REPUBLIC OF SLOVENIA

MINISTRY OF THE ECONOMY

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Analysis of the potential for the application of high-efficiency cogeneration of thermal energy and electrical energy in Slovenia

Report to the European Commission

in accordance with Article 6 and Annex IV of Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand.

Ljubljana, July 2007

CONTENTS

1 INTRODUCTION

The analysis of potentials and barriers that Member States are required to prepare under Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market (hereinafter: the Directive) is also the basis for developing further incentives for the development of cogeneration in the country.

The starting-points for the analysis were:

- the state of cogeneration and national and global circumstances for the development of cogeneration,
- experience to date in promoting cogeneration,
- reporting obligations for Member States on potentials and instructions for their preparation under the Directive,
- previous analyses of potentials for cogeneration of thermal energy and electrical energy in Slovenia and international experience.

The content of the analysis of national potentials for the cogeneration of thermal energy and electrical energy, obligatory under the Directive, is prescribed. Within the scope of the instructions for the implementation of the Directive, a group of experts has been commissioned by the European Commission to prepare detailed instructions for reporting on national potentials. We prepared our work by taking into account the draft instructions for the establishment of national potentials that are currently available[1] and the adopted harmonised reference values for determining energy savings.[2]

In the analysis of potentials for cogeneration we took into account useful heat demand, different cogeneration technologies according to the classification under Annex I to the Directive, different sources of energy and their availability. As well as an estimate of technical potential, we also estimated the cost efficiency of achieving energy savings using a dynamic estimate taking into account projections of heat use and other circumstances for 2010, 2015 and 2020. We carried out separate analysis of the circumstances preventing the implementation of high-efficiency cogeneration projects, in particular economic and financial barriers, technical barriers connected with access to fuels and networks, and administrative barriers in procedures. A report on the scheme for certifying the origin of energy and on administrative procedures and their coordination are also an obligatory part of the report. The last chapter contains a review of national policy and legislation and the current incentives for high-efficiency

[1] EC DG TREN: Analysis and Guidelines for Implementation of the CHP Directive 2004/8/EC, Interim Version – Annex Report III, Draft Guideline on Establishment of National Potentials, COWI et al, June 2005.

[2] Commission Decision of 21 December 2006 establishing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC of the European Parliament and of the Council (notified under document number C(2006) 6817).

cogeneration in Slovenia and a description of planned changes to the incentive mechanisms.

The methodology used for the estimate of potentials is described in detail in the report. The estimates were prepared by sectors: the detailed estimate of potentials for cogeneration in industry is based on the heat demand model prepared on the basis of data from the Statistical Office of the Republic of Slovenia for all 1 799 industrial enterprises from regular monitoring of energy consumption in industry in Slovenia and additional data from the survey on potentials for and barriers to the implementation of cogeneration projects that we carried out using a smaller sample within the context of the project. Potentials for cogeneration in district heating systems were also processed in detail. In other sectors we estimated useful heat demand on the basis of model estimates consistent with the long-term projections of energy demand taken into account in the most recent strategic documents: the Operational Programme for Reducing Emissions of Greenhouse Gases and the Operational Programme for the Implementation of the NEC Directive.

2 COGENERATION IN SLOVENIA

2.1 Situation

Cogeneration of heat and electricity (CHP) is relatively well developed in Slovenia and already has a long tradition. The technology is present above all in district heating systems and the manufacturing industry, while examples in general use are still very rare. The state of cogeneration has been monitored by the SURS for the last four years using EUROSTAT methodology (Table 1), while older figures were compiled using alternative methods.

The main characteristics of CHP use in Slovenia are the following:

- production of electricity from cogeneration is increasing while capacities are practically unchanged: from 2002 to 2005 the production of electricity from CHP increased by an average of 9.7% annually (Fig. 1)

- in the total capacity of electricity production, CHP has an 11% share and supplies 7.5% of the demand for electricity – both figures are for 2005,

- cogeneration has a very important role in district heating systems, since 66.7% of all district heat is from CHP.

Table 1: Cogeneration of heat and electricity in the period 2002–2005[3]

	2002	2003	2004	2005	Annual growth 05/04 [%]	Ave. annual growth 05/02 [%]
Installed electrical power [MWe]	339	339	338	336	-0,6	-0,3
Production [GWh]	837	910	977	1104	13,0	9,7
High-efficiency	390	374	418	370	-11,5	-1,7
Efficiency below 75%	447	535	559	734	31,3	18,0
Fuel consumption [TJ]	65.961	61.314	63.972	64.016	0,1	-1,0
Number of units [1]	32	32	31	36		
Gross electricity consumption [GWh]	13.466	13.985	14.492	14.793	2,1	3,2
Share of electricity from CHP [%]	6,2	6,5	6,7	7,5		

Source: SURS

[3] The Statistical Office of the Republic of Slovenia monitors cogeneration using the uniform EUROSTAT methodology from 2002. In 2005 36 cogeneration units were included in the gathering of statistical data.

Production [GWh]

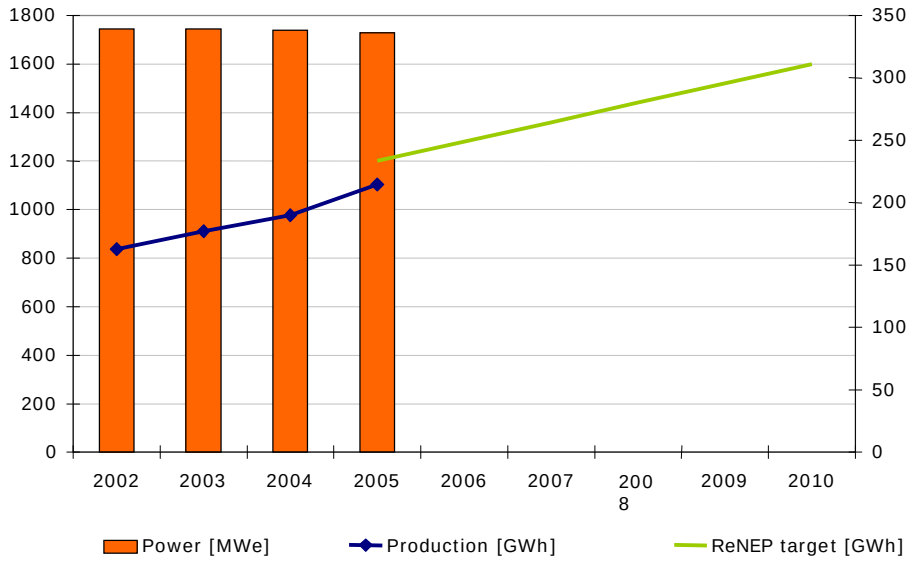

Fig. 1: CHP capacities and production from 2002 to 2005 and ReNEP targets

In recent years electricity consumption in Slovenia has been growing very rapidly, by on average 3.9% a year, and the share of this energy product in energy end-use is growing. The structure of electricity production in Slovenia is spread across three main sources: 39% of electricity is produced in a nuclear power plant,[4] 38% in thermal power plants and 23% in hydroelectric power plants (Fig. 2). The share of natural gas in the supply of electricity is very small (4%). Other thermal power plants use brown coal and lignite.

[4] Data on production are shown according to the international OECD/EUROSTAT methodology. Specific records in Slovenia's balance do not take into account half the production of the nuclear power plant, which the power plant is obliged to deliver to Croatia as a result of the latter's ownership of the plant.

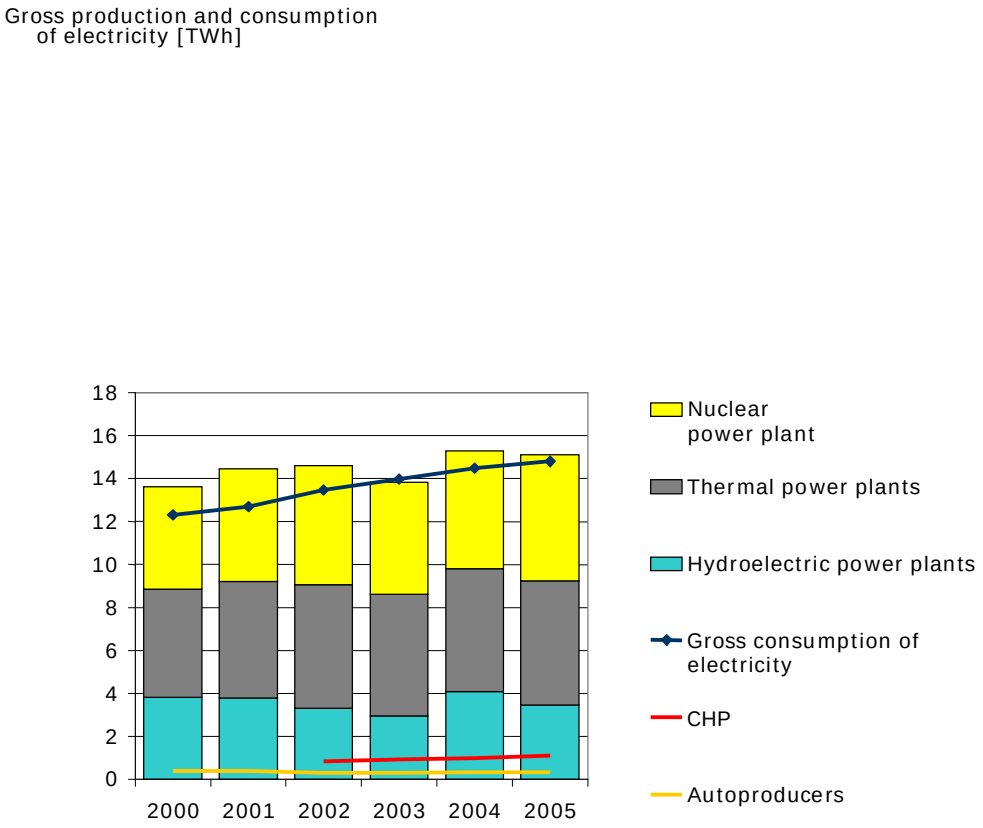

Fig. 2: Production and consumption of electricity and the role of CHP and autoproducers from 2000 to 2005

In 2005 the total installed power of CHP units was 336 MWe, while the total power of power plants in Slovenia in 2005 was 2 990 MWe. Cogeneration thus represents 11% of total capacity. Gross production of electricity by CHP amounted to 1.1 TWh in 2005. Of this, autoproducers produced 673 GWh. In terms of gross electricity consumption in Slovenia, which has reached 14.8 TWh, the share of autoproduction is 7.5%.

