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NEEDS

New Energy Externalities Developments for Sustainability

INTEGRATED PROJECT

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Possible internalisations of external costs and policy recommendations

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1. Executive summary

The deliverable D.6.1- RS 1d/WP6 "*Possible internalisation of external costs and policy recommendations*" presents the NEEDS RS1d/ WP6 results in Poland, Hungary, the Czech Republic, Slovakia, Tunisia, Egypt and Estonia. These RS1d partners describe the energy sector fiscal policy instruments, estimate the perspectives of internalising the external costs and provide recommendations for further internalisation in energy policy. Stockholm Environment Institute Tallinn Centre (SEI-Tallinn) has worked as the RS1d WP6 coordinator and has edited the contribution of each partner.

At present, Poland, Hungary, the Czech Republic, Slovakia and Estonia have the differentiated systems of environmentally related charges (fees, taxes, feed-in tariffs) in place already and they use also some administrative methods for mitigation air pollution and stimulating the more sustainable energy sector development. But all these measures are not strong enough to achieve the environmental policy goals.

Tunisia and Egypt are more conservative, the energy sector is supported via high subsidies thus, the energy prices are low.

The energy producers, governments and politicians in all these countries are relatively reluctant to increase pollution charges in the energy sector that are now actually much lower than the calculated external costs. With only minor exceptions, there is no political will to increase the rate of internalisation of external costs.

Internalisation of external costs should be an efficient instrument to elaborate for strategic goals of environmental policy. But it is often in conflict with major social and political concerns: first – loss of sectoral or international competitiveness; second – negative distributional impacts and third – a potential driver of inflation. These are the reasons why the possibilities for internalisation of external costs into the energy taxes and prices in practise are limited. Exceptions may be the countries that already have real alternatives to the fossil fuels – abundant renewable energy sources and/or nuclear energy available.

2. Synthesis and conclusions

2.1. Introduction

This report aims at discussing results obtained from national implementations of ExternE methodology with particular focus on the level of external cost internalisation using both taxes/charges and subsidies for renewable energy sources. We also reflect objectives of energy policies and potentials for green tax reforms and removal of harmful subsides in six new EU member states – Bulgaria, Czech Republic, Estonia, Hungary, Poland and Slovakia – as well as in three Mediterranean Partner Countries – Egypt, Morocco and Tunisia.

2.2. Energy policy drivers

Virtually all the countries under consideration face some common challenges related to long-term energy policy objectives. In the light of recent volatility of oil prices affecting also other energy prices, security of supply plays a prominent role. In this respect, a dependence on import of energy sources is key issue both in NMS and MPC considered in the project. There is a big difference in the level of liberalisation of the energy market – while it is almost completed in NMS (except for Estonia and Bulgaria), this is only in early stage in MPC (partial opening, tenders etc.).

On the top of the efforts to decrease dependence on imports is a promotion of renewable energy sources. In the medium to long term perspective all the countries strive to achieve much higher representation of renewable sources in energy balance as can be documented by the national targets for 2020 in the following table.

Table 1: Overall national targets for renewable sources in final consumption of energy

	Share 2005	Target share 2020
Bulgaria	9.4%	16%
Czech Republic	6.1%	13%
Estonia	18.0%	25%
Hungary	4.3%	13%
Poland	7.2%	15%
Slovak Republic	6.7%	14%
Egypt	7%	14%
Morocco	2%	10%
Tunisia	2%	n.a.

Source: Annex I to Proposal for a directive on the promotion of the use of energy form renewable sources, COM(2008) 19 final; Mediterranean Energy Perspectives 2008:248).

While the largest potential in NMS is with the biomass for heating, wind (both on- and off-shore), and also potential increase in hydro-energy use, in MPC the largest potential is expected from solar and wind (both on- and offshore) energy.

Growing energy demand (what is the case particularly in MPCs) and the need for renewal of existing power plants coming to their end-of-life also affects the current situation. The latter situation is mostly common in NMS and is also coincidental with environmental and safety requirements.[1]

Thus, decisions on new electricity and/or heat generation units have to be taken in foreseeable future. In spite of that avoidance of external costs plays rather marginal role in the decision making, environmental concerns are of great importance. This holds true particularly in NMS with respect to both emissions of CO_2 and some of the classical pollutants. In the first case trading in CO_2 emission trading is seen as one of the influencing factor for choice of energy sources.[2] In the latter case of classical pollutants, the main impetus is pronounced by the obligations stemming from Large Combustion Plants Directive and National Emission Ceilings Directive setting total caps on emissions of sulphur dioxide (SO_2), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC) and ammonia (NH_3).

In some of the new member states we are facing a revival of nuclear energy use. At present, the following projects are either planned or in progress:

- expansion of NPP Mochovce in Slovakia,
- expansion of NPP Temelin in Czech Republic,
- NPP Belene in Bulgaria,
- joint Baltic project for a new nuclear power plant in Lithuania.[3]

2.3. Economic instruments

Since late 80's there is a growing appreciation of economic instruments' potential for the internalization of external costs.[4] The idea of environmental taxation[5] levied on environmentally harmful products and activities also coincides with the polluter-pays principle. Shifting the revenues of environmental taxes into reduction of direct taxes is labelled as environmental tax reform (ETR).

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[1] E.g. decommissioning of nuclear power plants in Bulgaria (Kozloduy) and Slovakia (Jaslovske Bohunice).

[2] For example, dominant Estonian electricity producer Eesti Energia has postponed the decision on renewal of oil-shale fuelled Narva PP until a final decision on emission trading after 2012 is taken.

[3] In February 2006 the prime ministers of the three Baltic countries signed a joint declaration on possible construction of a new nuclear power plant in Lithuania.

[4] See e.g Pearce et al (1989).

[5] Environmental tax is defined by OECD as 'any compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance' (OECD 2001).

In addition, due to lack of internalization market often fails to provide for proper incentives for development of less burdensome alternatives and thus and consequently involvement of state resources in the form of subsidies is also acknowledged. The opposite side of this coin is a removal of such subsidies that are harmful for the environment.[6]

There is an obvious difference in use of economic instruments addressing environmental problems between NMS and MPC. While in most NMS the portfolio of such economic instruments as well as their share on total governmental revenues is broadly comparable with those in place in EU-15 countries, economic instruments used in MP countries are represented by traditional excise duties on mineral oils, and recently introduced subsidies for renewable sources and energy efficiency (i.e. in the form of custom duty reductions).

In the traditional classification of environmental levies, resource charges and emission/pollution charges relate to energy production, while energy taxation is levied on energy consumption.

All the six NMS apply emission charges for number of pollutants emitted to atmosphere. The basic rates are shown in the following table. These rates are applicable irrespective of emission limits set for particular sources except for Bulgaria where only emissions exceeding limits are charged, while the basic rates are multiplied by certain factor in case of emission limit exceeding in Slovakia.

Table 2: Air pollution charges (in EUR/tonne)

	SO2	NOx	Particulates / dust	CO	CO2	VOC / total organic carbon	Heavy metals
Bulgaria*	3	900	20				
Czech Rep	40	32	120	24		80	801
Estonia	21	48	21	3	1.02	48	768
Hungary	199	477	107				
Poland	107	107	71		0.06		
Slovakia	64	48	160	32		128	1280/640

* non-compliance fee

Other pollution charges levied on emissions to water and disposal of waste as well as charges on extraction of natural resources do not have, in general, much importance in relation to energy production life-cycle in terms of rates and revenues.[7]

[6] Note, however, that the definition of environmentally harmful subsidy is rather unsettled, see e.g. OECD (2005).

[7] One the very specific exemptions are Estonian charges on oil shale mining, mining wastes and oil shale ash, that represented about 60% of environmental levies paid in energy sector.

Energy taxes on energy products used for heating (mainly coal and natural gas) and on electricity have only recently been introduced in most new member states as an implementation of EU acquis and particularly the Energy Taxation Directive. Prior to this, energy products were taxed primarily for use as propellants and only some of them were also taxed for use as heating fuels (e.g. LFO and LPG).

Table 3: electricity taxation in EU member states (per MWh, as of January 2009)

	Business use		Non-business use		VAT
	NatCurr	EUR	NatCurr	EUR	%
Bulgaria	1.4	0.72	1.4*	0.72*	20
Czech Rep.	28.3	1.154	28.3	1.154	19
Estonia	50	3.2	50	3.2	18
Hungary	252	1.04	252	1.04	20
Poland	20	5.91	20	5.91	22
Slovakia		0.66		*	19

* zero rate/exemption of electricity used by households.

Source: EC DG Taxation and Customs

Also in NAC excise taxes are in general levied on hydrocarbons for use as propellants and for electricity generation. Electricity itself is not taxed and some energy products when used for electricity also profit from zero tax rate[8].

Energy sector has an important share on total allocation in EU emission trading with CO_2 allowances. However, the experiences from first trading period 2005-2007 show substantial over-allocation of emission allowances in five NMS[9]. Windfall profits gained from selling of unused allowances by some energy producers point to considerable failures in setting of allocation caps and may be seen as state aid of its kind.

[8] E.g. in Morocco natural gas for electricity generation in generators with installed capacity over 10 MW has a zero tax rate according to the custom code amended in 2005.

[9] Bulgaria only entered EU in 2007 and effectively did not participate in the first trading period.

Table 4: Emission trading – allocation and verified emissions

	annual cap 2005-7	Difference between allocation and verified emissions (%)				annual cap 2008-12
		2005	2006	2007	2005-2007	
Czech Republic	97.6	18	16	10	15	86.8
Estonia	19	33	50	39	41	12.72
Hungary	31.3	16	17	13	15	26.9
Poland	239.1	17	13	13	15	208.5
Slovakia	30.5	21	19	24	21	30.9
Bulgaria	42.3					42.3

Source: EEA (2009), EC (2008)

Support for renewable electricity generation is basically focusing both on investment support and operational cost support. Investment support is dominantly funded from EU structural and cohesion funds. For the operational cost support four out of our six NMS use feed-in tariffs, while Poland and Bulgaria use quota obligation system with tradable certificates of origin.

2.4. Internalisation

A basic approach for assessment of internalisation of external costs is a comparison between calculated external costs and environmental taxes and charges levied upon the emission of pollutants during electricity (and/or heat) generation or upon their consumption. In spite of relative simplicity there are however some limitations originating from the scope of assessment and data availability. One particular problem is linked to energy taxation of combined heat and power generation where different taxation regime often applies for electricity and for heat, thus splitting of external costs is needed.

To allow for comparison between external costs and environmental taxes and charges (that mostly refer to 2008) we recalculate external costs from EUR_{2000} to EUR_{2008} using overall HICP change for EU25, giving a multiplication by 1.21.[10] Therefore, the unit external costs

The following table provides comparison of external costs for dominant power plants in respective countries.

[10] This approach is different from the approach taken in chapter on Hungary below since no purchase parity power weighting is adopted, thus the results are not directly comparable.

Table 5: External costs and the level of internalisation

country		Slovakia	Poland	Hungary	Estonia	Bulgaria	Czech Rep	Egypt	Tunisia	Morocco
facility		**EVO1 3/4 5/6**	**Belchatow**	**Mátra FGD**	**Narva-P**	**Maritsa East 2**	**Prunéřov I, II**	**Kuriemat**	**Rades A**	**Jorf Lasfar**
technology		fluid/wet bottom boilers	PP	cond. FGD	PFBC			Steam Turbine	Thermal	
fuel		hard coal	lignite	lignite	oil shale	lignite	brown coal	HFO/NG	NG	Coal
total	c€/kWh	9.30	7.45	5.58	7.31	7.21	6.45	3.99	2.94	13.04
total	mio EUR/a	144.4	2199.2	265.8	621.5	388.9	515.7	208.4	46.7	1316.5
SO2	t/a	3409	130678	3336	66810		14459			
NOx	t/a	2107	43867	5930	10752		16858			
PM10	t/a	4907	3671	68,9	26775		950			
Internalisation: emission charges		0.8%	0.9%	1.3%	2.1%		0.2%			
Electricity tax	EUR/MWh	0.66	5.91	1.04	3.2	0.72	1.15			
Internalisation: electricity tax		0.7%	7.9%	1.9%	4.4%	1.0%	1.8%			
Internalisation : emission charges + electricity tax		1.5%	8.9%	3.2%	6.5%	1.0%	2.0%			
avg. electricity (generation) price	c€/kWh	5.8	5.5	6.5	2.9		6.72			
electricity price for households	c€/kWh	14.81	14.30	15.64	8.21	4.97	14.64	1.14	9.10	
RES support top-up	c€/kWh			0.80	0.19		0.16			
Internalisation : emission charges + electricity tax + RES support				17.6%	9.1%		4.6%			

Notes: prices in EUR_{2008}

Sources: RS1d WP5 national implementation reports, national energy regulation offices.

An obvious conclusion is apparent from the table – the level of internalisation is fairly low for existing power plants in all considered countries. The highest internalisation level is attained at Polish Belchatow power plant with almost 9%; which is due to relatively high electricity taxation (as compared to other NMS). If the cross-subsidy for support of renewable sources is also taken into account as a means of external cost internalisation, then Hungarian Matra power plant has the highest level of internalisation reaching almost 18%.

2.5. Conclusions and policy recommendations

In **Poland** the environmental charges are determined in fact by political acceptability and revenue requirements (revenues to funds). Charge rates are not high enough yet to stimulate investments in emissions reduction, rates are well below the marginal abatement cost and external costs.

There is limited chance of increasing the charge rates to the efficient level, mainly for a resistance from the power generation producers. Strong arguments are raised that the ecological tax reform, which affects mainly the domestic energy sector, simply double existing regulations, giving no any additional economical or environmental benefits.

However, the process of internalisation of energy externalities actually proceeds under different environmental regulations and schemes that are obligatory for the Polish energy sector. Most of the EU directives, incorporated to the Polish law, aim to achieve a certain level of energy mix or emissions.

In **Hungary** due to the fact that electricity is very expensive and security of supply has been sharply pronounced by politicians, no political will has been pronounced by government actors for increasing the internalisation rate.

The present energy tax (0.08 c€/kWh) and levied environmental charges cover only the local externalities occurring in the territory of Hungary. External costs calculated by ESW for regional and global scale are much higher.

Internalisation of regional external costs needs an international collaboration of policy makers since a unilateral drastic increase of the level of internalisation l would lead to a decrease of the economical competitiveness of the country.

A democratic, stepwise increase of internalisation of external costs should be introduced, first taking into account the environmental damages caused in Hungary.

