Commission completed its review of member states' systems for implementation of renewable energy systems and concluded that due to widely varying potentials and developments in different member states a harmonisation seems to be very difficult to achieve in the short term. Furthermore, competition between different national schemes was perceived as healthy over this transitional period (Commission of EC, Support). The Commission called for intensified coordination between member states with regard to the biomass sector. This EC review concluded that the effectiveness of policy mechanisms being deployed in the member states for solid biomass electricity was significantly lower than for wind, confirming previous suspicions that the development of biomass is lagging behind expectations at EU level. The following conclusions were drawn:

- Even in countries where the level of support was considered enough it appeared that the biomass sector was not yet ready to cope with the risk of the green certificate schemes
- The success of feed-in tariff schemes varied depending on the actual overall level of support
- Secondary instruments, especially small-investment plant support and tax relief, are good catalysts for jumpstarting biomass. They also have the advantage of less interference with the wood market
- In many cases infrastructure barriers are significant (Good management of agriculture and forest residues provides a firm starting base).

It was noted that the analysis of the biomass sector is complex, with significant variations in generation cost, feedstocks, conversion processes and plant sizes. The complexity of the sector and regional variations mean that other factors play a strong role, as do support mechanisms.

2.7 Biomass Action Plan from 2005

Stakeholder consultation on a proposed EU biomass action plan was carried out in the first quarter of 2005, followed by publication of the final biomass action plan at the same time that the review into support of renewable energy sources was carried out. The action plan was published in December 2005. It aims to establish measures to increase the development of biomass energy from wood wastes and agricultural crops by creating market-based incentives for its use and removing barriers to the development of the market. It is seen as a first coordinating step, setting out measures to promote biomass in heating, electricity and transport, followed by cross-cutting measures affecting biomass supply, financing and research (Commission, Biomass). Over 30 proposals were made in the document. Those with relevance to policy/support mechanisms are the following:

- Proposed EC legislation in 2006 or renewable energy heating
- Encourage member states who apply a reduced VAT rate to gas and electricity to also apply such a rate to district heating
- Encourage member states to harness all cost-effective forms of biomass electricity generation
- Encourage member states to take into account, in their support systems, the fact that, in CHP plants, biomass can provide heat and electricity at the same time
- A report in 2006 on possible revision of the biofuels directive to set national targets, use obligations and certify minimum sustainability criteria
- Promote public procurement of clean vehicles, including those using high levels of biofuels
- Assess the implementation of the energy crop scheme
- Encourage member states to establish national biomass action plans (Thornley, BioEnergy)

2.8 Energy Green Paper from 2006

The main aim of the green paper is to develop a common, coherent European energy policy, which would allow Europe to speak with a common voice, taking the lead in the global energy debate to lay the foundations for secure, competitive and sustainable energy. This approach was agreed upon by heads of state and government in 2005. It is written against the backdrop of a number of key concerns in the European and global energy market. These concerns include increasing global energy demand, European import dependency, rising prices, climate change and the needs to substantially renew European energy infrastructure and develop fully competitive energy markets (Commission, Green Paper 2006). From this changing energy landscape the Green Paper identifies six key areas that must be addressed:

- Energy for growth and jobs in Europe
- An internal energy market that guarantees security of supply
- Tackling security and competitiveness of energy supply, towards a more sustainable, efficient and diverse energy
- An integrated approach to tackling climate change
- A strategic European energy technology plan to encourage innovation
- Development of a coherent external energy policy for Europe (Thornley, BioEnergy)

3 GENERAL EUROPEAN UNION ENERGY POLICY

Energy policy is the manner in which a given entity (often governmental) has decided to address issues of energy development including energy production, distribution and consumption. The attributes of energy policy may include legislation, international treaties, incentives to investment, and guidelines for energy conservation, taxation and other public policy techniques.

A national energy policy comprises a set of measures involving that country's legislation, treaties and agency directives. The energy policy of a sovereign nation may include one or more of the following measures:

- statement of national policy regarding energy planning, energy generation, transmission and usage
- legislation on commercial energy activities (trading, transport, storage, etc.)
- legislation affecting energy use, such as efficiency standards, emission standards
- instructions for state owned energy sector assets and organizations
- active participation in, co-ordination of and incentives for mineral fuels exploration and other energy-related research and development
- fiscal policies related to energy products and services (taxes, exemptions, subsidies etc.)
- Energy security and international policy measures such as:
    - international energy sector treaties and alliances,
    - general international trade agreements,
    - special relations with energy-rich countries, including military presence and/or domination

Frequently the dominant issue of energy policy is the risk of supply–demand mismatch. Current energy policies also address environmental issues. Some governments state explicit energy policy, but, declared or not, each government practices some type of energy policy.

Although the European Union has legislated, set targets, and negotiated internationally in the area of energy policy for many years, and evolved out of the European Coal and Steel Community, the concept of introducing a mandatory common European Union energy policy was only approved at the meeting of the European Council on 27 October, 2005 in London. Following this the first policy proposals, Energy for a Changing World, were published by the European Commission, on 10 January, 2007 (NationMaster.com).

The possible principles of Energy Policy for Europe were elaborated in the Commission's green paper: A European Strategy for Sustainable, Competitive and Secure Energy on 8 March 2006 (Commission, Green Paper 2006). As a result of the decision to develop a common energy policy, the first proposals, Energy for a Changing World were published by the European Commission, following a consultation process, on 10 January 2007.

The 2007 proposal claimed that it will lead to a post-industrial revolution, or a low-carbon economy, in the European Union, as well as increased competition in the energy markets, improved security of supply, and improved employment prospects. Although the proposals have been adopted by the European Commission, they require the approval of the European Parliament but were debated and approved at a meeting of the European Council on 8 and 9 March, 2007 (Commission, Green Paper 2006).

Key proposals include:

- A cut of at least 20% in greenhouse gas emissions from all primary energy sources by 2020 (compared to 1990 levels), while pushing for an international agreement to succeed the Kyoto Protocol aimed at achieving a 30% cut by all developed nations by 2020
- A cut of up to 50% in carbon emissions from primary energy sources by 2050, compared to 1990 levels
- A minimum target of 10% for the use of biofuels by 2020 (Commission, Green Paper 2006)
- That the energy supply and generation activities of energy companies should be 'unbundled' from their distribution networks to further increase market competition
- Improving energy relations with the EU's neighbours, including Russia
- The development of a European Strategic Energy Technology Plan to develop technologies in areas including renewable energy, energy conservation, low-energy buildings, 4th generation nuclear power, clean coal and carbon capture
- Developing an Africa–Europe Energy partnership, to help Africa 'leap-frog' to low-carbon technologies and to help develop the continent as a sustainable energy supplier

A mandatory renewable energy target is a government legislated requirement on electricity retailers to obtain specific proportions of total electricity sales from renewable energy sources according to a fixed timeframe. The additional cost is distributed across most customers by increases in other tariffs. At least 66 countries, including 27 EU countries have renewable energy policy targets of some type. The EU baseline target is 20% by 2020.

4 DIRECTIVE 2006/32/EC ON ENERGY END-USE EFFICIENCY AND ENERGY SERVICES

4.1 Introduction

There is a need for improved energy end-use efficiency, managed demand for energy and promotion of the production of renewable energy, as there is relatively limited scope for any other influence on energy supply and distribution conditions in the short to medium term, either through the building of new capacity or through the improvement of transmission and distribution. This Directive thus contributes to improved security of supply. Improved energy end-use efficiency will also contribute to the reduction of primary energy consumption, to the mitigation of CO_2 and other greenhouse gas emissions and thereby to the prevention of dangerous climate change. These emissions continue to increase, making it more and more difficult to meet the Kyoto Protocol commitments. The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro, Brazil, from 3 to 14 June 1992. The treaty is intended to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (Wigley, The Kyoto Protocol). The Kyoto Protocol establishes legally binding commitments for the reduction of four greenhouse gases (carbon dioxide, methane, nitrous oxide, sulfur hexafluoride), and two groups of gases (hydrofluorocarbons and perfluorocarbons) produced by Annex I (industrialized) nations, as well as general commitments for all member countries (UNFCCC, Article 2). As of 2008, 183 parties have ratified the protocol (UNFCCC, Ratification Status), which was initially adopted for use on 11 December 1997 in Kyoto, Japan and which entered into force on 16 February 2005. Under Kyoto, industrialized countries agreed to reduce their collective GHG emissions by 5,2% compared to the year 1990. National limitations range from 8% reductions for the European Union and some others to 7% for the United States, 6% for Japan, and 0% for Russia. The treaty permitted GHG emission increases of 8% for Australia and 10% for Iceland (UN Environmental Programme)[1]. Improved energy end-use efficiency will make it possible to exploit potential cost-effective energy savings in an economically efficient way. Energy efficiency improvement measures could realise these energy savings and thus help reduce dependence on energy imports. Furthermore, a move towards more energy-efficient technologies can boost innovation and competition.

To substantially bring down energy consumption, effective action is impossible without first identifying the factors underlying waste in order to come to grips with them in the future. Even without high and volatile oil prices, which have led to a downgrading of the prospects of economic growth in Europe, there would be very good reasons for the European Union to make a strong push towards a re–invigorated programme promoting energy efficiency at all levels of European society. According to numerous studies, the EU could save at least 20% of its present energy consumption, or the present combined energy consumption of Germany and Finland, in a cost-effective manner (ECEEE, Proceedings 2005). Energy saving is without doubt the quickest, most effective and most cost-effective

[1] Industrialized countries has to cut greenhouse gas emissions by 5,2%

manner for reducing greenhouse gas emissions, as well as improving air quality, in particular in densely populated areas. It will therefore help Member States in meeting their Kyoto commitments. Secondly, it will constitute a major contribution to the longer term EU efforts in combating climate change through further emissions reductions, as part of a future post 2012 regime within the United Nations Framework Convention on Climate Change. Kyoto includes defined "flexible mechanisms" such as Emissions Trading, the Clean Development Mechanism and Joint Implementation to allow Annex I economies to meet their greenhouse gas (GHG) emission limitations by purchasing GHG emission reductions credits from elsewhere, through financial exchanges, projects that reduce emissions in non-Annex I economies, from other Annex I countries, or from Annex I countries with excess allowances. In practice this means that Non-Annex I economies have no GHG emission restrictions, but have financial incentives to develop GHG emission reduction projects to receive "carbon credits" that can then be sold to Annex I buyers, encouraging sustainable development (Graves, Public Attitudes). Only CDM Executive Board-accredited Certified Emission Reductions (CER) can be bought and sold in this manner. Under the aegis of the UN, Kyoto established this Bonn-based Clean Development Mechanism Executive Board to assess and approve projects (CDM Projects) in Non-Annex I economies prior to awarding CERs. (A similar scheme called Joint Implementation, or JI, applies in transitional economies mainly covering the former Soviet Union and Eastern Europe). In addition, the flexible mechanisms allow Annex I nations with efficient, low GHG-emitting industries, and high prevailing environmental standards to purchase carbon credits on the world market instead of reducing greenhouse gas emissions domestically. Annex I entities typically will want to acquire carbon credits as cheaply as possible, while Non-Annex I entities want to maximize the value of carbon credits generated from their domestic Greenhouse Gas Projects. Many developing countries fully recognise the essential role of energy efficiency in addressing these multiple challenges. Europe therefore needs to set an example in this respect, leading to the development of new policies, cooperation and technologies that can assist the developing world to address this challenge.

The lack of information and training on the latest technologies and their economic and financial impact on the rate of return from investment, combined in some cases with an aversion to the risk associated with early adoption of new technologies and techniques, can encourage investors such as banks to continue to support outdated technology even when they are not the most efficient or offering the best return. Considerable investment is needed to harness these potential savings, in terms of new energy-efficient equipment and energy services. Europe is a world leader in this area and energy services are largely local in character (Kranzl, Deriving Efficiency). The promoters of energy-saving technologies obviously need to make their case when seeking support from potential investors such as banks or venture capital funds. Energy service companies (ESCO's) will also have a role to play here. Industry, investors, and consumers in general should also be encouraged to include the energy-saving alternative in their financial planning. Players should be made aware of the very positive cost-benefit ratio, and sometimes, very short pay-back periods – even less than a year in certain cases – for investments in energy efficiency. Simple tools could be developed for risk-assessment of projects such as lifecycle analysis handbooks and computer programmes and investment grade energy audits. There is, moreover, a lack of access to adequate financial instruments supporting measures which bolster energy efficiency, such existing measures being predominantly small in scale.

The energy-efficiency performance of countries varies widely. Europe could be actively engaged in establishing and adopting standards on energy efficiency that can be

internationally compatible. A further reason is the contribution energy efficiency can make to economic and social development. Therefore, energy efficiency is an issue in the interest of all energy importing countries, including those in the Union, and should be integrated into their global strategy for security of energy supply. European industry is at the forefront in technology, and occupies the strategic high ground in the global competition on energy-efficiency technology in most sectors, including turbines, combined heat and power and district heating technologies, household appliances and building materials. The export potential for energy efficient products and services has not been systematically assessed, but it is estimated that the business opportunities deriving from stronger efforts on energy efficiency are not less significant than those related to renewable energy (Directive 2006/32/EC).
Directive 2006/32/EC on energy end-use efficiency and energy services repeals council directive 93/76/EEC of 13 September 1993 to limit carbon dioxide emissions by improving energy efficiency (SAVE). The purpose of this Directive is the attainment by Member States of the objective of limiting carbon dioxide emissions by improving energy efficiency, notably by means of drawing up and implementing programmes in the following fields:

- energy certification of buildings,
- the billing of heating, air-conditioning and hot water costs on the basis of actual consumption,
- third-party financing for energy efficiency investments in the public sector,
- thermal insulation of new buildings,
- regular inspection of boilers,
- energy audits of undertakings with high energy consumption

Programmes include laws, regulations, economic and administrative instruments, information, education and voluntary agreements whose impact can be objectively assessed (Directive 93/76/EEC).

4.2 Main goals

Action at community level could be research and technological development, promoting best practices and technology, better use of taxation and specific energy measures in different sectors (buildings, monitoring vehicles consumption). The national level is in many ways more appropriate for putting measures to encourage energy efficiency into effect. Such measures may include regulators, better control of the electricity supply chain, the introduction of certification mechanisms and optimisation of road transport. Industry has already moved in the direction of energy efficiency. Furthermore, driven by economic incentive, it is to be expected that industry will make additional significant improvements in its processes and the machines it uses (electric motors, compressors, etc.). European and national legislation impacts the energy consumption of industry, and to compensate, industry itself must take the necessary measures to fulfil the cap on greenhouse gas emissions imposed by the national allocation plans as foreseen in the emissions trading directive (Directive 2003/87/EC). It is in this respect that energy efficiency is a necessary tool. Energy saving overall derives from a change in consumer behaviour. This means, for example, enacting a policy making public transport more attractive, thereby encouraging

car users to take the bus or train instead; or educating people on how to reduce heat losses from their house.

The purpose of this Directive is to enhance the cost-effective improvement of energy end-use efficiency in the Member States by providing the necessary indicative targets as well as mechanisms, incentives and institutional, financial and legal frameworks to remove existing market barriers and imperfections that impede the efficient end use of energy. The Directive is also a catalyst for creating the conditions for the development and promotion of a market for energy services and for the delivery of other energy efficiency improvement measures to final consumers.

The aim of this Directive is not only to continue to promote the supply side of energy services, but also to create stronger incentives for the demand side. The public sector in each Member State should thus set a good example regarding investments, maintenance and other expenditures on energy-using equipment, energy services and other energy efficiency improvement measures.

In its Resolution of 7 December 1998 on energy efficiency in the European Community, the Council endorsed a target for the Community as a whole to improve energy efficiency in final consumption by an additional one percentage point per annum up to the year 2010. Member States should therefore adopt national indicative targets to promote energy end use efficiency and to ensure the continued growth and viability of the market for energy services, and thus contribute to the implementation of the Lisbon strategy. The adoption of national indicative targets to promote energy end-use efficiency provides effective synergy with other Community legislation that will, when applied, contribute to the achievement of those national targets. In aiming to achieve their national indicative target, Member States may set themselves a target higher than 9 %. The improvement of energy efficiency will benefit from an exchange of information, experience and best practice at all levels, including, in particular, the public sector. Therefore, Member States should list measures undertaken, in the context of this Directive, and review their effect as far as possible in energy efficiency action plans (Directive 2006/32/EC).

This work also started during unsettling problems of energy usage in the buildings sector which accounts for 40% of the EU's energy requirements. It offers the largest single potential for the improvement of energy efficiency. Research shows that more than one-fifth of the present energy consumption and up to 30–45 M tons of CO_2 annually could be saved by 2010 by applying more ambitious standards to new and refurbished buildings - which represents a considerable contribution to meeting the Kyoto targets.

The aim of improved energy efficiency has been set out in earlier existing legal instruments. Among the main Community legislation for the sector are the Boiler Directive (92/42/EEC), the Construction Products Directive (89/106/EEC) and the buildings provisions in the SAVE Directive 93/76/EEC). The Directive on the energy performance of buildings in force since January 2003 builds on those measures with the goal of providing for an ambitious step-ahead to increase the energy performance of public, commercial and private buildings in all Member States.

In spring 2008, the European Commission launched a public consultation on the recasting of the Energy Performance of Buildings Directive (2002/91/EC), which closed on 20 June 2008.

The Directive on energy efficiency of buildings was adopted, after a lively discussion at all levels and with overwhelming support from Member States and the European Parliament, on 16th December 2002 and entered into force on 4th January 2003. It is considered a very

important legislative component of energy efficiency activities of the European Union designed to meet the Kyoto commitment and responds to issues raised in the recent debate on the Green Paper on energy supply security.

Estimates project a cost-effective savings potential realisable by 2010 of around 22% within the building sector - if this potential was realised, around 20% of the EU Kyoto commitment could be met. Transposition of this Directive by 2006 at the latest will allow a portion of this potential to be translated into reduced energy consumption.

The Directive is set to promote the improvement of energy performance of buildings with four requirements to be implemented by the Member States:

- A general framework for a methodology of calculation of the integrated performance of buildings
- Setting of minimum standards in new and existing buildings
- Energy Certification of Buildings
- Inspection and assessment of heating and cooling installations

The Directive is foremost a measure that concerns a very large number of actors on all levels and with different impacts and different motivations: designer, housing associations, architects, providers of building appliances, installation companies, building experts, owners, tenants, essentially all energy consumers in the European Union.

4.3 Mechanisms

The Directive proposes that all types of information relating to energy-efficiency should be widely disseminated in an appropriate form, including through billing, to relevant target audiences. This can include information on financial and legal frameworks, communication and promotion campaigns, and the widespread exchange of best practice at all levels. It says that Member States shall adopt and aim to achieve an overall national indicative energy savings target of 9 % for the ninth year of application of this Directive, to be reached by way of energy services and other energy efficiency improvement measures. It proposes to take cost-effective, practicable and reasonable measures designed to contribute towards achieving this target. Each Member State shall draw up programmes and measures to improve energy efficiency and also ensure the removal of those incentives in transmission and distribution tariffs that unnecessarily increase the volume of distributed or transmitted energy. In this respect Member States may impose public service obligations relating to energy efficiency on undertakings operating in the electricity and gas sectors respectively. Member States may establish a fund or funds to subsidise the delivery of energy efficiency improvement programmes and other energy efficiency improvement measures and to promote the development of a market for energy efficiency improvement measures. Such measures shall include the promotion of energy auditing, financial instruments for energy savings and, where appropriate, improved metering and informative billing. The funds shall also target end-use sectors with higher transaction costs and higher risks. If established, the funds may provide for grants, loans, financial guarantees and/or other types of financing that guarantee results. Member States shall ensure the availability of efficient, high-quality energy audit schemes which are designed to identify potential energy efficiency improvement measures and which are carried out in an independent

manner, to all final consumers, including smaller domestic, commercial and small and medium-sized industrial customers. According to the Directive, Member States shall ensure that, in so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity, natural gas, district heating and/or cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use (Directive 2006/32/EC).

Energy savings in a particular year, following the establishment of this Directive, that result from energy efficiency improvement measures initiated in a previous year not earlier than 1995 and that have a lasting effect may be taken into account in the calculation of the annual energy savings. In certain cases, where circumstances can justify it, measures initiated before 1995 but not earlier than 1991 may be taken into account. Measures of a technological nature should either have been updated to take account of technological progress, or be assessed in relation to the benchmark for such measures.

The Directive says that the Commission will provide guidelines on how the effect of all such energy efficiency improving measures should be measured or estimated, based, wherever possible, on existing Community legislation (Directive 2006/32/EC).

4.4 System of punishment

Taking full account of the national organisation of market actors in the energy sector and in order to favour the implementation of energy services and of the measures to improve energy efficiency provided for in this Directive, Member States should have the option of making it compulsory for energy distributors, distribution system operators or retail energy sales companies or, where appropriate, for two or all of these market actors, to provide such services and to participate in such measures (Directive 2006/32/EC). But there is no punishment system proposed in the document. The general idea is that countries, by way of internal energy market regulations and laws, should show the support schemes and ways to promote energy efficiency. If any of the Member States do not reach their goals there is no real plan for what will happen in that situation.

4.5 Difficulties in usage

This Directive requires action to be undertaken by the Member States, with the fulfilment of its objectives, depending on the effects that such action has on the final consumers of energy. The end result of Member States' action is dependent on many external factors which influence the behaviour of consumers as regards their energy use and their willingness to implement energy saving methods and use energy saving devices. Therefore, even though Member States commit themselves to making efforts to achieve the target figure of 9 %, the national energy savings target is indicative in nature and entails no legally enforceable obligation for Member States to achieve it.

Since the objectives of this Directive, namely to promote energy end-use efficiency and to develop a market for energy services, cannot be sufficiently achieved by the Member States and can be better achieved at Community level, the Community may adopt its own measures. This Directive does not go beyond what is necessary in order to achieve those objectives.

The Directive explains that a bottom-up calculation method means that energy savings obtained through the implementation of a specific energy efficiency improvement measure are measured in kilowatt-hours (kWh), in Joules (J) or in kilogram oil equivalent (kgoe) and added to energy savings results from other specific energy efficiency improvement measures (Directive 2006/32/EC). It is written that the authorities or agencies will ensure that double counting of energy savings, which results from a combination of energy efficiency improvement measures (including mechanisms), is avoided. But it is not explained how the counting should be done. Assuming that it won't be a problem of calculations is not solving a problem. The terms of this directive and its proposed mechanisms' disturbing effects will play a sizeable role in overall summary reports and are impossible to remove. And it is very important to note that double counting is not the only difficultiy in estimating results.