CHP technology is present in 11 systems of district heating (DH), while the two largest DH systems in Ljubljana and Velenje predominate with a total of 71% of district heat. Two thirds, 6.6 PJ, of district heat is produced by cogeneration. Gross consumption of district heat in 2005 was 9.9 PJ. More than half of district heat is consumed by households, while 27% is consumed by industry (technological steam and heat for heating), as shown in Fig. 3. In end-use of energy for heat purposes, district heat had a 12% share in 2005.

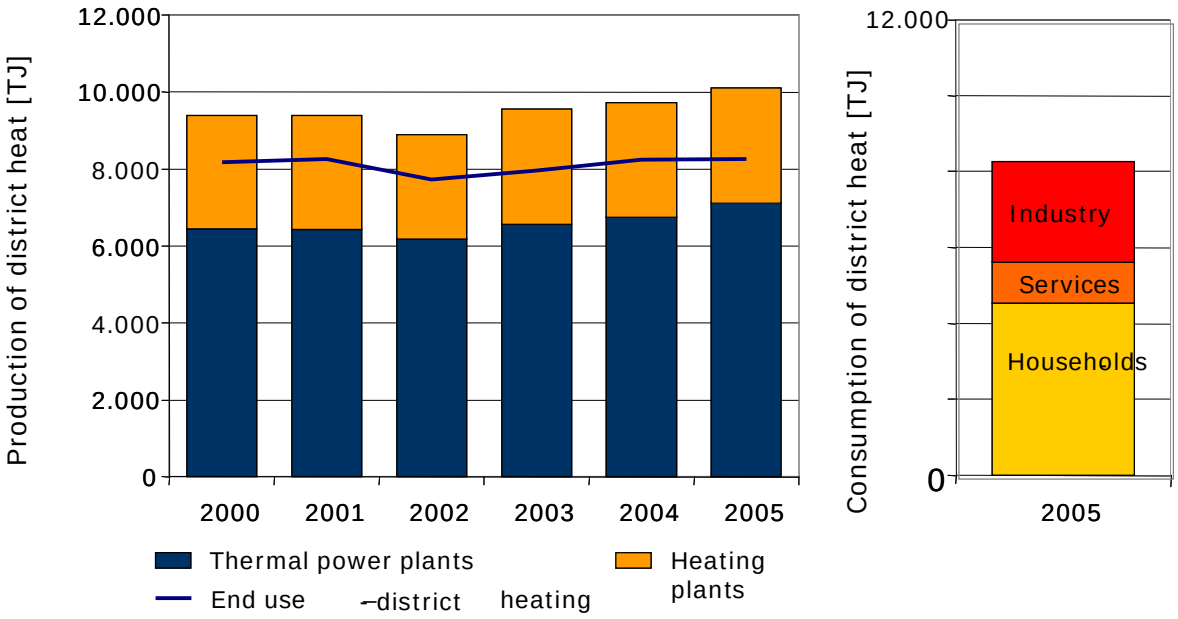

Fig. 3: Production and consumption of district heat and the role of CHP in supply, 2000–2005

2.2 Development of CHP

Despite the apparent stagnation and unchanged total capacity for cogeneration, development in this sector in Slovenia has been very brisk in the last few years.[5] In the period 2002–2006 (Figs. 4 and 5):

- 34 new units with a total power of 39.7 MWe were built. This represents a 14% share of the total capacity for CHP in Slovenia and a 28% share of the total power of all units smaller than 10 MWe for cogeneration,

- predominant among the new units were units in systems of district heating and public enterprises in the utilities sector (cogeneration at waste dumps and treatment plants),

- less than a quarter of projects from this period were in industry. Total cogeneration capacities in the manufacturing industry are even falling, since more capacities have ceased operation than have been newly built,

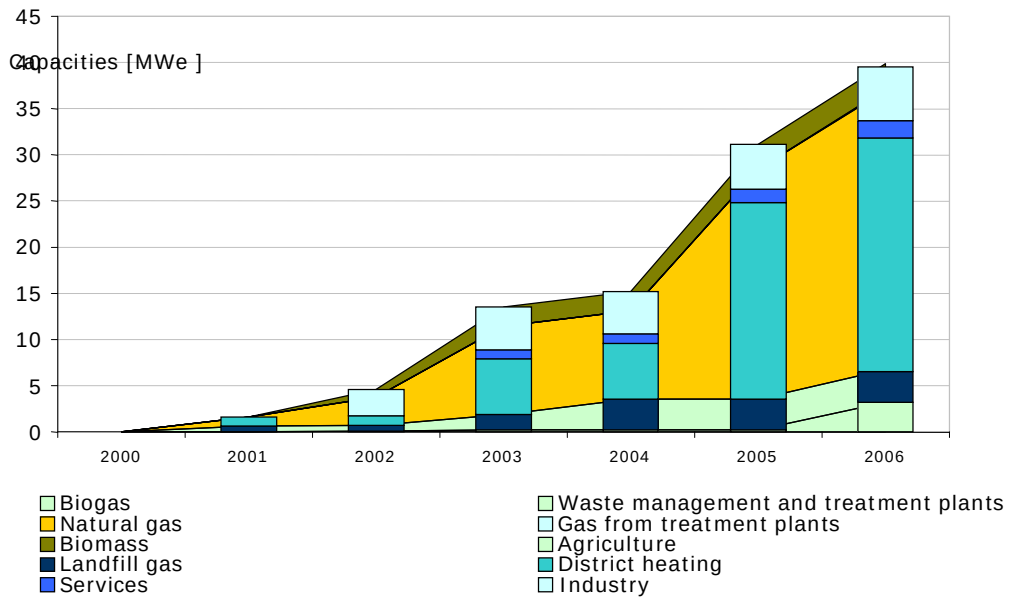

Fig. 4: Dynamics of construction of new units by fuels and sectors from 2000 to 2006

[5] In order to analyse movements in the period 2000-2006 we used the following sources of data: SURS's autoproducer statistics 2000–2005; register of qualified producers; survey on incentives and barriers to cogeneration carried out as part of this project and additional direct inquiries directed to plant owners.

- the most commonly used fuel is natural gas (78%), while the other new units use renewable sources of energy: landfill gas, biomass and biogas – the shares of these fuels are similar, at around 7%,

- gas generators represent the predominant technology (92%), while other units use steam technologies,

- the majority of units are therefore relatively small (average unit power 1.2 MWe), while in total installed capacity gas generators of a power of more than 2 MW per unit predominate.

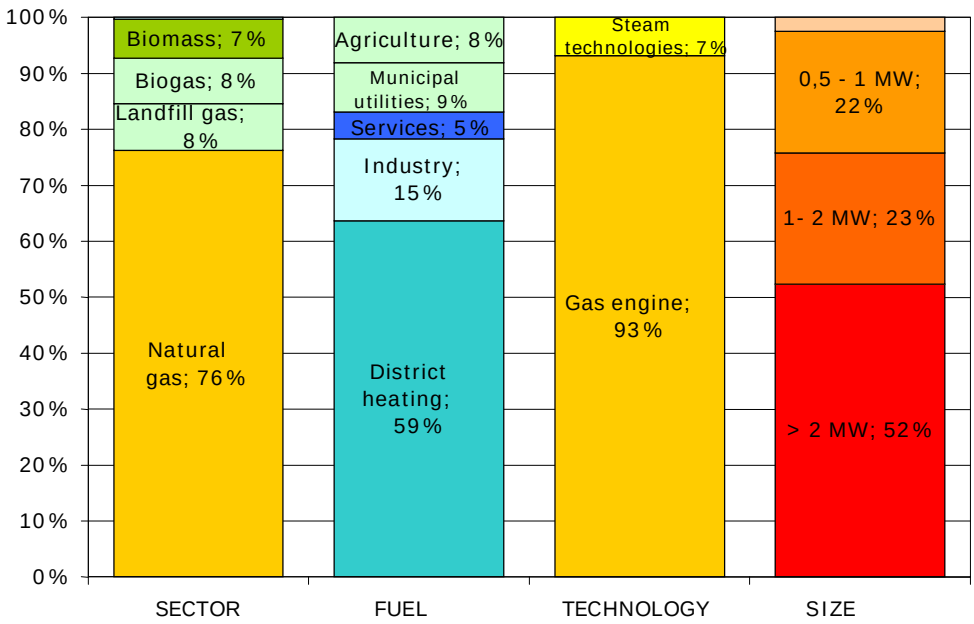

Fig. 5: New CHP units by fuels, sectors, technologies and size from 2000 to 2006 (share in total installed capacity)

3 TECHNICAL POSSIBILITIES FOR COGENERATION

3.1 Previous national analyses of possibilities for CHP

Before beginning the new analysis we reviewed technical literature containing estimates of the possibilities of cogeneration of heat and electricity in Slovenia. Even in 1996, the Resolution on the strategy of energy use and supply envisaged a doubling of the share of qualified production of electricity by 2010 and the regulation of conditions for its development. Background documentation for the strategy was mainly based on a review of feasibility studies.[6] Potential for qualified production in the country – high-efficiency CHP and production of electricity from renewable sources of energy – was estimated at 240 MW, of which 140–190 MW from cogeneration technologies: in industry (75–80 MW) and district heating systems (64–99 MW) and 4 MW in other systems. This potential would enable a doubling of qualified production of electricity, which was adopted as the objective of the Strategy.