The performance of the different combination of the possible instruments of internalisation, such as taxes, levies, emission and renewable energy quotas, feed-in tariffs should be analyzed in a complex way.

In the **Czech Republic** the role of economic instruments is rather limited and the internalisation of external costs from electricity generation in conventional power plants is fairly low (below 3%, or 7% if cross-subsidy for renewable sources is accounted for). However, energy market liberalisation and feed-in tariffs create favourable conditions for the development of renewable energy.

Within the current system of economic instruments, air pollution charges seem to be the appropriate instrument for internalisation as long as electricity taxation provides only weak link to how the electricity is produced. This suggestion is also acknowledged in the preparation of next steps in ETR, when shifting its focus from climate change to clean air.

In **Slovakia** the energy policy follows three dominant objectives – safeguarding of energy generation capacity, security of supply, and decrease of energy intensity. Reform of renewable energy support is currently underway with the aim to create more stable and stimulating system.

The current setting of economic instruments fails to reach any internalisation objective, e.g. emission charge rates for SO2 and NOx are by about two orders of magnitude lower than estimated marginal external costs. The only positive feature of the system seems to be multiplication of rates when emission limit is exceeded. Similarly, emission trading for SO2 and NOx does not make a significant impact on emissions at present.

In **Tunisia** a major feature in energy sector is a distorted pricing system where energy (incl. electricity) is strongly subsidised. This leads to a great decline from competitive prices and to a wide gap between sales prices and economic prices.

The main two energy taxes are defined for budgetary and distributional purposes and not for environmental considerations.

Eco-tax has no sense now, since priority would be to check undesirable behaviour by raising tariffs to meet competitive levels, and thus remove environmentally adverse subsidies.

External costs estimated for the representative energy mix, amount 1,9 c€ per kWh, and about 21 % of economic price of electricity. All taxes (excise tax + VAT) amount only to 12 % of economic price. This gap indicates the difficulty of the task (Table 4). Despite these complexities, a price-based internalisation option could take the path of differentiating excise taxes and VAT levels according to external costs.

In **Egypt** the most of energy products, including heavy fuel oil, gas oil, natural gas and electricity receive high subsidies from the government.

To stimulate the use of renewable sources s in the production of electricity emphasis is given to subsidies, such as feed-in tariffs and competitive bidding processes.

The monetary evaluation of the damage (calculated external costs) of energy sector gives a significant result – more than 1 billion USD per year. Unless more remedial actions are taken, the damage will rise by about 50% in 2010. The control of emissions to environment is an important part of environmental management, but cannot lead to the most effective management itself.

The incorporation of environmental objectives into the concept of economic and social policy of the whole country is very important. The environmental policies must be developed through the co-operative process between the all ministries and interest groups. The Cost Benefit Analysis (CBA) provides a common framework for analyzing policies in all sectors.

In **Morocco** energy sector has undergone substantial reform in recent years aiming at restructuring and liberalising of the market and grid in the European electricity market.

Following the introduction of concessions (Jorf Lasfar CHP, wind park at Tétouan) and partnership (Tahddart NG CHP) in electricity production, partial liberalisation is underway – total liberalisation is envisaged for industrial consumers, while market regulation will continue for household consumption. Until recently, electricity tariffs for industrial use were lowered by 35% to stimulate industrial development. Energy sector provides also important budgetary revenues. However, since 2005 an exemption from excise duty on natural gas has been adopted for a use by ONE and concessioners for electricity production with installed capacity over 10 MW.

Morocco has adopted ambitious targets for renewable sources. The most promising sources are wind and solar energy. By 2012 Morocco aspires to achieve 8% share of renewable energy on total balance.

In **Estonia** the optimal rate for internalising external costs should be calculated on the basis of detailed cost-benefit analysis and then finally decided through the public debate where the all interest groups can participate and present their arguments.

The cost-benefit assessment of the technologies and scenarios in Estonian electricity sector development plan 2008-2018 was carried out using the average production costs, calculated external costs and risks estimates by experts. It is the first attempt in Estonia to find out the best electricity sector scenario on the basis of monetary valuation of the all important economic, social and environmental costs.

Investments to electricity and heat production sectors are made for more than 20 years and therefore the rapid changes in energy sector could occur economically inefficient. The process of internalising the external costs should be continued increasing step-wise the externalities to be included.

There are many opportunities in better utilisation of air pollution charges. This does not mean to increase rates only, what is seen as compromising industry competitiveness, but also appropriate recycling schemes that stimulate to dynamic efficiency in uptake of new technologies and continuous decrease in emissions per unit of produced energy.[11]

One of the caveats in reforming energy taxation for better addressing of climate policy objectives is the way how the environmental objective is captured in the tax base. Current design based prevailingly on uniform rates and tax breaks for incommensurable purposes is clearly inefficient. The idea of splitting tax base to energy and environmental component deserve particular attention in this respect.

The experiences gained in first trading period in EU emission trading system are of mixed nature. The system proved itself stimulating but suffered from over-allocation, thus contributing only little to overall CO2 emission reduction. However, the appealing features of better targeting overall emission cap calls for considering an introduction of such a system for classical pollutants from large polluters. Here, a credit-offset system may build upon the potential linking to BATs under IPPC Directive.

Particularly in MPC countries a phasing out of environmentally harmful subsidies still represents the number one objective.

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[11] A good example is Swedish NOx tax that is recycled back into the energy production sector according to efficiency criteria.

Among the subsidies favouring internalisation of external cost promotion of renewable sources play key role. If the public policy seeks to improve overall welfare, better linking to external costs avoided is advisable. Then, this needs to be also reflected in state aid policies at present endorsing the 'extra cost' approach.

From the internalisation point of view, the amount of support for renewable sources should, at least in the long term perspective, correspond to difference in external costs between renewable and conventional energy generation. This is true regardless to whether the support takes the form of direct subsidy (fixed premiums, feed-in tariff, tradable green certificates) or indirect form (e.g. tax on conventional energy sources). Ambitious targets for RES development in distinctively differing conditions in CEE and MPC countries may press for broaden the portfolio of support measures and increase in both direct and indirect subsidies.

On the other hand there is an apparent need for further continuous harmonisation of RES support especially in EU countries that is supposed to bring more cost-effectiveness to the support framework. Though, this does not necessarily meaning unification of the support schemes.

The level of internalisation plays an important role here. The choice and design of those schemes should take account of incurred social costs, including external costs avoided.

Ultimately, the need for optimal design of particular instruments in this field and their mixes clearly points to broader employment of quantitative analytical tools that can compare outcomes of different nature. Environmental benefit-cost analysis is one of such instruments and can be applied both at project and policy level.

Last but not least, external costs calculation methodology should be further developed towards higher detail, transparency and reliability.

3. Country profiles

Following country profiles builds in part upon the work done in national implementation in the WP5 of RS1d. Their ultimate goal is to illustrate country specific approaches to internalisation policies (including promotion of renewable sources), provide a comparison of external costs with environmental taxes and charges currently in place, and point to steps that may be taken in order to gradually increase the level of internalisation.

3.1. Bulgaria

3.1.1. Introduction

Energy generation balance in Bulgaria suffered from shut down of two reactors in NPP Kozloduy in 2003 and further two reactors in 2006. Until now, Bulgarian government claims compensation for the closure, which was part of pre-accession treaty, from the EU.

With respect to energy security, over 70% of Bulgaria's total energy consumption comes from imports[12]. Dependency on the import of natural gas and crude oil is almost complete and is traditionally only directed at the Russian Federation. Such absolute dependence has proven to be critical during Russia-Ukraine dispute over gas transit in January 2009.

Proven reserves of lignite are sufficient to ensure electric generation for 50-55 years according to Bulgarian Ministry of Economy and Energy. Renewable energy sources are estimated to about 6 Mtoe/year. Thanks to huge decrease of domestic electricity consumption in second half of 1990's, Bulgaria turned into a net electricity exporter (around 10% of gross generation in 2006), but following closure of NPP Kozloduy units 1-4 export of electricity decreased.

Starting from 01 July 2007, the Bulgarian electricity and gas market has been fully liberalised. In a controversial step, the Bulgarian government decided to establish a national energy champion and merged five state-owned energy companies (dominant power utility, dominant gas supplier, largest coal mines, largest power plant and nuclear power plant) into a holding company, the Bulgarian Energy Holding, in September 2008.

All prices in the internal market along the generation – supply to end-user chain, as well as the predominant part of generated/sold electricity in the country are still subject to price regulation. The mandatory purchase and non-market prices for part of the electricity generated in the country arising from the implementation of Public Service Obligations limit the development opportunities for a competitive energy market.

The share of renewable energy sources in final energy consumption was 9.4% in 2005, the share on gross electricity production was 11.8% in 2005, almost entirely coming from hydropower. Proposed EC Renewable Energy Directive sets an ambitious target of 16% share of RES on the final consumption of energy in Bulgaria in 2020.

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[12] EUROSTAT figures show only 46.6% share because nuclear fuel is counted as domestic.

3.1.2. Economic instruments and internalisation of external costs

Economic instruments play an important role in the process of harmonization of the Bulgarian energy sector with the EU practices. These instruments include: pollution taxes, input taxes, product taxes (gasoline), export taxes, import tariffs (duty free for import of equipment and/or components of equipment for technologies using renewable energy sources), tax differentiation (lower taxes for unleaded gasoline), tax relief (environmental equipment or investment in environmental projects), fines (increased nearly 100 % in the period 2007/1997), investment taxes credits, accelerated depreciation and subsidies. Financial instruments include grants, soft loans, revolving funds, eco-funds, sectoral funds, location incentives and emission trading.

The state-of-the-art in use of economic instruments in energy sector is greatly differentiated. The rate of **air pollution non-compliance fee** is related to the release of emissions above the environmental standard and in correspondence with the total volume of pollution based on the quantity of working hours of the respective facility. There are different rates set for 16 different polluting substances, including NO2 (0.9 c€/kg), lead (c€/kg), phenols (55 c€/kg), SO2 (0.003 c€/kg) and dust (0.02 c€/kg). Non-compliance fees are differentiated also in correspondence with the geographical location. For instance, fines are tripled if the pollution takes place near national parks and doubled if it takes place near protected regions, water-supply sources or sanitary zones.

The Report of the Ministry of environment and water (2006) indicates that non-compliance fees are rather marginal as the revenues were only about €700,000 in 2005. Obviously, when compared to the level of pollution and external costs caused, these economic instruments are far from the sufficient level.

In the EC Accession Treaty Bulgaria was granted transitional period for the application of the minimal **excise duty** rates for most of energy products, including electricity and coal and coke for district heating purposes until January 2010. In addition, zero rate is applied on natural gas pursuant to Article 15(1)(g) of Energy Taxation Directive since the share of natural gas in the total energy consumption is lower than 15%. As of January 2009 the rates are set as follows:

- BGN 1.4/MWh (EUR 0.72/MWh) for electricity, with zero rate on electricity consumed in households;
- BGN 0.6/GJ (EUR 0.31/GJ) for coal and coke, with tax exemption for coal and coke used in households.

With respect to **promotion of renewable energy** sources, feed-in-tariff was introduced in 2003. In 2007, new Law on Renewable and Energy Alternative Sources was adopted introducing a priority access to the grid and a purchase obligation in respect to renewable energy for which a certificate of origin has been issued. The preferential prices are set annually by the State Energy and Water Regulatory Commission ranging from BGN 782/MWh (EUR 400/MWh) from photovoltaic plant with less than 5 kWp installed capacity, to BGN 184/MWh (EUR 94/MWh) for biomass plant using energy crops, BGN 168/MWh (EUR 86/MWh) for wind power plant of more than 800 kW installed capacity and BGN 97/MWh (EUR 49.5/MWh) for small hydropower plant.

In addition, producers of heat from RES are entitled to 20% investment subsidy for energy efficient technologies.

Bulgaria faced significant delay in preparation of the national allocation plan for EU **emission trading** system for 2007 and was also the last member state having its national allocation plan for second trading period adopted by the European Commission. An annual cap was set for second trading period at 42.3 mil allowances for (emissions from ETS-covered installations were estimated at 40.6 million tonnes of CO_2 in 2005).

Following table shows a comparison of external costs for major power plants in Bulgaria (except for NPP Kozloduy).

Table 6: External costs and the level of internalisation

facility		Dimitrovgrad TPP	MaritcaEast 1	Maritca East 2	Maritca East 2	Maritca East 3	Sviloza TPS	Sviloza TPS
fuel		lignite	lignite	lignite	lignite+cleaning	lignite	hard coal	hard coal+purification
total	c€/kWh	71.28	40.24	7.21	6.86	7.69	1.15	0.43
total	mio EUR/a	213.8	449.9	388.9	370.0	415.4	48.2	18.2
Electricity tax	EUR/MWh	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Internalisation: electricity tax		0.1%	0.2%	1.0%	1.0%	0.9%	6.3%	16.7%
household electricity price	c€/kWh	6,72	6,72	6,72	6,72	6,72	6,72	6,72

Note: prices in EUR_{2008}

The results show that the level of internalisation is quite low, especially for outdated technologies such as Dimitrovgrad and MaritsaEast TPPs. Despite the internalisation level does not account for emission charges it should be pointed out that they does not any important role here as they are levied only for exceeding of emission limits.

3.1.3. Policy recommendations

The fulfilment of the EU indicative target for Bulgaria: 11 % share of renewable electricity on gross electricity consumption in year 2010 (Directive 2001/77/EC), is a very challenging objective. Appropriate geographical locations for wind-farms are limited, solar potential is much lower than in countries like Cyprus, Malta, Greece, Italy and Spain, the opportunity cost for producing biomass is also high. In addition, development of those alternative energy sources supposes huge investments with appropriate return only in the long-term.

Recent discussions on the advantages and disadvantages of renewable energy support schemes, focusing prominently on feed-in tariffs, fixed premiums and green certificates. Feed-in tariff schemes have the advantages of investment protection and promotion of state of the art technologies with an excellent long-term investment return. However, we believe that the current experiences with fixed premium paid above the spot electricity price (Germany and Denmark) are more suitable for Bulgaria. This fixed premium has two key advantages: firstly, it stimulates all users of renewable energy, regardless of the capacity of production, secondly, it allows appropriate mix of renewable sources and/or selection of the most viable renewable energy sources, based on the cost-benefit analysis, and thirdly, it stimulates the technological diversity.