4.6 Disturbing Effects

4.6.1 Free Rider

The free rider effect is usually defined as the "portion of gross programme impacts that would have occurred even if there had been no programme. A free-rider is a customer who would have adopted the actions recommended by the programme even without the programme and who participates directly in the programme" (SRCI 2001).

This term regards actors who make use of facilities or support, provided by EEI[2] promotion measures, but would have taken energy-saving measures anyway. This behaviour poses a problem in calculating energy savings due to EEI promotion measures, where a difference should be made between related savings (from end-user EEI measures taken with promotion) and induced savings (from end-user EEI measures taken only because of promotion). According to the definition of the ESD[3] target, induced savings must be reported and free-rider savings are part of the autonomous savings. This is an argument for why ESD energy savings should be corrected for the fraction of free riders. However, the ESD does not explicitly mention this, and it therefore needs a decision from the Commission about whether to correct energy savings for the free-rider effect or not (EMEEES). Several reasons may explain the free-rider effect, especially adjustment factors usually considered in the top-down approach: autonomous effect, energy price effect, natural change effect. A way to address the free-rider effect could then be to list possible reasons for free-riders, and thus avoid double counting adjustment factors.

The free rider effect can occur in three ways (Commission, Green Paper on EE):

- pure or full free-ridership exists when all of the gross impact related to an installation or some other unit of programme implementation would have occurred exactly as it did in the programme, even if the programme had not existed
- partial free-ridership exists when only some portion of the gross impact would have occurred in the absence of the programme

[2] Energy Efficiency Improvement

[3] Energy Services Directive. Shortcut name of "Directive 2006/32/EC of the European Parliament and of the Council on energy end – use efficiency and energy services and repealing Council Directive 93/76/EEC", Official Journal of the European Union

Deferred free-ridership is more complex. It exists when some portion of the gross impact would have occurred in the absence of the programme, but would have occurred at a later date.

4.6.2 Multiplayer Effect

The opposite of the free-rider effect (also termed spill-over effect) is the Multiplayer Effect. For instance, obligatory high-efficiency boilers in new dwellings lead to cost reductions that make this boiler also attractive for existing dwellings, even without subsidies. Thus the EEI promotion measure "mandatory high efficiency boilers in new dwellings" provides more savings than the intended effect for the target-group. In this case, the induced energy savings are larger than the savings related to the EEI promotion measure (EMEEES).

4.6.3 Rebound Effect

The rebound effect is usually defined as "a change in energy using behaviour that yields an increased level of service and that occurs as a result of taking an energy efficiency action" (TecMarket).

This term (also called take-back effect) regards the energetic effects of spending money that is saved by applying profitable energy saving measures. It is measured by the difference between the projected and actual savings. It consists of direct, indirect and macroeconomic effects that can happen following the installation of more efficient equipment. There are two rebound types, one in the energy domain (direct rebound effect) and another in the economic domain (indirect or macro rebound effect).

Direct Rebound Effect

The consumer chooses to use more of the resource instead of realizing the energy cost savings. An example of this term is a higher thermostat setting after implementing insulation measures. A person with a more efficient home heater may chose to raise the setting on the thermostat. Also a person driving a more efficient car may drive more. Part of the avoided expenditures on energy is used to increase comfort levels. However, in most cases the money is spent on goods or services outside the energy domain (see indirect rebound). Because the direct rebound effect is coupled to specific end-user EEI measures, it must be corrected for in bottom-up evaluations[4].

Indirect Rebound Effect

The consumer chooses to spend the money saved by buying other goods which use the same resource. It regards energy expenditures saved that are spent on non-energy products or services. The energy used to design, produce, operate, and use these products and services decreases the initial effect of savings on total energy consumption. A person whose electric bill decreases due to a more efficient air conditioner may use the savings to

[4] The standard strategy of evaluation of logic programs is top-down and depth-first: from the goal, a number of clauses are identified as being possibly able to prove the goal, and recursion over the literals of their bodies is performed. An alternative strategy is to start from the facts and use clauses to derive new facts; this strategy is called bottom-up. It is considered better than the top-down one when the aim is that of producing all consequences of a given program, rather than proving a single goal. In particular, finding all consequences of a program in the standard top-down and depth-first manner may not terminate while the bottom-up evaluation strategy terminates

buy more electronic goods. By nature this rebound effect has to be analysed at a high aggregation level. Often indirect rebound effects are not taken into account, as it is difficult to prove in top-down evaluations that increased energy use is due to earlier profitable energy savings, leading to the saved money spent on new products and services, the production of which needs energy (instead of new appliances with attractive properties or any other reasons for a "natural" growth in the demand for energy services). It can also be calculated in an economic analysis on an aggregate level based on a bottom-up evaluation of the benefits and costs of specific EEI measures (EMEEES).

Under certain circumstances, the rebound effect could actually turn an increase in efficiency into an increase in demand. Actual measures of the rebound effect for electric end-use equipment have been found to be between 0% and 40%. That is, the actual decrease in demand realized can range from 100% to about 60% of the projected amount (Greening, Energy Efficiency).

DEVICE	SIZE OF REBOUND	NUMBER OF STUDIES
Space Heating	10-30%	26
Space Cooling	0-50%	9
Water Heating	10-40%	5
Residential Lighting	5-12%	4
Home Appliances	0%	2
Automobiles	10-30%	23

Figure 4.1 Measured Rebound Effects on Various Devices (Greening, Energy Efficiency, 2000)

4.6.4 Double Counting

This term characterizes interaction between the effects of EEI promotion measures or driving factors. Concretely it means that the combined effect of two measures or driving factors is smaller (overlapping combination) than the sum of the separate effects. Interaction can occur between:

- two specific EEI promotion measures
- a specific and a horizontal EEI promotion measure
- exogenous drivers (e.g. energy prices) and EEI promotion measures (EMEEES)

Interaction can happen not only between two measures implemented at the same time, but also between earlier and later measures. Interaction is relevant for savings that result from packages of EEI promotion measures, because the effects of the elements evaluated individually do not just add up. On the other hand, interaction is not relevant for total energy savings evaluated bottom-up or total top-down, because here the effect of interaction is by nature already accounted for in the calculation of savings.

The combined effect of two EEI promotion measures can also be greater (reinforcing combination) than the sum of the separate effects. Therefore, combined EEI promotion measures must usually be evaluated as a package right away, which is best with an integrated monitoring and evaluation approach. This should also automatically avoid

double-counting (EMEEES).

4.6.5 Hidden Structure Effects

Those effects are relevant for top-down saving calculations only. Changes in energy use can be attributed to growth in activities (volume effect), energy savings and other changes in the socio-economic system (structure effects). In top-down analysis it is attempted to filter out structure effects as much as possible. However, due to lack of statistical data, it is not possible to take account of all structure effects. Therefore, the total energy saving figure monitored top-down will be mixed up with so-called hidden structure-effects. For instance, lower occupancy rates for dwellings can emerge as "savings", if the efficiency increase is derived from the change in average gas use for space heating (EMEEES).

4.6.6 Earlier Policy

The energy savings from earlier policy have been defined separately from energy savings due to early action. In energy saving calculations for monitoring, only EEI promotion measures from concrete time, with verifiable effects still lasting in the programme period, are eligible (early actions). The energy savings from EEI promotion measures before, and measures without verifiable effects, constitute energy savings from "earlier policy". For example, current measurements of the effects of subsidies for the improvement of windows systems in buildings, which is also caused by a previous propagation programme of this kind of improvements. They should not be part of monitoring programme energy savings. However, due to the uncertain aggregated saving effect, it is difficult to determine this correction (EMEEES).

4.7 Discussion

The most important barrier to increased energy efficiency is a lack of information (on costs and availability of new technology; lack of information on costs of own energy consumption; lack of training of technicians on proper maintenance and the fact that these aspects are not properly taken into account by market participants). This can be a particular problem when making investments which are often long term. If you can find a sector undergoing a long term trend, you are by definition looking at a potential investment opportunity, especially if that sector is one of the most important in all of the economy, and if its growth is based on a scientific certainty and if the price to earnings multiples of many stocks in that industry are reasonable (Kingsdale, Investment Philosophy). Investment decisions can also be influenced by the split-incentive problem, e.g. between the landlord (who installs the boiler) and the tenant (who pays the heating bill); or where a corporate investment budget is not coordinated with the energy budget. There can also be misleading prices (due to the exclusion of externalities, a lack of transparency). Technical barriers such as the lack of standardisation of energy-using equipment and components can also make it more difficult for new energy efficient technologies to have a rapid impact on the market.

5 DIRECTIVE 2001/77/EC ON THE PROMOTION OF ELECTRICITY PRODUCED FROM RENEWABLE ENERGY SOURCES IN THE INTERNAL ELECTRICITY MARKET

5.1 Introduction

This Directive is focused on the need to promote renewable energy sources that contribute to environmental protection and sustainable development. The economics of sustainability deal with natural, human–made, and human capital. It is thus more than environmental economics, because it includes the development of an economy and society, not just management of environmental issues. Economics in general deals with the production and distribution of wealth and is sometimes defined as the science dealing with the use of, or allocation of, scarce resources (Rogers, An introduction to sustainable development). The concept of sustainability explores the relationship between economic development, environmental quality, and social equity. This concept has been evolving since 1972, when the international community first explored the connection between quality of life and environmental quality at the United Nations Conference on the Human Environment in Stockholm. However, it was not until 1987 that the term "sustainable development" was defined as "development that can meet the needs of the present generation without compromising the ability of future generation to meet their own needs". This definition established the need for integrated decision making that is capable of balancing the economic and social needs of the people with the regenerative capacity of the natural environment. Sustainable development is a dynamic process of change in which the exploration of resources, the direction of investments, the orientation of technological development, and institutional changes are made consistent with future as well as present needs (Rogers, An introduction to sustainable development). In addition this can also create local employment, have a positive impact on social cohesion, contribute to security of supply and make it possible to meet Kyoto targets more quickly. It is therefore necessary to ensure that this potential is better exploited within the framework of the internal electricity market. The promotion of electricity produced from renewable energy sources is a high Community priority as outlined in the White Paper on Renewable Energy Sources for reasons of security and diversification of energy supply, of environmental protection and of social and economic cohesion. The increased use of electricity produced from renewable energy sources constitutes an important part of the package of measures needed to comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and of any policy package to meet further commitments (Directive 2001/77/EC).

5.2 Main goals

The purpose of this Directive is to promote an increase in the contribution of renewable energy sources to electricity production in the internal market for electricity and to create a basis for a future Community framework thereof. It suggests that all Member States should be required to set national indicative targets for the consumption of electricity produced from renewable sources. The Commission will assess the extent to which Member States have made progress towards achieving their national indicative targets, and to what extent

the national indicative targets are consistent with the global indicative target which was set at a level of 12% of gross domestic energy consumption by 2010. Considering that the White Paper's indicative target was 12 % for the Community as a whole by 2010 provides useful guidance for increased efforts in Member States. If necessary for the achievement of the targets, the Commission will submit proposals to the European Parliament and the Council which may include mandatory targets. A legislative framework for the market in renewable energy sources needs to be established. In January 2008 The European Commission (EC) proposed a renewable energy directive as part of a comprehensive energy and climate change package. The new directive aims to establish national renewable energy targets that result in an overall binding target of a 20% share of renewable energy sources in energy consumption in 2020 within the European Union, and a binding 10% minimum target for biofuels in transport to be achieved by each member state (IHS Energy).

Member States operate different mechanisms of support for renewable energy sources at the national level, including green certificates, investment aid, tax exemptions or reductions, tax refunds and direct price support schemes. One important means to achieve the aim is to guarantee the proper functioning of these mechanisms. Increased market penetration of electricity produced from renewable energy sources will allow for economies of scale, thereby reducing costs (Directive 2001/77/EC).

5.3 Systems and mechanisms of support

Financial investment schemes provide incentives for the actual investment and implementation phase of RES-E facilities. Also, tax incentives (reduction of income tax and VAT) are commonly used, whereas soft loans and voluntary agreements are of minor importance. It turns out that for each of the considered sectors electricity, heat and transport there are quite typical kinds of policies in EU (Joergensen, Altener Program). For example, China’s elimination of coal subsidies is also kind of support mechanism for development of renewable energy.

5.3.1 Investment Aid

These credits stimulate investment and job creation by attracting new investment projects and promoting expansion or diversification of existing enterprises. Eligible enterprises can benefit from credits calculated as a percentage of the value of the investment project.

5.3.2 Tax Incentive

A Tax Incentive is a temporary reduction or elimination of a tax. Governments usually create tax incentives as a means of promotion for business investments. The taxes that are most commonly reduced by national and local governments are sales taxes. In developing countries, governments sometimes reduce or eliminate corporate taxes for the purpose of attracting Foreign Direct Investment or stimulating growth in selected industries. Tax incentives are given in respect to particular activities, and sometimes also only in particular areas with a view to develop that area of business. Several EU countries have implemented tax incentives for the promotion of RES-E. They first of all refer to a reduction of income tax and VAT.

5.3.3 Tax Exemption

A Tax Exemption is an exemption from all or certain taxes of a state or nation in which part of the taxes that would normally be collected from an individual or an organization are instead foregone. Normally a tax exemption is provided to an individual or organization which falls within a class which the government wishes to promote economically, such as renewable energy investors. Tax exemptions are usually meant to either reduce the tax burden on a particular segment of the market in the interests of fairness or to promote some type of economic activity through reducing the tax burden on those organizations or individuals who are involved in that activity. Tax exemptions have a history of being tools of social and economic change with unintended consequences.

5.3.4 Subsidies

Subsidising is any financial input, including tax relief, to lower the costs of RES or RUE projects, whether it is prior to, under or after the investment phase. Examples of subsidies before the investment phase are R&D–support for RES/RUE-technologies, subsidising of the manufacturing of these and demonstrations and pilot projects. Subsidies in direct connection with the investments may be direct grants or tax relief schemes. Also, the subsidies may be in the form of more attractive financing opportunities than can be obtained in the market. Post-investment subsidies (during the operation of the RES/RUE-schemes) may be assured feed-in tariffs or bonus schemes per kWh of electricity generated. Investment Subsidies are a common strategy to provide incentives for investment. Subsidies can be granted either as a percentage (%) of investment costs, per unit of electricity generated or by capacity installed. It is a fine tuned promotion program for different technologies and it can be adjusted with respect to the kind of technology being promoted. Investment Subsidies are usually only awarded for new installations. Subsidies for new investments exist in most EU countries, especially in Finland, Greece, Luxemburg and Portugal. However, it should be noted that the actual efficiency of promotion schemes often is strongly influenced by the budget that is available for these programmes.

5.3.5 Green Certificates

Carbon trading is sometimes seen as a better approach than a direct carbon tax or direct regulation. By solely aiming at the cap it avoids the consequences and compromises that often accompany other methods. It can be cheaper and politically preferable for existing industries because the initial allocation of allowances is often allocated with a grandfathering provision where rights are issued in proportion to historical emissions.

A central authority (usually a government or international body) sets a limit or cap on the amount of a pollutant that can be emitted. Companies or other groups are issued emission permits and are required to hold an equivalent number of allowances (or credits) which represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, limiting total emissions to that level. Companies that need to increase their emission allowance must buy credits from those who pollute less. The transfer of allowances is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed. Thus, in theory, those that can easily reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest possible cost to society. There are active trading programs in several pollutants. For greenhouse gases the largest is the European

Union Emission Trading Scheme. Markets for other pollutants tend to be smaller and more localized.

A recent Green Book on Energy Efficiency mentions explicitly the possibility of green certificates to become common to various EU countries. A Green Certificate also known as Renewable Energy Certificates (RECs) is a tradable commodity proving that certain electricity is generated using renewable energy sources. Typically one certificate represents generation of 1 Megawatt hour of electricity. Green certificates represent the environmental value of renewable energy generated. The certificates can be traded separately from the energy produced. Several countries use green certificates as mean to make the support of green electricity generation closer to market economy instead of more bureaucratic investment support and feed-in tariffs. Such national trading schemes are in use in Poland, Sweden, UK, Italy.

5.3.6 Feed In Tariffs

This promotion strategy has attracted attention since the late 1980s especially in Denmark, Germany, Italy and Spain. Today it is the most popular promotion instrument for RES-E. Feed-In Tariffs indicate the price per unit of electricity that a utility or supplier has to pay for renewable electricity from private generators (also called "producers"). Thus, a federal (or provincial) government regulates the tariff rate. The level of Feed-In Tariffs varies strongly between countries. In most countries Feed-In Tariffs vary depending on technologies and the size of plants. Depending on the technology the range of the Feed-In Tariffs varies about 300 to 500 percent (Joergensen, Altener Program).

5.3.7 Energy taxes

One of the most important indirect promotion schemes is the use of an energy tax to provide disincentives for the non–renewable solutions or solutions based on high-energy consumption.

5.4 System of punishment

In the proposed directive there is nothing written about a system of punishment or any other kind of penalty system. The general idea is that countries, in the form of internal energy market regulations and laws, should present the support schemes and the way to promote energy from renewable sources. If a Member States does not reach their set goals there is no plan in place for what should happen. The only thing that will be investigated is the attempt by the country to change the distribution and layout of its current energy sector profile.

5.5 Weakness of law

The definition of biomass used in this Directive does not assume the use of a different definition in national legislation for purposes other than those set out in this Directive. This means that theoretically there is a possibility to use, as a biomass, material which could be

forbidden on other markets. It also means that it is possible to count energy which was once assumed to be harmful as green energy.

In the Directive it is stated that a legislative framework for the market in renewable energy sources needs to be established. However such a market has not been established yet. And this statement doesn't change anything. It says that it is too early to decide on a Community-wide framework regarding support schemes, in view of the limited experience with national schemes and the current relatively low share of price supported electricity produced from renewable energy sources in the Community.

It is proposed in the Directive that it will be appropriate for the Commission to monitor the situation and present a report on experience gained with the application of national schemes. If necessary, the Commission should, in light of the conclusions of this report, make a proposal for a Community framework with regard to support schemes for electricity produced from renewable energy sources. That proposal should contribute to the achievement of the national indicative targets, be compatible with the principles of the internal electricity market and take into account the characteristics of the different sources of renewable energy, together with the different technologies and geographical differences. But in reality these are only words. In internal energy market mandatory targets will depend on current policy, or policy makers, who make decisions based on the lobbying of special interest groups.

The Directive states that when favouring the development of a market for renewable energy sources, it is necessary to take into account the positive impact on regional and local development opportunities, export prospects, social cohesion and employment opportunities, especially as to how these concern small and medium-sized undertakings as well as independent power producers (Directive 2001/77/EC). But usually it works in exactly the opposite way. Regional and local development is forgotten, bigger size projects are favourable.

It maintains that in certain circumstances it is not possible to ensure full transmission and distribution of electricity produced from renewable energy sources without affecting the reliability and safety of the grid system, and guarantees in this context may therefore include financial compensation. This is going to increase cost of renewable energy because the systems will be overdesigned and have an unnecessarily oversized installed capacity.

In article 3, the Directive states (Directive 2001/77/EC) that Member States shall publish, every two years, a report which includes an analysis of success in meeting the national indicative targets taking account, in particular, of climatic factors likely to affect the achievement of those targets. The report should also indicate to what extent the measures taken are consistent with the national climate change commitment. The Commission's report, containing its conclusions, shall be published every two years. This report shall be accompanied, as appropriate, by proposals to the European Parliament and to the Council. If the report concludes that the national indicative targets are likely to be inconsistent, for reasons that are unjustified and do not relate to new scientific evidence, with the global indicative target, these proposals shall address national targets, including possible mandatory targets, in the appropriate form. Basically this means that there is no pressure to make any energy changes and no punishment system.

Article 7, which concerns grid system issues (Directive 2001/77/EC), suggests that without prejudice to the maintenance of the reliability and safety of the grid, Member States shall take the necessary measures to ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources. They may also provide for priority access to the

grid system of electricity produced from renewable energy sources. When dispatching generating installations, transmission system operators shall give priority to generating installations using renewable energy sources insofar as the operation of the national electricity system permits. This seems to be an appropriate theoretical application but in the real market it may cause only problems.

5.6 Discussion

Many conditions differ among countries, even in regions within countries, such as natural resource endowments, regional policy and economic systems, and cultural traditions. All of these factors can lead to differences in energy costs and prices. Natural resource endowments are important because they can impact the energy choices countries make.

The intent of the Directive is to provide an overview of and basis for analysis of promotion schemes for RES and RUE. There is a particular focus on the financial and regulatory aspects. Almost all EU countries provide some kind of R&D support for RES-E.

When acting as a financial post–investment-push approach, energy taxes have a strong impact on both RUE and, because of broad exemptions for renewables, also for RES. Therefore this instrument cannot be classified clearly to one kind of technology. Countries[5] within the scope of this dissertation have at least some kind of energy taxes. The most important of those are taxes on transportation fuels, heating oil and electricity. With respect to RUE, non-financial strategies are dominating. The emphasis in the field of electricity currently is put on labelling and in the field of heat on regulatory schemes (building regulations). As can be expected building regulations depend to a large extent on the climate conditions in the countries.

Compared to RUE in general there is much more focus on financial incentives when it comes to RES. In the field of electricity generation from RES, post-investment schemes strongly dominate and are partly combined with subsidies. In the field of heat generation from RES strong emphasis is given to investment subsidies which often are combined with tax incentive schemes – especially reduction of VAT and income tax. Promotion schemes in the field of transport are heavily dominated by post investment tax incentives, above all tax exemptions of biofuels and relatively high taxation of fossil fuels (Joergensen, Altener Program).