A similar estimate is made in the study Energy conservation strategy for Slovenia. In this study energy savings and economic indicators were analysed using a uniform methodology. The estimate of the primary energy saving was calculated using reference efficiencies of separate production for electricity – 33% – and for heat – 75%. Cost effective energy savings amounted to 21 PJ. Potentials-related generation amounted to 20.37 PJ of useful heat and 11 PJ of electricity. Cogeneration capacity was 550 MW. (Note: in 1994 consumption of final energy in Slovenia without transport and electrical energy was 82 PJ).

In the Development programme of Slovenia in the qualified electricity producers sector the economic potential for cogeneration by 2010 was estimated at 15 MW in heating plants in district heating systems and at 25 MW in industry. Potential for exploitation of biogas and biomass was estimated at 10 MW and 8 MW respectively. The estimate includes the renovation of existing industrial heating plants using gas technology. The estimate only included small and medium-sized units of up to 10 MWe.

The Resolution on the National Energy Programme (ReNEP)[7] set the target of doubling the production of electricity from cogeneration from 800 GWh in 2000 to 1 600 GWh by 2010. This takes into account all cogeneration but the programme did not specify a special objective for cogeneration from renewable sources of energy. On preparation of the ReNEP the technical potential for cogeneration in Slovenia was estimated at 600 MW of additional capacities, above all in industry and district heating plants. Electricity generated in cogeneration amounts to 3.6 TWh a year. Feasibility studies elaborated to date have confirmed 250 to 350 MW of potential projects, above all in industry and district heating plants.

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[6] The review included 18 cogeneration feasibility studies for various locations in industry, district heating systems and the services sector. Total capacities for CHP were estimated at 190 MW.

[7] OJ RS, No, 57/04.

The Operational programme for reducing greenhouse gas emissions by 2012 recapitulates the targets and methods of implementation from the ReNEP. For this programme the potential for cogeneration was also estimated with regard to economic efficiency from the social point of view. The planned increase in cogeneration – units under 10 MW – was classified into price brackets: 20 kt of reduction of GHG will be attained with specific costs of under EUR 5/t CO_2, 40 kt with costs of between EUR 5/t CO_2 and EUR 20/t CO_2 and a further 10 kt with costs of over EUR 20/t CO_2. Economic efficiency from the point of view of the investor, which because of the system of incentives with guaranteed purchase price is different, is dealt with in Chapter 5 of this document.

3.2 Data sources and methodology for the assessment of technical options

Technical potential was estimated in detail for:

- industry,
- district heating systems,
- residential buildings and service activity buildings.

Industry. Analysis of potentials in industry was based on the following main sources of data:

- figures from the SURS on energy use in industry, using a sample of more than 1 799 industrial consumers,
- SURS statistics on autoproducers,
- two surveys carried out for the needs of this report among industrial companies on the current situation and barriers to and development plans for autoproduction,
- analyses of possibilities for CHP in individual locations.

Previous analyses of potentials at the national level were also examined.

Useful heat consumption in industry was estimated on the basis of SURS figures using a model that takes into account the structure of production and processes in individual sectors and the presence of fuels in industrial locations. The possibility of high-efficiency cogeneration with use of useful heat was estimated by sectors. The estimate of technical potential took into account options for new units and for the modernisation or replacement of existing cogeneration units.

District heating systems. As in the case of industry, the main source of data was the SURS, which covers all district heating systems in Slovenia with its collection of data on district energy. We studied a chronological series from 2000. For cogeneration in district heating systems we obtained additional information from a survey and from analyses of the possibilities for CHP in individual locations.

The housing sector and buildings in the services sector. The key data sources for this sector are statistical data, including a household consumption survey. These data are processed using models for the long-term planning of energy and climate policy. Projections are harmonised with the projections on the consumption of fuels on which the OP GHG by 2012 and the OP NEC are based.

A model for long-term energy planning called REES SLO (Reference Energy, Economic and Emissions System for Slovenia was used. This model is implemented in the MESAP environment, based on a methodology of integrated planning in energy. The estimate of heat consumption in households is based on detailed analysis of housing in Slovenia. The assessment of the possibilities of use of different technologies takes into account, as well as the energy characteristics of structures, an estimate of the density of energy consumption in residential buildings in Slovenia. The methodology of integrated energy planning requires modelling of the effects of energy efficiency measures. Planned programmes and the autonomous development of markets in this sector were taken into account. Future heat energy needs in the sector will be influenced above all by:[8]

- the new standards for buildings that are being prepared for the implementation of the Energy Performance of Buildings Directive,
- objectives and measures for the implementation of Directive 2006/32/EC on energy end-use efficiency and energy services.

Both sets of planned measures are taken into account in projections of consumption of useful heat for heating and domestic hot-water production.

In the case of service activities consumption of useful heat was estimated from statistical data. As in other countries, estimates of potentials in this sector are rather rough as a result of less detailed statistics. The potential for cogeneration deriving from cooling needs has not yet been included in the estimate presented. The estimate of technical potential took into account options for new units and for the modernisation or replacement of existing cogeneration units.

8 The estimate did not include the effect of the conclusions of the spring 2007 meeting of the European Council on increasing energy efficiency by 20% on national policy in the energy efficiency sphere.

3.3 Technical potential by sectors

The total potential for new capacities is estimated at 1 033 MWe. The estimate of technical potential took into account options for new units and for the modernisation or replacement of existing cogeneration units.

Table 2: Estimate of technical potential for CHP in Slovenia

	Power [MWe]			
	2007	2010	2015	2020
District heating	66	82	189	210
Households	242	249	255	260
Services	198	204	209	213
Industry	267	276	298	350
Total	773	812	951	1 033

3.3.1 Industry

CHP potential in industry was established on the basis of an estimate of useful heat consumption in industrial enterprises. We estimate useful heat consumption on the basis of the SURS database for 2004, which brings together data on the consumption of electrical energy, heat and fuels in industry and includes 1 799 reporting units. Consumption of fuels for heating purposes is separated into:

- direct consumption in industrial processes,
- consumption for the production of technological steam, warm water and hot water in combustion plants.

On the basis of previous analyses we estimated the share of fuel used in combustion plants for the production of heat. The expert estimate is based on previous analyses of industrial sectors, above all data on consumption from energy companies, and a comparison with other countries, and takes into account the structure of production and knowledge of processes by individual industrial sector. The shares of consumption of individual fuels in combustion plants by industrial sectors are given in Table 3. For fuels not shown in the table – all types of coal, LPG and other fuels (wood and wood waste) – the share of consumption in combustion plants for the production of heat is considered to be 100%.

Consumption of fuels for current production of heat from cogeneration and consumption of heat supplied from district heating systems was dealt with separately. To estimate the useful heat currently produced from fuels we took into account an annual average efficiency in all combustion plants (boilers) of 85%. In the estimate of potential for cogeneration we took into account 90% of the useful heat consumption thus

established, on the assumption that the remaining 10% is produced by peak boilers. Heat used for the production of electrical energy in CHP is determined using an efficiency of 95% on the electrical side.

Table 3: Share of consumption of fuels in combustion plants in industrial sectors

		Coke	ELHO	HO	NG
			%		
DA	Food, drinks, tobacco products	100	64	100	47
DB	Textiles; textile, fur products	100	100	100	89
DC	Leather and leather products	100	100	100	100
DD	Wood processing and wood products	100	100	100	100
DE	Fibres, paper; publishing, printing	100	100	100	100
DF	Coke, petroleum products and nuclear fuel	100	100	100	100
DG	Chemicals, chemical products and man-made fibres	100	100	100	98
DH	Rubber and plastic products	100	100	100	100
DI	Other non-metallic mineral products	0	0	8	0
DJ	Metals and metal products	0	0	100	70
DK	Machines and appliances	100	100	100	100
DL	Electrical and optical equipment	100	100	100	100
DM	Vehicles and vessels	100	100	100	100
DN	Furniture, other manufacture, recycling	100	100	100	100

We thus estimated the total useful heat that can be produced in cogeneration in industry. We estimated: total potential, potentials by sectors and potential with regard to the presence of natural gas.