In Bulgaria, green certificates system (producers and importers do have to use a certain percentage of biofuels) is operational since 2007. The main objective of a system of tradable green certificates is to stimulate the penetration of green electricity into the electricity market. In a green certificate system, certification serves two purposes. It functions as an accounting system to verify whether demand has been met or, when there is no demand, to measure the amount of electricity produced from renewable energy sources (RES-E). Secondly, it facilitates trade; through the establishment of green certificates (GCs) a separate market for the renewable characteristic of the electricity will originate besides the market for physical electricity.

The Green Certificate Market in Bulgaria is strongly regulated. It determines the minimum mandatory quotas as a percentage from the total annual electricity production. An important step leading to more intensive development of RES sector is the determined by the State Energy Regulation Commission for preferential prices for electricity generated from RES. Having in mind the current situation in Bulgaria and especially the lack of proper institutionalization of this mechanism, we believe that passing the price of green certificates on to the consumers of electricity is the most realistic approach.

We would recommend also that the validity of those certificates must be at least three years or even longer, simply because a year period may end up with zero value for the certificates which were not utilized for different reasons.

In other cases, secondary instruments especially small investment-plant support and tax relief are good catalysts for an increase of biomass use. Given the large variations in operational costs caused by i.e. different sources (forest residues, short rotation coppice, straw, animal waste, etc.), different conversion processes of transformation (co-firing, gasification, etc.) and different sizes (existing sizes of biomass plants can vary by a factor of 200), differentiated tax and investment relieves should be applied, based on specific feed-stocks and technologies.

It is of Bulgarian interest to stimulate as much as possible the production of electricity based on renewable resources. Such policy is determined by different legal, economic and environmental factors. As a EU member state, Bulgaria must fulfil its obligation in this field by year 2020 and beyond. No doubt, it will improve the environmental qualities and will further enhance the technological development.

At the same time, we believe that the country needs more detailed comparative analyses of the different alternatives. Special attention has to be paid to two key issues: better utilization of the nuclear power potential under the highest possible safety standards. EcoSenseModel and other relevant analytical instruments clearly show that the nuclear energy in Bulgaria has an excellent cost-benefit ratio and close to zero emissions for more than 30 years. It is indicative that both USA and the EU have downsized substantially their doubts about the future of NPP. Recent Russian-Ukrainian gas supply crisis is an additional argument in support of the idea that the current independence of the Bulgarian energy production (52%) could be increase by the increase of the nuclear power capacity.

Because of the same reason (energy independence), and also because of some additional factors like (a) much lower cost; (b) reserves for more than 30 years and (c) installed capacity delivering now more than 40% of the electricity, more attention has to be paid to the conventional coal-based technologies. Recent development at TPP Maritsa-East II and TPS Sviloza proved that new environmentally friendly technologies are capable of combining high cost effectiveness with excellent environmental standards. Therefore, we believe that the scarce budget resources of the least development country-members of the EU, like Bulgaria, should be focused on the conventional energy sector.

3.2. The Czech Republic

3.2.1. Introduction

The State Energy Policy (2004) sets ambitious indicative targets for continuous decline in energy intensity by 3-3.5% annually and in electricity intensity by 1.4-2.4% annually. The long term goal in respect to renewable energy sources is to increase the RES share to about 15-16% in 2030 and 8% share of RES-E in gross electricity consumption in 2010. The dominant share is expected to come from biomass (about 85% in 283 PJ from RES in 2030).

In January 2007 the Czech government set up Independent Energy Commission with the task to review previous energy policies and to recommend next steps in securing energy needs of the Czech Republic based on independent analyses. The draft version published in fall 2008[13] recommends the following steps:

- promote competition on the energy markets,
- give priority and systematic support to energy savings,
- take account of decrease in importance and increase of price of lignite in the long-term perspective,
- acknowledge nuclear energy as an option for electricity generation and important part of energy mix,
- recognize renewable energy sources as indisputable part of energy mix and give consideration to support for heat generation from RES,
- pursue proactive climate politics on national and international scene,
- promote building of new oil and gas pipelines in cooperation with EU and NATO members,
- push ahead realistic and effective support for energy generation from RES at EU level and revision of EU ETS.

The regulatory regime related to environmental impact from energy generation consists of both administrative (command-and-control) and market-based (economic) instruments. The main effort in emission reduction from stationary sources took place in first half of nineties. The dominant role was given to command-and-control instruments represented by emission standards according to Air Protection Act of 1991, Air Protection Administration and Charges Act of 1992 and related secondary legislation.

It was only in 2001 when new steps were taken as a part of the preparation for EU accession. New pieces of legislation were adopted including Integrated Prevention Act and Air Protection Act fully transposing respective EC legislation on large combustion plants, emission ceilings as well as IPPC.

Starting from 2006 the electricity market is fully liberalised and all consumers may freely choose their suppliers. In addition, in the transmission system was unbundled from electricity generation and distribution. The Energy Regulatory Office controls the prices for transmission, provision of system services, activities of electricity market operator, electricity

[13] Independent Expert Commission for assessment of energy needs of the Czech Republic in the long term perspective, Final report, Praha, 30. 9. 2008.

generation for renewable and secondary energy sources and from combined production of heat and power, and for provision of last-mile delivery. The full liberalisation in the gas market took place in 2007. The tariffs for gas have four components – commodity, transport, distribution and storage.

The price of heat energy (especially for households) is regulated by Energy Regulatory Office.

3.2.2. Economic instruments in the energy sector

The fiscal policy in the energy sector encompasses various economic instruments, most notable ones being environmental levies and subsidies for renewable energy sources. Apart from rather marginal environmental levies related to coal mining and natural gas extraction, the two most important levies in place are air pollution charges and energy taxes.

Air pollution charges were among the first economic instruments introduced in the former Czechoslovakia in 1967. Currently, the Air Protection Act of 2002[14] sets the detailed rules on charging operators of stationary air pollution sources basically according to installed capacity. The charges (except for small pollution sources below 200 kW) are due for a group of core pollutants including particulate matters, sulphur dioxide, nitrogen oxides, volatile organic compounds, polycyclic aromatic hydrocarbons (PAHs) and heavy metals, and two classes of other harmful substances (e.g. benzene and its compounds). The rates are set per tonne of pollutant as shown in the table.

Table 7: Air pollution charge for medium, large and very large installations

pollutant	charge (CZK/t)	charge (EUR/t)
Core pollutants		
Particulate matters	3 000	120
SO2	1 000	40
NOx	800	32
VOC*	2 000	80
Heavy metals and their compounds	20 000	801
CO	600	24
NH3	1 000	40
CH4	1 000	40
PAHs	20 000	801
Other pollutants		
Class I	20 000	801
Class II	10 000	401

* except for VOCs charged as other pollutants

[14] Act no. 86/2002 Coll., on protection of air and amendment to certain acts, as amended.

Class I pollutants include asbestos, benzene, beryllium and their compounds. Class II pollutants include fluorine, chlorine and bromine and their organic and inorganic compounds, sulfane and carbon disulphide.

The administration of charges is split between levying that is carried out regional (large and very large installations) and local (medium-size installation) authority while collecting of charges is vested to custom authorities. Levying and collection of air pollution charges from small sources is carried out by local authorities. The revenues from air pollution charges amount to approx. 500 mio. CZK annually and represent one of the major sources of State Environmental Fund funding.

The rates are deemed to be ineffective in terms of motivation effect – according to some studies they are well (several times) below marginal costs of pollution abatement and consequently giving little stimuli to further emission reductions. This also renders ineffective an optional deferral and remission of up to 60% charge due in case of commencing activities leading to decrease in emissions.

Energy taxes represent a new instrument only introduced starting from January 2008. Their introduction was a part of approximation to acquis communitaire and particularly to the Energy Taxation Directive[15]. Due to a number of reasons including potential severe impact on energy prices, liberalisation and opening of electricity market the Czech government requested a transitional arrangement. Similarly to other new member states the Czech Republic were allowed to a total exemption for taxation of electricity, natural gas and solid fuels in the Czech Republic until end of 2007.

The new taxes are now dealt with in the sections 45 through 47 of the Act no. 261/2007 Coll., on stabilisation of public budgets. As a principle, these taxes are levied on a delivery for final consumption. The obligation to pay the tax generally rests with a supplier but the tax burden is borne by final consumers.

The tax on natural gas is levied upon the amount of gas delivered in MWh of gross heating value and the tax rates are set according to type of use. In principle two tax rates are set – CZK 264.8 per MWh (EUR 3 per GJ) for use as propellant and CZK 30.6 per MWh (EUR 0.347 per GJ) for heat production, stationary engines and construction works. Tax exemptions are granted to use of gas in electricity production, efficient combined heat and power generation, inland navigation (except for pleasure crafts), mineralogical and metallurgical processes, technological losses in distribution and other uses than for engine propulsion or heat generation.

The tax on solid fuels is based on the amount of solid fuels delivered in GJ of gross calorific value with only one tax rate of CZK 8.5 per GJ (EUR 0.347 per GJ). Enumeration of taxed commodities includes hard coal, lignite, briquettes, coke and other solid fuels used for a production of heat. Calorific value of a fuel sample shall be proven by an accredited laboratory, otherwise a default value of 33 GJ per ton shall be used. Tax exemptions are granted to solid fuels used for electricity generation, combined heat and power generation in highly-efficient generators if the heat is delivered to households, in inland navigation (except for pleasure crafts), in metallurgical and mineralogical processes, coke production and other uses than for engine propulsion or heat generation.

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[15] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, OJ L 283/51.

The tax on electricity is levied upon the delivery of electricity to final consumer and the tax rate is CZK 28.3 per MWh (EUR 1.154 per MWh) regardless whether the electricity is used for business or non-business purposes. There are various exemptions put in place – foremost for environmentally friendly electricity – that is defined as electricity of solar, wind or geothermal origin, produced in hydroelectric installations, generated from biomass or from products originating from biomass, generated from methane emitted by abandoned coal-mines or generated in fuel cells.

Revenues from the tax on natural gas are estimated at CZK 1.5 billion annually and the price of natural gas for final consumption is predicted to increase by approximately 4.2% (including VAT). Revenues from tax on solid fuels are estimated at CZK 1.7 billion annually, and the tax is predicted to lead to 9.1% increase of coal prices. Tax revenues are estimated at CZK 1.1 billion annually, with relative negligible impact on electricity price (less than 1%). It is estimated that the introduction of the three environmental taxes will induce energy savings of 0.35-1.7% compared to energy consumption in 2005.

The idea of **environmental tax reform** has relatively long history. The first ETR concept was worked up by the Ministry of Finance in 2000. Further proposals were prepared in 2004 and 2005 but the real steps were taken only after general election in 2006. When the Government approved a public budget stabilisation in May 2007, it was envisaged that the introduction of new energy taxes will be offset by lowering in taxation of labour. However, there was no explicit revenue recycling mechanism set leaving the decision to a later date.

In late 2008, a cut in the rate of the state employment policy contribution by 0.4% has been adopted effective from January 2009. From the fiscal perspective this cut broadly corresponds to predicted revenues from the three abovementioned energy taxes.

Greenhouse gas **emission allowance trading** is another new economic instrument introduced starting from 2007. In spite of its aim - reducing GHG emissions – the politically motivated decision on allocation in first trading period lead to over-allocation (the difference to verified emissions was 12.7%) and consequently to collapse of market in allowances. Some critics also argue that free allocation of permits which allowed some actors to achieve significant windfall profits (the dominant energy producer CEZ jsc. earned more than CZK 5 billion in the first trading period) effectively barred faster development of renewable sources[16]. The annual allocation for second trading period is 86.64 million allowances that is some 11% lower compared to first trading period.

Promotion of renewable energy sources in electricity production in line with RES directive[17] is set down in the Act on Promotion of Use of Renewable Sources[18] with an aim to achieve an indicative target of 8% share of electricity from renewable sources in the gross consumption of electricity. The Act introduces two different support schemes for renewable electricity production: feed-in-tariffs (guaranteed purchase price) and green bonus (premium).

[16] See e.g. Tilford (2008)

[17] Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.

[18] Act no. 180/2005 Coll., on the promotion of electricity production from renewable energy sources and amending certain acts

In principle, renewable electricity producer may opt either for feed-in tariff with a fixed price or a combination of market price of electricity with an entitlement for green premium.

The charge for promotion of renewable electricity generation, combined heat and power generation and secondary sources development is a top-up on final electricity price charged to end-users. The rate has been increased from 34.13 CZK/MWh in 2007 to 40.75 CZK/MWh in 2008.

The guaranteed prices for feed-in tariffs and green premiums are set annually by Energy Regulatory Authority according to Renewable Energy Act. The prices and bonuses are differentiated according to type of renewable energy source (hydro, wind, biomass, solar etc.) and date of commissioning. The purchase prices ranges between CZK 13,000 per MWh for solar installations to around CZK 2,500 per MWh for wind and small hydro installations.

As a means for implementing EC Directive on **promotion of combined heat and power** production a fixed surcharge on electricity price as well as tax exemptions for high-efficient cogeneration units were introduced. A surcharge is set annually by Energy Regulatory Authority according to installed electricity generating capacity ranging from CZK 240/MWh for installations with generating capacity up to 1 MWe to CZK 45/MWh for installations over 5 MWe.

In 2005 Czech government adopted **National programme for efficient energy management** and use of renewable and secondary energy sources for 2006-2009. The programme is carried out by state programmes of 11 ministries and totalling to approx. CZK 8 billion during this period.

State programme of Ministry of Environment targets reduction of emissions from medium-sized and large air pollution sources. Grants, soft loans and interest subsidies are granted from the State Environmental Fund with yearly budget of CZK 100 mil. (approx. EUR 3.7 mil.).

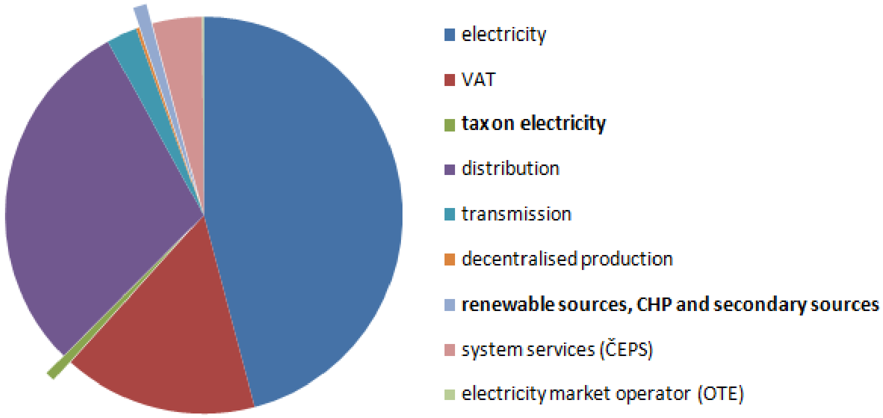
Under Environmental Operational Programme (dominantly funded from EC sources – Cohesion and Structural Funds) a specific support scheme is set for reduction of NOx and dust emissions from combustion installations over 5 MW in total amount of CZK 475 mil. (EUR 19 mil.) until 2013.