[5] Slovak Republic - chapter 9, Czech Republic - chapter 10, Poland - chapter 11

6 DIRECTIVE 2003/30/EC ON THE PROMOTION OF THE USE OF BIOFUELS OR OTHER RENEWABLE FUELS FOR TRANSPORT

6.1 Introduction

Natural resources and their prudent and rational utilisation include oil, natural gas and solid fuels, which are essential sources of energy but also the leading sources of carbon dioxide emissions. However, there is a wide range of biomass that could be used to produce biofuels, deriving from agricultural and forestry products, as well as from residues and waste from forestry and the forestry and agri-foodstuffs industry. The transport sector accounts for more than 30% of final energy consumption in the Community and is expanding. Between 1990 and 2004, GHG (Greenhouse Gas) emissions from transport increased by 32.2%, or 2 per cent per year on average. The share of transport in total EU25 GHG emissions rose from 17% in 1990 to 24% in 2004. Emissions from international aviation and shipping (outside Kyoto) have risen by 86% and 45% respectively, and accounted in 2004 for 22% of transport emissions. Emissions of climate-changing GHGs (Greenhouse Gases) from the EU-25 increased by 18 million tonnes (0.4 %) between 2003 and 2004. The increase of GHG emissions from the transport sector excluding international aviation and shipping was 2.2%. If we include the emissions from international bunkers, the increase in transport emissions is much higher, namely 3.1%. Excluding international bunkers, GHG emissions of the EU-25 compared to 1990 have been decreasing (-4,8%) while the transport sector GHG emissions have increased more than one quarter (25,9%). If we include international bunkers, GHG emissions of the EU-25 have decreased (-2,7%) and the transport sector GHG emissions have increased almost one third (32,2%). If transport emissions had not increased since 1990 but rather stabilised, the overall reduction of GHG in the EU-25 (including the emissions from international bunkers) would have been -8,1% (instead of -2.7%). If the same calculations are applied without considering the emissions from international bunkers (i.e., all 'Kyoto' emissions) the reductions would change from -4.8% to -8.4%. In conclusion, if the emissions from the transport sector would not have increased the EU would already be complying with the target of an 8% reduction of GHG emissions, defined in the Kyoto Protocol. The share of the transport sector's emissions has been continuously growing since 1990. Without international bunkers the contribution grew from 15% in 1990 to 19.4% in 2004. Including international bunkers the share grew from 17.4% in 1990 to 23.6% in 2004 (European federation for transport and environment, GHG Emissions).

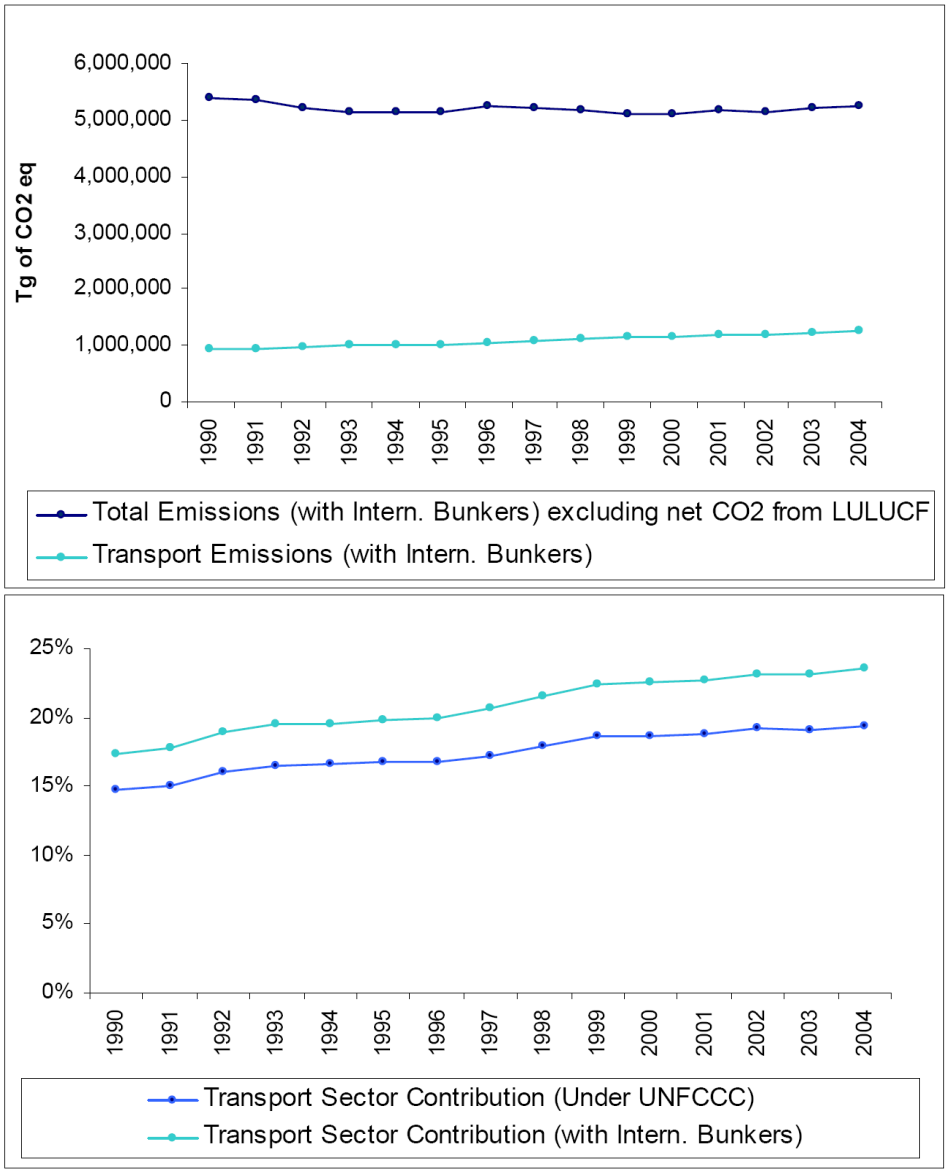


Figure 6.1 The evolution of total GHG emissions in the EU-25 (European federation for transport and environment, GHG Emissions, 2006)

Greater use of biofuels for transport forms a part of the package of measures needed to comply with the Kyoto Protocol. As a result of technological advances, most vehicles currently in circulation in the European Union are capable of using a low biofuel blend without any problem. The most recent technological developments make it possible to use higher percentages of biofuel in the blend. Some countries are already using biofuel blends of 10% and higher. Promoting the use of biofuels in transport constitutes a step towards a wider application of biomass which will enable biofuel to be more extensively developed in the future, whilst not excluding other options and, in particular, the hydrogen option (Directive 2003/30/EC).

6.2 Main goals

This Directive aims at promoting the use of biofuels or other renewable fuels to replace diesel or petrol for transport purposes in each Member State, with the intent of contributing

to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources.

Increased use of biofuels for transport, without ruling out other possible alternative fuels, including automotive LPG[6] and CNG[7], is one of the means by which the Community can reduce its dependence on imported energy and influence the fuel market for transport and hence the security of energy supply in the medium and long term. Promoting the use of biofuels in keeping with sustainable farming and forestry practices laid down in the rules governing the common agricultural policy could create new opportunities for sustainable rural development in a more market-orientated common agriculture policy geared towards the European market and to respect for flourishing country life and multifunctional agriculture, and could open a new market for innovative agricultural products with regard to present and future Member States. The Commission Green Paper 'Towards a European Strategy for the Security of Energy Supply' sets the objective of 20% substitution of conventional fuels by alternative fuels in the road transport sector by the year 2020.

Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets. A reference value for these targets shall be 5.75%, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010.

6.3 Mechanisms

According to article 4, Member States shall report to the Commission each year, on (Directive 2003/30/EC):

- the measures taken to promote the use of biofuels or other renewable fuels to replace diesel or petrol for transport purposes,
- the national resources allocated to the production of biomass for energy uses other than transport,
- the total sales of transport fuel and the share of biofuels, pure or blended, and other renewable fuels placed on the market for the preceding year. Where appropriate, Member States shall report on any exceptional conditions in the supply of crude oil or oil products that have affected the marketing of biofuels and other renewable fuels.

In these reports, differentiation of the national targets shall be motivated and could be based on the following elements:

[6] LPG, Liquefied petroleum gas (also called GPL, LP Gas, or autogas) is a mixture of hydrocarbon gases used as a fuel in heating appliances and vehicles, and increasingly replacing chlorofluorocarbons as an aerosol propellant and a refrigerant to reduce damage to the ozone layer

[7] CNG, Compressed Natural Gas is a fossil fuel substitute for gasoline (petrol), diesel, or propane fuel. Although its combustion does produce greenhouse gases, it is a more environmentally clean alternative to those fuels, and it is much safer than other fuels in the event of a spill (natural gas is lighter than air, but disperses quickly when released)

- objective factors such as the limited national potential for production of biofuels from biomass;
- the amount of resources allocated to the production of biomass for energy uses other than transport and the specific technical or climatic characteristics of the national market for transport fuels;
- national policies allocating comparable resources to the production of other transport fuels based on renewable energy sources and consistent with the objectives of this Directive.

6.4 System of punishment and difficulties in usage

The Directive states (Directive 2003/30/EC, p. 14) that new types of fuel should conform to recognised technical standards if they are to be accepted to a greater extent by customers and vehicle manufacturers and hence penetrate the market. Technical standards also form the basis for requirements concerning emissions and the monitoring of emissions. Difficulties may be encountered in ensuring that new types of fuel meet current technical standards, which, to a large extent, have been developed for conventional fossil fuels. The Commission and standardisation bodies should monitor developments and adapt and develop new standards, particularly concerning aspects of volatility, so that new types of fuel can be introduced, whilst maintaining environmental performance requirements. In that case there is a question of the manipulation of fuel standards just to reach set goals. Instead of increasing fuel parameters, which will cause fuel producers to work on quality of fuel, this path will be focused on preparing exact standards for fuel producers, so they can supply the market.
Since the objective of the proposed action, namely the introduction of general principles providing for a minimum percentage of biofuels to be marketed and distributed, cannot be achieved sufficiently by the Member States by reason of the scale of the action, and can therefore be achieved better at Community level, the Community may adopt measures in accordance with the principle of subsidiarity. The principle of subsidiarity holds that a larger and greater body should not exercise functions which can be carried out efficiently by one smaller and lesser, but rather the former should support the latter and help to coordinate its activity with the activities of the whole community. This principle defines subsidiarity as the idea that a central authority should have a subsidiary function, performing only those tasks which cannot be performed effectively at a more immediate or local level. It was introduced to the European Union in the Treaty of Maastricht as a general principle applicable to all areas of non-exclusive competence.
In other words, it means the State shall take action only if and insofar as the objectives of the proposed action cannot be sufficiently achieved by the communities and can therefore, by reason of the scale or effect of the proposed action, be better achieved at the State level.
It means that policies should always be made at the lowest possible level, and that the higher level should only legislate when there is unanimous agreement that uniform regulation is necessary. This will basically result in Member States citizen's money being used for backing up fuel producers who otherwise would not be able to survive in normal market conditions.

It is stated (Directive 2003/30/EC, Article 3, p. 4) that in the measures that they take, the Member States should consider the overall climate and environmental balance of the various types of biofuels and other renewable fuels and may give priority to the promotion of those fuels showing a very good cost-effective environmental balance, while also taking

into account competitiveness and security of supply; Which sounds nice but will depend only on the efforts of lobbyists.

The Directive declares (Directive 2003/30/EC, Article 4, p. 2) that on the basis of report, the Commission shall submit, where appropriate, proposals to the European Parliament and to the Council on the adaptation of the system of targets. If this report concludes that the indicative targets are not likely to be achieved for reasons that are unjustified and/or do not relate to new scientific evidence, these proposals shall address national targets, including possible mandatory targets, in the appropriate form. This only shows that there is no punishment or penalty system and no need to have a strong impact on the current situation.

6.5 Discussion

The biofuels market is not like any other market because its development is intimately associated with its total or partial exemption from the tax on petroleum products. The cost associated with the tax exemption of biofuels has led certain States to define overall financial packages corresponding only to production quotas authorised to benefit from tax exemption.

All the reports submitted to the Commission so far are available on the Commission's website (Commission, MS Reports in the frame of Directive 2003/30/EC). In these reports, Member States may indicate the national objectives for the introduction of biofuels over the period 2008–2020. On 10 January 2007, the Commission submitted a progress report on the use of biofuels in EU Member States to the Council and the European Parliament. The Member States showing the best results in 2006 were Germany, Austria, Sweden, France and Lithuania. The share of biofuels in these countries (on the basis of energy content) amount to 6.32%, 3.54%, 3.10%, 1.75% and 1.72% of all gasoline and diesel for transport purposes placed on the market. The average for the EU-27 amounted to 1.76% in 2006 (calculated in proportion to the respective fuel consumption of Member States). Today, these limits are still purely political because European law allows the member States to benefit, after authorisation, from a total exemption for biofuels consumption without any production restrictions (Biofuels-platform.ch).

On 10 January 2007, the Commission submitted a progress report on the use of biofuels in EU Member States to the Council and the European Parliament. In this report, the Commission again asserts that an increasing use of biofuels shall have significant beneficial effects on the security of supply and contribute to the reduction of greenhouse gas emissions. The use of biofuels is the only solution currently available to reduce the near-total dependence on fossil fuels in the transportation sector and is one of the ways to significantly reduce greenhouse gas emissions.

The Commission further states that the share of biofuels in 2005 hardly exceeded 1% (compared with 2% according to the original target of Directive 2003/30/EC). It also concludes that the target of 5.75% biofuels by 2010 will most likely not be reached and believes (based on the policy and existing measures) that the penetration of biofuels in 2010 will be 4%.

It is essential that the Council should review the biofuels directive (Biofuels-platform.ch):

- Confirm its determination to reduce its dependence on oil in the transportation sector and to move towards a low carbon economy

- Establish minimum standards for the share of biofuels in 2020 (standards with a penalty system similar to green certificates)
- Ensure that low performance biofuels are discouraged while high performance biofuels are encouraged (in terms of environmental impact and security of supply)
- Establish standards for vehicles' engines performance for producers
- Review the directive, taking into consideration the Directive on Energy Efficiency (Directive 2006/32/EC) and the possibilities of cooperation these documents provide on the way to reduce carbon dependency.

7 SUMMARY OF MAIN EUROPEAN COUNCIL'S REGULATIONS

The impact of future economic growth, coupled with an increasing population, means that we will be increasing our need for more energy. It is equally disturbing that we have not been able to end our reliance on fossil fuels. Work is underway on alternate energy sources, like wind, solar, geothermal and so on, and nuclear power is already available. The remaining scientific uncertainties surrounding nuclear energy are not grounds for complacency, but they require the application of the "precautionary principle", which is found in Principle 15 of the Rio Declaration on Environment and Development adopted at UNCED:

"In order to protect the environment, the precautionary approach shall be widely applied by countries 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" (Rogers, An introduction to sustainable development)

The energy sector is an area with a large number of players: governments, national regulators, large enterprises, local authorities, etc. Therefore, to mobilise all players and transform energy-efficiency policy over the long term, a strong political message is essential. Forceful action in the field of energy efficiency indeed requires a general structuring framework. It is the national, regional and local authorities, as well as industry, which will be responsible for implementing this framework. Only a combination of measures at the various levels (EU, Member States, regions, local level, industry) will allow the whole potential to be exploited.

In recent years, thanks to Russia's gas transmission blackmail, the topic of internal energy markets and security appeared. The significant issue of coherent energy policy for Europe became a main goal of policymakers.

The history of regulations and documents established by the European Council shows that there is substantial awareness and anxiety that set goals won't be reached. Published communications and proposals with information on how to improve systems and promote green energy are showing that there is the expectation of that fact and that policy will fail.

Currently, EU-wide vast sums of public money are wasted subsidising different types of energy technologies. The major reasons for this waste are:

- money spent is not targeted
- rebates are too high
- money is spent without any performance requirement of the technology

8 CENTRAL EASTERN EUROPEAN COUNTRIES' ENERGY SECTOR IMPLEMENTATION INTERNAL RULES

Since 1 May 2004 a number of new countries have joined the European Union. Included in this group of ten countries is a region which can be named central east Europe. This region includes Poland, the Czech Republic and Slovakia. The three countries are similar in many ways but the differences between them are greater than expected. For these countries, benefits connected with membership in the European Union are significant, but their membership also requires some work and changes to obsolete systems. The energy sector is one of these areas which require changes. Other similarly primitive regions also have problems related with resources and technology.

The mandatory implementation of energy policy on central eastern European countries' energy markets caused by the regulations and penalty systems created by the European Union and a comparison of these markets show differences and political paths which are struggling to meet the goals which were set for them by outside forces. For some the markets the imposed legislation has worked properly but in some cases it has been detrimental to the central eastern European energy markets.

9 SLOVAK REPUBLIC

9.1 Introduction

The Slovak Republic is a country situated in central east Europe, sharing borders with Poland, Ukraine, Hungary, Austria and the Czech Republic. The total area is about 49,000 square kilometres and its population is around five million. The largest city is its capitol, Bratislava. The Slavic people arrived in the territory of present day Slovakia between the 5th and 6th centuries during the Migration Period. In the course of history, various parts of Slovakia belonged to Samo's Empire (the first known political unit of Slavs), Great Moravia, the Kingdom of Hungary, the Habsburg (Austrian) monarchy, Austria-Hungary and Czechoslovakia. The present-day Slovak Republic became an independent state on 1st January 1993. Slovakia is a high–income economy with one of the fastest growth rates in the EU. Slovakia is largely dependent on the importation of energy sources; it imports more than 90% of all its energy consumption. In financial statements energy represents almost 20% of all imports. Coutnries which can lower their energy dependence on imports can significantly increase the use of renewable energy sources (RES), and can furthermore contribute to the reduction of greenhouse gas emissions and finally to the reduction of the negative effect of energy production on the environment. It is possible that in a half century the world‘s oil resources will be exploited under respectable conditions (the price influence of this prospect is markedly visible already) and the lifetime of fossil fuel sources can optimistically be estimated at only 100 to 200 years (natural gas 85 years and coal 200 years) (Viglasky, Opportunities and visions).

At present, Slovakia imports about 90% of its total energy demand. The Slovak primary energy requirements are heavily depended on imported oil, gas, coal and nuclear fuel, mainly from Russia. This amount of energy importation makes it necessary to look for any new possible RES and to emphasise their environmental reliability. Today, the share of RES in the overall primary energy consumption (OEC) of Slovakia is described as being between 2 and 4%, depending on the source (Holoubek, 2008).

Because crude oil and natural gas stores are being rapidly exploited and mining of the remaining coal will rise in price, RES will be the most important domestic energy sources in the near future. Fortunately, Slovakia has quite a substantial RES potential, which is expected to be mostly at the regional, municipal and residential levels (Viglasky, Development of bio energy).

In the Slovak Republic, large-scale hydro energy is the only RES with a notable share in total electricity consumption. Between 1997 and 2004, this market share has stabilised. The share taken up by small-scale hydro energy has decreased by 15% per year on average over the same period. An extended development programme with 250 selected sites for building small hydro plants has been adopted. In the Slovak Republic, the highest additional mid-term potential of all RES lies with biomass. The Government has decided to only use this source in remote, mountainous, rural areas, where natural gas is not available. Between 1997 and 2004, the Slovak republic has moved further away from its RES target (Commission, Slovak Republic).

9.2 Energy sector overlook

The development of the use of RES would provide Slovakia with significant potential to reach European Union goals. Slovakia's 90% dependency on foreign primary energy sources as well as its international responsibilities in the area of climatic changes influence the question of the use of RES and make it especially topical. This actuality was strongly supported by Slovakia's entrance into the EU as was Slovakia's goal of achieving the aims of the EU in the area of power engineering. On 27th September 2001 the European Parliament and the Council of EU adopted Directive 2001/77/EC. The Directive was published in the official publication of the EC on 27th October 2001. The aim of the Directive is to support the use of RES for electric power production so that 22.1% of the overall power consumption is from RES power production by the year 2010 (Viglasky, Opportunities and visions).

Table 9-1 Energy production from Renewable Energy Sources (Viglasky, Opportunities and visions, 2007)

Type of RES	**Technically exploitable potential**	**Current exploitation**	**Unused potential**
	GWh / year		
Geothermic energy	6,300	340	5,960
Wind energy	605	0	605
Solar energy	5,200	7	5,193
Hydro energy	6,607	5,093	1,514
Small hydro plants (up to 10 MWe)	1,034	202	832
Bio-fuels	*2,500*	*330*	*2,170*
Biomass	*11,237*	*3,523*	*7,714*
Forest biomass	*1,864*	*494*	*1,370*
Heating plants	*1,837*	*0*	*1,837*

Wood processing industry	*4,406*	*2,638*	*1,768*
Agricultural biomass	*2,322*	*60*	*2,262*
Waste-water treatment plants (sludge)	*230*	*13*	*217*
Waste from households	578	318	260
Total	**26,876**	**4,402**	**22,004**

9.2.1 Biomass

Forests cover more than 40% of Slovak territory (Slovak Centre of Biomass Use for Energy, Wood Heating). One possibility for the replacement of at least a portion of fossil fuels in district heating systems (a high percentage of them are fired by coal, others by oil or natural gas) is the use of biomass. Biomass fired boilers offer an attractive alternative. Slovakia only has a small number of highly populated cities but a relatively high number of municipalities with 3 to 10 thousand inhabitants. An impressively large number of these municipalities are heated by district heating systems. A high percentage of them are fired by coal, others by oil or natural gas (Ministry of Environment of Slovak Republic, Analyza). Boilers are mainly well maintained but are old and require imported fuel. The amount of biomass, which could annually be used in these conditions in Slovakia for heat and electricity generation, is enormous.

The most promising renewable source for heat production is biomass. The total p.a. suitable for energy production purposes is some 75.6 PJ. Biomass energy has the potential to combine economic, environmental and social benefits. Current electricity production is 30 GWh from biomass and 2 GWh from biogas (Doubrava, Potentials of renewable energy):

- Biomass utilization is through the association BIOMASA - leader in Slovakia;
- Slovakia has 16 producers of briquettes, 6 in pellets with production 40 000 t of briquettes and 28 000 t of pellets;
- Biomass firing takes place in Liptovský Ondrej, Prašice, Turňa nad Bodvou, Tlmače;
- Of the total area of Slovakia (4,903,423 hectares) agricultural land covers 49,7 % and forest land 40.84 %. Decrements in the agricultural land were not significant in recent years; however it was possible to observe a change of arable land to meadows and pastures (Doubrava, Potentials of renewable energy).

For short term, a number of biomass energy concepts seem to be the most promising:

- Replacement of small and medium scale coal fired heating systems by bio-fuels fired systems.
- Co-combustion of wood residues in existing coal fired power systems.
- Implementation of low cost anaerobic digestion systems with CHP generation.