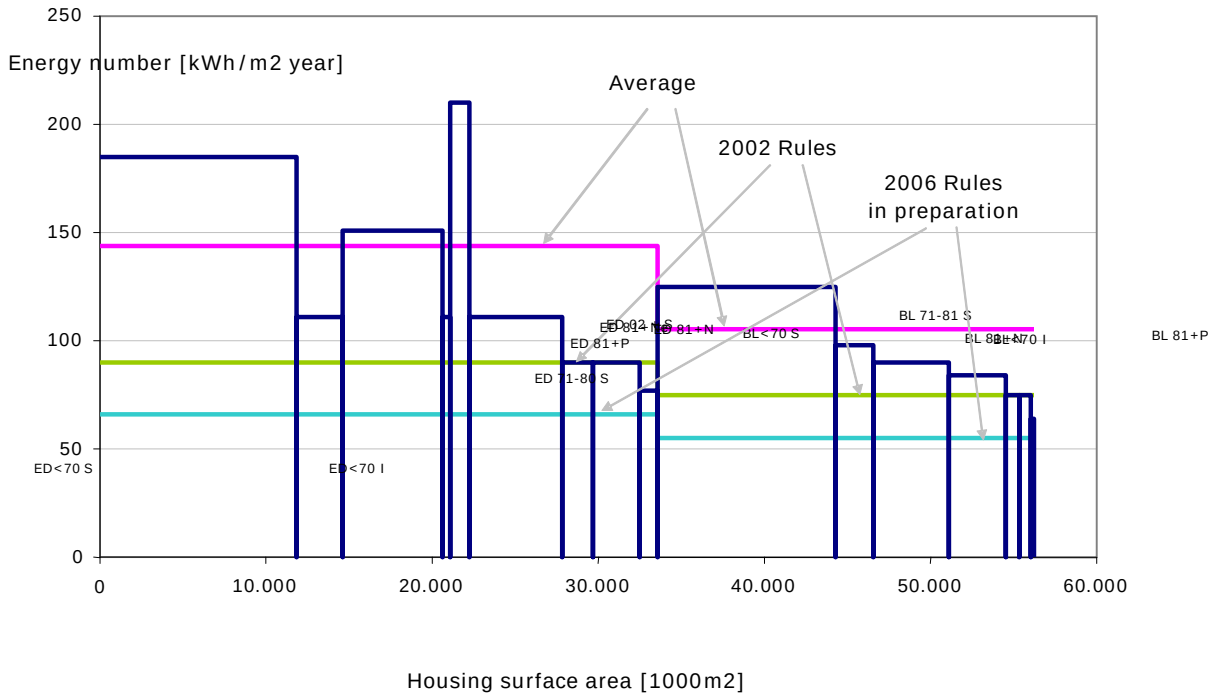
Table 4: Potential for cogeneration in industrial sectors

		Power [MWe]	
		Total	with NG*
DI	Other non-metallic mineral products	69 – 103	52 - 78
DJ	Metals and meal products	58 - 87	51 - 77
DG	Chemicals, chemical products and man-made fibres	24 - 36	22 - 33
DA	Food, drinks, feed and tobacco products	16 - 24	10 - 15
DB	Textiles, leather apparel, textile and fur products	14 - 21	10 - 16
DH	Rubber and plastic products	14 - 21	12 - 18
DD	Wood processing and wood, cork, straw and wicker products, excluding furniture	13 - 20	03 - 04
	Others	25 - 38	18 - 26
	TOTAL	233 - 350	178 - 267

Note: * potentials in locations where natural gas is present

3.3.2 The housing sector and buildings in general use.

Housing is characterised by relatively high fragmentation of construction, since single-family dwellings account for an almost 60% share in terms of surface area but a 66% share of necessary useful heat for heating. The structure of housing in terms of the type and age of buildings and energy needs for heating is shown in Fig. 6. Single-family dwellings, pre-1970 blocks of flats and unfinished houses represent, with their high energy number, the greatest potential for reducing energy consumption and GHG emissions. The Rules from 2002 prescribe a 40 or 30% lower energy number than the current average in the case of single-family dwellings or blocks of flats. New Rules on the efficient use of energy in buildings are currently being prepared, and will introduce, on the basis of pragmatic use of CEN EPBD standards,[9] a methodology for the assessment of the overall energy performance of buildings, taking into account the energy necessary for heating, production of hot water, ventilation, air conditioning and lighting. It will also lay down stricter minimum requirements regarding energy performance that will bring a saving in final energy for the operation of a building of around 30% compared to the 2002 Rules.[10]



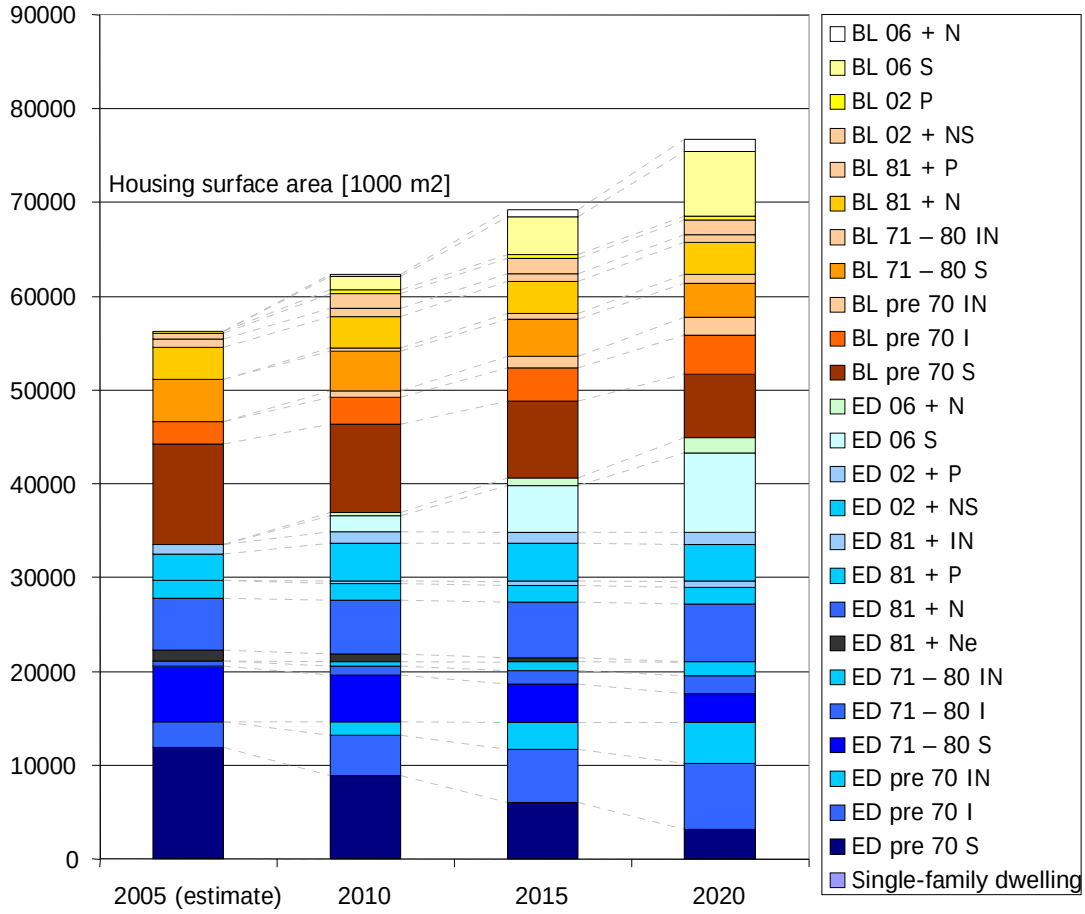
Legend: ED – single-family dwelling, BL – blocks of flats, S – standard, I – improved, N – new standard, P – recommended standard

Fig. 6: Structure of housing by age, surface area and energy needs for heating

[9] The CEN EPBD standards were developed on the basis of the requirements of Directive 2002/91/EC (EPBD). They contain 43 standards in three areas: construction physics (calculation of heat transfer through ventilation and radiation, calculation of the energy necessary for heating and cooling the building, etc.), ventilation systems and cooling and air conditioning systems and systems for heating buildings and producing domestic hot water.

[10] Source: Operational programme for reducing greenhouse gas emissions in Slovenia by 2012.

The expected development of housing is rather uncertain. In view of trends in recent years and increased housing saving, it is possible to expect a slight increase in construction in the coming years. The reference scenario elaborated with regard to the development of housing envisages the construction of around 1.1 million m^2 of new housing annually up to 2020, renovation of 1.5% of all blocks of flats and 3% of single-family dwellings annually (around 1.2 million m^2 of housing per year)[11] and a 20% share of new buildings built to the recommended superstandard, more demanding than the applicable rules (an additional 15% reduction in heat consumption per m^2 of heated area). A projection of the structure of housing up to 2020 with estimated renovation/measures (transitions between classes) is shown in Fig. 7.