Recently, Supreme Audit Office assessed investment intensities for RES projects carried out under previous national programme (2002-2005) and found the system fragmented with lacking focus on optimal RES composition.

3.2.3. Internalisation

As mentioned earlier the main economic instruments for internalisation are emission charges and energy taxes. In addition, cross-subsidy for renewable sources paid on the top of electricity price can be also seen as a internalisation measure (with the exception of subsidy that is higher than external costs avoided). The following figure shows the composition of final electricity price for residential customers in 2008. The share of both, energy tax and renewable top-up is quite insignificant.

Figure 1: Composition of residential electricity price in 2008



In the following table we show the level of internalisation due to all three instruments (emission charge, electricity tax and renewables top-up). To allow for common price level all estimates are converted to EUR_{2008}.

Table 8: External costs and the level of internalisation

facility		Dětmarovice	Tisová I, II	Hodonín	Mělník II, III	Prunéřov I, II	Ledvice II, III	Tušimice II	Počerady	Chvaletice
fuel		hard coal	brown coal	lignite/biomass	brown coal	brown coal	brown coal	brown coal	brown coal	brown coal
total	c€/kWh	4.90	8.74	10.75	5.13	6.45	8.12	6.54	6.13	6.36
total	mio EUR/a	124.5	131.5	39.7	136.2	515.7	158.5	314.7	379.2	152.3
SO2	t/a	1991	5662	2325	2668	14459	7484	10400	8388	3127
NOx	t/a	4181	1882	284	4516	16858	3717	9707	14642	4320
PM10	t/a	174,542	151,818	58,371	362,158	950	168	124	201	273
Internalisation: emission charges		0,2%	0,2%	0,3%	0,2%	0,2%	0,3%	0,2%	0,2%	0,2%
Electricity tax	EUR/MWh	1,154	1,154	1,154	1,154	1,15	1,154	1,154	1,154	1,154
Internalisation: electricity tax		2,4%	1,3%	1,1%	2,2%	1,8%	1,4%	1,8%	1,9%	1,8%
Internalisation : emission charges + electricity tax		2,5%	1,6%	1,3%	2,5%	2,0%	1,7%	2,0%	2,1%	2,0%
electricity (generation) price	c€/kWh	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72
household electricity price	c€/kWh	14,64	14,64	14,64	14,64	14,64	14,64	14,64	14,64	14,64
RES support top-up	c€/kWh	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16
Internalisation : emission charges + electricity tax + RES		5.9%	3.4%	2.9%	5.6%	4.6%	3.7%	4.5%	4.8%	4.6%

Note: prices in EUR_{2008}

Source: National implementation report, NEEDS RS1d WP5

The overall level of internalisation for conventional power plants is fairly low, between 3-6%, with cross-subsidy for renewable sources making major part of this share. It is envisaged that this cross-subsidy will continuously increase in following years as renewable energy production expands.

In the next table a relation between the support for renewable sources and external costs of different renewable electricity generation installations is shown. The rates of feed-in tariffs and green premiums refer to installations set in operation in 2008.

Table 9: Renewable electricity: external costs and feed-in tariffs

	Total external costs	Feed-in tariff	Green premium*
	c€/kWh	c€/kWh	c€/kWh
hydropower, run of river <10MW	**0.09**	**11**	5
wind on-shore	**0.15**	**10**	7
biomass (straw) CHP	**3.64**	**14**	8
biomass (woodchips) CHP	**1.02**	**10**	4
MCFC (biogas)	**5.03**	**16**	10

Notes: prices in $EURcents_{2008}$

* premium paid above the market price of electricity (i.e. 6.72 c€/kWh)

If a crude comparison is made with external cost estimates for conventional power plants referred in previous table one can conclude that (except for substitution of Hodonin PP for wind turbine) feed-in tariff rates are higher than the difference in external costs (i.e. external cost avoided if we speak about substitution of conventional power plants).

3.2.4. Policy recommendations

In spite of relatively broad portfolio of economic instruments their role remains somehow limited. Most of these instruments were introduced with a motivation objective, however, low tax/charge rates give little chance to induce change in behaviour of tax/charge payers. Only recently introduced emission trading seems to harness market forces in achieving cost-effective emission reductions. Hence, such potential for dynamic efficiency of market based instruments suggest the need to depart from current strong reliance on command-and-control measures.

The current system of energy taxation has an unpleasant feature that energy products for heat generation are taxed as inputs while energy products for electricity generation are generally exempted and electricity is taxed as output. This compromise is not sufficient especially from environmental point of view as it precludes tax differentiation according to the environmental performance of fuels used for electricity generation (except for tax exemptions and reductions allowed by the energy taxation directive).

Relatively unsatisfactory situation in ambient air quality especially in highly industrialised and urbanised areas, still poses significant threat to human health and environment. To respond to this challenge the Ministry of Environment has started drafting a new Air Protection Act in fall 2008 with particular aim to improve effectiveness of air pollution charges. Out of the three options discussed in early discussions on the draft law – (1) increase the rates with inflation, (2) approximate the rates to marginal abatement costs or (3) to external costs, only the first two options were explored further. There were mainly two factors that precluded linking the rates to external costs – a lack of understanding in how the external costs are calculated and unacceptability of substantial increase in emission charges.

Though, with the current system of economic instruments, air pollution charges seem to be the appropriate instrument for internalisation as electricity taxation provides only weak link to how the electricity was produced.

An alternative, only recently opened within the discussion on recasting of EC integrated pollution directive, is the emission trading in NOx and SO2. As with other economic instruments it allows for achieving reduction in emissions in the cost-effective way. In contrast to emission charges, cap-and-trade system does not set the price over the emission unit but limits the total emission volume over regulated entities. Thus, it may fit well into other regulatory schemes such as emission ceiling set in respective EC directive. Still, setting the cap and method for allocation of emission permit is quite demanding and politically sensible task as may be learned from EU ETS evolution.

A broad range of measures supports the development of renewable energies. These mostly take a form of direct state aid, such as guaranteed purchase prices in feed-in-tariffs and green bonuses. Until now, these subsidies are primarily based on recovery of investment costs. While this often leads to substitution of fossil sources for their renewable counterparts, it does not automatically imply any reduction in external costs. In addition, using subsidies for direct internalization of external costs is further undermined by environmental state aid guidelines as they allow using external costs avoided to determine amount of state aid only in exceptional cases[19]. This is however not very consistent with the objective to correct market failure in presence of externalities.

Last but not least it should be also noted that economic theory suggests that subsidies tend to achieve the optimal level of pollution at higher costs than other economic instruments such as taxes or tradable permits[20]. In this respect, tradable guarantees of origin envisaged in draft renewable energy directive may represent an option for increasing cost-effectiveness in promotion of renewable sources.

Until now the aim to internalize external costs is only addressed in the environmental policy documents. In this respect State Environmental Policy 2004-2010 (SEP) and Sustainable Development Strategy clearly stick to polluter-pays principle. In SEP's sectoral policies chapter the internalisation of external cost in energy industry is advised as it is expected to contribute to decrease of environmental impact from energy production. Among the measures proposed the emphasis is put on energy savings, greater use of renewable energy sources, development of new high-efficient technologies and combined production of heat and electricity.

With respect to legal requirements for new energy generation installations the respective laws set various requirements including environmental impact assessment and integrated permitting but does not set any obligation to monetize externalities pertinent to the project. To some extent it is expected that meeting such requirements as best available techniques are safeguards in itself reduction in external costs.

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[19] See point 35 of Community guidelines on State aid for environmental protection, OJ C 82, 1. 4. 2008, pp. 1-33.

[20] See, e.g., Goulder and Parry (2008), p. 5 ff.

One of the problems with governmental policies such as state environmental policy, state energy policy and state raw material policy is an apparent lack of coherence. Despite introduction of mandatory strategic environmental assessment of such policies relatively little has changed to date. This shows a need for more frequent integrated modelling and assessment with more emphasis on synergies, inter-dependencies and side-effects.

Among the tools proposed for internalisation of external costs a privilege place is ascribed to environmental tax reform. The preparation of next steps in ETR is still underway, shifting its focus from climate change to clean air. However, as mentioned earlier, the attempt to reform air pollution charges so that they reflect external costs of particular pollutant emissions has failed in the very beginning of the process. This, however, does not mean that no internalisation will occur but to the contrary – the primary objective is to emphasise polluter-pays principle. This may promote internalisation even better than the first stage of ETR that was build around energy taxation that affects primarily end-users not producers.

3.3. Egypt

3.3.1. Introduction

Egypt, in common with other developing countries, faces great challenges to improve the quality of life of its people. Energy is a key to development. It is fundamental to all manufacturing processes; it is needed to grow food, for cooking, lightning. It is access to the modern world transport, telecommunications and information. Most of energy products in Egypt, including heavy fuel oil, gas oil, LPG, natural gas and electricity receive high subsidies.

Use of energy inevitably affects the environment and these impacts can subtract from welfare. Energy is probably not the highest environmental priority in arid countries. Water contamination, coastal degradation and desertification are more pressing. Even in the matter of air quality, the energy sector is not the only culprit. Dusts and toxic emissions arise from the uncontrolled burning of urban waste. Many industrial processes produce particulates that enter the atmosphere; in some cases these are contaminated with heavy metals.

Moreover in many respects the energy sector is improving its performance. The substitution for natural gas in power generation has reduced particulate and sulphur emissions from power plant almost to zero. Efforts have been made to substitute for natural gas in other areas as well, in industry and in transport. Nevertheless the damage resulting from energy sector is still considerable. It is estimated to a little more than 1 billion $ per year and it appears that the damage will rise by about 50% in 2010 unless more remedial action are taken. An Environmental Protection Fund will in accordance with the “Environment Act of 1994” be set up at the Egyptian Environmental Affairs Agency (EEAA). The Fund will receive the amount specifically allocated to it in the General State Budget by way of support, donations and grants presented by national and foreign organization concerned with environmental projection, fines and compensation awarded by courts of law or via out-of-court settlements for damage caused to the environment, as well as revenues from the protectorates fund. The financial resources of the Fund shall be exclusively used for the purpose of realizing its objectives. The Agency will offer incentives to institutions and individuals engaged in activities and projects directed to environmental protection purposes.

Electricity generation and demand were increasing at an average growth rate of 7% during the past seven years. The main output share from electricity generation in the grid system comes from steam turbines (base load), followed by combined cycle (base and medium load). Gas turbines are mainly used to cover peak energy demands and therefore have a minor share in total electricity generation. The total output share of renewable adds up to roughly 14%.

In beginning 2008, the installed capacity was 23,344 MW, of which some 85 % were thermal (75% state-owned and 10% private sector plants). Hydro accounted for 13.6% and wind for 0.9% of the total installed capacity. More than 1,500 MW are added every year to the electricity generation system of Egypt.

The thermal power plants are mainly fuelled with natural gas (about 80%) and HFO (about 20%). The quantity of light fuel oil (LFO) used in the combined cycle plants is insignificant. The overall fuel consumption rate of the thermal generation park is 0.226 t/MWh and the overall thermal efficiency improved to 38.6%.

3.3.2. Economic instruments in energy sector

Most of energy products in Egypt, including heavy fuel oil, gas oil, LPG, natural gas and electricity receive high subsidies. According to EEHC's annual report, subsidies in electricity sector reached 3,016 million EGP in 2005/06 (377 million EUR). Most of the subsidies are targeted to the residential sector. Rural areas and poor communities, land reclamation projects, small agricultural projects and other crucial industrial projects are also receiving subsidies. The prices for electricity are regulated so that the average household consumption (184 kWh/month) is priced according to the second segment and would pay an average of 9.2 Pt/kWh or 1.14 EUR¢/kWh, while an average commercial client consuming 468 kWh/month falls into the third segment, that is priced at 35.4 Pt/kWh or 4.43 EUR¢/kWh. The overall average tariff is estimated at 2.5 EUR¢/kWh. This average electricity tariff is too low to provide a basis for cost recovering. Therefore, the Government of Egypt foresees annual average tariff increases of at least 7.5%.

3.3.3. Internalization

External effects are not taken into account in decision making. There is no economic market for these effects. Internalisation of external costs can be efficient way to reduce the negative side effects of different sectors. It is an important precondition to:

1) Improve efficiency
2) Improve safety and reduce environmental impacts.
3) Finance the general budget
4) Make the polluter / user pay
5) level out the income distribution

Five most typical Egyptian power plants have been chosen to estimate their environmental burden and external cost produced. The power plants are the following:

1- Cairo North Power Plant (Combined Cycles)

2- Cairo West Ext. (Steam)

3- Sidi Krir 1 & 2 (Steam)

4- Damietta (Combined Cycle)

5- Walidia (Steam)

The external costs calculations for the five reference energy technologies calculated by using of EcoSense web version. The external costs are the highest for Steam power plants and the lowest for the Combined Cycles Power Plants. The average value for Steam Power Plants is 1.64 Eurocents/kWh and for the Combined Cycles power plant is 0.42 Eurocents/kWh. These values are less than the unit cost of average tariff for electricity in Egypt which is about 2.5 EUR¢/kWh.

External costs can be expressed not only as a percentage of energy production, but also as damages produced by each air pollutant (PM, SO2, NOX). Most harmful is PM emissions, mainly for a local scale. Number of Years of Life Lost [YOLL] due to 1000 ton emission of fine dust PPM2.5 in Egypt equal 748. If monetary value of 40000 $Euro_{2005}$ per Year of Life Lost is used the damage costs per year will be equal to 29.2 Million $Euro_{2005}$.

Local damage costs from air pollution are estimated at $ 1.2 billion / year, affecting Egypt's economy by reducing its productive output. The growth rate without the implementation of new policies is projected to be 3.5% annually; i.e environmental impacts from air pollution are projected to grow by 3.5% per year. Air pollution can be internalization via market based instruments in addition to regulation.