The following concepts are expected to become more attractive for medium to long term:

- Implementation of small to medium scale CHP combustion or gasification systems provided that the electricity price has risen sufficiently.
- Cultivation and utilization of energy crops (ECs) where no wood residues are available. From an agricultural point of view, cultivation of ECs or SRCs[8] forms attractive alternative for the cultivation of food crops (Hartsough, Recent reports on SRC harvesters in Europe)

The highest share of used agricultural land (2,255,000 ha) is represented by arable land (61.7%), which is the basis of intensive plant production, mainly in agricultural production areas of Slovakia. Cereals (58 %), fodders (19%) and industrial crops (15.8 %) are the most prominent crops grown on the arable land (Ministry of Agriculture of the Slovak Republic, 2007).

Table 9-2 Area of used agricultural land (Ministry of Agriculture of the Slovak Republic, 2007)

Indicator	**Area in ha**		
	2001	**2002**	**2003**
Utilised agricultural land	2 ,54,801	2,236,424	2,236,036
Of that:			
- arable land	1,409,222	1,377,482	1,379,379
- permanent covers	28,934	27,795	28,240
- other areas including domestic gardens	32,740	32,479	33,684
- permanent meadows and pastures	783,905	798,668	794, 773

[8] Short Rotation Woody Crops

Biomass is the source that has the largest technical potential (46% of all RES), closely followed by geothermal energy (26%) and solar energy (21%). The technically exploitable potential for wind and small hydropower have respectively a share of less than 3% and less than 5% of the RES technical potential (Doubrava, 2007).

Slovakia's total annual capacity in the production of forest biomass suitable for energy production will reach around 1,080 thousand tons by 2010 (16.9 PJ) (Doubrava, Potentials of renewable energy). It is realistic to increase the amount of forest biomass available after 2010 through more intensive wood cutting and growing of energy crops in an area of 45,400 ha. Energy crops are a promising source of biomass fuel, which can be grown in areas unsuitable for conventional agricultural and forestry production, on land temporarily set aside from agricultural production, contaminated land suitable only for non-food production, and on damaged land in industrial agglomerations.

The wood-processing industry produces 1,410 thousand tons of waste annually (18.1 PJ) (Doubrava, Potentials of renewable energy), of which 2/3 originates from mechanical wood processing and 1/3 from black liquor. The greatest waste producers are large wood-processing companies, which also most frequently use this waste for energy purposes. Another possible source fuel is the production of agricultural biomass – cereal, corn and sunflower straw, winter rape, orchard and vineyard wood waste.

The production of biofuels will increase significantly by 2010 due to the implementation of the objectives set out by Directive 2003/30/EC. The estimated production of biodiesel amounting to 100 thousand tons is equivalent to 11.0 PJ of heat.[9]

The production of biogas from cattle manure can reach 277 million m^3 annually, which corresponds with 6.9 PJ of heat. Wastewater treatment plants are an important source of biogas. There are currently 24 co-generation units in operation using their own biogas and it is expected that co-generation units will be built at all wastewater treatment plants in larger towns. Theoretically, biomass with energy equivalent to as much as 46.5 PJ can be produced in agriculture without negatively affecting agricultural production (Doubrava, Potentials of renewable energy).

Table 9-3 Biomass potential in Slovakia (Ministry of Agriculture of the Slovak Republic, 2007)

Biomass kind	**Energy equivalent**	
	TWh	**PJ**
Agricultural biomass	12.89	46.5
Forest biomass	4.69	16.9
Waste from wood-processing industry	7.36	26.5
Total	**24.94**	**89.9**

[9] 100 000 t / 0,88 kg/l * 37,27 MJ/l * Efficiency

9.2.2 Solar energy

Solar potential in Slovakia is in total up to 54 000 TWh, while usable potential (real) is 9.4 TWh (estimated for solar collectors) and 1537 GWh (estimated for solar modules)

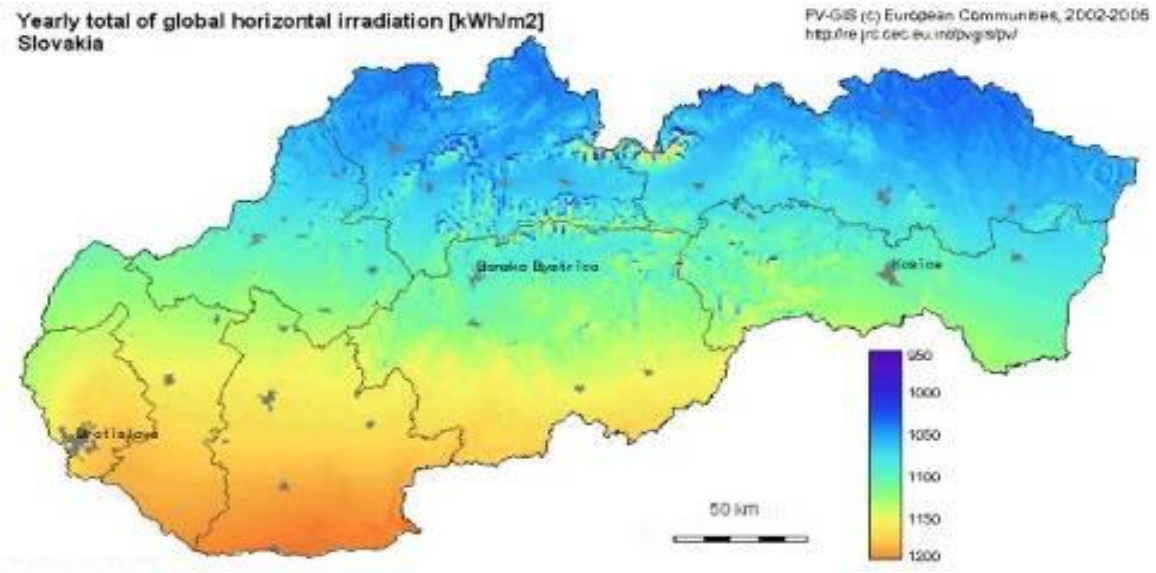


Figure 9.1 Yearly global irradiance energy (Ministry of Agriculture of the Slovak Republic, 2007)

Heat production in Slovakia is represented by installed solar collectors in the total installed area of over 55 000 m^2, which give 100 TJ. There is a growing tendency for around 5 000 m^2/year (7 400 m^2 installed in 2006). Average heat production is around 500 kWh/m^2/year.

Electricity in Slovakia is produced by PV photovoltaic solar modules. Installed power is around 15 kWp , which gives around 0.01-0.015 GWh/year. The Largest installation is 6 kW PV[10] modules in eastern Slovakia (feeding alarm and safety lights). There are also about 40 telephone cabins with an electric power supply of 50W and free-standing lamps.

There is a goal of PV installed power of 300 MWp in 2015, which will be a 1% contribution to the total electricity demand of the Slovak Republic (Doubrava, Potentials of renewable energy).

9.2.3 Geothermal energy

The Slovak Republic has around 26 perspective areas of available geothermal sources with the potential for 60 GWh of annual electricity production. Slovakia has 116 verified holes with temperature frames of 18-129 °C and thermal power of 314.3 MWt (Holoubek, 2008).

Geothermal water is used in 36 areas with power of 131MWt (which is 42.7%, 2.3% from total). In 12 locations it is used for greenhouse heating and in 2 for fish farming. 32 locations use geothermal water for recreation purposes. For home heating there are installations in 10 locations – Galanta with 1240 flats and a hospital (Doubrava, Potentials of renewable energy) (Doubrava, Potentials of renewable energy).

[10] Photovoltaics

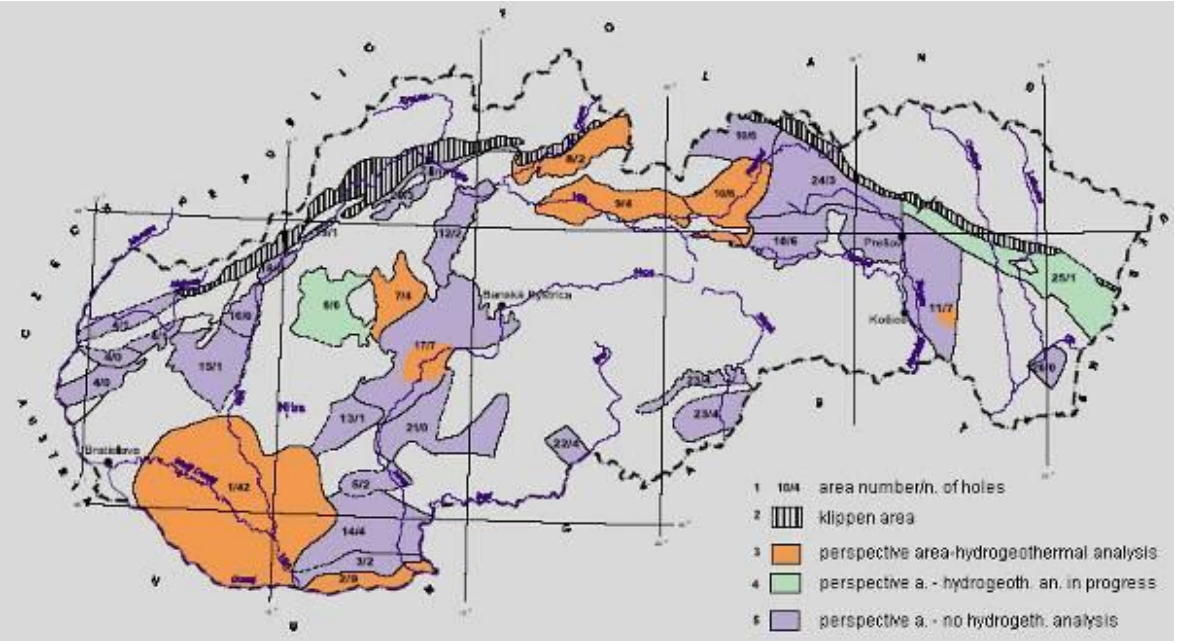


Figure 9.2 Geothermal energy perspective areas (Ministry of Agriculture of the Slovak Republic, 2007)

9.2.4 Hydro energy

Hydro energy is the most used renewable energy source in Slovakia, with a share of almost 63% of RES. It contributes more than 90% to electricity production from all RES and about 13 to 20% from primary sources of electricity production. In 2005 it was 16.9% (Doubrava, Potentials of renewable energy).

Total hydro energy potential is up to 6.6 TWh:

- 5.6 TWh large WEPP[11]
- 1 TWh small WEPP

Electricity production strongly depends on water flow. In previous years it was:

- 2002 – 5.2 TWh
- 2004 – 4.1 TWh
- 2005 – 4.2 TWh

Future speculation concerning new large WEPP suggests a power plant on the river Ipel (600 MW up to 2015) and a storage plant in Sered (64 MW up to 2015).

[11] Water Energy Power Plant

Speculation concerning a new small WEPP recommends the rivers Hron and Vah with instalations of 1 – 3 MW power size (Doubrava, Potentials of renewable energy).

9.2.5 Wind energy

Natural conditions of the Slovak Republic determine a total usable potential of only 600 GWh/year, due to the presence of national parks. Possible installed power is 300 MW, which is 5% of total electric energy plants installed. The most suitable areas are Kysuce, Orava, Spiš and Malé Karpaty.

Current installed power is 5 MW (Doubrava, Potentials of renewable energy):

- Cerová: 4x660 kW
- Ostrý vrch (Myjava): 500 kW (pilot run)
- Skalité: 4x550 kW

There are almost no places in Slovakia where yearly average wind speed is over 5 m/s. This was long-term measured in specific places. Average wind speed:

- Krížna (5,7 m/s)
- Červenica – Dubník (5,7,m/s)
- Chopok (9,8, m/s)

Possible wind energy installations in Slovak Republic depends on wind conditions. Table below shows average wind speed and energy production possibilities.

Table 9-4 Average wind speed and potential in electricity production (Ministry of Agriculture of the Slovak Republic, 2007)

Type of location	**Average wind speed (m/sec)**	**Energy production (kWh/m^2 yearly)**
Poor	5,5	330 - 420
Acceptable	6,5	550 - 690
Good	7,5	850 – 1 050
Very good	8,5	1200 - 1 540

9.2.6 Biogas

The utilization of biogas in Slovakia is completely negligible. There are only 5 biogas plants, which use agricultural biomass (Holoubek, 2008).

9.3 Trends and forecasts concerning energy production

9.3.1 Trends in renewable energy production

Currently the technically available production potential of RES, combined with the introduction of the power production in big power water plants that will be used, is no more than 16%, leaving 80% of the RES potential available. Analyses of the development of the RES availability in Slovakia pointed out that in certain conditions there is a complex use of biomass concerning the natural conditions, most significant use of biomass is for RES[12]. In terms of technically usable potential (e.i., potential, that can be used after the introduction of available technology and that is limited by administrative, legal and environmental obstacles, not only by economical ones) the largest share among RES is held by biomass (60%). Technically utilizable potential of biomass theoretically represents up to 15% of annual gross domestic energy production in Slovakia. However, there are problems of objective quantification of technically utilizable potential of biomass (as well as other RESs) due to ambiguous data and a lack of unified methods for its calculation in Slovakia (Holoubek, 2008).

According to the proposal of the Strategy of Higher Utilization of Biomass and Solar Energy in Households, 1500 jobs should be directly created in Slovakia by 2010. The amount includes a number of jobs in the area of cultivation, extraction, harvesting, processing and utilization of biomass itself, as well as production and utilization of biogas. The number of job opportunities should increase by a further 3000 when the production of equipment for utilization of biomass is taken into consideration as well (Sluka, Meaningful and effective utilization of biomass in Slovakia).

Concerning the size of the technically available potential, the most promising source is biomass, which is useful not only for simple combustion but also for more demanding production of electric power or bio fuels. In comparison with EU goals, Slovakia's use of RES potential falls short. Drawbacks of the RES usage indicators are moderated by the production of electric power by big water power plants, but without taking these into consideration, the use of RES is minimal. Even worse seems to be the indicators for the share of RES in the use of primary power resources, where Slovakia barely reaches 3%. Similarly the situation is unfavourable in the use of bio fuels in transportation (Doubrava, Potentials of renewable energy).

[12] Following are examples of such study: Work of For Mother Earth, Friends of the Earth-CEPA, Center of Energy Alternatives

Table 9-5 Renewable energy potential and share in Slovak Republic (Viglasky, Opportunities and visions, 2007)

Source – type of energy	**Technically available potential**	**Current use**	**Unused potential**
Biomass	**11 237**	**3 523**	**7 714**
Biological fuels	**2 500**	**330**	**2 170**
Water power plants	6 607	5 093	1 514
Small water power plants	1 034	202	832
Solar energy*	5 200	7	5 193
Geothermal energy	6 300	340	5 960
Wind power	605	0	605
Total [GWh/year, (PJ)]	**26 876 (96,75)**	**4 402 (15,85)**	**22 004 (79,27)**

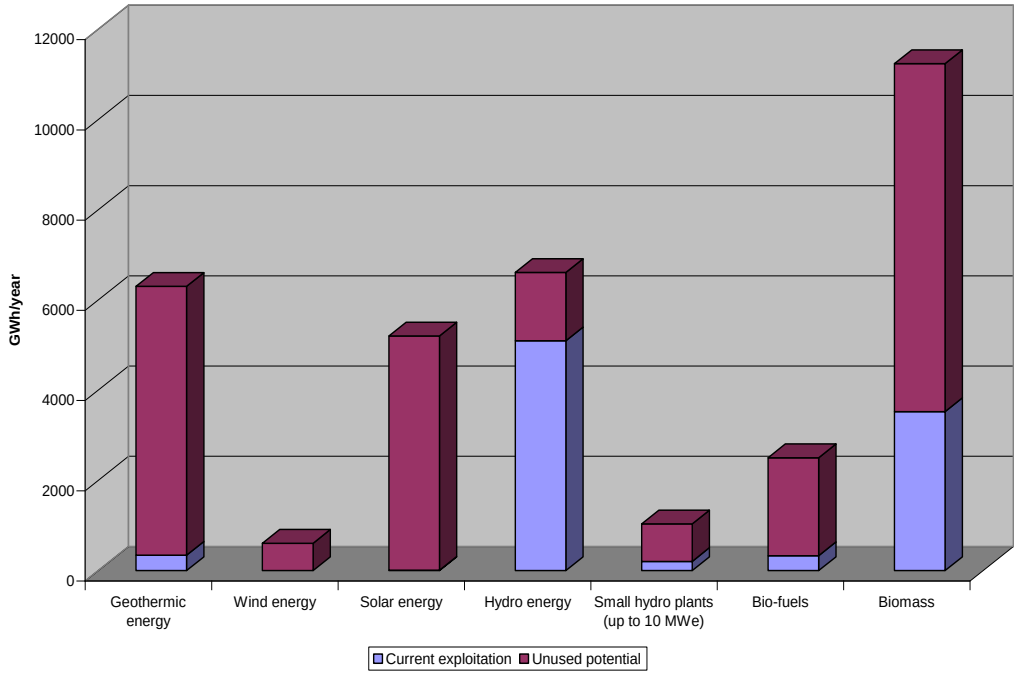


Figure 9.3 Renewable energy sources potential and share in Slovak Republic (Ministry of Agriculture of the Slovak Republic, 2007)

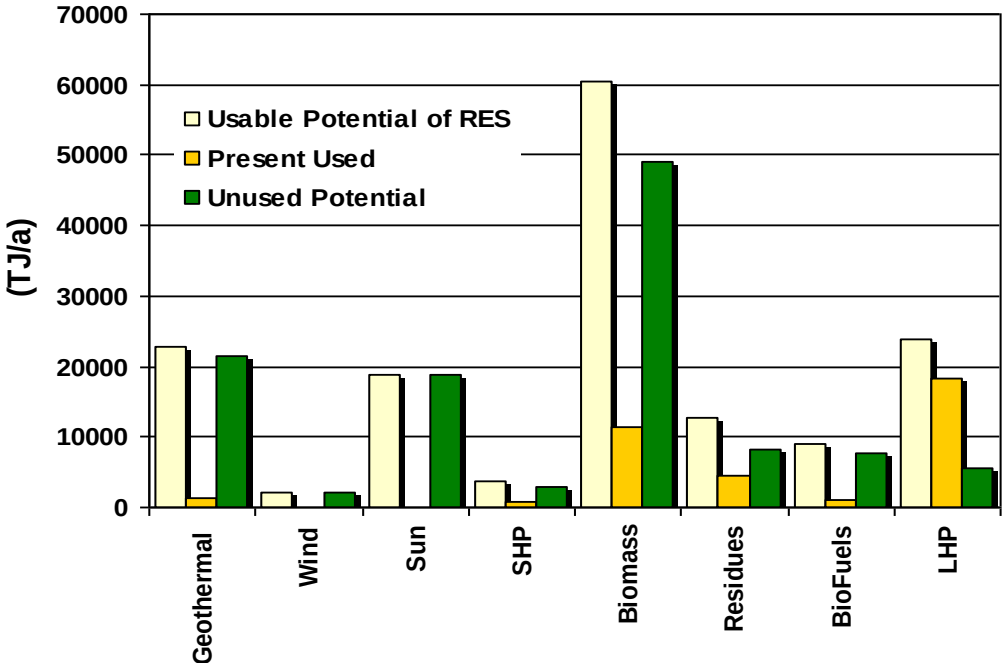


Figure 9.4 Renewable energy annual potential and share in Slovak Republic (Viglasky, Energeticke, 2007)

9.3.2 Trends in renewable energy source usage

Current estimates of shares of biomass and biofuels in annual primary energy sources consumption (PES) in the Slovak Republic are in the range of 1.0 – 1.5 %. Under Slovak climate conditions the significant increase in the current share of biofuels in PES consumption to between 6 and 12 % can be achieved (already a reality in Austria), which would also bring important benefits to the national economy. Increased utilisation of uncultivated soils (current estimate: more than 500 000 ha) would help to achieve this goal. Utilisation of biomass on a wide scale would result in the creation of new jobs, which would help to solve unemployment problems in Slovakia. Moreover, a significant reduction of brown coal extraction and release of harmful emissions (e.g. CO_2, NO_X, SO_2) would be realised (Slovak Centre of Biomass Use for Energy, Wood Heating).

Presently biomass is by far the most important of the renewable energy-carriers, behind hydropower, in Slovakia as well as in many countries of the Europe. But the role of biomass (biomass involves landfill gas, municipal and industrial organic residues, agricultural residues, wood crops, forest residues and ethanol / bio-diesel) in national energy-economies is not so simple to define. It is utilized for different services, which are more or less complicated depending on the technologies applied, more or less expensive depending on investment- and running costs and even different concerning their social acceptance when implemented. For example, the domestic wood processing industry utilizes almost 97% of the wood cut. The share of wood consumption, in individual sectors of the wood-processing industry, varies according to tree species and the qualitative structure of the wood cut. Approximately 3% of softwood and almost 7% of hardwood cut is used for the production of veneers, ply-woods, matches, and other special wood

products. Approximately 69% of softwood and 36% of hardwood is used in the lumber industry. Approximately 23% of softwood and 48% of hardwood is used for cellulose, chipboard and fibreboard production. Approximately 5% of softwood and 9% of hardwood is used for energy purposes (Rastislau, Issues and opportunities).

For the further extension of biomass use, the markets of heat, of electricity and of fuels are possible. Following calculations of AEBIOM[13], presently within the European Union 92% of the bio-energy resources are utilized for heat generation, 7% to produce electricity and 1% for the production of fuels. In the heat market, one has to differentiate between heat for industrial purposes and low temperature heat. Measures for a further development and integration of more bio-energy into national energy-economies have been listed by the participating countries. Predominantly, deployment of biomass seems to be favourable in those fields where it is already present today, meaning an extension will in many cases be easier than the establishment of a completely new market (Viglasky, Development of bio energy).