Legend: ED – single-family dwelling, BL – blocks of flats, S – standard, I – improved, IN – improved superstandard, N – new standard, P – recommended standard, Ne – unfinished

Fig. 7: Housing projection up to 2020 (by structure)

Despite the planned increase in housing area by around 22% by 2015, owing to the use of the 2002 Rules and, from 2007, as a result of the effects of the Rules currently being prepared, it is estimated in the case of new building and the renovation of old housing, that the growth in necessary useful heat for heating will not be significant. As a result of the further tightening of standards, there will be a reduction in the average energy

[11] The extent of renovations was estimated on the basis of figures from the analysis carried out by Rihard Sendi ('Urbanisti•ni institut RS, Upravljanje, vzdrževanje in prenova stanovanj', in *Stanovanjska anketa – stanovanjsko poro•ilo*, FDV, 2006.

number of single-family dwellings from the current 145 kWh/m^2 to 113 kWh/m^2, and that of blocks of flats from the current 105 kWh/m^2 to 91 kWh/m^2, or a total average reduction of 18%.[12]

Slovenia does not currently have a complete inventory of buildings (surface area, energy properties, etc.) in the services and public sectors that would enable a comparative detailed estimate for this sector. In this estimate we have relied above all on energy consumption figures in the sector.

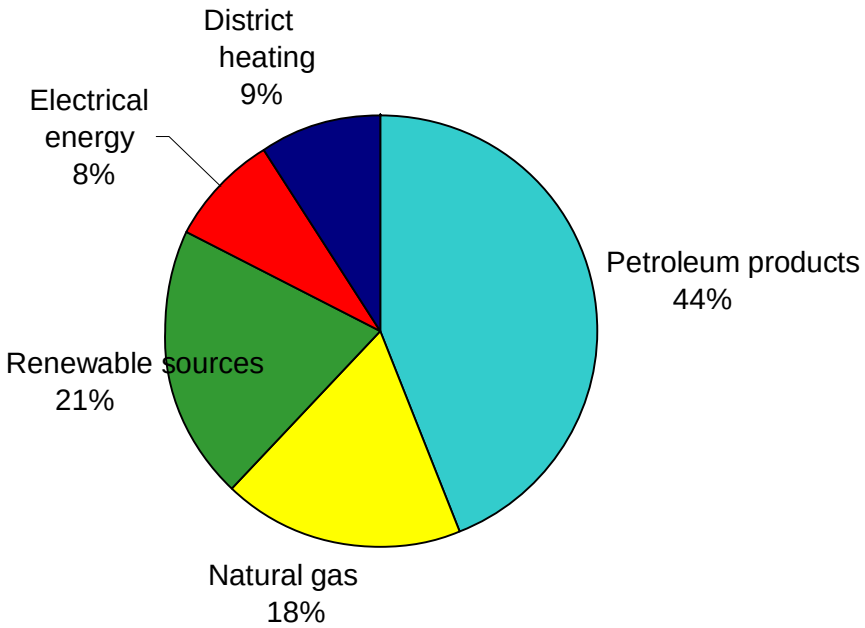


Fig. 8: Structure of energy products for heating and hot-water production in households and services, 2004 (Source: IJS)

In the estimate of the cogeneration potential, the consumption of useful heat for heating and domestic hot-water production was taken into account, except in that part that is supplied from district heating systems and on the basis of renewable sources of energy. In the estimate of the cogeneration potential we separate potential with regard to the size of buildings and density of settlement. Areas are defined as densely settled areas with regard to density of energy consumption. A model estimate was prepared in previous studies on a grid measuring 100 m x 100 m for the whole of Slovenia on the basis of data from the population census on the size and age of buildings. Potential for CHP in general use (households and services) was estimated conservatively and is shown in Table 5.

[12] The 2002 Rules would themselves reduce the average energy number of single-family dwellings from 156 kWh/m^2 in 2000 to 130 kWh/m^2 in 2005, and of blocks of flats from the current 108 kWh/m^2 to 103 kWh/m^2 or together by an average of 12%. Further reduction will be the consequence of the standard currently being prepared.

Table 5: Potential for cogeneration in general use

	Power [MWe]			
	2007	2010	2015	2020
Households	242	249	255	260
• multi-family dwellings – densely populated areas	55	57	58	60
• multi-family dwellings – sparsely populated areas	30	31	32	32
• single-family dwellings – densely populated areas	36	37	38	38
• single-family dwellings – sparsely populated areas	121	124	127	130
Services	198	204	209	213

4 BARRIERS TO COGENERATION

4.1 Survey on options for and barriers to the development of cogeneration

Owing to Slovenia's size and the great interest in cogeneration on the part of enterprises, we decided to review potential projects for cogeneration and barriers to their implementation by means of a questionnaire. The questionnaire complements the other methods that we used in the analysis of potentials and analysis of barriers.

The purpose of the analysis was to:

- study technical conditions for cogeneration,
- study plans for cogeneration,
- identify barriers to cogeneration,
- study the effect of barriers on the implementation of projects,
- establish the suitability of various forms of incentives for cogeneration.

Questionnaires were sent to the following potential investors:

- operators eligible for emissions trading,
- autoproducers who already have autoproduction units,
- producers and distributors of district heat,
- major users of electricity,
- major users of thermal energy.

The questionnaire covered the following sets of questions on:

- the enterprise,
- heat supply,
- existing plants for cogeneration and heat supply,
- cogeneration plans,
- barriers to the implementation of the cogeneration project,
- additional incentives for cogeneration.

The invitation to take part in the survey was accepted by 70 of those to whom it was addressed. The majority of respondents are from manufacturing enterprises (46); 10 are from other industrial activities and another 10 are from the services sector; 29 of the respondents are involved in the emissions trading scheme. The structure of the respondents is shown in detail in Fig. 9.

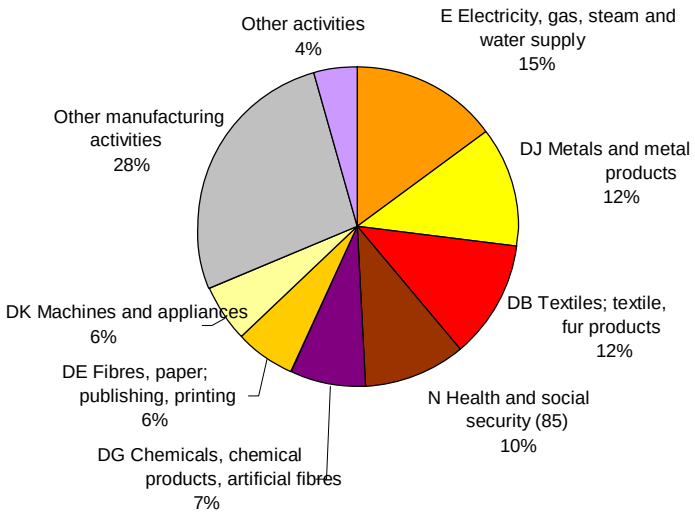


Fig. 9: Enterprises included in the survey by areas of activity

The respondents have installed boilers of a total capacity of 1 050 MWt and their annual production consists of 71% technological steam and 29% hot water.

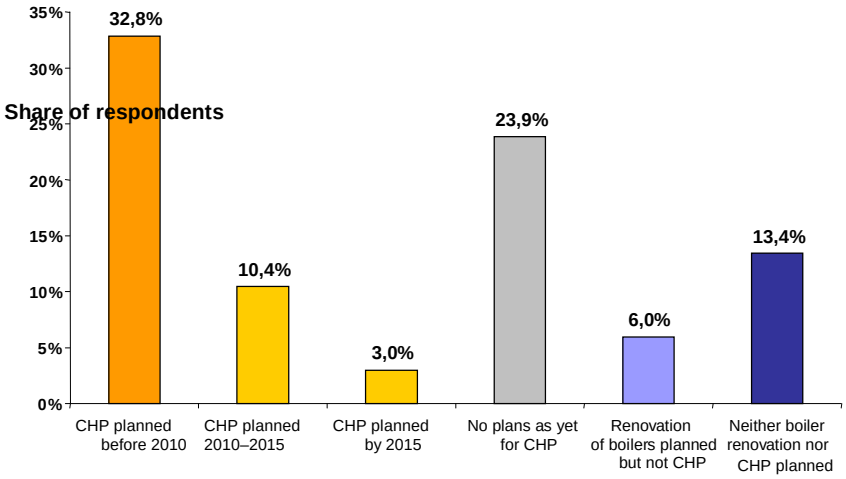


Fig. 10: Dynamics of plans for CHP

The survey took in 31 planned cogeneration systems in various phases of preparation or implementation. Fig. 10 shows the planned construction dynamics. The survey only included two modernisations of existing units. The remainder are new or additional cogeneration units. It is also interesting to note that of the ten respondents that already have cogeneration systems, seven are planning new units. For the most part the planned new units are natural gas units, although 7 wood biomass units and 5 other fuels units are

also planned. Predominant as the envisaged technology are engines (17, of which 2 are steam engines and the remainder internal combustion engines) and turbines (13: 7 gas, 3 steam and 3 gas/steam), as shown in Fig. 11. Among the planners, 19 are included in the emissions trading scheme and 12 are not.