3.3.4. Policy recommendations

Ownership rights over the environment are limited. Individuals and organizations producing pollution therefore are not obliged to pay any clearly identifiable owner for the damage that they cause. There is therefore no simple market price for the willingness to accept such damage and environmental impacts are therefore known as external costs. They do not enter into market appraisal of a project. They may enter indirectly through the need to reduce emissions to some negotiated or imposed limit.

If we can place a value on the damage done by emissions to the environment then we can proceed a normal with the Cost Benefit Analysis. Many of the values used in Cost-Benefit Analysis are adjusted for one reason or another and there is no especial problem in bringing in a whole new set of external costs.

The problem is more to know what these external costs are. One method is to follow the emission from the project physically through the environment and to work out what damage they cause. This is the basis of dose-response function that underlines most modern approaches.

Often the control costs of environmental impacts are taken as a fair measure of damage costs. At the optimum this is true. Theoretically the marginal cost of controlling a pollutant should equal to the marginal damage that it inflicts.

Internalisation of external costs can be done by a wide variety of methods and instruments. Potential government instruments can be classified as follows:

- Market-based instruments (pricing, emission trading)
- Regulation
- Infrastructure Provision
- Environmental Planning
- Communication & Information

In Egypt, we look at the policy instruments for the internalization of such costs. Emphasis is given to subsidies, such as feed-in tariffs, competitive bidding processes to stimulate the use of renewable in the production of electricity.

In February 2008, the Supreme Energy Council of Egypt, headed by the Prime Minister, approved an ambitious plan to satisfy 20% of the generated electricity by renewable energies by 2020, including a 12 % contribution from wind energy, i.e. reaching about 7200 MW grid connected wind farms. This means adding about 600 MW wind farm annually. To support realizing this strategy, the Egyptian electricity sector has drafted a new electricity act to encourage renewable energy utilization and private sector involvement.

The policy to foster increasing wind energy contribution consists of two phases: In Phase 1 Competitive Bids approach will be adopted through issuing tenders requesting private sector to supply power from wind energy. The financial risk for investors is reduced through guaranteeing a long term power purchase agreement. In Phase 2 the support system will be extended through the implementation of feed-in-tariff taking into consideration the prices achieved in phase 1.

Meanwhile, the private sector is also encouraged to play a key role in realizing the strategy of 2020 through establishing wind farms to satisfy their own needs from electricity or to sell electricity to other consumers through the national grid at regulated grid use tariff.

The national environmental action plan is the key tool used by the Government of Egypt to set and implement environmental policy across all sectors. It aims to make the environment a factor in the determination of energy policy from the beginning of policy design. The control of emissions to environment is an important part of environmental management, but cannot itself lead to the most effective management. The incorporation of environmental objectives into the initial concept of policy for the sector is equally important. The environmental policies can only achieved through a co-operative process among responsible ministries. The Cost Benefit Analysis provides a common framework for analyzing all polices in all sectors. It is systematic use across all sectors.

In the present Egyptian situation, most important policies that need to be followed in order to foster internalisation of external costs are the following:

1. reforming pricing of energy – gradual abolition of subsidies to energy products and electricity;
2. demand side management – increase public awareness and promote energy savings in industry, service sector and households;
3. reduction of transmission and distribution losses;
4. promotion of electricity generation from wind and other renewable sources;
5. setting of mandatory standards and labelling.

3.4. Estonia

3.4.1. Fiscal policy instruments for internalisation

The main fiscal policy instruments of the energy sector are the fossil fuel prices, fuel excise taxes, environmental charges and feed-in tariffs.

Environmental charges and taxes were introduced in Estonia since 1991. Now are these charges and taxes about 2,2% of GDP and 7,9% of all taxes in state budget. The most important environmental tax in 2007 was the fuel excise tax – 6,43% of all state budget taxes (Table 5). In 2008 the excise taxes for all fuels were raised (petrol 0,36 €/l, diesel fuel 0,33 €/l, light fuel oil 0,06 €/l).

Table 10: Environmental taxes and charges, Estonia, 2002-2007

	2002	2005	2007	2007
	Mio€	Mio€	Mio€	%
Taxes to state budget, total	2 041	2 933	4 327	100
Fuel excise tax	116	214	278	6.43
Other environmental taxes	11	4	4	0.10
Environmental fees, total	23	41	63	1.46
...air pollution	2	9	18	0.41
...water pollution	2	4	4	0.09
...waste disposal	7	16	22	0.51
...water resources	5	6	9	0.22
...mineral resources	6	8	18	0.41

Source: Ministry of Environment

Estonia increased since 1996 every year the air and water pollution fees around 10-20%, water resources fees around 10% and mineral resources fees around 5-10%.

The environmental charges of the energy sector for air pollution emissions, oil shale mining and wastes processing in 2006 exceeded 37 Mio€. The total environment related tax burden of the energy sector is due to mainly oil shale mining (incl. mining wastes), oil shale ash disposal charges and CO_2 emissions charges.

The calculated external costs for the Narva oil shale power plant that produces over 80% of the electricity in Estonia, depend on the technology used. External costs of the old pulverised combustion technology for 8500 GWh electricity per year total to 514 Mio€ or 6,04 c€/kWh and for the new circulating fluidised bed combustion (CFBC) technology total to 235 Mio€ or 2,76 c€/kWh. The Narva oil shale power plant is going to replace the old pulverised combustion boilers with 450-600 MW new CFBC technology in 2012.

The calculated external costs are about 14 and for the new technology about 9 times higher compared to the revenues from environmental charges. One of the reasons for this big difference is that the environmental fee for CO_2 in Estonia was 1 €/t in 2006, but the external costs were calculated at the rate 19 €/ tCO_2. This introduces a difference of about 2,3 c€/kWh /Table 6/.

At the top of it, all electricity consumers have to pay a fee for subsidising of renewable energy and combined heat and power generation. The level of the fee in 2007 was 2.18 EEKcents/kWh (1.39 EUR/MWh), while in 2008 it is 3.03 EEKcents/kWh.

Impact of CO_2 emission allowance price is especially important in electricity generation due to high emission factor from oil shale burning. For second trading period some 9.2 million tonnes out of total 12.72 mil tonnes covered in NAP were allocated to Eesti Energia, operator of Narva PP, what has been calculated to almost cover the estimated need of 9.4 million tonnes annually.

The Table 6 illustrates as an example the results of an analysis how much the Estonian household electricity tariffs will increase if all calculated external costs would be internalised and if electricity is generated by the Narva power plant only using the most efficient and environmentally friendly CFBC technology.

3.4.2. Internalisation

Production costs, investments, taxes and prices are economic indicators, fixed by legislation, book-keeping rules and market conditions. These indicators are transparent, checked by annual audits and tax departments, published in statistics, analysed by banks and other financial institutions.

External costs are calculated on the basis of environmental damage research, hypothetical concentration-response functions, pollution statistics and expert estimates. No real market exists for external costs and benefits. Calculated external costs are less transparent and less reliable, not checked by auditors or any other financial institution.

The important methodological question arises here: how to calculate the appropriate (optimal) proportion of external costs to be internalised in energy prices?

Ecological tax reform can be the tool for efficient implementation of environmental policy. But this tool could come in conflict with three main political concerns that obstruct currently a more general use of tax rates that fully reflect the external costs:

1. loss of sectoral or international competitiveness,
2. the negative distributional impacts (for low-income households),
3. accelerating the inflation.

These political concerns may be used also as <u>the criteria for calculating the appropriate share of external costs for internalising within environmental taxes.</u>

Table 11: The impact of internalisation of external costs, Estonia, 2006

	Fuel		oil shale	gas	oil	wood
	Technology		CFBC	CHP	CHP	CHP
1	Net electricity generation	GWh	8 500	460	460	190
2	SO2	kg/MWh	0.098		1.783	0.274
3	NOx	kg/MWh	0.650	1.370	1.630	0.716
4	PM10	kg/MWh	0.450	0.011	0.178	0.089
5	CO2 (operation only)	kg/MWh	800	722	939	526
6	**External costs, ESW**					
7	Regional health, materials, crops	c€/kWh	0.31	0.25	1.07	0.27
8	Biodiversity losses	c€/kWh	0.04	0.10	0.12	0.05
9	GHG, operation costs, 19 €/t	c€/kWh	2.41	1.37	1.78	
10	Total external costs	c€/kWh	2.76	1.72	2.97	0.33
11	**Cost and tariff estimates**					
12	Electricity generation cost	c€/kWh	4.45	3.05	3.52	5.40
13	El. gener. day-tariff for households	c€/kWh	5.41	4.01	4.48	6.36
14	El. distrib. day-tariff for households	c€/kWh	4.79	4.79	4.79	4.79
15	Day-tariff for households	c€/kWh	10.2	8.8	9.27	11.15
16	Day-tariff + total external costs	c€/kWh	12.96	10.52	12.24	11.48
17	Regional ext costs / day-tariff	%	3	3	12	2
18	GHG operation costs / day-tariff	%	24	16	19	
19	Total external costs / day-tariff	%	27	20	32	3

Source: National implementation of the ExternE, Estonia. 2008. NEEDS, No 5.1-RS1d, Table 9.

The final goal of environmental policy– tax rates that fully reflect the external costs must be balanced with other social and economic goals. To find the optimal balance between all these goals a number of various methods and models could be used.

The environmentally related taxes are introduced already in all European countries. They are used to find the balance between environmental, social and economic goals.

Some data and results of an analysis for comparing the calculated external costs per kWh with the electricity tariffs are presented in Table 2 (Hungary) and Table 6 (Estonia). Comparing roughly similar data for two countries allows to answer the following questions;

1. Are the calculated external costs comparable with the similar electricity generation technologies in other countries?
2. What could be the increase in electricity tariffs if all external costs will be internalised?
3. How higher electricity tariffs influence the abovementioned three criteria (competitiveness, inflation, distribution of tax burden)?

Table 12: Electricity generation costs and tariffs, Hungary and Estonia, 2006

		Estonia	Hungary
Fuel		oil shale	lignite
Technology of condensing power plant		CFBC	Pulv.
Net electricity generation	GWh	8 500	4746
SO2	kg/MWh	0,10	0,70
Electricity generation cost	c€/kWh	4,45	2,68
El. gener. day-tariff for households	c€/kWh	5,41	8,81
El. distrib. day-tariff for households	c€/kWh	4,79	5,74
Day-tariff for households	c€/kWh	10,2	14,55
Environmental charges	c€/kWh	0,13	0,08
Electricity tax	c€/kWh	0,06	0,08
Total external costs	c€/kWh	2,76	4,58
Day-tariff + total external costs	c€/kWh	12,96	19,12
Total external costs / day-tariff	%	27	32

Source: tables 2 and 6

Explanation of terms used:

CFBC – circulating fluidised bed combustion technology

Pulv. – pulverised combustion technology

The selected power plants in Table 12 have similar electricity generation capacity and similar fuels, but different fuel combustion technologies, electricity generation costs and external costs per kWh. External costs per kWh in Estonia are less than in Hungary because the CFBC technology is cleaner. The old oil shale pulverised combustion technologies in Estonia have similar external costs as in Hungary. The external costs are calculated on the basis of same methodology and are therefore well comparable.

The

Table 11 and Table 13 below did not describe all used technologies. Electricity market in Hungary is liberalised already and the electricity prices are higher than in Estonian state-controlled electricity market (liberalisation of the Estonian electricity market is planned after the new connections are built with Europe and Finland). Since 1 January 2009 the Estonian market will open by 35%, the full liberalisation is planned from 2013. It is the reason, why in Hungary the household electricity day-tariffs are also much higher than in Estonia. The result of internalising all types of external costs is, that the electricity day tariffs would increase about 30% in both countries. Comparing these increased electricity tariffs with low-income household budgets in Estonia and Hungary one could see how critical the tax burden and income distribution problems are.

For the selected basic fossil fuel technologies (Table 7) the sum of environmental charges and taxes is less than calculated external costs about 20 times in Estonia and about 30 times in Hungary. It means that the electricity tax and pollution charges in both countries are determined not only by the calculated external costs, but mainly by other social and economic factors.

3.4.3. Policy recommendations

1. Internalisation of external costs must take into account the social and economic policy goals – sectoral and international competitiveness, low inflation rate, optimal distribution of tax burden and others.
2. The optimal level for internalising external costs should be calculated on the basis of complex cost-benefit analysis and then finally decided through the public debate where the all interest groups can participate and present their arguments. This democratic debate avoids serious economic and social policy mistakes.
3. The input data for monetary valuation of externalities must be reliable. It is recommended to improve the statistics and the annual reporting system of enterprises and organisations.
4. Legal requirements are needed to implement detailed cost-benefit analyses for every major proposed regulation, development plan or public investment project. These requirements create the regular demand for cost-benefit analysis and monetary valuation of externalities.
5. Investments into the electricity and heat production are made for more than 20 years and therefore the rapid changes in energy sector could occur economically inefficient. The process of internalising the external costs should be continued increasing step-wise the externalities to be included.
6. External costs calculation methodology should be further developed towards higher level of detail, transparency and reliability. It is much anticipated that all stakeholders in ExternE framework in Europe could have free access to the databases and web based software, ESW to be used for local, regional and global scale calculation of external costs. It is the major precondition for further development of common understanding and also, implementation of the concept of external costs.

3.5. Hungary

3.5.1. Introduction

Since the start of the project, a few important facts have to be taken into consideration: the Ukrainian–Russian gas dispute, the extremely high oil prices and the liberalization of the electric energy market. The national model for the deregulated electricity sector was laid down by legislation in 2001. After 2003 big consumers, after 2004 all non-household users and after 2007 all consumers are eligible to buy electricity from the supplier of their choice. Producers can get access to the national transmission grid by regulated codes, consumers will pay standardised grid charges. Act CX of 2001 on Electricity included regulation complying with Directive 96/92/EC. After it came into force, however, a new Directive was adopted on 26 July 2003 (Directive 2003/54/EC of the European Parliament and of the Council), which re-regulated the Internal Electricity Market of the European Union and superseded Directive 96/92/EC.