9.4 Goals to reach according to Directives and internal mandatory targets

To fulfill the commitment goals set by the EU would mean that in 2010 there would be 9.24 TWh produced from RES (concerning the overall consumption of electric power in the Slovak Republic in 2010 on the level of 29.6TWh) (Viglasky, Opportunities and visions). Originally, the Council of Europe demanded the indicative aim of 35.1%. Because of the short negotiation period until the completion of accessing negotiations and after the verification of the autonomy of the aim by the European Council, the Slovak Republic accepted the European Council proposal‘s ambitious but unrealistic indicative aim for the level of 31%. Through more negotiations the Slovak Government proposed to modify the indicative aim to 6.58 TWh of RES electricity production, that is 22.1%. Slovakia considered the proposed aim to be realistic because the electricity production from RES in 1999 was 4.47 TWh, i.e. 16.0% (according to IEA statistics). Finally, the level of 19.0% was stated for the transition period, according to the Slovak Government proposal. National Reports of the Slovak Republic and other countries will be regularly reviewed by the European Council. The Council will review the gained progress in individual countries and the correspondence between the national indicative aims and the global indicative aim defined in the White Book, which proposes to use RES and to cover 12% of the use of primary power sources so that the share of RES in electric power production would cover 22.1% by the year 2010. The ratio of RES to the use of primary power sources represents approximately 6% in the EU, in Slovakia the ratio is lower than 3%, from which more than half of the contribution represents water power plants, the rest is biomass, with a small representation of geothermal energy. In considering the primary power sources consumption per citizen, Slovakia is on at 85% of the EU average. Because energy imports to Slovakia are 90% of the used sources and account for 20% of the commercial balance, effective use of RES has a special meaning (Viglasky, Opportunities and visions).

Participation of Slovakia in the EU means that it has a responsibility to reach the EU’s common aims. The basic document dealing with the use of RES in the EU is the White Book of RES (Commission, White Paper 1997), and the consequent practices of the EU

[13] AEBIOM, European Biomass Association, www.aebiom.org

state the responsibility of each member state to secure the increased share of RES use. The Slovak Republic therefore has the task of ensuring that the production of electric power from RES is at 19% (5,852TWh, optimum of 22.1%, which is around 6,807 TWh) (Commission, White Paper 1997, P 1.3) by the year 2010, and increasing the optimal share of RES in overall primary energy sources from 3% to 12% and to increase the use of bio fuels to 5.75% of all production in 2010.

The current electricity production from RES of 5.2 TWh (including large hydroelectric power plant potential), stands for 16% of household electricity consumption.

To reach a 4% RES-E[14] (without large hydro) contribution from total electricity production of 31 000 GWh, Slovakia needed to produce 4 times more electricity from RES in 2004 (Doubrava, Potentials of renewable energy).

Table 9-6 Renewable energy production and production forecast (Doubrava, Potentials of renewable energy, 2007)

Source/Year	**2004 [GWh]**	**2010 [GWh]**	**Difference [GWh]**
Small SHP	250	350	100
Biomass	33	410	377
Wind	6	300	294
Biogas	2	180	178
Total	**291**	**1 240**	**949**

9.5 Energy policy to reach goals

Progressive policy-making has the greatest impact on renewable energy's future. In the past decade, technology costs have dropped dramatically, which is the key to getting renewable energy onto the grid. Conventional sources of energy pose significant threats to current and future global security, environmental quality, health and social well being. The market needs help to incorporate negative externality costs into market prices. Waiting for the market to make renewable energy cost-competitive with conventional energy sources would make it too late to reverse the effects of climate change, ecosystem destruction and pollution. Governments have the opportunity to accelerate the use of renewable resources through effective policy. Currently, one of the biggest obstacles to putting renewable

[14] Electricity produced from renewable energy sources

energy into the mainstream is that for the most part it is not cost competitive. Governments have the power to create policy that affects the price of both fossil and renewable fuels through subsidy reform and taxes. Also, funding renewable energy production or accelerating consumption through electricity feed-in laws, technology procurement, concessions, targets and tradable certificate programs will lead to more equalized prices (Johansson, Energy for Sustainable Development). Other ways to increase the competitive capabilities of renewable energy include energy taxes for fossil fuels, tax relief on renewables, de-taxation of biofuels, the long term internalisation of externalities, and the cooperation of the agricultural- and energy sectors on all levels of policy. From the side of the European Union, a lower threshold of taxation of fossil fuels, European Emission standards and a harmonisation of CO_2 taxation in the Union are required (Holoubek, 2008).

9.5.1 Current situation

Waste biomass in countries where there is a paper- and pulp- and a wood-processing industry, is already utilized at a considerable amount for the process of heat and electricity production. It is a by-product of the processes and if not utilized for producing energy it would create a waste disposal problem. Big plants allow technologies for cogeneration (economies of scale) and the mostly energy-intensive processes need both electricity and process heat. A further extension of bio-energy in this sector will mainly depend on the development of the structure of this industrial branch.

Branches of industry which are not involved in the processing of wood will only be interested in bio-energy if it is cheaper for them, as compared to fossil fuels, which will only be the case with the help of, for example, energy taxes on fossil fuels (Ministry of Environment of Slovak Republic, Analyza vplyvu platnej legislativy).

Biomass sources for the production of electricity will mainly be found in the wood processing industry. However, plants for the production of electricity (or combined heat- and power production plants) will be possible where there are special regulations which favour them. Examples for such regulations are:

- Minimum tariffs for delivering electricity to the grid (like in Italy, Spain or Germany).
- Special financial support, subsidies (Denmark).
- Higher taxation of fossil fuels.
- Minimum amount of Biomass-electricity for everyone operating a grid – otherwise penalty.

Without regulations a higher amount of electricity from biomass will not be possible.

Other sources of biomass like bio-gas, sewage gas or traffic fuels presently play a modest role as compared to the importance of biomass in the low temperature heat market. Often, coordination between the agricultural and energy policies of the Union is missing and, consequently, needed. For the introduction of bio-fuels, different strategies are deployed (mixing with fossil fuels, utilisation in environmentally sensitive areas, usage instead of heating oil), but sometimes the raw material is scarce because farmers can profit from other (food) crops.

RES-E policy in the Slovak Republic includes the following measures (Commission, Slovak Republic):

- A measure that gives priority regarding transmission, distribution and supply was included in the 2004 Act on Energy.
- Guarantees of origin are being issued.
- Tax exemption is granted for RES-E. This regulation is valid for the calendar year in which the facility commenced operation and then for five consecutive years.
- A system of fixed feed-in tariffs has been in place since 2005.
- Subsidies up to €100,000 are available for the (re)construction of RES-E facilities.

In 2005, the National Programme of Biofuels Development was adopted. Legislation concerning the minimum amount of biofuels on the Slovakian market and a decree laying down the requirements for fuel quality and maintenance of records of fuels were issued in 2006.

RES-H is promoted through the Programme supporting Energy Savings and Utilisation of RES (2003). It aims to create a favourable climate for investments. Subsidies up to €100,000 are also available for the (re)construction of RES-H facilities (Commission, Slovak Republic).

9.5.2 Financial support and incentives

Subsidies and/or funds for biomass installations, incentives, financing tools and increased payment for electricity from biomass as well as (where wanted) for short rotation coppice are sub-summarized. There is a plethora of documents concerning energy policy and supporting the production of green energy, such as (Gadus, Vyroba a vyuzitie bioplynu):

- Conception of usage renewable energy sources from 2003
- Concept of using forest biomass for energy purposes from 2004
- Development of renewable energy sources in terms of country indicative targets achieving from 2004
- National program of biomass development from 2005
- Analysis of biomass production subsidies impact on biomass for energy purposes production from 2006
- National program concerning achieving indicative targets from 2006
- Strategy of using renewable energy sources in Slovak Republic from 2007
- Biomass usage action plan on years 2008 – 2013 from 2008

Unfortunately there is no interest in the market for the production of green energy, and these financial supports are not effective. The Slovak Republic has also problems with strategic investors on renewable energy field. Finally, the financial situation of investors in Slovakia is unlike the situation in other Member States.

9.6 Current difficulties in achieving goals

Problems caused by EC‘s directives and problems with achieveing goals in The Slovak Republic are for example:

- Weak implementation of mechanisms of developing renewable energy sources production
- No interest in production of green electricity and green heat by investors
- RES development is not a main issue in the national energy plan or the interest of government
- No guarantees of green energy buying price (Gadus, Vyroba a vyuzitie bioplynu)
- Lack of information about possibilities of RES development
- Huge problems with reaching set levels of production
- Small geothermal energy usage and no interest of investing in geothermal energy by government
- Resignation of big hydro energy systems connected with environmental impact. Whole possibilities of using this energy concerning current policy and trends
- No interest in landfill gas utilization
- Competition in the market
- Improper financial support
- No clear renewable energy policy. Current depends only on lobbying by the industry and energy producers sector
- Low usage of European Union financial support for developing renewable energy production instalations
- Not enougth monetary funds in potential investors (Gadus, Vyroba a vyuzitie bioplynu)

9.7 Discussion

There are certain difficulties concerning the low environmental awareness of residents. The negative legacy of the past years (import of cheap energy carriers from the former Soviet Union), misshapen prices and cross subsidies have led to an over-consumption of energy, overheated dwellings and houses, large energy losses and low energy efficiency. To change the existing patterns of behaviour requires considerable effort.

Regarding the political and legislative point of view, despite Slovakia's official declarations and commitments within the European Union, the utilization of renewable

energy sources (including solar-thermal energy) is still out of the focus of the governmental energy policy, in addition to receiving very poor support from the state authorities. Moreover the flat rate Value Added Tax of 19% has applied to solar-thermal collectors since 2003 (the previous VAT rate was 6%) (Bytterm A.S., Examples to follow).

However, some positive changes may be visible. According to the "Strategy of wider utilization of renewable energy sources in Slovak Republic, Measurement 5 - Program of wider utilization of biomass and solar energy in households" in order to achieve the goals in the section of heat power industry, it will be necessary to ensure investment support (in the form of subsidies) for personal entities for the usage of solar energy and biomass for heating and preparation of domestic hot water (boilers for combustion of biomass and solar systems) in dwellings and family houses during the period 2007-2015 (Bytterm A.S., Examples to follow).

Priorities for future production of renewable energy in Slovakia can be focused on:

- Development of policy to promote effective implementation of European Union regulations
- Improvement of programs concerning information on possibilities of green energy usage and possibilities of production of green energy
- Development of policy to support renewable energy production and set minimal price of sale for different kinds of RES production
- Effective implementation of international development programmes
- Development of environmental standards for sewage sludge. Which will include usage of sewage sludge as raw material for biogas plants. It will also consist of better quality measures for sewage sludge
- Reinforcement of environmental awareness. Especially in government and society

10 CZECH REPUBLIC

10.1 Introduction

The Czech Republic is a landlocked country situated in central Europe, sharing borders with Germany, Poland, Slovakia and Austria. The total area of the state is 78,900 square kilometres and its population is roughly 10.2 million inhabitants. The capital is Prague, home to 1.2 million people. The country is divided into 14 regions. The climate is temperate, but since 1989 there have been many days in summer with extremely high temperatures. The period since 1989 was characterized by significant social, industrial and ownership changes and separation of the former Czechoslovakia in 1993. The Czech Republic joined the European Union in May 2004 and made a great effort to meet major reforms and adopt „acquis communautaire“[15]. The size of industry was reduced, but the Czech Republic is still a country with a high level of industry. New industrial plants were built (car making, electronics, machinery) and other branches were phased out (coal mining, steel production and foundries). Privatisation brought a strong participation of RWE, E.ON, Dalkia and other western companies. Immediately after the fall of the Soviet Union economic growth was rather slow but recently recovered and became robust.

The structure of TPES[16] has been slightly changing since 1989 in favour of nuclear power at the expense of coal. The energy intensity is now almost stabilized at the level 11MJ/ (with a very slight drop now after a period of sharp decrease between 1995 and 1999). The Czech energy sector is divided into branches according to primary source of energy (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic).

[15] The term acquis communautaire is used in European Union law to refer to the total body of EU law accumulated thus far. The term is French: acquis means "that which has been acquired", and communautaire means "of the community"

[16] Total Primary Energy Supply

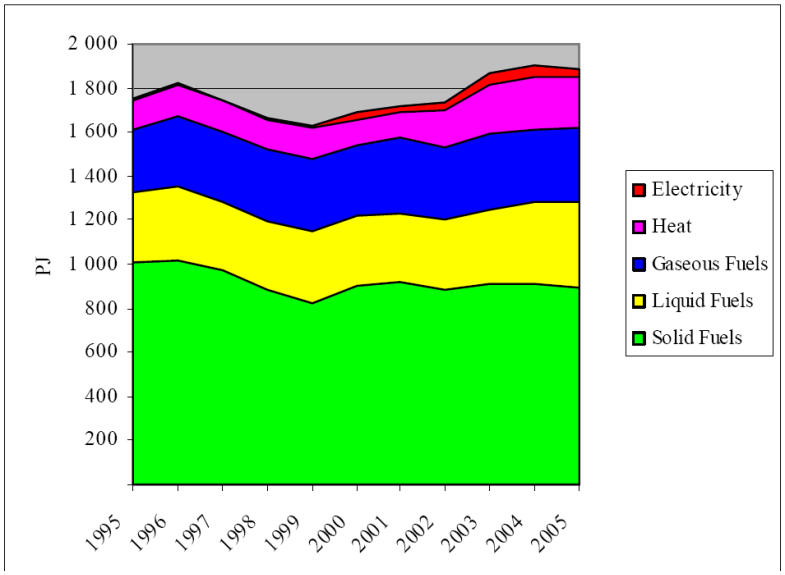


Figure 10.1 Total primary energy sources in Czech Republic (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic, 2007)

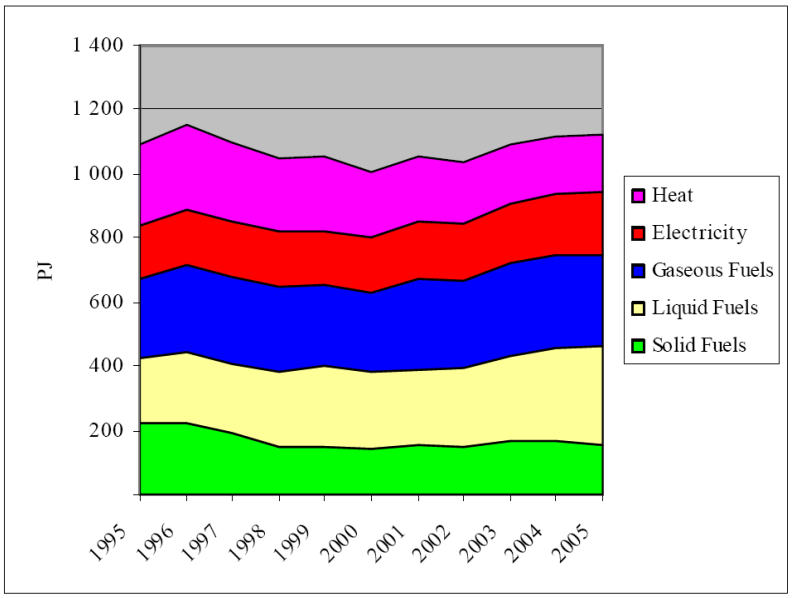


Figure 10.2 Total final energy consumption in Czech Republic (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic, 2007)

10.2 Energy sector overlook

The only significant domestic source of energy is coal, both brown and hard. The coal industry was historically the most important branch. Current coal output accounts for 50 million tons of brown coal and 15 million tons of hard coal. Coal still represents 47% of the total primary energy supply. The main coal basins are located in northern Bohemia and in northern Moravia. A significant amount of the hard (coking) coal is exported. Coal has been mainly burned in coal-fired power stations, heat only plants, and combined cycle plants. Coke is produced from hard coal. There are no subsidies in the mining sector and no price regulation (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic).

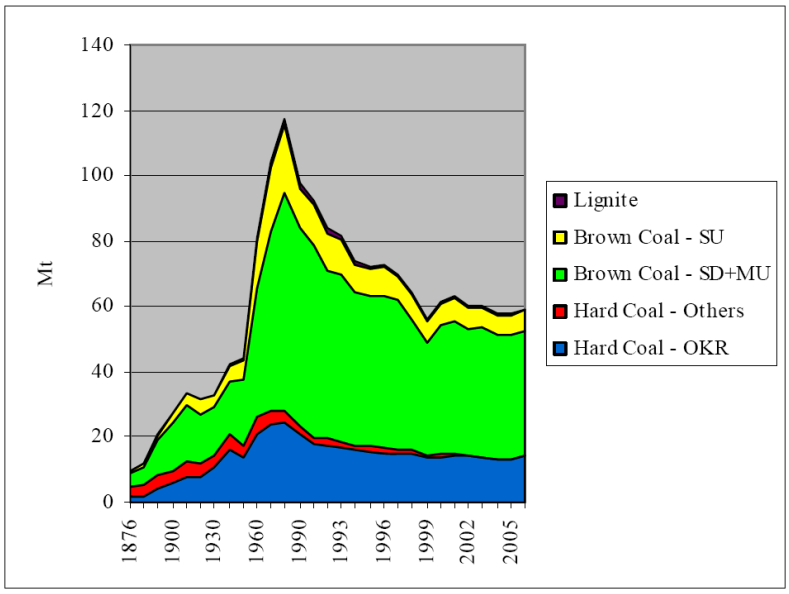


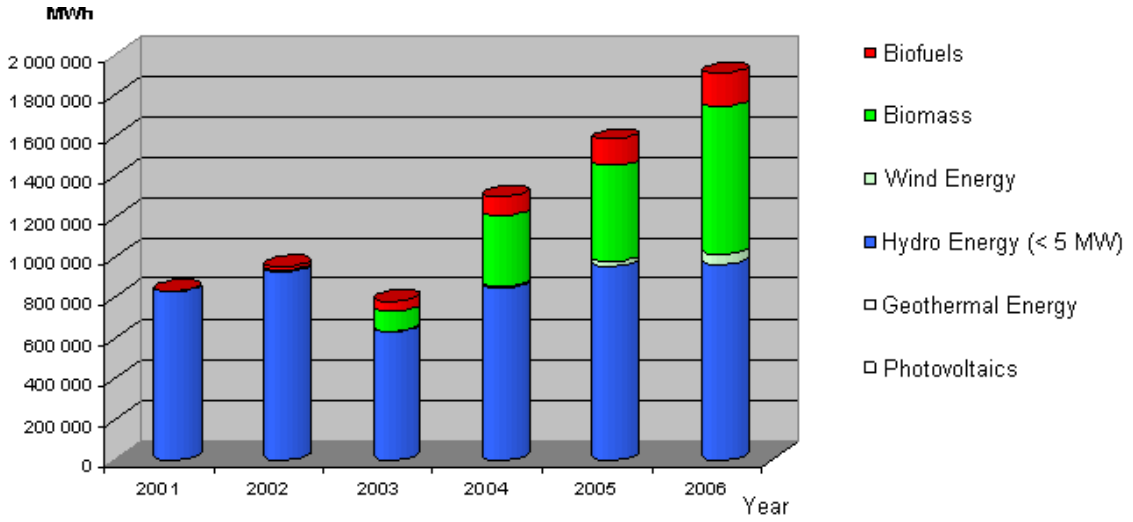
Figure 10.3 Coal production in Czech Republic (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic, 2007)

The power sector's production is based on coal, nuclear energy (Dukovany and Temelin plants), hydro potential (river hydro and pumped plants) and negligibly on other RES. The largest domestic power producer ČEZ a.s. keeps roughly 50% of the market share. Gross electricity generation was 83 TWh in 2005. Transmission of electricity is in hands of the state owned company ČEPS a.s. Distribution grids belong to main suppliers. The full opening of the power market introduced in 2005 was based on EU directives. ČEZ is the third largest power exporter in Europe, after France and Germany (Energy.eu).

The gas sector represents import, transport and distribution of the natural gas being imported from Russia and Norway on the basis of long-term contracts through pipelines (i.e. 18% of TPES). The main gas companies (transportation, distribution, storages) are owned by RWE. Full opening of the gas market started in January 2007. The stability of the gas system is underpinned by underground gas storages – partly in hands of a private firm which produces 1% of the gas supply from south Moravian gas reserves.

The oil sector reprocesses and delivers 20% of TPES. The majority of oil is imported from Russia (Druzhba pipeline) and the rest from various suppliers through IKL pipeline. The state firm MERO owns both pipelines. Domestic production of high grade oil for special purposes oscillates round 300,000 t/a. Major refineries were privatised in 2004 and bought by Polish PKN Orlen with minority shares of Shell, Conoco and Agip. Oil and product prices are based on the global oil market. Numerous Czech distributors and European OMV, Agip, Slovnaft perform distribution of liquid fuels. The network of pipelines for products is managed by Czech ČEPRO, a state company. Emergency oil reserves totalling 90 days of annual oil imports are administered by the state agency ASMR according to the national law and in compliance with EU and IEA requirements.

The share of energy from renewables is low, reflects the realistic potential and represents 3% in TPES. The share of electricity produced from RES reached almost 4% in 2005. A certain progress in RES utilization is expected in biomass burning, wind farms and geothermal heat plants (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic).



2007)

The current energy situation in the Czech Republic:

- In 2006, the total electricity production from RES was 3.5 TWh, where 1.9 TWh was from supported RES and 1.58 TWh was from large hydro power stations
- The share of electricity production from RES was equal to 4.87 % in 2006
- According to past developments, the indicative target for the Czech Republic of 8% in 2010 seems to not be realistic
- The future development of RES in the Czech Republic is anticipated in the State Energy Concepts, indicating potentials of particular RES in 2010

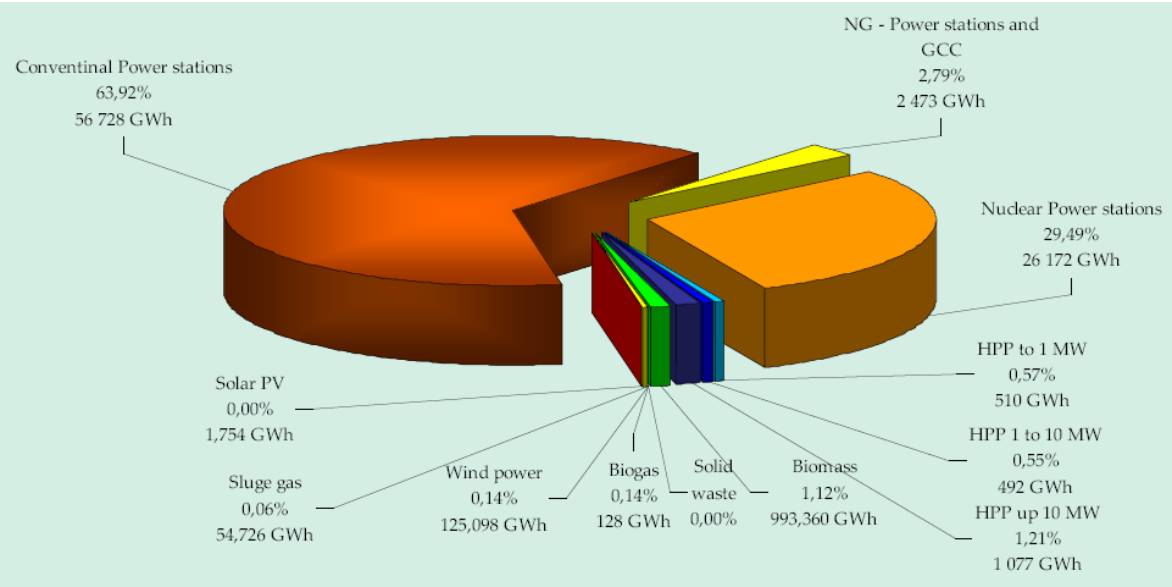


Figure 10.5 Mix of gross electricity production in year 2007 (Vlo, Renewable energy sources in Czech Republic, 2007)

10.3 Trends and forecasts concerning energy production

The Czech Republic shall exert a substantial effort to comply with the Spring 2007 European Council conclusions on targets in savings, reduction of carbon emissions, share of RES and biofuels. The Czech energy policy was adopted by the government in 2004 and made projections of supply and demand in various scenarios for a period covering the next 30 years. The major energy legislation has been stated in the Energy Act No. 670/2004. Coll., Energy Management Act No. 406/2000 Coll. and Act on renewable energy No. 180/2005 Coll (Ministry of Industry and Trade of Czech Republic, Energy of the Czech Republic).