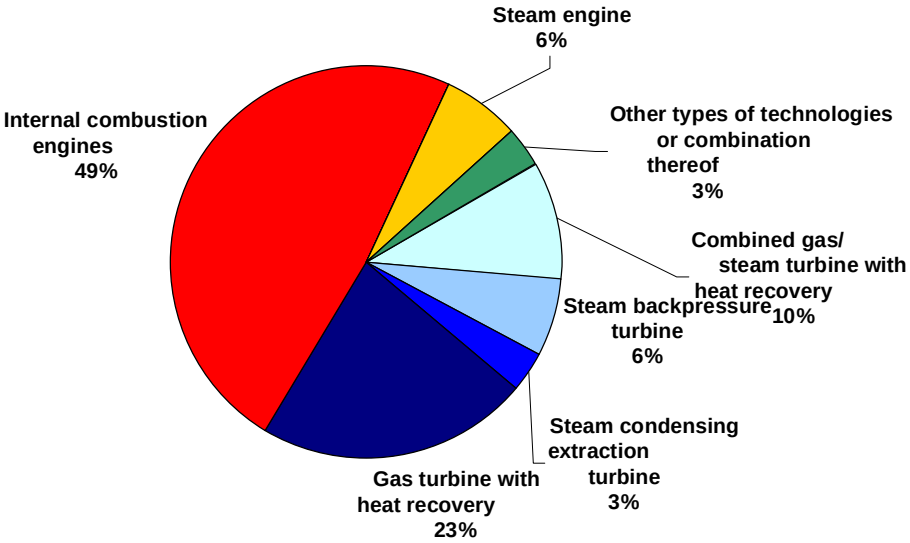


Fig. 11: CHP plans by technologies

4.2 Barriers

The main barriers to the realisation of plans are risks (76% of respondents cite risks as a barrier), unsatisfactory economic effects (70%), demanding administrative procedures (66%) and the availability of funds for projects of this type (64%). Less frequently cited are technical barriers (49%), difficulties relating to availability of personnel (48%) and difficulties in placing heat or electricity (36%). Organisational barriers within enterprises are cited least frequently of all (30%), as shown in Fig. 12.

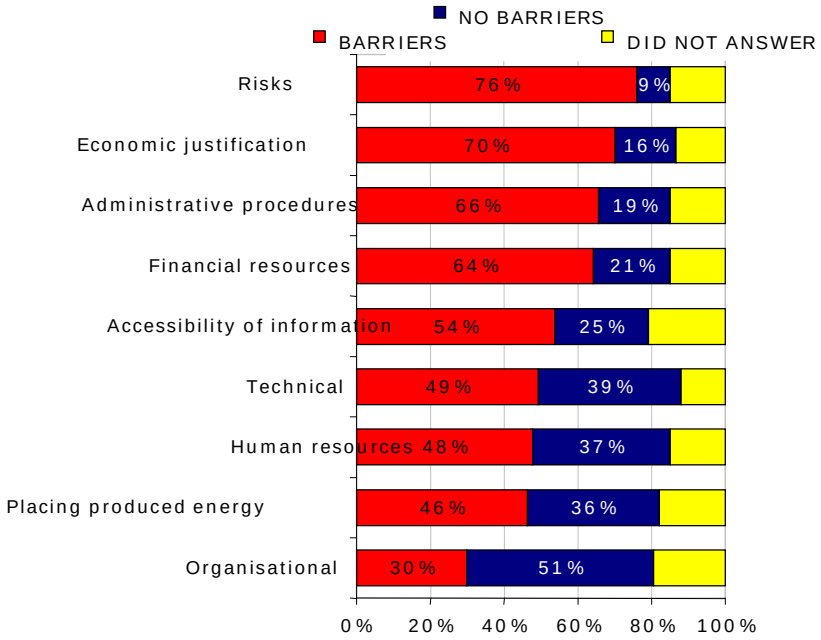


Fig. 12. Barriers to the implementation of cogeneration of heat and electricity projects

Risks of the project. Only 6 of the respondents manage all risks without difficulties. The largest number encounter risks relating to the purchase prices of energy products (53%), while fewer encountered other risks: purchase prices of electricity (27%), prices or quantities of emissions coupons (22.4%), reserves in the case of failure of electricity generation (18%) and the sale of thermal energy (18%). They are less sensitive to operating risks (16%) and least sensitive to risks in implementing investment projects (13%), as shown in Fig. 13.

Economic justification of the project. Only 11 respondents do not have difficulties with the economy of projects. Barriers to projects are: long return on investment period (35% of respondents), high investment (29%), low profitability (23%), high price of fuel (20%) and conditions when the price of electricity from cogeneration is higher than the current purchase price of electricity (12%), as shown in Fig. 14.

Administrative barriers. Administrative barriers are also of key importance, since procedures are too long (24%) and also complicated (16%). Respondents also cited difficulties relating to knowledge of procedures (32%). The largest number mention barriers in procedures for obtaining environmental permits (19%), procedures for obtaining qualified producer status (16%) and procedures for connection to the distribution network (15%); 5 respondents (8%) stated that procedures had come to a halt or that they had become involved in a dispute.

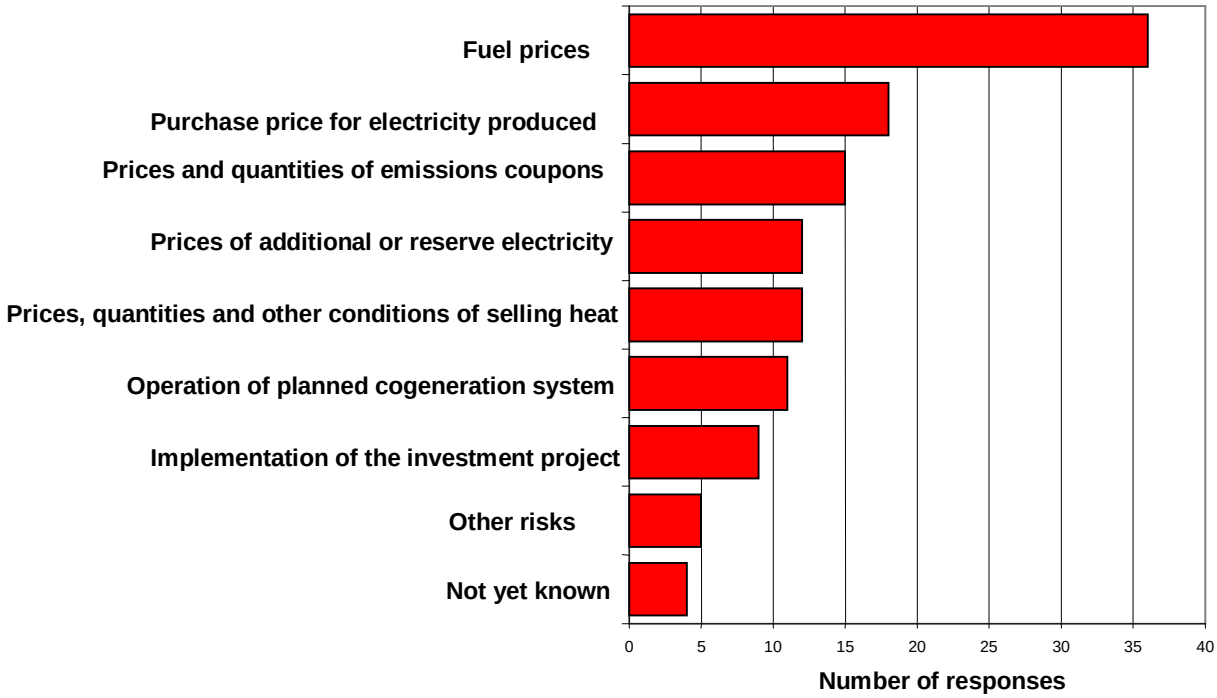


Fig. 13. Risks by categories of possible variables that are barriers to cogeneration projects

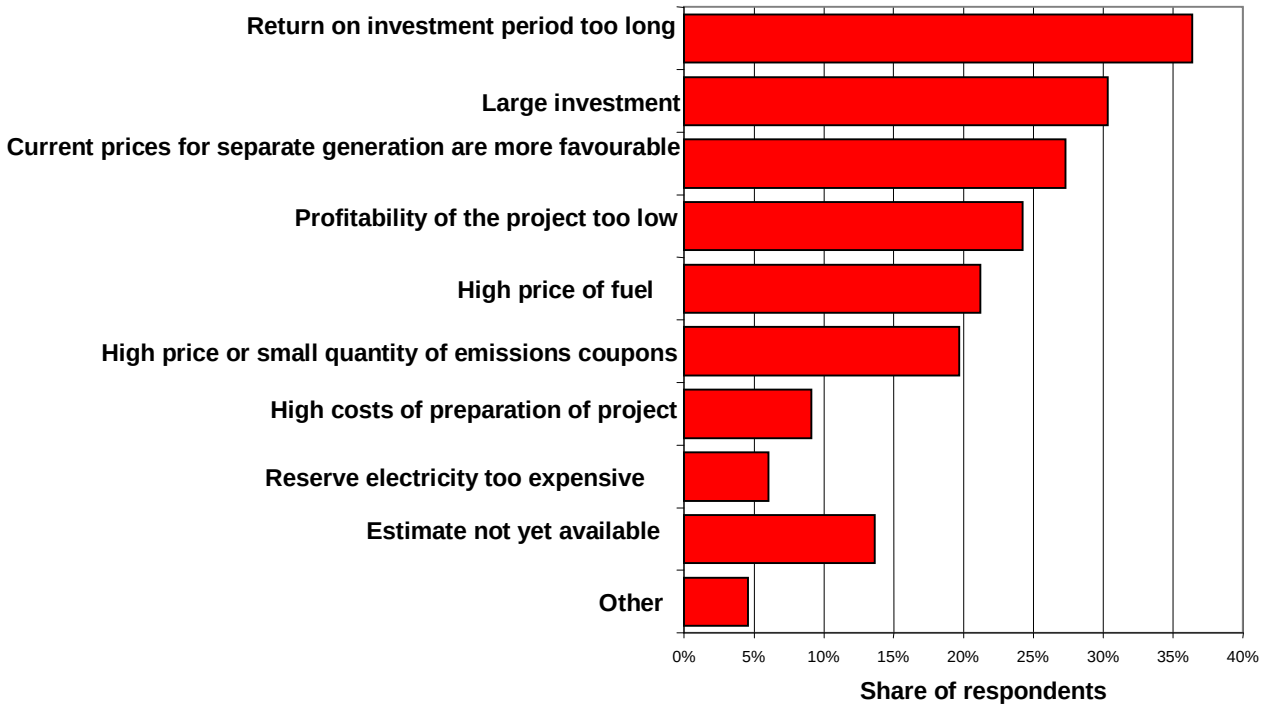


Fig. 14. Difficulties with the economic acceptability of cogeneration projects

Availability of funds. Only 14 respondents could provide funds for the project without major difficulties. The fact that they would rather devote funds to projects within their basic activity than to investments in cogeneration is a barrier to the implementation of the project in 30% of cases; the absence of purpose-specific loans is a barrier for 19% of