Recently the security of supply has been sharply emphasised by all parties. This fact and the relatively high energy prices do not favour good negotiation position for the internalization of the environmental costs. Hungarian economic growth was related to substantial energy saving while at present consumption is 15 % below the level of 80s, the GDP growth was 40 %. Further energy potential is therefore limited. After liberalization of the market energy prices went up substantially, at present representing 15 % of total overhead costs of households being double of EU15. The Ministry of Economics and the Ministry of Environment have polarized opinion on the taxing and the potential of renewable energy sources in the energy mix since it might generate even higher prices. The inflation in the past ten years resulted in an eightfold price increase while energy prices became 20 fold during the same period. The market liberalization that was supposed to increase competitiveness finally resulted in much higher prices. The extra profit remains as profit of the multinational utilities. On economic level two objectives must be met, reduction of extra profit of the companies and internalization in a very unfortunate political condition when security of supply has been much sharper emphasized.

At present the most important environmentally adverse subsidy is related to the mine allowance being much too low – 12 % compared to 40 % in 1993. Further subsidies can be considered as secondary subsidy:

- Landscape remediation and re-cultivation of mining sites;
- Low land use prices for mining;
- Low assurance obligation for environmental damages.

3.5.2. Price-based instruments

In 2003 the energy tax on the sales and imports of electric power and natural gas was introduced. Sales to residential consumer are exempt for the duty of paying the tax. The amount of the tax in 2005 was 186 HUF/MWh (0.740 €/MWh) of electricity, and 56 HUF/GJ of natural gas, according to Act LXXXVIII of 2003. The energy tax on electricity is independent from the primary energy source and the electricity generation technology. The energy tax is not an optimal instrument since it does not lead to the preference of electricity generation technologies with low environmental impact, and therefore low external costs.

Also in 2003, an environmental load charge was introduced. The charge is to be paid by the users of the environment in proportion to the quantity of pollutants emitted to the atmosphere, surface waters and soil. The amount of the levy is pollutant-specific and calculated on a yearly basis. Residential sources, stationery sources providing district heating as well as mobile sources are exempt from the environmental charges. The following pollutants are levied: air (SO2, NOx, solid, non-toxic particles), water (COI, phosphor, inorganic nitrogen, mercury, cadmium, chrome, nickel, lead and copper). Soil-related levy is not pollutant-specific, its amount based on the quantity of waste waters.

Considering air pollutants, the environmental charge is 50 HUF/kg for SO_2, 120 HUF/kg for NO_x and 30 HUF/kg for non-toxic dust (TSP) according to Act LXXXIX of 2003. Using exchange rate (251.5 HUF/€ for 2008), these values are equivalent to 199 €/t for SO_2, 477 €/t for NO_x and 119 €/t for TSP. The act came into force in 2004, with a temporary reduction of the calculated charges (40% of the calculated charges were applied in 2004 and 2005, 75 % in 2006, 90 % in 2007 and 100 % in 2008 and onwards).

Subsidized payment system is a compensation fund for electricity sold in the framework of mandatory take of regime. The sum is paid by the transmission system operator from the fund for the entity (public utility wholesaler, public utility supplier) who is obliged to take over such kind of electricity. 48.2 billion HUF was paid for such generated energy in 2007. Electricity co-generated in CHPs, as well as generated from renewable energy sources and waste is subsidized.

The total liberalization of the Hungarian electricity market started in the beginning of 2008, based on the Act LXXXVI of 2007 on electricity that came into force on 15 October 2007. The feed-in tariffs of electricity are regulated according to the act on electricity mentioned above by Government Decree 389/2007 (23 XII). These prices are dependent on the primary energy source, the capacity of the power plants as well as the time period of the supplied electricity (peak, valley period). Quotas for subsidized electricity are allocated by the Hungarian Energy Office for each power utility. The subsidy for renewables and co-generation is included in the price of electricity, it amounts 2 HUF/kWh (0.8 c€/kWh) in 2008.

External cost calculation results for present technologies in Hungary are listed in Table 37, compared to electricity related tariffs and levied environmental charges (as of August 2008). All prices and costs are expressed in €$_{2008}$. The electricity prices as well as taxes and subsidies expressed in HUF were recalculated using the exchange rate (251.5 HUF/€).**Chyba! Záložka není definována.** The external cost data (EC) were recalculated from €$_{2000}$ to €$_{2008}$ using the harmonized indices of consumer prices (*HICP*) (a factor of 1.6 for Hungary),

$$EC_{2008} = EC_{2000} \frac{HICP_{2008}}{HICP_{2000}},$$

and subjected to a scaling scaled with GDP/capita at purchase power parity (PPP) for Hungary,

$$EC_{HU} = EC_{EU25} \frac{GDP_{HU} PPP_{EU25}}{GDP_{EU25} PPP_{HU}},$$

(a factor of 0.603 compared to EU25 for year 2008), obtained from the EUROSTAT database.**Chyba! Záložka není definována.**

Table 13: Operation-related external costs, electricity generation costs and tariffs for six fuel cycles typical for the Hungarian energy market.

Electricity generation alternatives		A	B	C	D	E	F	Average
Fuel		Lignite	Coal	Natural gas	Natural gas	Wood	Nuclear	
Technology		Cond.	Cond.	Cond.	CC	BFB	PWR	
Net electricity generation	GWh/a	4,746	1,235	1,407	697	341	12,952	31,204
SO2	t/a	3,336	1,984	151	4	1	0.320	12,705
NOx	t/a	5,930	1,399	458	182	518	4.490	22,489
PM10	t/a	69	22	48	0	43	0.080	1,382
CO2 (operation only)	kt/a	6110	1355	862	302	10	0.178	18,145
Allocation ratio for electricity		1.00	0.97	1.00	0.81	0.93	1.00	
SO2	kg/MWh	0.700	1.558	0.107	0.005	0.003	0.000	0.407
NOx	kg/MWh	1.244	1.099	0.326	0.212	1.407	0.000	0.721
PM10	kg/MWh	0.014	0.017	0.034	0.000	0.117	0.000	0.044
CO2 (operation only)	kg/MWh	1,282	1,064	613	353	27	0.014	582
External costs, EcoSenseWeb calculations								
Regional health, materials, crops	c€/kWh	2.00	2.70	0.34	0.22	1.65	0.06*	0.90
Biodiversity losses	c€/kWh	0.14	0.14	0.04	0.02	0.14		0.09
Hungary, health, materials, crops	c€/kWh	0.42	0.51	0.05	0.05	0.44		0.12
GHG, operation costs, 19 €/t	c€/kWh	2.44	2.02	1.16	0.67	0.05	0.00003	1.10
Accident risk	c€/kWh						0.02	0.01
Total external costs	c€/kWh	4.58	4.86	1.54	0.91	1.85	0.07*	2.08
Cost and tariff estimates								
Electricity generation cost	c€/kWh	2.56	3.10	4.52	4.52	4.23	2.80	3.34
El. generation day-tariff for households	c€/kWh	8.41	8.41	8.41	8.41	8.41	8.41	8.41
El. distribution day-tariff for households	c€/kWh	5.48	5.48	5.48	5.48	5.48	5.48	5.48
Day-tariff for households	c€/kWh	13.88	13.88	13.88	13.88	13.88	13.88	13.88
Pollution charge	c€/kWh	0.08	0.09	0.02	0.01	0.07	0.00	0.05
Energy tax	c€/kWh	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Subsidy for renewables/cogeneration	c€/kWh	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Total internalized costs	c€/kWh	0.95	0.96	0.89	0.88	0.95	0.87	0.92
Regional external costs / day-tariff	%	14.4	19.4	2.4	1.6	11.9	0.4	6.3

GHG operation costs / day-tariff	%	17.6	14.6	8.4	4.8	0.4	0.0	8.0
Total external costs / day-tariff	%	33.0	35.0	11.1	6.6	13.3	0.6	15.0
Internalized external costs / day tariff	%	6.9	6.9	6.4	6.4	6.8	6.3	6.6

Cond.: Condensing power plant

CC: combined cycle

BFB: bubbling fluidized bed combustion

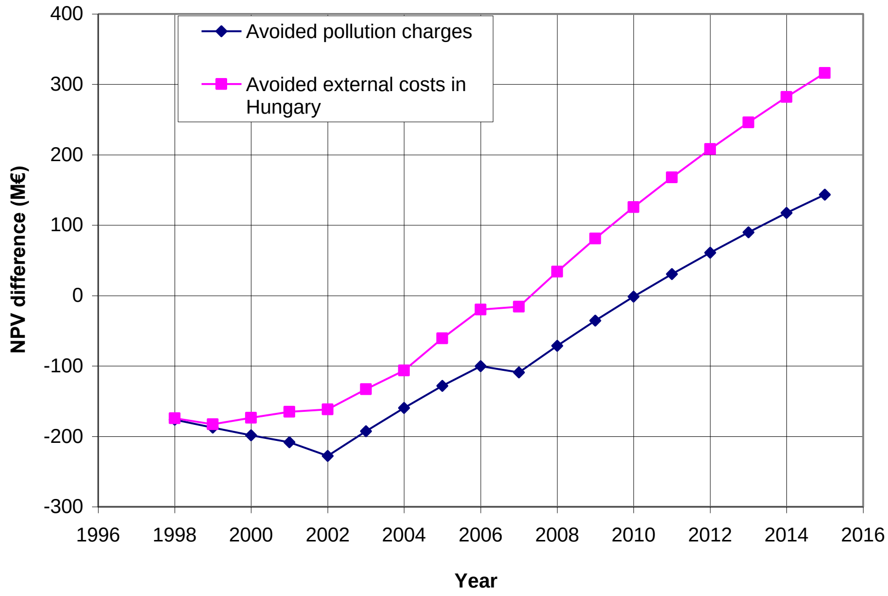
PWR: pressure water reactor

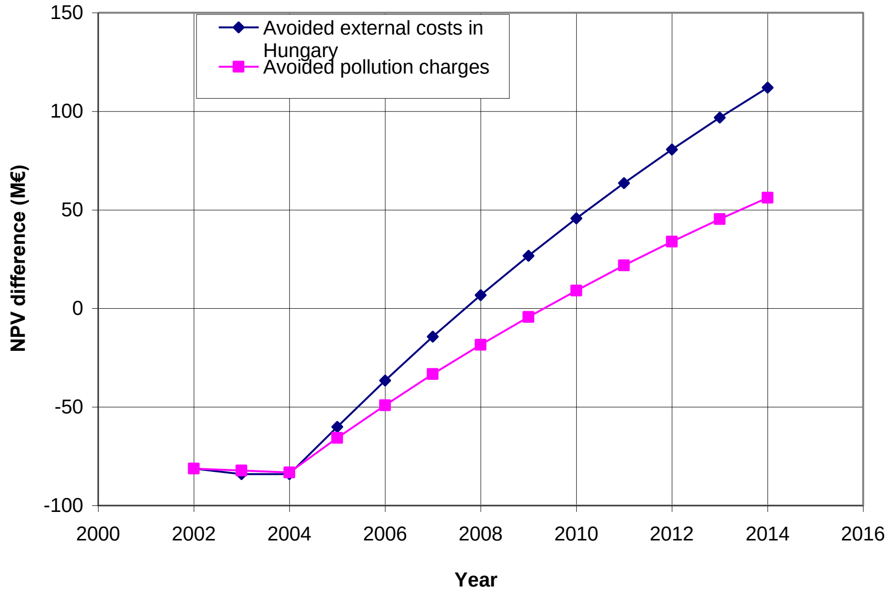
* For nuclear, effect of globally dispersed radionuclides also included

It is clear from Table 13 that the present energy tax (0.08 c€/kWh) and levied environmental charges cover only the externalities occurring in the territory of Hungary for natural gas and nuclear fuel cycles. External costs calculated for regional and global scale are much higher. Regional externalities of coal based electricity generation can reach 20 % of the electricity price. Middle estimate of GHG externalities accounts for around 17 % of the electricity price for present coal and lignite based technologies. However, regarding the average external costs of the present energy mix and the subsidy for renewables and co-generation as part of the internalization, the regional external costs are – on average – internalized. Regarding the total external costs, the internalization rate is around 44%. On one hand, most of the consumers use the electricity originating from the average fuel mix of the country, therefore the incorporation of the subsidy for feed-in tariff in the electricity price seems to be a proper method for part of the internalization. On the other hand, the differences in the external costs related to different fuel cycles should be taken into account in the internalization method, the “polluter pays” principle should also be followed.

Although the pollution charges compensate around half of the external costs occurring within the territory of Hungary, their introduction gave an impulse to retrofit projects aiming emission reduction of the most polluting electricity generation technologies. Investments on wet scrubber FGD systems are economically profitable even if avoided pollution charges are considered (Figure 2).

Figure 2: NPV difference due to retrofit program including emission reduction investments in lignite (top) and coal burning power plants (bottom), calculated for each year





Regarding the nuclear fuel cycle, the external costs of nuclear waste deposit as well as the decommissioning of nuclear facilities are partly internalised through the Central Nuclear Monetary Fund regulated by the 41/2004. (VII. 7.) Decree of the Minister for Home Affairs (BM). The payments into the Fund during the operation period of the nuclear power plant will cover the costs occurring in the future. The Paks NPP paid around 24 billion HUF into the Fund in 2004 that had a total amount of around 85 billion HUF at the end of 2005.

The Hungarian Ministry for Economy and Transport commissioned a policy paper,[21] mentioning that the internalisation of external costs using taxes or supports would lead to (i) the increase of the efficiency of use and distribution of resources, (ii) the decrease of social damage, (iii) the promotion of sustainable development, (iv) the achievement of environmental goals. Act LXXXVIII of 2003 on energy taxes includes the possibility of incorporating external environmental damages to energy prices, but this possibility is not fully exploited. The aim of increasing the competitiveness of renewable energy technologies such as geothermal in Hungary, a higher demand appears for internalization of the external costs at an increased level.

In Hungary due to the fact that electricity is very expensive and security of supply has been sharply pronounced by politicians, no political will has been pronounced by government actors for increasing the internalization rate, especially by means of pollution charges allocated at the electricity producers. Neither the ministry responsible for energy issues nor the Ministry of Environment has any proposed agenda on this matter. Mainly civil organizations emphasize this need, but it never gets accentuated and never explicit ideas are formulated. The tendency of NGOs is more and more to emphasize one exclusive aspect of the energy problem usually limiting the discussion to environmental damage. Such views do not meet the public interest, since at this platform the economic values are dominating. The results of the project will be disclosed to various stakeholders in the hope of growing interest of the public. As long as the government is not willing to cooperate in this respect the selection of the best economic instrument will not be in the focus of the parties.