Electricity production from renewable sources	2005 (GWh)	2010 – 8% (GWh)
Small hydro power plants	914	1121
Wind power stations	76	930
Burning biomass	342	1050
Burning biomass and fossil fuel	323	1050
Biogas	99	250
Geo-therma energy	0	15
Solar radiation	0	15
Total	**1754**	**4431**

Figure 10.6 RES electricity production and forecast (Fiřt, Safety of supplies in power industry, 2007)

10.4 Goals to reach according to Directives and internal mandatory

The European Commission target is to enlarge the RES share within the EU to 20 % by 2020. At present, the share is 6.5%. For particular countries, their specific conditions shall be respected. Another target, to reach 10 % share of biofuels in the fuel sector, came into existence in the last 5-7 years. The present target is 5.75 % in 2010. The last commitment is 20% reduction of CO_2 until 2020, and in case of a wider consensus, 30% savings of CO_2. Indicative Target set by the RES – E[17] European Directive from 2001 (Directive 2007/71/EC) is 8% share of RES in gross electricity consumption by 2010.

The Czech Government supports new RES growth through:

[17] Electricity from Renewable Energy Sources

- Subsidized renewable electricity prices
- Five-year tax holiday
- Direct subsidies
- Emission reduction units revenue (Beitler, Phytomass Thermal Power Plant)

Mandatory targets set by the newly proposed RES Framework Directive from 2008 are 13% share of RES in the final consumption of energy in 2020 and at least 10% share of biofuels in the final consumption of energy in transport in the Czech Republic in 2020.

The Indicative Target set by the RES – E[18] European Directive from 2001 (Directive 2007/71/EC) is 8% share of RES in gross electricity consumption by 2010. The Indicative Target set by the European Biofuels Directive from 2003 (Directive 2003/30/EC) is biofuels consumption of 5.75% of petrol and diesel use for transport in 2010.

National Commitments In 2004, the parliament of Czech Republic approved the national energy strategy setting targets for 2030:

- RES share in electricity production should be 16 – 17% in 2030
- RES share in the primary energy sources 6% in 2010 and 15 – 16 % in 2030

10.5 Energy policy created to reach goals

10.5.1 General policy

The Czech Republic's legislative framework, in relation to renewable energy sources, has been strengthened by a new RES Act adopted in 2005 and a Government Order regulating the minimum amount of biofuels or other RES fuels that must be available for motor fuel purposes. Targets for increasing RES in total primary energy consumption have been set at the national level. The use of biomass in particular is likely to increase as a result of the new legislation.

In order to stimulate the growth of RES-E, the Czech Republic has decided on the following measures:

- A feed-in system for RES-E and cogeneration, which was established in 2000.
- A new RES Act, adopted in 2005, extending this system by offering a choice between a feed-in tariff (a guaranteed price) or a "green bonus" (an amount paid on top of the market price).

Premiums to the electricity price are foreseen for producers of electricity from combined heat and power plants. Besides this, investment support (from 30-80%) is available whenever the applicants are non-profit enterprises.

The use of biofuels is being encouraged through an air protection Act (2002), which requires that a minimum amount of biofuels (or other fuels produced from RES) is made

[18] Electricity from Renewable Energy Sources

available to the market for example, as of 1 September 2007, 2% of the total amount of motor-vehicle diesel fuel. Between 2007 and 2012, this should amount to 4.2m tons. Government Resolution No 1080 of 20 September 2006 provides for a minimum quantity of biofuels in the range of motor-vehicle fuels without any subsidies or state support.

The Ministry of Industry and Trade was set to begin its most ambitious subsidy programme for RES in the second half of 2007 (Commission, Czech Republic).

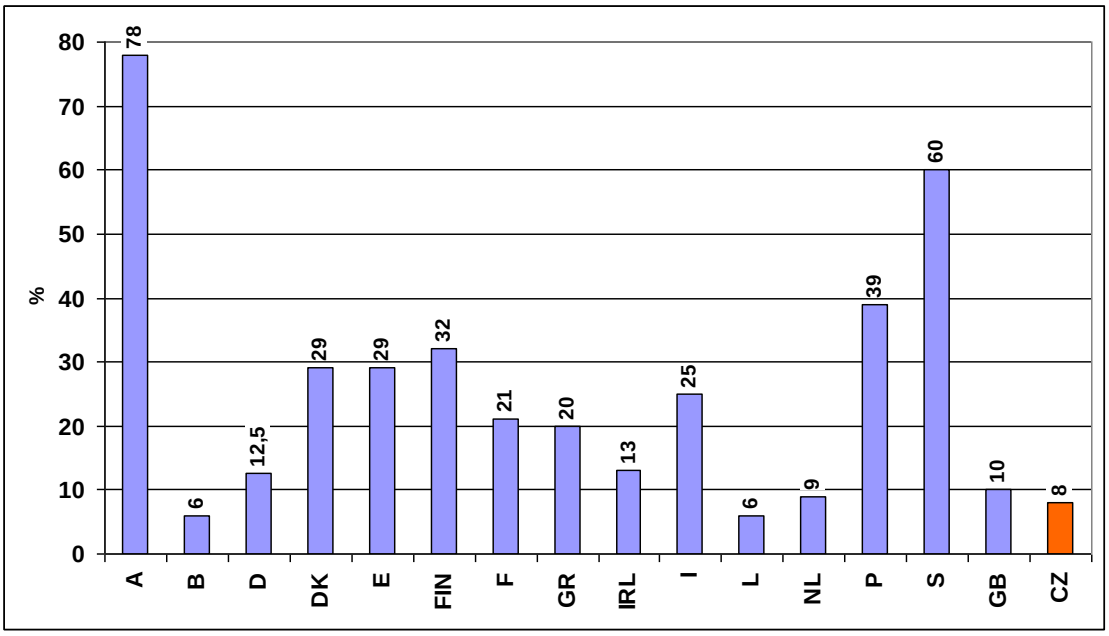


Figure 10.7 Ratio of electricity production from RES (Fiřt, Safety of supplies in power industry, 2007)

Support of electricity production from renewable energy sources in the Czech Republic is realized in a paper called "Act No. 180/2005 Coll on support of electricity production from renewable sources of energy". Main issues raised in paper are:

- The renewable sources, within the meaning of the Act, are defined as renewable non-fossil natural sources of energy, such as wind energy, solar radiation energy, geo-thermal energy, water energy, soil energy, air energy, biomass energy, waste deposit energy, sludge gas energy, and biogas energy.
- Preferential connection to the grid. There is an obligation for operators of the regional grid systems and the transmission system operator to purchase all electricity from renewable sources
- According to the law, there are two support schemes, i.e., purchase prices and green certificates (extras to the market price of power energy)
- The guarantee of revenue per unit of electricity produced over a 15-year period as of the date a plant is put into operation
- Year-by-year decrease of purchasing prices for new sources by 5 %, as the max. The law introduces a preferential connection of RES into the distribution or the transmission system (Fiřt, Safety of supplies in power industry)

In 2007 there was set pricing on renewable energy resale with over 30 categories of RES, according to fuel, technology and the source operation start up (Ministry of Economy of Czech Republic, Decizion no. 8/2006 on Renewable Energy Sources pricing).

10.5.2 Feed in tariff and Green Bonuses

A feed-in system for RES-E and cogeneration came into force in 2002. This scheme only led to a few new renewables installations. The RES Act adopted in 2005, extended this system by offering a choice between a feed-in tariffs (a guaranteed price) or a "green bonus" (an amount paid on top of the market price).

Feed-in tariffs apply to electricity supplied and metered at the delivery point between the generating plant and the respective distribution system operators.

Green bonuses apply to electricity supplied and metered at the delivery point between the generating plant and the regional system operators and supplied by the generator to an electricity trader or eligible customer. Producers can choose if they sell electricity for purchase prices or offer it to trader for „market-price" and simultaneously get extra green bonuses (paid by the operator of the Transmission System). The "Energy Regulatory Office" determines the feed-in tariffs and the green bonuses each year in advance. The prices may not be lower than 95% of the value of the year before (EREC, Renewable energy policy review).

10.5.3 State programme for energy saving and the use of renewable energy sources

Investors in renewable electricity can receive aid from the State programme for energy saving and the use of renewable energy sources. Subsidies from the programme (coordinated by the Ministry of Industry and Trade) may be a maximum of 30% of capital costs, but no more than CZK 2,8 million[19].

Subsidies from the programme (coordinated by the Ministry of the Environment) may be a maximum of 90% of the basis for the calculation of the aid in the case of local government units (municipalities) and non-profit organizations. In 2006, subsidies for the support of renewable electricity production totalling CZK 31,3 million[20] were granted from the Ministry of Industry and Trade and the Ministry of Environment resources (EREC, Renewable energy policy review).

10.5.4 Tax exemption

Tax exemption is one of the most common financial supports in developing renewable energy installations. This approach is popular in many European Union countries, for example Finland. There is neither an income tax in the year a renewable electricity plant is installed or for the following 5 years.

10.5.5 EU Structural Funds

From 2004, investors in renewable electricity production had the opportunity to obtain aid from the EU's Structural Funds via the Operational Programmes. The Operational

[19] 2 800 000 CZK = 100 000 EUR
[20] 31 300 000 CZK = 1 128 000 EUR

Programme for 2004–2006 focused, amongst other things, on the construction and restoration of plants using RES.

Subsidies may be a maximum of 46 % of capital costs, but no more than CZK 30 million[21]. In 2006, aid for 55 projects with total capital costs of CZK 1,817 billion[22], projected capacity of 32,25 MW and envisaged electricity production of 140,1 GWh was approved (EREC, Renewable energy policy review).

10.5.6 Support for Heat

The European Regional Development Fund–State Environmental Fund (SFŽP) is the Operational Programme for 2004–2006 and includes the subsidy scheme "Exploitation of Renewable Energy Sources", intended for legal persons (non–business). The scheme focuses on the construction of plants using biomass, on transforming current systems into systems using RES, and on the use of RES – heat from municipal boiler houses.

Subsidies from the ERDF (the European Regional Development Fund) may be a maximum of 75% of the basis for the calculation of aid (eligible costs), but no more than the equivalent of EUR 10 million.

In addition, a project can be co–financed from the State Environmental Fund (SFŽP) up to a total amount of 90%. SFŽP resources may be used to obtain a subsidy for project documentation of up to 50% of eligible costs. This may be a maximum of 3% of the basis for the calculation of investment aid, but no more than CZK 3 million[23] (EREC, Renewable energy policy review).

10.5.7 Support for Biofuels

The addition of biomaterial is obligatory for producers, distributors, and importers. Government Resolution No 1080 of 20 September 2006 provides for a minimum quantity of biofuels in the range of motor–vehicle fuels without any subsidies or support from the state. On the basis of this resolution, amendments were made to the following legislation:

Act No 86/2002 Coll. on clean air protection. The amendment to this act concerns the setting of a minimum amount of biofuels. Any person bringing motor-vehicle petrol or diesel fuels into tax free circulation in the Czech Republic must ensure that they contain at least a minimum proportion of biofuels (EREC, Renewable energy policy review).

10.5.8 Support for all RES

The programme "Promoting the cultivation of crops for energy use in 2007"was incorporated into the national support programme specifying the conditions for granting subsidies in 2007. The objective is to promote the establishment and maintenance of standing crops for energy use with aid of CZK 3000 per hectare[24]. In this programme, stated energy crops must be grown specifically for energy use. In 2007, 1,771 hectares were sown with energy crops and approximately 5,314,000 CZK[25] was disbursed (EREC, Renewable energy policy review).

[21] 30 000 000 CZK = 1 081 000 EUR
[22] 1 817 000 000 CZK = 65 400 000 EUR
[23] 3 000 000 CZK = 108 000 EUR
[24] 108 EUR / hectar
[25] 5 314 000 CZK = 192 000 EUR

10.6 Current difficulties in achieving goals

Growing electricity production from RES is bringing some safety and stability of supply problems:

- Stochastic electricity supplies to the network, from wind and solar systems
- Backup requirements (in case of wind power plants at the level of 90 % of WPP rated capacity - for 2010)
- In 2006, the rated capacity of wind power plants in the Czech Republic equalled 60–70 MW, with an average annual utilization of 1,120 hours (12.8%).

General barriers for development of renewable energy sources usage in Czech Republic are:

- Natural conditions in the Czech Republic
- Many suitable locations are excluded because of environmental protection
- Long time for project preparation
- Complicated and lengthy approval process for construction of installations
- Local public opposition to certain types of projects (especially large wind farms)

The main financing barriers for development of RES utilities are:

- Lack of experience and expertise
- Perceived high credit risk, excessive collateral/equity requirements
- Lack of project investors
- Lack of seed capital and project development capacity
- Lack of well prepared, investment–ready projects
- Lack of capital equity can only partially be solved with investment subsidy (Hajek, Obstacles and perspectives of Energy Saving)

There are also some legislative problems. One main problem is the lack of cooperation between agriculture and energy policies.

10.7 Discussion

In the Czech Republic the main barriers for development of renewable energy are natural conditions, excluding suitable localities because of environmental protection, difficulties in preparation, complication and approval of projects. But the biggest problem in Czech Republic is connected with financing. There is lack of experience, high credit risk, lack of investors, capital and well prepared projects. There are also some legislative problems. One of main problem is the lack of cooperation between agriculture and energy policies.

The number of experienced investors is increasing and so is their ability to push projects to a bankable stage.

RES support strategy should focus on:

- Determination of RES support for the next period in accordance with the Act no. 180/2005 Coll.
- Respecting the current situation in the area of RES, reflecting changes in technical-economic parameters, developments of new technologies
- Gradually, making the green certificate system more beneficial (electricity procured for regulated prices is applied, according to the law, to cover the loss incurred by RDS)
- Required support coordination:
    - Operation program of business and innovation
    - Operation program of environmental protection
    - Operation program of agriculture
    - State program of energy savings
    - Operation support vs. investment support - subsidies must be accounted for in economics of particular projects, the operation support should be reduced (Fiřt, Safety of supplies in power industry)

11 POLAND

11.1 Introduction

The Republic of Poland is a country in central east Europe. Poland is bordered by Germany, Czech Republic, Slovakia, Ukraine, Belarus, Lithuania and Kaliningrad Oblast, a Russian exclave. Poland also has access to the Baltic Sea. The total land area is about 313,000 square kilometers, which makes Poland the 69th largest country in the world and the 9th in Europe. The population of Poland is about 39 million people which make it the 33rd most populous country in the world. The establishment of a Polish state is often identified with the adoption of Christianity by its ruler Mieszko I in 966, when the state covered territory was similar to that of present–day Poland. In 1989, communist rule was overthrown and Poland became what is constitutionally known as the "Third Polish Republic". Poland is a unitary state made up of sixteen voivodeships. Poland is also a member of the European Union, NATO and OECD.

Poland, along with many other countries, has ambitions to increase the use of renewable energy sources. Bioenergy use was about 4% (165 PJ) of primary energy use (3900 PJ) and 95% of renewable energy use (174 PJ) in 2003, mainly as firewood in the domestic sector (Nilsson, Energy policy and the role of bioenergy in Poland). Targets have been set to increase the contribution of renewable energy to 9.0% in 2010, in accordance with the EU accession treaty, and to 14% in 2020. Bioenergy is expected to be the main contributor to reaching those targets. From a resource perspective, the use of bioenergy could at least double in the near term if straw, forestry residues, wood-waste, energy crops, biogas, and used wood were used for energy purposes. The long-term potential, assuming short rotation forestry on potentially available agricultural land is about one-third, or 1400 PJ, of current total primary energy use. However, in the near term, Poland is lacking fundamental driving forces for increasing the use of bioenergy (e.g., for meeting demand increases, improving supply security, or further reducing sulphur or greenhouse gas emissions). There is yet no coherent policy or strategy for supporting bioenergy (Ministry of Environment of Poland, Renewable energy in Poland).

Relatively little has been written on renewable energy and energy policy in Eastern Europe given the importance of those countries for developing and increasing the use of renewable energy in the EU, and the implications for the EU Common Agricultural Policy (CAP).

The Common Agricultural Policy (CAP) is a system of European Union agricultural subsidies and programmes. It represents 46.7% of the EU's budget, (49.8 billion EUR). The CAP combines a direct subsidy payment for crops and land which may be cultivated with price support mechanisms, including guaranteed minimum prices, import tariffs and quotas on certain goods from outside the EU. Reforms of the system are currently underway, reducing import controls and transferring subsidy to land stewardship rather than specific crop production. Detailed implementation of the scheme varies in different member countries of the EU. Until 1992 the agriculture expenditure of the European Union represented nearly 49% of the EU's budget. By 2013, the share of traditional CAP spending will have been cut almost in half (32%), following a decrease in real terms in the current financing period. The aim of the common agricultural policy (CAP) is to provide

farmers with a reasonable standard of living, consumers with quality food at fair prices and to preserve rural heritage (Commission of the European Communities, CAP).

Bioenergy has been identified as the most important and promising renewable source of energy for Poland (Figorski, Biomass for Power Generation or Local Heating). How the potential bioenergy supply can be matched with demand, and under what market and policy conditions, in order to reach the assumed targets is the biggest question faced by Poland. Bioenergy in Poland will develop in a broader context. The economy is in many ways still in a process of profound changes in the transition from a centrally planned economy to a market economy, faced with various economic and social development problems, including high unemployment – about 20.6% in 2004 (Ministry of Economy and Labour of Poland, Poland 2004 Report).

The current unemployment rate is 10% (Poland Economy Watch, Poland unemployment rate)(Rastislau Hrvol 2006) but it is important to mention that after joining the European Union in 2003, large groups of Polish workers, specialists and students left Poland for work in other EU's countries.

Restructuring is unfolding as the energy markets are liberalized, and several companies from Western and Northern Europe are moving in as investors in the energy sector. Many countries are also looking to Poland as a source of carbon dioxide emission and as a host country for Joint Implementation (JI) projects.

Joint implementation (JI) (UNFCCC, Kyoto Protocol, Article 6) is one of three flexibility mechanisms set forth in the Kyoto Protocol to help countries with binding greenhouse gas emissions targets meet their obligations. Under Article 6, any Annex I country can invest in emission reduction projects (referred to as "Joint Implementation Projects") in any other Annex I country as an alternative to reducing emissions domestically. In this way countries can lower the costs of complying with their Kyoto targets by investing in greenhouse gas reductions in an Annex I country where reductions are cheaper, and then applying the credit for those reductions towards their commitment goal. A JI project might involve, for example, replacing a coal-fired power plant with a more efficient combined heat and power plant. Most JI projects are expected to take place in so-called "economies in transition," noted in Annex B of the Kyoto Protocol. Currently Russia and Ukraine are slated to host the greatest number of JI projects. Unlike the case of the Clean Development Mechanism, the JI has caused less concern of spurious emission reductions as the JI, unlike the CDM, takes place in countries which have an emission reduction requirement. The process of receiving credit for JI projects is somewhat complex. Emission reductions are awarded credits called Emission Reduction Units (ERUs), where one ERU represents an emission reduction equaling one tone of CO2 equivalent. The ERUs come from the host country's pool of assigned emissions credits, known as AAUs. Each Annex I party has a predetermined amount of AAUs, calculated on the basis of its 1990 greenhouse gas emission levels. By requiring JI credits to come from a host country's pool of AAUs, the Kyoto Protocol ensures that the total amount of emissions credits among Annex I parties does not change for the duration of the Kyoto Protocol's first commitment period.

Environmental drivers for the energy sector thus include commitments under the Kyoto Protocol and resulting climate policy, but also compliance with the Convention of Long-Range Trans-boundary Air Pollution and various EC Directives (Nilsson, Energy policy and the role of bioenergy in Poland).

11.2 Energy demand

The prospects for expanding the modern use of bioenergy are partly determined by the current and future broader structure of the energy sector in Poland. Primary energy use in Poland has decreased slowly since the deep economic recession in 1989–1991. Primary energy use in 1990 was 4217 PJ, representing a 25% decrease from the 1988 level of use. Although the economy recovered during the rest of the 1990s, with typical annual GDP growth rates of about 4–6%, primary energy use continued to decrease slowly and was 3812 PJ in 2000. The consumption of energy is strongly correlated with the development of the economy both from global and sector perspectives. It is the development of particular industries in the economy which results in changes in the structure of global energy consumption. On the one hand Poland experiences more economical technologies, but on the other hand these technologies are more commonly used. The contribution of particular economic sectors to the creation of renewable energy consumption in Poland in recent years and the direction of changes in this area were presented in many research projects (Zawada, Energy consumption in Poland). The industrial sector accounted for more than half of this decrease of GHG emissions (Institute for Energy, 2003). Various projections and scenarios show that final energy use in Poland may be stable, or increase by as much as 19% by 2020 under different assumptions and macro-economic scenarios (Council of Ministers of Poland, The Summary of Energy Policy Assumptions for Poland).