respondents, 17% do not have the funds, and the same number have problems finding a strategic partner willing to invest and to supply them with energy on a contractual basis.

Other barriers. In other fields the following barriers are also frequent: low heat consumption or no possibility of selling heat (24%), no trained personnel for projects of this type (24%) or suitable personnel too busy (18%), priority given to projects relating to the basic activity (14%). Investors lack information about: the state of the equipment market (27%), administrative procedures (25%), State financial incentives and technological solutions (28%).

4.2.1 Recommendations for future incentives

Incentives for industry. The respondents considered that the most important form of incentive for industry for CHP is a premium for the generation of electricity for own needs. This was followed by guaranteed purchase and guaranteed prices for electricity. The third most important incentive are premiums for the sale of electricity from CHP on the market. Incentives in the form of additional emissions coupons were classified as more important incentives by 14 respondents – a large number if we take into account the fact that only 29 participate in the emissions trading scheme.

Additional incentives for CHP. Opinions on additional incentives for CHP are as follows:
the largest number of respondents are in favour of co-financing of the preparation of projects (34%). This is followed by premiums for electricity for own use or for network sale (25%), fixed purchase prices (23%), purpose-specific low-interest loans (18%) and promotion of mechanisms such as leasing or guaranteeing electricity supply (18%). Four respondents proposed incentivising CHP through non-refundable investment funds.

Improvements to administrative procedures. The proposals submitted also showed that the majority of barriers in administrative procedures could be eliminated by means of simplification or abbreviation. Several respondents also proposed regulating procedures in such a way as to make it possible to obtain permits with one application and in one place. Most of all they would like a guide to administrative procedures to be published – this was the most frequently circled response (33 times) in the entire questionnaire.

On the basis of the survey we find that current conditions for the development of cogeneration are not good:

- the greatest barrier to investors is the uncertain price of natural gas or the relation between the price of electricity and the price of natural gas,
- the majority of potential investors consider the economic indicators of CHP projects to be poor: profitability is low or there is a long return on investment period,

- a significant number of investors encounter difficulties as a result of high initial costs or the related provision of financial resources.

5 ECONOMIC POSSIBILITIES FOR CHP

5.1 Methodology for estimating cost efficiency

We estimated the specific costs of achieving energy savings and the economic efficiency of projects from the point of view of the investor and society. We calculated the following financial indicators for typical projects:

- specific cost for saved energy
- internal profitability rate and
- return on investment period.

We also estimated the specific costs of generated electricity and the level of investment or the costs of realisation of projects.

Model. For the economic analysis we used the VEM tool developed at the IJS and designed for the assessment of investment projects in the sustainable energy sphere. In the economic analysis we take into account above all the following categories of costs and income: initial costs, of equipment and labour: mechanical technology including costs of fuel delivery and storage; electrical installations; construction work; fitting and transport costs; training costs; project preparation; annual costs: fuel; other operating costs: labour, regular maintenance, insurance, rent, general costs and financing; periodic costs: investment maintenance and income: sale of electricity to the network and sale of thermal energy (we take into account avoidable costs of separate production of thermal energy).

Financial analysis. The following are taken into account: income from the sale of electricity to the network at guaranteed purchase prices. Corporation tax levied on the project is taken into account.

Estimate of market potential or attainable potential. In the estimate of market potential, besides economic criteria we take into account limitations of available resources, project risks (for the investor) and other non-economic criteria (such as priority for projects in the basic activity and hidden costs of projects).

5.2 Economic and financial assessment

Average production costs and a comparison with the average market price of SIT 8/kWh for individual typical qualified producers[13] by individual types of qualified power plants (QPPs) by type of primary energy source and size class are shown by the graph and table below. In all cases the QPP's cost price of production is higher than both the average market price and the guaranteed uniform purchase price under the scheme for QPPs.

[13] Under Slovenian legislation a qualified electricity producer is a producer who produces electricity in a qualified power plant from renewable energy sources or through high-efficiency cogeneration in accordance with Directives 2001/77/EC and 2004/8/EC.

The differences are thus greater than premiums in the case of all QPPs, while greater differences are noted above all in solar QPPs and smaller units of wind QPPs and biomass QPPs. Smaller differences between cost price and purchase price occur in all types of power plants.

Table 6: Comparison of production costs of individual QPPs with average market price

Type of qualified power plant (QPP) by type of primary energy		Power	Production costs	Difference re market price	Premium
	Size class	[kW]	[€/MWh]	[€/MWh]	[€/MWh]
Biomass QPPs	up to 1 MW	600	103.5	70.1	36.3
	over 1 MW	1500	75.9	42.5	34.1
Other QPPs (biogas)		120	126.8	93.4	87.5
QPPs or heating plants using municipal waste	up to 1 MW	100	58.3	24.9	19.8
	1 MW to 10 MW	3.000	50.4	17.0	16.1
District heating plants	up to 1 MW	700	69.0	35.6	24.6
	1 MW to 10 MW	3.000	60.8	27.4	22.5
Industrial heating plants	up to 1 MW	700	62.4	29.0	20.2

Note: the market price used is € 33.4/MWh

Costs analysis (by primary energy source and size class) shows that CHP units are uneconomic given current conditions on the market. It is also evident that even with guaranteed purchase and guaranteed purchase prices or premiums, the level is not enough to guarantee economy and suitable profits for CHP projects. The simple return period for investments in QPPs is around 10 years for the majority of QPPs, which given a guaranteed duration of 10 years for the scheme enables at least the minimum required economic conditions for the implementation of new QPP projects. The return period taking into account the 8% discount rate is for the majority of QPPs between 15 and 20 years, as shown in Fig. 15.

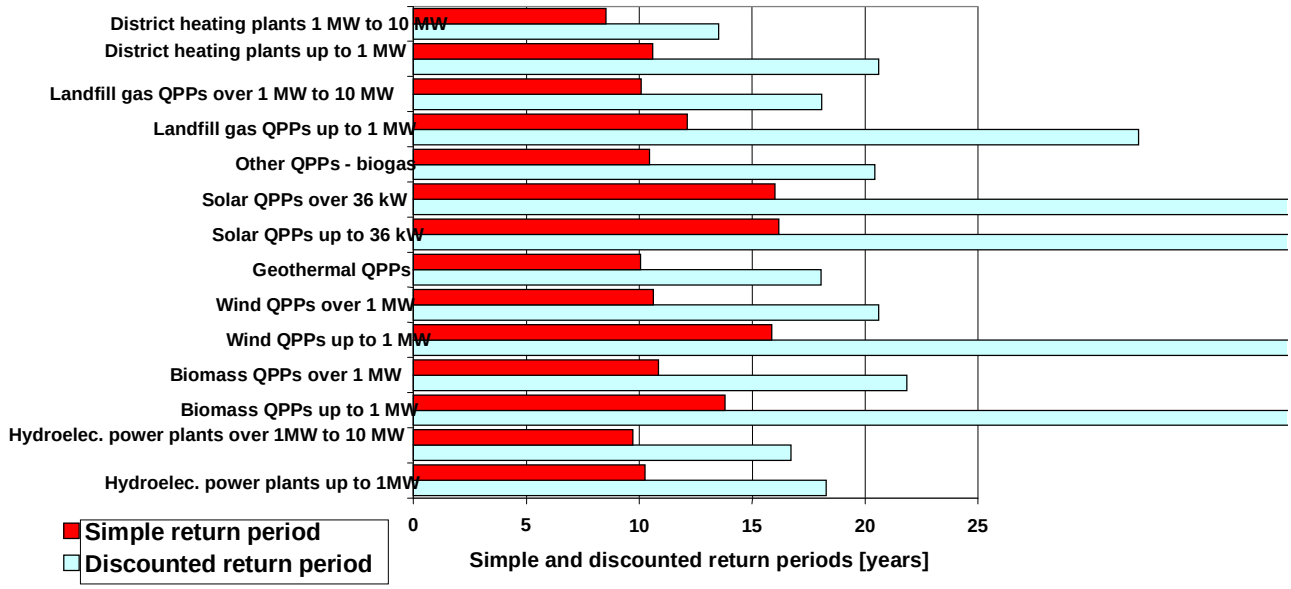


Fig. 1: Simple and discounted return periods for individual QPPs

On the basis of the costs analysis and economic calculation for typical units of qualified power plants shown in the table below, it is evident that the net current value (NCV) of the currently applicable premiums under the present scheme does not exceed the NCV of total investment costs in any of the qualified power plants, as can be seen from Table 7. It is however necessary to take into account the fact that with the general growth in market prices, the amount for subsidies or support received by a QPP diminishes.