3.5.3. Quantity-based instruments

Hungary joined to the Protocol of Kyoto in 2002, and negotiated that the greenhouse gas emission will be 6 % lower in the performance period of 2008–2012 than the average of 1985-87 years. Hungary takes part in the emission trading system of EU since 2005. The second national allocation plan for the period of 2008–2012 considers a 2.75 % lower total quota of emission units for Hungary than the first National Allocation Plan approved for the trial period of the emission trading system (years 2005–2007).

3.5.4. Optimal regulation

Lower environmental damage of energy sector is attainable only with international collaboration. States without grand economical capital can not give financial assistance to new technologies so they use very often out of date technologies with high external costs. In this case external costs incorporated in selling price of electricity endanger the competitiveness. International collaboration and quota system with stock market for different pollutants can assist environmental investments. Restriction of trade can enforce the ‘voluntary’ cooperation. These steps are not sufficient in developing countries where a preferential loan is necessary to launch a new technology.

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[21] Magyarország primerenergia-hordozó struktúrájának elemzése, alakításának stratégiai céljai. In: Az Új Magyar Energiapolitika tézisei a 2006-2030 közötti időszakra, Gazdasági és Közlekedési Minisztérium, 2005. p. 57. [in Hungarian]

The guaranteed, relatively high delivery price and the shortage in resources limit the development of renewable electricity. If every power plant gets quota of different pollutants proportional to the share of production and they trade with it, this profit can make a contribution or possibly substitute the guaranteed delivery price of renewable electricity. (For example in 2007, wind energy had 0.3% share of energy mix in Hungary. 1.8 M€ quota of different pollutants would be incidental to this part of electricity generation if calculation leant on external costs in 2005. Surplus in revenues of electricity was 5.58 M€ in the same year if delivery price was compared with selling price of the second cheapest power plant in Hungary. In this way, trade with quota makes possible around 30% reduction in delivery price.)

The present retail price of electricity is too high in Hungary since VAT is maximal (20 % general VAT applies also to electricity, 5 % preference VAT applies only e.g. medicals and books) and the present prices already generate inflation. The only fiscal solution to keep the retail prices is the reduction of VAT or reducing the extra profit earned by the multinational companies possessing by vast majority ownership of multinational utilities. This so-called Robin Hood tax – extra tax of 8 % – was approved by the Hungarian Parliament on 10 November 2008, which is expected to be used for social compensation of high residential district heating costs.

In the Hungarian energy sector one of the most important steps is to increase the elasticity of the electricity generation system with pump-reservoir hydro power plant. This investment would make possibility to radical change in the primary energy mix. Thus the environmental aspects could get primary importance in decision analysis. It would be possible subserve many investments from VAT of electricity.

The internalization level in the Hungarian electricity system is not expected to be increased, but the present complex internalization system including taxes levies and subsidies should be slightly reformed to reach a more righteous system. In order to increase the competitiveness of renewables, the subsidy system for renewables should be separated from the subsidy system for co-generation in natural gas fuelled CHPs. In 2007, around 70% of the subsidy was paid to natural gas CHPs and less than 30% for electricity generated from renewables.

A democratic, step-by-step increase of internalization of external costs should be introduced, first taking into account the environmental damages caused in Hungary. The total internalization of regional effects needs an international collaboration of policy makers since a unilateral drastic increase of internalization level would lead to a decrease of the economical competitiveness of the country.

3.6. Poland

3.6.1. Economic instruments

The most distinctive feature of environmental management in Poland is its extensive system of pollution and natural resource charges collected and redistributed for abatement and conservation purposes through the special environmental funds. Charges are used for virtually all pollution issues (emissions, discharge and disposal of solid and toxic waste). In the recent years charges for environmental pollution have been changed several times, unfortunately according to inflation rate.

Actually Poland has a hybrid charge/standard instrument: a "normal charge" is paid on all emissions below an emissions standard and a "penalty fee" - up to ten times higher than the normal charge is paid on all emissions above the standard. In Poland emissions standards are source-specific and are set by a permitting process. Initially, the standards were relatively moderate, but the need to adjust Polish regulations to EU forced Poland to introduce new limits or implement European ones. It is especially the case for the power generation sector that has recently been faced with very stringent requirements.

Charge rates are determined by Poland's national environmental ministry for 63 specific air pollutants. The absolute levels of the charges are supposed to be determined by a number of considerations including ambient air quality guidelines and marginal abatement costs, but in practice are determined by political acceptability and revenue requirements. The current rates for emissions of basic pollutants to the air is 0.06 €/Mg for CO2, 107 €/Mg for SO2 and NOx and 71 €/Mg for particulates. Thus the efficient "Pigouvian" level of rate, preferred by policy theorists (i.e. equal to the marginal cost of abatement needed to meet policy objectives), should be roughly seven-ten times higher than the current one (e.g. for SO2). Consequently they are not high enough to stimulate investment in emissions reduction installations. These rates are also well below external costs related to gaseous pollutant emissions. But so far their basic aim is rather collection of funds rather than an incentive tool to improve a quality of environment. Despite this the Polish charge system, based on the user-pays and the polluter-pays principle, has become generally regarded as a successful model for collection and financing (subsidizing) projects related to the environmental protection. Revenues from charges and fines are distributed in the form of grants and loans to support investments in emission reduction and sewage treatment projects.

It seems that the plans of the Ministry of Environment to increase the charge rates will not meet with much support. One can see a considerable gulf between the declarations, included in governmental programs and policies, and the actual prospects and probabilities of their implementation.

Challenges facing Poland necessitate seeking new legal solutions, including the introduction of new economic instruments. The National Environmental Policy for 2003-2006 and some prospects for 2007-2010 (2002) emphasised just that. It recommends such instruments as:

- more stringent emission standards – emissions of SO_2, NO_x, PM, heavy metals etc,
- higher emission charges or taxes,
- system of tradable green certificates (TGC),
- product taxes and deposits,
- voluntary agreements,

- flexible mechanisms – JI and emission trading.

As regards the individual emissions standards Polish regulations are consistent with EU rules. The implementation of the emission trading system is one of the most significant changes emphasized in the national environmental policy. There is a need to apply the National Emissions Reduction Scheme and tradable emissions rights system for SO2 and NOx emissions in the Polish energy sector. This scheme does not require meeting individual emissions standards, but imposes the obligation to meet emissions ceiling for the energy sector as a whole. It is expected that such an alternative could bring a certain reduction of total costs for sources covered by the directive in relation to the traditional option with individual emissions standards. So far such estimates have not been analysed in detail yet. The scheme of emissions trading has been also finishing for CO2 emissions.

3.6.2. Internalisation

The main contribution of external costs estimations in a policy formulation can be seen in the following:

- the results indicate that the electricity production has significant external environmental costs and electricity is typically priced well below its full social cost,
- they provide valuable information on the scale of external costs of different fuels and technologies.

Most of governmental documents, programs and policies concerning the environmental protection actions of the Polish energy sector (National Environmental Policy 2002, The Second Environmental Policy 2000) approve the polluter pays principle, i.e. that price formation should fully reflect environmental (external) costs. They also state that energy producers must reduce harmful environmental impacts occurring either in or outside its area from all operations within the energy cycle in an economically efficient manner. Unfortunately the polluter pays principle and the need for the externality internalisation, thought has being explicitly mentioned in programs supported by the Polish Government, have not been implemented so far in practice. In fact, the problem of externalities is discussed only on the ground of academic field, though reliable calculations are exception than a general rule. Although practical recommendations for policy-maker are clearly identified by economists, their transfer to the relevant policy seems to be insufficient as yet.

The possibility of implementing of economic instruments in the Polish energy sector in order to internalise external costs of energy production, for example by higher emission charges or tax reform, examined in the broader context of ecological tax reform as well, is rather limited. As a matter of fact these options have been considered by the Ministry of Environment or the Ministry of Economy, but no legal actions are planned to do. The main argument against these regulations is that proposed tax reform would collide with the existing environmental charges. The implementation of tax reform for the Polish industrial plants is also not feasible as the global ceiling granted to Poland under the Kyoto Protocol will not be exceeded in near future.

There is also limited chance of increasing the charge rates to the efficient level, mainly for a strong resistance from the power generation producers. Furthermore strong arguments are also raised that the ecological tax reform, which affects mainly the domestic energy sector, simply double existing regulatory regulations, giving no any additional economical or environmental benefits. Moreover, the Polish energy sector is currently subject to comprehensive reforms (privatisation, liberalization, new environmental regulations), which exacerbate their economic situation. That is why there is no political determination to implement of a deep ecological reform, based on economical instruments like taxes, charges etc. A good example of resistance of the power generation industry is the hard-negotiated adjustment period for the implementation of 2001/80/EC directive or an agreement on NAP for CO2.

However, the process of internalization of energy externalities actually proceeds under different environmental regulations and schemes that are obligatory for the Polish energy sector. Most of the EU directives, incorporated to the Polish law, aim to achieve a certain (efficient?) level of energy mix or emissions. Examples are the targets setting for various kinds of renewable electricity, national levels of SO2, NOx, dusts and greenhouse gasses, financial rules to promote cleaner energy technologies and standards for energy efficiency.

These categories of priorities are of course the subject of an extensive research on the future development of the energy sector in Poland. Different modelling technologies, i.e. optimisation, macroeconomic (general equilibrium simulation) and system dynamics have been developed and extensively used for the analysis of different kinds of energy-economy-environment policies. Most of the energy models typically use a least-cost method to develop mid-term electricity and heat generation strategy according to imposed environmental constrains, included in these regulations. The examples of the models that have been used by the Polish governmental bodies (PSE S.A., Ministry of Economy) for energy and environmental policy planning are EFOM-ENV, ENPEP, IPM. They have been employed to examine the official government programs concerning the national energy policy, the micro-level effects of greenhouse gases reduction, costs of implementing the LCP Directive or CO2 trading scheme. Attempts to link these models with the CGE tool of the Polish economy have been also observed.

3.6.3. Policy recommendations

One of the crucial conclusions that can be drawn from this project is that the internalisation of external costs in the decision-making process can improve social welfare measured on the energy market. Basing on the results of EcoSense model appropriate values of externalities produced by air emissions were provided as an input to the partial equilibrium model of the Polish power sector development. The results were analysed for three scenarios, differentiated by the range of externalities included in the objective function. For the economic scenario (a full internalisation of externalities) substantial changes in the structure of energy production could be observed. First of all, from a social point of view, the extensive use of solid fuels in Poland should be reduced. In practice the possible strategies to achieve a social welfare improvement are the fall in energy production, the implementation of low emissions energy technologies and the greater use of abatement technologies. All of these measures should be extensively used depending on the scope of externalities considered. All these strategies working together substantially decrease the emissions of all air pollutants. The demand for electricity should be met to a large extent by gas and renewables with relatively low emissions coefficients. The position of traditional old coal fired power plants should diminish in favour of new clean coal technologies. However, the public electricity sector is likely to raise the level of electricity and heat production in contrast to the industry power and heat plants. The cost-effective strategy to limit air emissions is the common use of abatement technologies. According to the results of the model, all coal technologies should be equipped with FGD and

DENOX installations. All these measures could improve the social welfare compared with the expected mid-term development of the Polish energy sector. Given this it seems reasonable to promote these processes in many ways. Increasing attempts at the implementation of the EU environmental directives and instruments in Poland make this policy possible in the nearest future.

These conclusions should be carefully considered since it is very difficult to determine the exact implications of possible interventions on the energy market. It must be mentioned here that despite sophisticated techniques employed in that field, a high degree of uncertainties influences the reliability of external cost estimations and their potential impact on the optimal development of power sectors. This applies both to the different models' assumptions and exogenous parameters. As the sensitivity analysis (not presented here) revealed, the technological and economical assumptions implemented in the model might be crucial for the results. If we modify key parameters we will get essential changes in the volumes of the objective functions and major variables, i.e. the energy prices and the structure of energy production. Discount rate, price and income elasticities, values of externalities caused by air pollutants, future fuel prices, the growth rate of the economy, etc. appear to be crucial for such analysis.

3.7. Slovakia

3.7.1. Introduction

Slovakia is largely dependant on import of energy sources (almost 90% of primary energy sources) and the level of diversification is rather limited. With the exception of lignite, and negligible production of oil and natural gas in South-Western Slovakia, all fossil fuels (including nuclear) are imported. In this respect, the issue of security of supply is emphasised as oil, natural gas and nuclear fuel are imported from Russian Federation.

Energy policy of the Slovak Republic adopted in 2006 sets three general long-term objectives of the policy: (1) to secure energy generation satisfying the demand in a cost-effective manner, (2) security of supply, (3) to decrease energy intensity (the share of energy consumption on GDP). In the long-term perspective it is envisaged that nuclear energy, natural gas and renewable sources will play the dominant role, while the importance of coal will decrease.

The shutdown of two blocks of NPP in Jaslovske Bohunice in 2006 and 2008 caused some 13% drop in electricity generation capacity and consequently Slovakia became net importer of electricity. A new project consisting of two blocks (PWR reactors 440 MWe) in NPP Mochovce has been launched in late 2008 and is envisaged to be finalised by 2012/3.

In 2007, Slovakia became net importer of electricity when the total electricity consumption (29.6 TWh) exceeded total electricity production (27.9 TWh). It is expected that by 2010 about 1370 MW of installed generation capacity will disappear (in 2007 total installed capacity was 7508 MW) and 56% out of the generation capacity in place in 2006 will be phased-out by 2030. The electricity consumption forecast envisage an increase of around 13.5 TWh (46%) by 2030 (Ministry of Economy, 2008). National Energy Efficiency Strategy calls for cumulative energy savings of 9% during 2008-2016, 0.5% annually in 2017-2021and 0.1% in 2022-2030.

The potential of renewable energy is estimated to grow to 19% of total electricity production in 2010 and to 24% in 2030. The Renewable Energy Directive proposal[22] sets an overall target for renewable energy at 14% of final energy consumption in 2020. Currently, a new RES and CHP law is under preparation that will set more attractive framework for development of renewable electricity production (i.e. privileged access to grid, guaranteed take-off and prices fixed for 15 years) and highly efficient combined heat and power generation.

The biggest increase is expected in biomass use for heat generation (substituting natural gas) and CHP. A biomass technical potential is estimated at around 18% of total gross domestic energy consumption (147 PJ), with over 40 PJ from energy crops. The energy potential of hydropower is currently utilised at about 55% of total technical potential (24 PJ). The potential of geothermal energy is also deemed important but currently utilised only marginally.