11.3 Energy market

Hard coal and lignite account for a large, about 65%, but slowly decreasing share of primary energy use. The index of self-sufficiency (the ratio of primary production to primary use) in 2000 was 87%, about twice as high as the EU average. Domestic coal reserves are sufficient for about 60 years at the current rate of extraction. The share of oil is increasing due to growing demand for transportation fuels. For example, gasoline consumption increased by about 90% between 1990 and 2000, driven largely by the near doubling of the number of passenger cars from 5.3 to 10 million. There is also a slight increase in the share of natural gas as households and industry slowly shift to gas. In future projections, these trends are expected to continue.

Poland is a signatory of the Kyoto Protocol. The Kyoto Protocol[26] is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. This amounts to an average of five per cent against 1990 levels over the five-year period 2008 – 2012. The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol commits them to do so. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. 184 Parties of the Convention have ratified its Protocol to date. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh in 2001, and are called the "Marrakesh Accords" (Unfccc.int).

Poland is committing itself to a 6% reduction of greenhouse gas emissions in the first commitment period of 2008–2012 (UNFCCC, Kyoto Protocol). Poland's base year (1988)

[26] Detailed information in chapter 11.1

emissions were 478 Mton. Emissions in 2000 were 315 Mton (GUS, Statystyki emisji dwutlenku węgla do atmosfery). Poland is a potential source of emissions permits equivalent to 50–130 Mton of carbon dioxide equivalents in the first commitment period.

Electricity generation and consumption in Poland have remained relatively stable in the past 15 years. Gross generation in 2004 amounted to 145.2 TWh. The source of about 92% of electricity is hard coal and lignite (Commission, Poland). Green energy shares were around 4%, which basically consisted of hydro power, biogas and landfill gas, wind energy and some biomass CHP installations[27].

In contrast to heat demand, Polish electricity demand is projected to grow. Total electricity production has been projected to increase to 233 TWh in 2020, on average 2.2% per year. This corresponds to a per capita consumption of about 6000 KWh in 2020, assuming a relatively stable population below 40 million.

For the past few years, the annual production of industrial process heat and district heat (DH) in Poland is estimated to be 1100–1250 PJ. In addition, an estimated 360–570 PJ are used for space heat and hot water production in small individual boilers for dwellings, hospitals, schools, etc. District heating systems cover nearly 70% of heat demand in urban areas, and about one-third of the dwellings in Poland (Energy Market Agency, Energy efficiency report for Poland). In addition, there are about 8–9 million dwellings that have individual heating systems, roughly half of which have boilers with hydronic heat distribution systems (i.e., central heating) and half of which have stoves, using coal as the main fuel. Overall heat demand has been forecast to decrease by about 15% in the next 20 years as a result of modernizations and efficiency improvements, including end-use efficiency (Energy Market Agency, Energy efficiency report for Poland).

Natural gas is a potentially important competing fuel to biomass, depending on gas-grid access and relative prices. Between 1967 and 2001, the natural gas consumption increased from 90 to 431 PJ. Most of the natural gas is used in industry (40%) and in the residential sector (34%). Relatively little (4%) is used for heat and power production. Poland's domestic gas production is relatively stable at about 140–150 PJ per year. Domestic reserves are limited and the expanded use of natural gas will depend on imports. Natural gas consumption is expected to range between 650 and 1100 PJ in 2020 (Nilsson, Energy policy and the role of bioenergy in Poland).

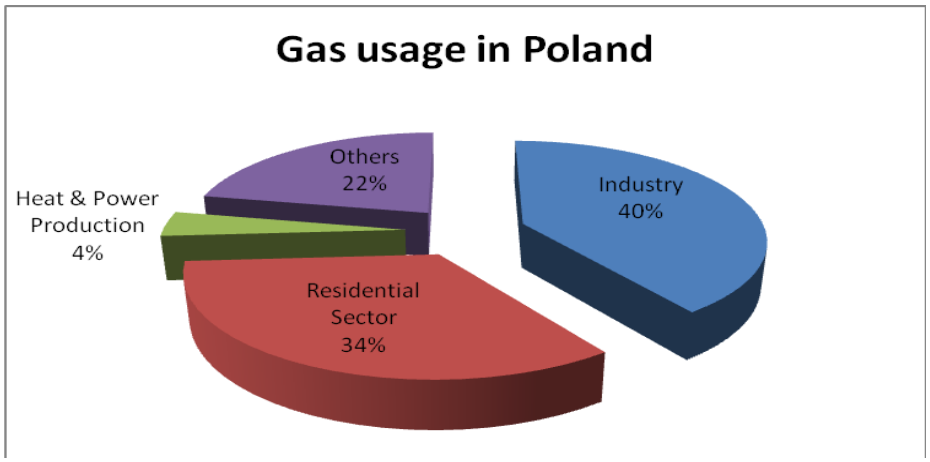


Figure 11.1 Gas usage in Poland (Nilsson, Energy policy and the role of bioenergy in Poland, 2005)

[27] Combined Heat and Power, Cogeneration is the use of a heat engine or a power station to simultaneously generate both electricity and useful heat

The Polish power sector is the largest in Central Europe and Poland is also the biggest energy consumer in the region. Coal-fired power plants meet most of Poland's annual energy demand. Poland has no nuclear power plants and only one research reactor. In recent years, Poland has experienced significant economic growth and electricity consumption is expected to rise by 80%-93% by 2025. Poland relies mostly on coal to meet its energy needs, but many coal-fired power plants have been operated for over 30 years and need to be modernized or decommissioned because of the level of pollution they produce. Poland has ratified the Kyoto protocol and must comply with its EU National Allocation Plan commitments (FORATOM, Country profile: Poland).

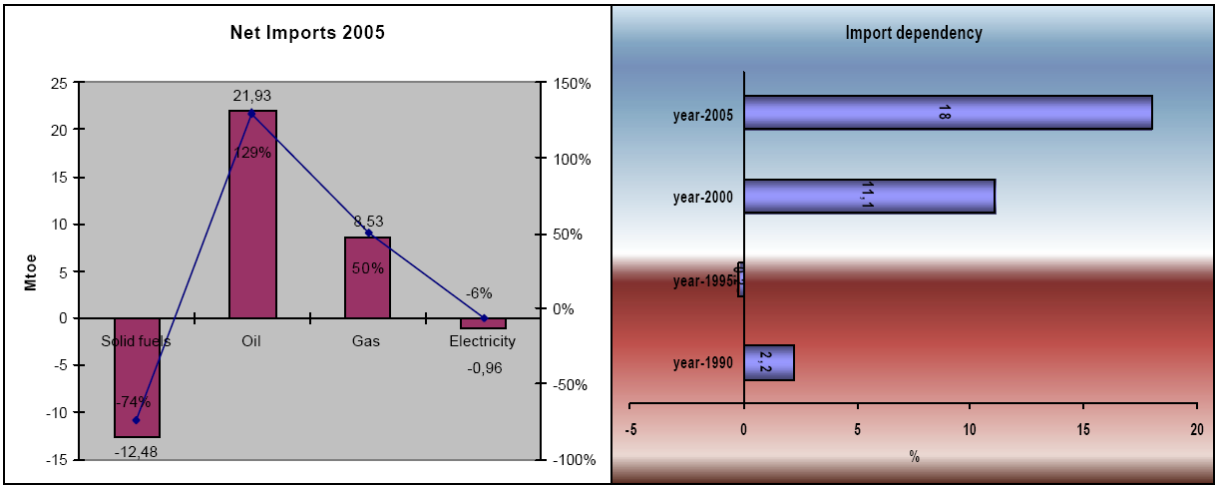


Figure 11.2 Net imports and import dependency of Poland (Commission, DG TREN, 2007)

Since 1989, district heating plants have been controlled and mainly owned by local government at the municipal, or commune level. The Energy Act of 1997 (Ministry of Economy and Labour of Poland, Prawo Energetyczne) (which requires development of local energy plans by each commune or district) gives local authorities an important decision-making role in energy supply planning, including liquid and gaseous fuels supply, energy efficiency programmes, and implementation of renewable energy technologies. Thus, local decision-makers play an important role for the bioenergy development especially in the district heating sector as most of the district heating systems are still municipally owned. Owners of district heating systems are likely to respond to economic policy instruments promoting bioenergy since the fuel-flexibility in currently coal-fired boilers is relatively high.

Large CHP and power plants have the option of co-firing with coal. This can be an important component in a strategy to develop the fuel market and bioenergy logistics. Larger-scale CHP plants and power plants have not been interested in bioenergy due to the uncertain system of renewable electricity purchases, the early stage of wood fuels market development, and relatively low costs of heat and electricity production based on fine coal combustion. However, interest is growing rapidly as compliance with the renewable electricity quota obligation is increasingly enforced. It started to be more profitable for energy producers to co–fire coal with wood, because of much higher prices of energy sale than classic fossil fuel burning. Under the quota obligation, somewhat increased electricity production costs from co-firing can easily be passed on to the consumers by higher energy resale price. These professional actors can respond quickly to this policy instrument through minor technical modifications and installations of new burners in existing plants.

In principle, all of the near-term wood fuel potential of 5–7.5Mm^3 (residues and fuel wood) could be absorbed by co-firing 10–15% biomass in electricity production (Ljunggren, Biomass co-combustion potential). The draw-back of co-firing is lower environmental benefits compared to small-scale fuel conversions, and that ash-recirculation is not possible.

Forestry and agricultural policy and practices are not coherent with the assumptions for bioenergy development in the renewable energy policy.

11.4 Renewable energy overlook

The interest in the energy use of biomass all around the world is constantly growing, since the interest is especially high in the countries with natural conditions (e.g. Sweden, Finland) (Hall, Biomass energy development). At present the energy use of the biomass in the EU represents 64% of the use of RES (Bauen, Biomass energy options and policy integration). Power engineering on the bases of the biomass, or in a more modern sense bio-power, is currently already supported in many countries, like Sweden, Finland and the United Kingdom, as a new science field which is developing extremely dynamically. Investments in the research and development of bio-power technologies and associated areas are the basic condition for the ability to react on the changing economy and environmental conditions not only worldwide, but especially in Europe. The non-systematic approach to development should lead to lower gross domestic product and competition. Slovakia, with its natural conditions – 42% of forested land and with 35% of agricultural land- should definitely hold one of the leading positions in Europe, as long as there is a change in the approach and the state authorities support the systematic research and technological development[28]. This research is very time consuming, multidisciplinary and its results are visible only after several years of systematic work. Parallel to the preparation of the intensive growth and use of the biomass in power engineering sector, either as a raw material or alternative bio fuel, there is a need to devote more attention to the development and production of effective technologies including harvesting technologies and the manipulation and processing of the technical biomass to the final commercial product - bio fuel, to the desired standard quality level. The same attention also needs to be given to modern power engineering technologies, which can secure the effective use of energy content in bio fuels with a minimal negative influence on the living environment.

Wood industries are currently the most important suppliers of bioenergy. Poland is also a large particle- and fiber-board producer with an annual production that reached 1.3 Mm^3 in 2001. Poland's wood harvest in 2001 amounted to 26.7 million m³, 25 million m³ of which was roundwood. According to preliminary figures for 2001 issued by the Central Statistical Office, Poland produced approximately 3.6 million m³ of sawnwood. A total of 4.6 million m³ of panels, which is close to the 2000 level, were produced by the wood-based panels industry. The country generated a total of 3 million m³ of particle boards, 15% of which were oriented-strand boards (OSB). The 2001 production of wood pulp amounted to 937,000 tons. Production of paper and paperboard was 1,950,000 tons. In 2001, Poland exported 756,500 m³ of sawnwood and 1,492,800 m³ of wood-based panels. Exports of

[28] Chapter 9, Slovak Republic

fiberboard reached 623,600 m³ (Ministry of Environment of Poland, Wood market review and prospects).

Most renewable electric power comes from water reserves. Poland is not an exception in this respect. In several developed countries the hydro-electric industry supplies the largest amount of electric power from renewable power sources. However, water power engineering plays only a small part in general power production due to the lack of suitable conditions to build water power plants. The construction costs of such plants are quite high, which is why the power industry is more popular in economically well-developed countries. The small potential of Polish water power engineering also results (primarily, as some would say) from a lack of heavy rainfall, mostly flat terrain, and soils of large permeability. The domestic reserves of hydro-energy are mainly concentrated in the Vistula River basin (about 68%). The rest are produced by the Odra River with its basin and the rivers of Pomerania. The most prospective regions for the development of water power engineering are the Muzury Lake District, Pomerania, the Carpathian and Sudety Mountains. The Polish hydro-energy reserves are estimated at 13.7 TWh/year (about 0.1% of world reserves). At present Poland uses only 12% of its hydro-energy reserves, which amounts to 7.3% of installed power in the country's power energy system. In comparison, France uses almost 100%, Norway 84%, and Germany 80% of their water reserves.

At present there are about 590 water power plants in Poland, most of which are small units with power output of less than 5 MW, with only 18 units having output of more than 5 MW. The biggest of them are Żarnowiec (716 MW), Porąbka-Żar (500 MW), Solina (200 MW), Włocławek (162 MW) and Żydowo (150 MW). The future of domestic water power engineering, as seen by specialists, lies in the development of a small water power industry (MEW). Although the construction of a water power plant in Nieszawa is being looked into, it seems that the completion of this project is out of the question. The biggest pumped-storage power plant is situated in Żarnowiec. It constitutes an important element of power regulation in domestic electrical power engineering system. It started to operate in 1983. It is fitted with four reversible generating sets, each having the power of 179 MW in turbine work and 210 MW in pump work. The Żarnowiec Lake (122 hectares of surface) forms the lower water body. The upper water body (artificial) was constructed on the flat hill top (13.6 million cubic metres). Such an amount of water allows the power plant to operate at 716 MW output for about 5.5 hours. The water from the upper water body is supplied to pump turbines through four steel pipelines of 1.1 km in length.

Poland is gradually increasing its biofuels marketing potential. As early as 2005, there were no obstacles to the addition of 5% of fatty acid methyl esters to diesel fuels (bio ethanol has been used as an additive to petrol since 1994). In 2006, the introduction of the Minister of Economic Affairs' Regulation of 8 September (Council of Ministers of Poland, Dz. U. No 166, Item 1182) on liquid biofuels quality requirements, created the conditions for placing two biofuels on the market:

- Fatty acid methyl esters used as direct fuel
- Diesel containing 20% of such esters

In addition to creating improved conditions for the development of the bio components and biofuels market, on 25 August 2006 the Parliament of the Republic of Poland adopted a package of two Acts: the Bio components and Liquid Biofuels Act (Council of Ministers of Poland, Dz. U. No 169, Item 1199 and 2007 No 35, Item 217 and No 99, Item 666) and the

Fuel Quality Monitoring and Control Act (Council of Ministers of Poland, Dz. U. No 169, Item 1200). The two Acts ensured full transposition of Directive 2003/30/EC into Polish law. Their most important provisions include:

- Enabling farmers to produce liquid biofuels for their own use. Farmers are now able to produce for their own use all kinds of liquid fuels used as direct fuel; in addition, the provision of security for excise duty will no longer be required in the case of pure vegetable oils and esters. The Fuel Quality Monitoring and Control Act requires liquid biofuels produced by farmers for their own use to meet only minimum quality requirements, essential for reasons of environmental protection. The annual own use production quota is 100 litres per hectare of arable land owned by the farmer.
- The introduction, as of 1 January 2008, of a requirement to ensure specified biocomponent participation in the transport fuels market. This requirement has been imposed on businesses producing liquid fuels or liquid biofuels and purchasing them intra-Community, for subsequent sale or for their own use. Such businesses are defined as entities implementing the National Indicative Target.
- The introduction of the concept of "captive fleet" into Polish law, defined as a group of at least 10 vehicles, agricultural tractors or off-road machines, or a group of locomotives or ships fitted with engines able to burn liquid biofuels, owned or used by individuals engaged in business, legal entities or organisations without a legal personality. The introduction of this concept has made it possible to use a wide range of liquid biofuels with high bio component content, other than those granted marketing authorisation, in vehicles and machines forming part of "captive fleets" (Ministry of Economic Affairs with the cooperation of other Ministries, Report to the European Commission of Directive 2003/30/EC).

11.5 Trends and forecasts concerning energy market

One of the most important elements of the international environment of Poland is connected with the process of the integration with the European Union. This is why it was attempted to preserve a maximal similarity to scenarios worked out by experts from the European Commission and presented in European Energy to 2020: A Scenario Approach (issued by the European Commission in 1996) and the European Union Energy Outlook to 2020 (issued by the European Commission in November 1999) in the construction of the macroeconomic development scenarios. There were a couple of scenarios prepared in the presented paper.

When constructing the scenarios, it was attempted to take into consideration various possible developmental situations, depending on the success or lack thereof, and connected with the implemented social and economic reforms of the country. The influence of macroeconomic parameters, depending on the shaping of the situation in the external environment of Poland, was also taken into consideration in the scenarios. Thus, it was attempted to reduce the set of possible conditions for the Poland's development down to rational sizes. It is possible to reach a general conclusion of the scenarios analysis.

A drop in the consumption of the primary energy is forecast in all scenarios during the first 8 years covered by the analysis as a result of a deep rationalisation of energy consumption, and especially of the network heat. A moderate increase in the demand for primary energy

occurs in consecutive sub-periods. There should be expected an increase in the demand for electric energy, especially in the sector of services and in households.

All scenarios predict a drop in the demand for hard coal, down to the level of around 83 million tonnes. All scenarios predict the extraction of brown coal in the stable level of ca. 65 million tonnes per year.

The demand for natural gas increases considerably in electric power generation and communal heating. The increase is smaller in other sectors of the economy. The earth gas becomes competitive for the coal due to a high efficiency in the conversion, a smaller unit emission of CO_2 and NO_x, as well as a practical lack of the emission of SO_2 and dusts. The demand increases up to the level of around 27 billion m^3.

The demand for crude oil and oil products increases. The existing reloading and transportation capacities considerably exceed present needs of the Polish refineries.

The demand for electric energy in the period covered by the forecast indicates a very dynamic increase from around 41% to 66%. In natural units, it means an increase up to 202 - 236 TWh in 2020.

The level of the increase seems to be high. The conducted various comparators analyses, including those of international data and referring mainly to the demand for the electric energy in the function of the speed of the increase in the GNP, indicate that, practically speaking, the increase in the consumption of electric energy usually exceeded the speed of the increase in the GNP in every country with an economic growth (Council of Ministers of Poland, The Summary of Energy Policy Assumptions for Poland).

Biomass energy is recognized as the most promising and most important renewable energy source in the 10–20 year time frame. However, it is also noted that in order to increase utilization of biomass as well as other renewable sources of energy, the state must create the necessary market conditions and support systems. The objectives are expected to be met through the implementation of support programmes for particular renewable sources and technologies.

There is now a growing competition for raw material between the production of board and pellets. In all, this may create incentives for the forestry sector to increase the production of wood chips and extraction of residues. The forestry industry developed the technical capacity and know-how for virgin wood chips production in the early 1990s when particle- and fiber-board production increased. This has provided a good basis for the development of forestry fuels production with the use of existing infrastructure, engineering know-how and logistics. A growing demand for pellets and briquettes provides an opportunity for wood industries to diversify and improve the utilization of by-products.

Small- and medium-scale CHP and heat boilers in district heating, as well as individual boilers in dwellings and other buildings, appear to be the most promising applications for bioenergy, in particular because sulphur emissions from coal-firing are reduced. In the case of boilers used for district heating in rural areas, the problem of availability of fuel does not exist. Biomass for district areas is available in almost all of Poland. Energy content in the transportation sector is also much smaller (Figorski, Biomass for Power Generation or Local Heating). The interest in using bioenergy is still relatively weak, but it is increasing. Various demonstration projects in small-scale district heating show both positive and negative results in terms of project development, technological problems and biomass supply. In the short term, development is expected to continue in district heating below 20–30 MW on the basis of partial financing from NFEP, Ecofund Foundation and Voivodship Funds. In the domestic sector, some users have switched to firewood in response to the

higher coal prices in northern Poland (EC BREC, Targeted actions in bioenergy network). Firewood, as well as pellets, may become an important option in new small-scale installations if there is a relative price advantage. However, fossil fuel taxes may be needed to promote domestic demand and decrease the exportation of firewood and pellets (Commission, Energy in Europe).

Poland would do well to specialize on a worldwide scale as a major promoter in technologies of underground coal gasification, the production of synthetic gas and liquid fuels from coal and also a future technology consisting of the production of hydrogen with the use of coal. Such is the opinion of Andrzej Siemaszko, director of the National Contact Point of EU Research Programmes. Poland has two major strong points to its benefit: thirteen years of experience in pumping carbon dioxide underground and modeling and controlling the process, and on the other hand, huge deposits of coal, unfeasible for mining but ideal for subterranean gasification. Bełchatów, Europe's largest power station which belongs to PGE can introduce a post-process, i.e. removing CO2 from exhaust gases, while the PKE/ZAK plant in Kedzierzyn would be the world's first zero-emission energy generation carbochemical complex, for coal gasification to generate electric energy, heat and synthetic fuels (Polish Market, Clean and safe energy generation in Poland).

11.6 Goals and energy policy according to legislation

''Development Strategy of Renewable Energy Sector'' adopted by Parliament in 2001, is the key document supporting renewable energy in Poland (Ministry of Environment of Poland, Renewable energy in Poland). The strategy elaborates short-, mid- and long-term objectives for renewable energy. The objective is to increase the share of renewable energy in Poland's primary energy balance to 9.0% in 2010 and to 14% in 2020 (Ministry of Economy of Poland, W sprawie szczegółowego zakresu obowiązków uzyskania i przedstawienia do umorzenia świadectw pochodzenia).

The general market and policy situation in Poland provides the background conditions for the development of bioenergy. In addition to general energy policy, it is important to identify four important aspects in relation to bioenergy development: fuel and electricity prices, renewable energy policy, agricultural and forestry policy, and financing of projects. The whole energy sector is going through restructuring, a process largely driven by the adjustment of Polish law to EU requirements. This includes adjustments of the heat, electricity and gas sectors to EU directives. This can be noticed in many regulations (Ministry of Environment of Poland, Renewable energy in Poland). The basic elements of energy policy are outlined in ''Assumptions of Energy Policy to 2020'' (Council of Ministers of Poland, Assumptions of the Power Policy of Poland until the Year 2020) based on an analysis of the present state and the expected future development of the energy sector. This includes taking account of important trends such as globalization, liberalization of markets and decentralization. The basic policy objectives are security of supply, enhanced competitiveness, and environmental protection.

The ''Energy Act'' from 1997 is the basic legal framework for the energy sector. It defines the Ministry of Economic Affairs as responsible for the energy sector in Poland. Important elements of the act include restructuring of the energy sector through unbundling, third party access (TPA), purchase obligations on electricity from CHP or renewable sources, a requirement for local energy plans, and the creation of a regulator. The ''Energy Act'' defines the responsibilities of the Energy Regulatory Office (URE) which was founded in 1997 as the government executive body. URE's overall aim is to secure regulatory

compliance as well as to protect consumer rights. The main tasks include licensing of energy production, transmission and trade, regulation of energy prices, and control of access to energy markets through TPA.[29] It also has duties in the promotion of energy efficiency.

Energy policy has focused mainly on restructuring, developing the natural gas infrastructure, and improving the energy efficiency of the economy. Renewable energy has been considered only in the long-term perspective. For example, ''Assumptions of the Energy Policy'' (Council of Ministers of Poland, Assumptions of the Power Policy of Poland Until the Year 2020) described renewable energy sources as having low technical potential and assumed that the utilization would not be very significant before 2020. In the 2002 revisions to this policy document, renewable energy is more explicitly recognized and its share in the energy balance is predicted to grow from an estimated level of 131 PJ (3.3% of primary energy) in 1999 to 157 PJ (4.0%) in 2005 (Council of Ministers of Poland, Assumptions of the Power Policy of Poland Until the Year 2020). Energy policy in Poland has been developing rapidly since 1997, and it is no surprise that various documents are not coherent concerning the role and future development of renewable energy and bioenergy.

Bioenergy R&D is another important component of a coherent policy and a strategy to develop bioenergy. There has not been any coordinated bioenergy research programme in Poland so far.
Bioenergy in Poland has been supported mainly through grants and soft loans, typically made available through bilateral financing. Environmental taxes, or tax exemptions, have been of less importance. Essentially, all investments in industrial and district heating applications have been made with 30-50% investment subsidies. The main sources of support include the National Fund for Environmental Protection and Water Management (NFEP), Voivodship Funds for Environmental Protection, the Ecofund Foundation (EF, capitalised through debt-for-nature swaps), Bank of Environmental Protection (BOS), Agricultural Property Agency (APA), and the Global Environment Facility (GEF) (Ecoenergia.pl). Although these funds have a broader environmental mandate, support for bioenergy projects, notably in district heating applications, has been an important part of the project portfolios.

Some of the projects were funded through bilateral cooperation with Sweden (Lowendahl, Sweden and the Baltic Sea Region Co – operation) (Sida—the development cooperation agency), Denmark (Danish Energy Agency), Finland and The Netherlands (AIJ and JI programmes) (Ministry of Economy of Poland).

There are expectations that JI will become a significant source of funding. Poland has been engaged in this activity since 1995 and several AIJ and JI pilot projects have been implemented, notably together with Norway, Canada, Finland and The Netherlands.

Over the years of its work, the JI Secretariat has received more than 60 AIJ programs and proposals. There are couple AIJ programs currently being implemented in Poland: fuel switching and energy efficiency measures (in collaboration with Norway), an energy supply system for the town of Byczyna (with the Netherlands) and sustainable heat and power improvements for public networks in the town of Szamotuly (with the Netherlands). The first AIJ program, co-financed by the Government of Norway, GEF and the Polish

[29] TPA, Third Party Access policies require owners of natural monopoly infrastructure facilities to grant access to those facilities to parties other than their own customers, usually competitors in the provision of the relevant services, on commercial terms comparable to those that would apply in a competitive market

partners, was launched in 1996. To date, the Norwegian program consists of 31 separate individual projects now under different implementation stages. These are:

- Twenty-two coal to gas conversion projects executed in non-industrial, small and medium-sized boiler-houses
- Nine projects for energy efficiency improvement in new residential buildings. The financing for these projects consists of:
    - A grant in the amount of 25 million USD allocated by GEF to Poland,
    - A grant from the Government of the Kingdom of Norway in the amount of 1.1 million USD,
    - The Polish government's own funds in the amount of 22 million USD (including the financial assets of the National Fund and the Provincial Funds for Environmental Protection and Water Management, credits allowed by the Bank for Environmental Protection, and the Polish investors' own funds)

The expected overall environmental effect achieved as a result of the program implementation will be the reduction of carbon dioxide emissions by 278,911 Mg CO_2/year. In the case of coal to gas conversion projects, the environmental effect was calculated as the difference in emission levels between new coal-fired boiler-houses and new gas-fired boiler-houses. In the case of projects for energy efficiency improvement in new residential buildings, the environmental effect is the difference in emission levels between a new building erected in accordance with the Polish Standard (for heat insulation of buildings) and a new building erected using advanced energy efficiency technologies.

In addition, the Polish Government signed an agreement with the Government of the Netherlands, under which 14 projects were pre-qualified and evaluated for possible implementation as JI programs. Under this program, two pilot projects were selected: the heating systems for two towns: Byczyna and Szamotuly. The Byczyna project involves the use of modern gas boilers to replace the existing coal boilers (with a total output of 4.4 MW). The Szamotuly project involves energy efficiency improvement in the process of heat energy production by fuel conversion (from coal to gas) and cogeneration. The total cost of the projects is estimated at 1,356,000 USD, where the AIJ component represents 912,000 USD. The environmental effect expected as a result of the project's implementation is the reduction of carbon dioxide emissions by 6,966 Mg CO_2/year. This effect is calculated as the difference in emission levels from the areas of the two towns in 1997 (before the investment project was started) and the emission levels following the modernization. It is not clear how environmental effects have been calculated and how they have been split between domestic measures and the AIJ component.

Moreover, two programs proposed by the Netherlands await approval by the Polish Government. One involves the construction of a bio-gas intake facility at a solid waste landfill and the other entails the use of waste wood for heat energy generation. Six programs have also been proposed by Switzerland (all of them designed to convert coal-based heating to systems based on gas/oil). Sweden has proposed one program (landfill gas disposal). The Dutch and Swedish programs await approval by the Minister of

Environmental Protection, whereas the Memorandum of Understanding must still be signed for the Swiss project. The expected environmental effect to be achieved as a result of the implementation of the above programs is a carbon dioxide emission reduction of about 96,215 Mg CO_2/year (Karaczun, Sobolewski).

The most important JI funds so far are PCF and the Dutch ERUPT programme. Both have short-listed various renewable energy projects including biomass CHP, landfill-gas and biomass district heating projects.

Several different actors, such as governmental, private sector, administrative may be involved in the development of bioenergy systems. The most important on the supply side include forest owners, wood industries, and farmers. Potential users of bioenergy range from individual households to large CHP and power plants.

Polish RES-E policy includes the following mechanisms:

- Tradable Certificates of Origin introduced by the April 2005 amendment of the Energy Act (1997).
- The Obligation for Power Purchase from Renewable Sources (2000, amended in 2003) involves a requirement on energy suppliers to provide a certain minimum share of RES-E (3.1% in 2005, 3.6% in 2006, 4.8% in 2007 and 9.0% in 2010). Failure to comply with this legislation leads – in theory – to the enforcement of a penalty. In 2005, these were not sufficiently enforced.
- An excise tax exemption on RES-E was introduced in 2002.
- The Energy Act of April 2007 incorporates a principal support mechanism of Certificates of Origin for RES-E: all energy companies selling electricity to end users have to obtain and present for redemption a specified number of Certificates or pay a substitution charge.
- A liquid biofuels quality requirement regulation entered into force in September 2006 (Directive 2003/30/EC).

Since January 2007, bio components for liquid fuels and liquid biofuels have been exempt from excise duty; preferential excise duty treatment was planned to increase under an Act of May 2007.

In 2007 the Polish Ministry of Economy published provisions to the Energy Efficiency Act, which will implement the ESD Directive 2006/32/EC on energy end-use efficiency and energy services in Poland. The implementation of this Law is in progress.

According to the published provisions to the Energy Efficiency Act, the Act will introduce "White Certificates" as the main instrument encouraging energy efficiency improvement. White Certificates confirm realisation of the energy efficiency measures and attainment of energy savings being results of the measures. Those savings may be reached by reduction of energy use by the end user, by the increase of energy conversion efficiency in energy or heat production, and also through cutting down energy losses in the transmission and distribution of energy. Companies selling energy (electricity, gas and heat) to end users will have to submit and redeem a specified amount of white certificates each year. The certificates can be obtained through realisation of energy efficiency improvements or by purchasing certificates on the market. According to the same provisions the improvement

of energy efficiency in industry will be additionally supported by a second instrument: voluntary agreements between industry and government on energy efficiency improvement.

As required by the ESD directive, the Act will ensure that the public sector takes a leading role in improving energy efficiency. It will be achieved through thermal modernisation of public buildings (authority, schools, hospitals, etc.), green public orders – governmental agencies and offices will be provided with energy efficient equipment, etc. Also, workshops for public administration employees on pro energy effective behaviour will be organised (ROCKWOOL).

An obligation to add a specified volume of bio-component to fuels was also introduced by two recent Acts (June 2006). Another element in this policy mix is structural funds, which can be used to improve the infrastructure of biofuels and other RES (Commission, Poland).

Economic incentives would be needed to tip the scale in favour of bioenergy in small-scale district heating and the domestic sector. Overall, it is expected that continued support through investment grants and JI projects will result in steady but low growth in small- and medium-scale applications.

It is a strategic short-term choice whether bioenergy should be supported to be used as a neat fuel in smaller plants or for co-firing in larger plants where the environmental benefits are likely to be smaller (at least for clean biomass fuels). In principle, Poland has already made this choice through implementing a quota obligation that can be expected to increase co-firing for electricity production considerably in the near future, as enforcement has now become stricter. EU emissions trading will provide additional incentive for plants covered by the scheme.

It would be unfortunate if the biomass resources are exclusively used for co-firing since this strategy does not fully realize the advantages of bioenergy when it is used as a neat fuel in smaller applications (Nilsson, Energy policy and the role of bioenergy in Poland).

11.7 Difficulties in achieving goals and implementation problems

Renewable energy sources cannot develop at the same rate because of the specifics of the sources itself as well as because of specific external conditions predominating in Poland. When analyzing the possibilities of development, one should remember that in Poland there is necessity to produce energy for heating. Specific kinds of renewable energy are more convenient for local use as small capacity energy sources that deliver energy for heating closed spaces. The utilization of such sources should be especially supported by government because, when using local small and very small renewable energy sources, the redundancy of system energy sources is avoided. The additional advantage of small local heat sources, in opposition to electricity sources, is that building costly grids is not needed.

In a free commercial market, RES still cannot compete with traditional technologies, such as large hydro, combined cycle plants based on natural gas, efficient coal-fired combined heat and power plants or nuclear power plants.

The most significant barriers in green energy development are:

- Strong fossil fuel lobbying. Especially in Poland.

- Complexity of the legal framework and particularly the authorization procedure, which is frustrating for many small investors.
- Inhibitive cost for interconnection to the grid (mostly reinforcement or construction of new network lines).
- Public acceptability is also an issue in certain cases, basically due to visual impact or other reasons
- Long lasting procedure of changing legal status
- Polish energy law is not harmonized with European Union's legislation
- Difficult and long lasting process of getting building permission
- Weak regulatory policy concerning acceptance of grid development plans. It does not optimize the cost with reference to the production, transmission, distribution and consumption.

In developing new wind power plants the biggest difficulties are with grid infrastructure and connection problems. These problems include:

- Insufficient grid infrastructure in Northern Poland, which is the best place to install wind energy.
- Infrastructure development plans are set, but investment priorities often change. For example the need to repair existing line before building new one.
- Lack of coordination between investors and energy buying companies.
- Connection conditions are sometimes hard to meet, very high transmission fees.
- Complex process of development procedures.
- Time consuming and relative complex set of procedures for the projects to obtain zoning plan as well as time consuming and complex procedure for environmental analysis in order to obtain the approval for wind energy
- Insufficient resources and knowledge to ease the process

In photovoltaic development the biggest problem is with the low awareness of a solar option, weak founding, lack of the real market and lack of potential in almost all of Poland.

It is expected that in 2010 the share of biofuels in the transport fuel market will be much lower than the National Indicative Target for that year. Entry into force of the Minister of Finance's Regulation of 22 December 2006 amending the Regulation on Exemptions from Excise Duty on 1 January 2007, at a time when there were no other biofuels market support mechanisms, impaired the production of diesel containing bio components and of bio components used as direct fuel.

Poland is a flat country with little wind and hydro energy potential. According to the existing estimates the main source of renewable energy in Poland in the foreseeable future is biomass. As a result, there is a massive trend towards co-fire biomass with coal in the existing power plants, driven by penalties imposed on power companies, which fail to meet the annual targets determined by the government's ordinance. Consequently, the wholesale price of green electricity reaches ca. 200 PLN/MWh compared with about 100 PLN/MWh for traditional "black" coal-based electricity. This difference is internalized in the average electricity price for final consumers, which can be considered a hidden subsidy. On the other hand, in the Polish climate conditions, heating needs are very significant, notably in

rural areas, where biomass is typically abundant and presents great potential as a low-cost heating fuel. However, replacement of the existing coal boilers by dedicated, highly efficient biomass boilers requires relatively significant investment outlays, which usually exceed the financial abilities of farmers or other individual households (Figorski, Biomass for Power Generation or Local Heating).

The move towards using biomass in co–firing caused considerable problems for sectors which were based on biomass, wood, and other bio sources. For example animal fats were used for the production of lime from limestone. Currently this sector cannot produce lime in the amount which it used to because of higher prices for animal fat and difficulties on the supply side. A similar situation can be found in the furniture sector which is based on wood.

11.8 Discussion

The ‘‘Energy Act’’ contains two elements of particular importance for the development of bioenergy and renewable energy in general. One is the ‘‘Electricity Feed-In Ordinance’’ and the other is the obligation of municipalities to prepare local energy plans. The ‘‘Electricity Feed-In Ordinance’’ obliges electricity suppliers to provide an increasing share of electricity from renewable sources in their supply mix, increasing from 3.1% in 2001 to 9.0% in 2010. The ordinance, however, has failed so far to produce the stable market conditions sought by investors. Prices have been negotiated on a case-by-case basis, in principle based on avoided costs, and have been on average 215PLN/MWh. Until 2004 there was no mechanism to enforce compliance and no scheme for renewable electricity certificates trading. Since 2004/2005, such mechanisms have been introduced and future compliance is expected. The local energy plans should include an account of possible ways of utilizing local energy sources but the experiences so far have been mixed. Many local governments do not have the capacity to prepare good plans and the ‘‘Energy Act’’ does not specify any deadline for the preparation of plans. Only about 10% of the municipalities have prepared energy plans so far (Nilsson, Energy policy and the role of bioenergy in Poland).

Poland’s coal deposits are sufficient for even hundreds of years of clean exploitation. The first pilot unit for subterranean gasification will take some two years to get started. Poland should become a leader in clean coal-processing methods, subterranean and surface coal gasification, carbon chemistry and hydrogen technologies, since these would allow Poland to resolve all its problems stemming from the climate package, while simultaneously opening the way to full energy security (Polish Market, Clean and safe energy generation in Poland).

Co–firing biomass with coal in the existing power plans typically involves hundreds of kilometers of road transportation of biomass from the place of origin to the power plant. Additionally, significant amounts of energy are lost in grinding and mixing biomass with coal before injection into the furnace. For Poland the preferred way of using biomass for energy purposes is using it locally for heat-only production. The market for small and medium sized biomass boilers is estimated at about 400 000 units (Teliga).

12 CONCLUSIONS

The Slovak Republic has substantial potential of renewable energy, bigger than in the Czech Republic and Poland. Current use is significant but in the last years development speed decreased. Implementation difficulties in the Slovak Republic are strongly connected with the low environmental awareness of residents. The negative legacy of the past years, import of cheap energy carriers from the former Soviet Union, misshapen prices and cross subsidies have led to an over–consumption of energy, overheated dwellings and houses, large energy losses and low energy efficiency. Renewable energy is out of the focus of the governmental energy policy and it is almost out of the national energy plan, in addition to receiving very poor support from the state authorities.

The Slovak Republic's main renewable energy sources should be biomass and geothermal energy, both for heating and electricity production. Unfortunately there is small geothermal energy usage and no interest of investing in geothermal energy by the government. In terms of biomass, big plants allow technologies for cogeneration and these energy–intensive processes need both electricity and process heat. A further extension of bio–energy in this sector will mainly depend on the development of the structure of this industrial branch. Without regulations a higher amount of electricity from biomass will not be possible.

Slovak renewable energy development support is well constructed. Unfortunately there is no interest in the market and these financial supports are not effective. The Slovak Republic also has problems with strategic investors in the renewable energy field. Finally, the financial situation of investors is unlike the situation in other Member States. The main reason the development speed decreased is that there are not enough monetary funds held by potential investors. But Slovakia seems to be an interesting and profitable market for investors from other countries. And I think that this could be the solution. The current focus on searching for domestic investors should be changed to a focus on promoting the possibility of investments in the Slovak Republic by other, wealthier nations. It is working in some sectors, like motorization for example, so it should also work in the energy market.

In the Czech Republic the main barriers for implementation of regulations and development of renewable energy are natural conditions and lack of renewable energy sources potential. Also some existing suitable locations are excluded because of environmental protection. The Czech Republic has the worst renewable energy potential among the compared countries.

Other important problems with development are difficulties in preparation and the complication of receiving approval for projects. However even that is not the biggest Czech problem. That is the fact that in last year, restrictions to movement on a renewable energy market came from problems of financing. There is a lack of experienced investors, high credit risk, a lack of capital and well prepared projects. There is also a lack of interest in investments towards green energy. There are also some legislative problems with cooperation between agriculture and energy policies.

The Czech Republic, as the third biggest energy exporter in the European Union, will have problems witch achieving the goals of Directive 32 (Directive 2006/32/EC). But it seems

that this is not the main issue in governmental energy policy and nothing will change in that sector.

According to past developments, the indicative target for the Czech Republic of 8% in 2010 seems to be unrealistic. In my opinion Czech renewable energy development support is the best between the discussed countries. It is a relatively young system but, compared to other countries, is well constructed. Similar to the Slovak Republic, the solution will be in searching for investors from other countries and the promotion of possibilities for investments in renewable energy, not only in domestic markets but also markets abroad.

The Polish objective is to increase the share of renewable energy in Poland's primary energy balance to 9.0% in 2010 and to 14% in 2020. The whole energy sector is going through restructuring, a process largely driven by the adjustment of Polish law to EU requirements.

The chief problems with development of green energy are because of the structure of the Polish system, which is still deeply influenced by previous decades. The complexity of the legal framework and particularly the authorization procedure is frustrating for many small investors. Energy companies are causing more difficulties by increasing costs for the interconnection to the grid and not coordinating well with investors. For example, in the wind power industry, there is not a sufficient grid infrastructure in northern Poland, where the best potential for these kinds of projects can be found. Investments also have problems with the lengthy procedure of changing legal status and getting building permissions. The procedure of obtaining a zoning plan is time consuming and very complex. It is the same situation with conducting the environmental analysis necessary for investments.

In a free market, green energy cannot compete with traditional technologies such as fossil fuels plants, combined cycle plants based on natural gas, efficient coal-fired combined heat and power plants. Moreover there is a problem with strong fossil fuel lobbying.

In my opinion Poland has the worst energy policy between the three considered countries. But I think that in the next years Poland won't have problems with reaching goals set by Directive 77 (Directive 2001/77/EC). The price of green electricity convinced some energy producers to move into its production. Bioenergy has been identified as the most important and promising renewable source of energy for Poland. It has become more profitable for energy producers to co–fire coal with wood because of much higher sale prices than classic fossil fuel burning. Increased electricity production costs from co-firing can easily be passed on to the consumers by higher energy resale price. And in terms of production costs, they are not much higher in Poland than anywhere else so energy producers are getting more. The move towards using biomass in co–firing caused huge problems for sectors which were based on biomass, wood, and other bio sources, for example the furniture sector. The same thing is happening in other sectors. For example animal fats were used for production of lime from limestone. Currently this sector cannot produce lime in the amount in which used to because of higher prices for animal fat and difficulties on the supply side. A similar situation can be found in the furniture sector which is base on wood.

In my opinion using biomass for co–firing in Poland is a very impractical idea. It can be used with much better environmental impact in small and medium CHP plants and heat boilers in district heating, and also in individual boilers. The best approach is to use biomass where it is, not transporting it to huge power plants. This is the best solution for the utilization of biomass sources.

Poland will have some problems with biofuels production. Potential of production and forecasts are showing that in 2010 the share of biofuels in the transport fuel market will be much below the National Indicative Target for that year. In my opinion the only country, considered in this study, which can effectively produce biofuels, is the Slovak Republic. In Poland and the Czech Republic there will be more problems with sources.

I think that energy policy should focus on classic energy sources and new technologies. Poland can become a world leader in the promotion of underground coal gasification, production of synthetic gas and liquid fuels from coal and also a future technology consisting of the production of hydrogen with the use of coal. Many countries have already looked and also are looking at Poland as a source of carbon dioxide emission certificates and a country for Joint Implementation (JI) projects.

The new member states have made large strides towards becoming fully competitive market economies, not least through the clear alignment of their policies with the EU. In particular the new member states are developing clearly defined projects, which may also be attractive to medium and small investors. Further progress, however, largely depends on whether procedures for adopting and implementing such legislation that explicitly supports RES and sustainable development can be sped up. The role of renewable energy in the New EU Member States is significant. The energy share of the total primary energy supply in these countries is heavily based on fossil fuels, mainly solids and oil. Electricity production is mainly produced from fossil fuels and nuclear plants. At present, these countries are heavily dependent on energy imports, mainly from Russia. This dependence is reflected in their vulnerability concerning energy supply. It is important to mention that the countries concerned have taken concrete measures in the promotion of RES since 1997, mainly due to the proximity of an accession to the EU, when the Luxembourg European Council agreed on starting the enlargement process and the EU White Paper was published.

Enlargement of the EU will help to bring stability and prosperity, both to the existing Union and to the acceding countries. In this sense, the updated overview of RES policies and the evaluation of success stories in the EU help to disseminate 'best-practice" information to these countries that do not yet have enough experience in this field (Patlitzianas, The role of RES in the New Member States of EU).

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