[22] COM(2008) 19 final

3.7.2. Economic instruments in the energy sector

Economic instruments featuring in energy sector does not differ significantly from other new EU member states. Traditionally, air pollution charges are levied upon release of emission from stationary sources. In the course of EU accession energy taxation and CO2 emission trading were introduced. In addition emission trading was also introduced for SO2 and NOx emissions.

Among subsidies, the most important measures in place are those supporting development of renewable energy use and combined heat and power generation.

Currently, **air pollution charges** are set by the 1998 Act on Air Pollution Charges covering broad range of pollutants. Basic rates are set for emissions up to permitted emission concentration limits while non-compliance rates (3 to 4 times higher than basic rate) are levied upon emissions exceeding emission limit.

Table 14: Air pollution charges (basic rates per tonne of pollutant)

pollutant	SKK/tonne	EUR/tonne
Core pollutants		
particulate matters	5 000	160.02
SO2	2 000	64.01
NOx	1 500	48.01
CO	1 000	32
total organic carbon	4 000	128.02
Other polluting substances		
class 1 (e.g. asbestos, BaP, Cd, Hg)	40 000	1280.17
class 2 (e.g. As, Pb, Ni, Cr, 1,3-butadiene)	20 000	640.09
class 3 (Br, F and their gaseous compounds, organic sulfites etc.)	10 000	320.04
class 4 (Cl and its gaseous compounds, amoniac, formaldehyde etc.)	2 000	64.01

Energy taxation was introduced starting from January 2008 with the Act on excise duty on electricity, coal and natural gas. The tax on electricity is set at 0.02 SKK/kWh (0.066 €c/kWh) until December 2009 and at 0.04 SKK/kWh (€c 0.13/kWh) from January 2010 on. The tax is exempted for renewable electricity only if the electricity is delivered directly to a final consumer or consumed by the producer. In the same manner, the exemption is set for electricity generated in highly efficient combined heat and power generators. In addition, tax exemption is granted for the electricity used in households pursuant to Article 15(h) of Energy Taxation Directive.

The tax on coal – that is meant to include hard and brown coal, lignite, coke and similar solid hydrocarbons – is set at the rate of 320 SKK/tonne (10.6 EUR/tonne). The tax exemption is granted to supplies i.e. for electricity generation, combined heat and power generation and for generation of heat intended for use in households.

Tax on natural gas is set differently for use as propellant and for heat generation. Until end of 2009 the rate is set at 0.02 SKK/kWh (0.066 €c/kWh) for use in heat generation and at 20 SKK/kWh (0.66 €c/kWh) for use as propellant. The rates will double starting from January 2010. The tax exemption is granted for supplies for electricity generation, combined heat and power generation, use in households and for generation of heat intended for use in households.

Emission trading for both greenhouse gases and classical pollutants is governed by Emission Quota Trading Act of 2004. While emission cap for CO2 is set in National Allocation Plan for all covered installations, for classical pollutants the overall cap and regional distribution is set by Ministry of Environment but the allocation to individual installations is set by respective regional authority. In addition, the law prohibits transfer of air pollution quotas for the pollutant increasing allocation for the participant installations situated in locations with air quality regulation concerning such pollutant.

In 2005 total verified emissions were lower than the annual allocation by 4 million tonnes of CO2 (13% over-allocation). The annual allocation for second trading period was set to 30.9 million tonnes much lower than originally proposed by Slovak government. In an attempt to overthrow the EC Commission decision the Slovak government filled a petition with EU Court of First Instance in 2007 (see case T-32/07) challenging the setting of total allocation. However, in February 2008 Slovakia withdrew the petition.

Price regulation in energy sector related to electricity generation from **renewable energy** sources and combined heat and power generation is governed by Regulatory Office for Network Industries decrees. Annex 1 to decree no. 2/2008 sets fixed purchase prices for renewable energy of different origin according to capacity and year of installation. The price is fixed for the period of 12 years from setting of the installation in operation. For installation put into operation from 2009 the prices are set for solar generation at 13,500 SKK/MWh (447 EUR/MWh), for small hydro at 3,400 SKK/MWh (113 EUR/MWh), for wind at 2,550 SKK/MWh (85 EUR/MWh) and for biomass between 3,500-4,000 SKK/MWh (116-133 EUR/MWh).

Similarly, electricity price generated from combined heat and power generators is fixed according to technology, fuel and installed capacity in range from 2,400 to 4,125 SKK/MWh (80-137 EUR/MWh).

3.7.3. Internalisation

In the framework of NEEDs projects the specific external cost of SO2 and NOx pollutants has been calculated. The next table compares the emission charges with external cost from different sources.

Table 15: Comparison of external costs and emission charges (EUR/tonne)

Item	SO2 EUR/t	NOx EUR/t
Specific external cost calculated by ECOSENSE model [1*]	7040	6724
ExternalCosts_CASES_Core [2^]	4439	5121
ExternalCosts_NEEDS_Core [2*]	5536	7221
Emission Charges	84.01	48.01

1* Balajka, Judák: Project no: 502687 NEEDS New Energy Externalities Development for RS 1d National Implementation of the ExternE, Slovak Republic

2* P. Preiss: Two sets of PRELIMINARY "External Costs per Ton of Emission" values for the most important classical air pollutants IER Stutgart, 9.7. 2007

Next table illustrates the share of SO2 and NOx in national emission balance by selected groups:

Table 16: Share of pollutants in emission balance (in %)

	SO2	NOx
Energy sources (public PP, CHP and HP included in IPCC category 1A1a	52.5%	14.6%
Total emission from stationary combustion (energy and technology combustion)	99.7%	56.8%
Road transport	0.2%	33.9%
Emission included in **N**ational **E**mission **I**nformation **S**ystem (NEIS), representing all sources with emission flue gas concentration limit as well emission charges. It includes IPCC categories 1A1 -energy, 1A2-industry, 1A4a commercial & services, 1A4c -agriculture, 1A5a -other comb.	93.4%	47.2%

From above table is seen that national environmental policy oriented on emission concentration limits and emission charges covers the cca 93 % while in the case of NOx it is less as 60% and substantial part of this emission is represented by road transport. Emission concentration limit are technology oriented abatement measure and compliance of its requirements is dependent on the technology used. On the other side, emission charges are "area oriented" and are dependent on bulk emission level. In the case of SO2 implementation of emission limits leads to substantial decrease of pollutant emission. Together with SO2 decrease, the measures applied to SO2 abatement (fuel switch, FGD, fluidized bed combustion) has positive synergy effect on other pollutants as NOx and PM decrease.

The effect of limits represented higher stimulation for technology innovation as well as changes in national fuel mix than emission charges. CBA indicates that external cost decrease of SO2 abatement was several time higher as NPV increase of SO2 abatement implementation. Impact of energy charge on the implementation of new abatement technology was analyzed in the case of electricity supply sector of Slovakia, using MESSAGE model. The use of emission charges on the level of specific external cost per one ton of SO2 and NOx were applied in this model. Considering the results of this modelling, the implementation of emission charges seems not be any exclusively applied policy measure. Existing legislation, using the stack emission concentration limits, stimulates the implementation of abatement technology and the newly installed units are in compliance with the strict environmental requirements as well. The better solution appears to be a combination of both policy measures. In the case of SO2 and NOx the operator should pay emission charges on the level equivalent to specific external cost. In case, when the technology does not comply with environmental requirements - e.g. emission concentration limits. The operator without any abatement action will be punished by functioning in this manner.

3.7.4. Policy recommendations

There is an obvious opportunity to improve the internalization of external costs from energy sector using currently existing economic instruments. However, current setting of all these instruments has substantial limitation to do so.

Air pollution charges lack motivation effect as the rates are below both external costs and marginal abatement costs. More motivation will be achieved in the case, when operator with technology which do not comply the stack emission concentration limits will pay emission charges close or the same as specific external cost pre 1 t of pollutant. In this respect, existing multiplication of rates for sources exceeding the limits seems to be an optimal approach.

Energy taxation effectiveness is dented as there is no differentiation in tax on coal (e.g. according to energy content, sulfur content etc.). Overall impact is further decreased as household consumption is also exempted from energy taxes.

Emission trading in SO2 and NOx is crippled by lack of market transactions. This seems to be due to three factors; first, despite of some 60 participants to the trading scheme, almost 75% of the allocated quotas are held by three companies (Slovenské elektrárne, Slovnaft, U.S. Steel Košice); second, virtually no decrease in overall allocation over time; and third, ban on transfers to non-attainment areas.

Until recently, RES-E support scheme was seen ineffective, mainly due to relative low feed-in-tariffs and lack of long-term certainty for investors.

3.8. Tunisia

3.8.1. Pricing and fiscal policy of the energy sector

Tunisian situation shows, actually like some other similar countries, a major feature in this field: a distorted pricing system where energy goods, among them electricity, are strongly subsidized. This leads to a great departure from competitive prices and to a wide gap between sales prices and economic prices.

More precisely, price formation goes through several steps where government interventions are important:

1) Energy primary inputs (oil, gas, imported or local) are transferred by public suppliers to refineries and electricity producers on the basis of a transfer price fixed by government, lower than international (CIF) price: this is the moment of an important subsidy, in fact the bulk of energy products subsidies.
2) Then a first important tax is applied: an excise tax based on quantities called Consumption tax (fee)
3) Third component consists in charges and margins of transporters and distributors
4) Then the second principal tax, VAT, is applied
5) Finally retailers' margins are added and sales prices decided by the government. This step may also be the cause for a second subsidy for some goods, when the fixed sales price is lower than the cost calculated upon the transfer price.

It is worthy to note that every step is decided or officially confirmed by public authorities. The main two energy taxes are defined for budgetary and distributional purposes and not for ecological or environmental considerations.

The detailed data and structure of main energy prices for 2006 and 2007 are presented in the Appendix 1 below. Some important statements could be pointed out:

- First, natural gas and electricity are heavily subsidized: around 50 % of economic price for natural gas, but less for electricity especially for low voltage which corresponds to housing and small activities; it is also the case of heavy fuel (about 50 % of economic price), particularly used by industries and power generation as a minor input
- The negative impacts of recent oil prices increase, where public policy for reducing subsidies, especially for hydrocarbons, are thwarted. It is particularly noted for gasoline and gas oil, for which the target to eliminate subsidies was within reach in 2006 and seems to be postponed for some years again. Nevertheless the policy of raising sales prices for all energy products is pursued.
- Apart from gasoline, taxes as related to economic prices appear to be not very high, more or less around 10 %, even if the operational indicator for public authorities and consumers seems to be the ratio to sales prices, around 18 % for natural gas and electricity and 20 % for gas oil and heavy fuel.

3.8.2. Incentive policy for energy sector

As far as renewable energies and energy efficiency are concerned, as well as for environment protection, public policy doesn't follow a price-based orientation but regulations grounded on quantitative norms and limitations on one hand, and fiscal and financial incentives for investments on the other hand.

As for environment protection and pollution reduction, three main directions are adopted:

- Ban imposed on firms to reject emissions and waste in natural environment without treatment
- Necessity for industrial projects to carry out impact studies before getting public authorization; these studies have to analyze direct and indirect effects on environment, mitigating measures as well as abatement costs. However, these studies appear so far rather qualitative and don't accomplish neither monetary valuation of externalities nor Cost Benefit Analysis.
- Grant subsidies, fiscal exemptions and friendly financial conditions for investments

For energy efficiency end renewable energies, the policy is similar: investments are subsidized; as detailed in joined Appendix, incentives may be allowances for investment, reductions of customs duties on imported equipments or VAT exemption for equipments and products used.

3.8.3. Internalisation

Standard economic theory recommendation for price-based internalization, with fiscal instruments, is to charge over competitive market price a tax equivalent to external costs. This is also the basic assumption of the Environmental Tax Reform approach.

External costs being available now, for a suitable context, this direction would be a straight option for internalization and optimal regulation[23].

However, economic situations are generally far from this nice situation and oppose difficulties to implement this recommendation. In particular, for Tunisian case, applying an eco-tax has no sense now, since priority would be to check undesirable behavior by raising tariffs to meet competitive levels, and thus remove environmentally adverse subsidies.

And this is the present direction of government policy of pricing energy products, to tell the truth hurried by the large increase of oil prices; in particular, electricity sales tariffs are supposed to rise at the average rate of 14 % per year in the period 2008-2011[24].

Despite these complexities, a price-based internalization option could take the direction of differentiating excise taxes, putting, for example, distinct VAT levels taking into account external costs.

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[23] In fact marginal costs of externalities are in concern, so an implicit hypothesis of constant returns technologies (at least for pollution) is assumed.

[24] Tunisian Ministry of Industry and Energy, National Program of Energy Conservation, Tunis, February 2008

Along this path, we recall that external costs estimated for alternative project, expressing a representative energy mix, amount 3 c€ per kWh, about 33 % of economic price of electricity. As reported in Table below, excise tax, including VAT, amounts only 12 % of economic price. This gap indicates the difficulty of the task.

This difficulty appears to be greater when we know the characteristics of electricity network, particularly that the public operator STEG is the main producer, even of wind electricity, and the unique purchaser and distributor of electricity, at a uniform price (depending on the voltage) whatever is the source of the electricity supplied. Of course it is always possible, when will and data are there, to establish a kind of equalization, by adopting a weighted tax rate where the component relative to fossil-based energy is increased by the external costs rate.

Table 17: Electricity prices, taxes and external costs

Tariff		low voltage	medium voltage	high voltage	average
Sales price net of Tax	€/kwh	0,07	0,05	0,04	0,06
Economic price	€/kwh	0,091	0,090	0,089	0,091
Tax	€/kwh	0,013	0,01	0,007	0,011
% net sales price		18	18	18	18
% economic price		14	11	8	12
External costs	€/kwh				0,03
% of economic price					33

Source: Source: Ministry of Industry and Energy, Tunisia; Société Tunisienne d'électricité et du Gaz (STEG), and own calculation.

As for quantity -based instruments, the use of these instruments could not be considered for the Tunisian case at least for two main reasons:

- First, Tunisia as many other developing countries are not liable to Kyoto emissions limits, and apart of the respect of national standard environment regulations, there is no compulsion for emissions quantifications.
- Then, the lack of detailed data about all sorts of emissions of production plants.

Actually we must add that there is a beginning governmental program settled by Ministry of Energy and Ministry of Environment and Sustainable Development, to measure emissions of all power plants in the country, and other programs to assess emissions of major pollutant industries.

These actions are all the more important and necessary as the Kyoto CDM instrument gives opportunities to financing clean projects, based on certified reductions of GHG emissions.

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