Table 7: Comparison of production costs of individual QPPs with average market price

Type of qualified power plant (QPP) by type of primary energy		Power	Investment	Annual premium	NCV investment – premium)
	Size class	[kw]	[EUR millions]	[EUR millions]	[EUR millions]
Biomass QPPs	up to 1 MW	600	2.48	0.09	-1.54
	over 1 MW	1500	4.13	0.22	-2.05
Other QPPs (biogas)		120	0.459	0.052	-0.004
QPPs or heating plants using municipal waste	up to 1 MW	100	0.13	0.01	-0.03
	1 MW to 10 MW	3 000	3.58	0.30	-0.88
District heating plants	up to 1 MW	700	0.58	0.07	-0.07
	1 MW to 10 MW	3 000	2.07	0.26	-0.08
Industrial heating plants	up to 1 MW	700	0.55	0.01	-0.02

Note: Discount rate used 8%, for a period of 15 years. Reduction of purchase price or premium by 5% after 5 years and by 10% after 10 years, in accordance with the purchase decree.

Premiums for individual QPPs also take into account the return on equity prescribed by Slovenian legislation; this is the minimum rate of discount of 8% for investments from public funds. The current return is less than 8% for all QPPs, as shown in Table 8. In the

case of solar power plants, the premium does not enable any return on equity (negative return), a situation especially marked in the case of small and medium-sized solar power plants.

We justify the taking into account of capital costs in the calculation of the premium by the need to cover all long-term costs, which include capital costs, so as to guarantee the basic condition for investments in new QPPs using renewable energy sources (RES). The sufficient profitability of RES QPP projects, with return periods that are still acceptable to investors, can only be ensured through premiums that also include capital costs. If the premium set merely covered the difference between RES production costs and the market price, without taking into account capital costs, investments in RES would not provide the profits that investors require, and this would make it impossible to attain the required and binding goal of a share of electricity production from RES, in accordance with the Directive on the promotion of electricity produced from RES.

Table 8: Return on equity taken into account in the premium for individual QPPs

Type of qualified power plant (QPP) by type of primary energy		Power	Premium	Return on equity included in premium
	Size class	[kw]	[SIT/kWh]	
Biomass QPPs	up to 1 MW	600	36.26	2.30%
	over 1 MW	1500	34.09	6.00%
Other QPPs (biogas)		120	87.51	6.80%
QPPs or heating plants using municipal waste	up to 1 MW	100	19.78	4.40%
	1 MW to 10 MW	3.000	16.15	7.30%
District heating plants	up to 1 MW	700	24.62	0.49%
	1 MW to 10 MW	3.000	22.45	4.20%
Industrial heating plants	up to 1 MW	700	20.16	Premium does not include return on equity (- 0.1%)

Note: Return on equity calculated for investments (Table 7) in QPPs for the present premium values

In the case of biomass, aid in the form of premiums does not exceed the value of the investment. When the purchase decree is amended, a new category taking into account the advantages and lower investment costs for biomass co-incineration will be introduced.

5.3 Market potential / attainable potential

The table shows additional capacities for cogeneration by sectors in the period 2008–2012, elaborated on the basis of the plans of plant operators and analysis of the potential of cogeneration in Slovenia.[14]

Table 9: Forecast number of new CHP units in 2008–2012. The potential is attainable through implementation of planned policy and measures under the Operational programme for the reduction of emissions of greenhouse gases

New CHP units	Capacity [MWe]			Production [GWhel]		
	2008	2010	2012	2008	2010	2012
Industry	14	48	68	101	368	518
District heating	3	6	54	12	24	284
Service sector and households	6	12	20	27	50	87
RES (biomass and biogas)	10	19	24	56	110	138
TOTAL	33	84	166	197	552	1 026

If we evaluate these findings from the point of view of the reduction of GHG emissions, we can estimate that in 2012 the relative saving[15] of GHG emissions as a result of the introduction of technologically more efficient cogeneration will be around 382 kt of equivalent CO_2, as shown in Table 10.

Table 10: Savings of CO_2 emissions in new CHP units

	CO_2 emissions [t equiv. CO_2]			
	2008	2010	2012	2008 - 2012
Increase in emissions in the location	40	115	233	129
Indirect reduction of emissions in Slovenia	-118	-331	-616	-355
Total	-78	-216	-382	-226

In the estimate of attainable potential we relied above all on the state of readiness of projects and barriers to their implementation, information obtained from current studies of the feasibility of projects in industry and district heating systems, with a systematic

14 The table does not include new units in TE-TOL (except biomass co-incineration), but the total planned realisation is significantly lower than economic potential.

15 In the calculation of the saving we take into account the increase in emissions in a location on introduction of cogeneration (except in the case of RES) and the reduction in emissions at another location in the Republic of Slovenia as a result of the electricity produced in cogeneration (0.6 kg CO_2 / kWhel).

examination by means of a survey on options for and barriers to cogeneration in Slovenia and data from other sources.

Attainable potential for cogeneration is greatest in industry and represents more than 50% of the total potential generation of electricity from CHP. On the basis of a survey among industrial consumers it was established that cogeneration is being planned in 31 enterprises, 22 of which envisage completion by 2010 (4 systems under construction, project documentation being prepared for 4 systems and feasibility studies being carried out for 13 projects). A total of 37.5 MWe of planned capacity by 2010 and 40.5 MWe by 2015 was identified. Enterprises participating in the emissions trading scheme are more active, since they account for 81% of planned capacities by 2015, which however is not surprising since they are the largest energy users. Natural gas units predominate among the planned systems, with 7 using wood biomass and 5 using other fuels. Engines are the prevalent technology, with turbines accounting for a slightly lower number.

6 COGENERATION IN ENERGY POLICY

In 2004 the Government of the Republic of Slovenia adopted the Resolution on the National Energy Programme (ReNEP)[16], the basic strategic document that, in accordance with the principles of the Energy Act (EA)[17], plans and coordinates the activity of actors in the field of energy management. It sets out the objectives of energy policy and the mechanisms for their implementation. The ReNEP was harmonised with the strategic guidelines from the 2000 Green Paper on security of energy supply in the EU and with the directives applicable at that time. The ReNEP sets out the objectives of energy policy, as follows:

- the competitiveness of energy enterprises, the commercial sector and the country
- security in the provision of energy services and
- reduction of environmental impacts.

With the ReNEP Slovenia has set itself ambitious targets for the development of sustainable energy options. The following targets are planned to be met by 2010 to encourage energy efficiency and the use of renewable sources:

- increasing energy efficiency in industry, services and transport by 10% compared to 2004, with the even stricter target of a 15% increase in the public sector,
- increasing use of renewable energy sources for the production of electricity to 33.6% (Directive 2001/77/EC) and increasing the use of renewable sources to supply heat to 25%,
- doubling the production of electricity from cogeneration from 800 GWh in 2000 to 1,600 GWh in 2010.

In the light of the EU target under the Strategy for the promotion of cogeneration and the removal of barriers to its development, which is to double at EU level the share of electricity from cogeneration by 2010 (i.e. to 18%), the Slovenian target is only slightly behind.

As well as targets, the ReNEP defines the plan of government mechanisms for their attainment. The ReNEP places the promotion of cogeneration among the objectives and mechanisms from the environmental field, while at the same time underlining the importance of cogeneration for improving the strategic security of supply. The long-term plans of climate policy and air protection policy recapitulate the ReNEP's targets for efficient energy use, renewables and cogeneration and support them with their own mechanisms. There are two key programmes in this field: the Operational programme for

[16] Resolution on the National Energy Programme (ReNEP), (OJ RS, No 57/2004).

[17] Energy Act, OJ RS, No, 27/07, EZ-OCT2; The Energy Act defines the principles, elements and preparation of energy policy. The objective of energy policy is to ensure conditions for the safe and secure supply of users with energy services according to market principles and the principles of sustainable development, while taking into account its efficient use, economic exploitation of renewable energy sources and environmental protection conditions.

reducing greenhouse gas emissions by 2012 (OP GHG) and the Operational programme for achieving national emissions ceilings for pollutants in Slovenia (OP NEC, the programme relates to the implementation of Directive 2001/81/EC).
The ReNEP envisages an integral regulation for the promotion of cogeneration that in addition to defining the method of promoting cogeneration will include regulation of systemic services such as 'peak power' and 'reserve power', standardised methods of connecting micro and small qualified power plants to networks with regard to the power of the plant for type projects, assessment of the possibility of cogeneration at every new installation or replacement of a boiler with a thermal power greater than 500 kW. The ReNEP also envisaged analysis of technical potential for cogeneration, the adoption of a regulation on certificates of origin of electricity from high-efficiency cogeneration, the implementation of information and training programmes, the subsidising of a study of the feasibility of cogeneration, promotion of investments in cogeneration and the development of financial mechanisms for investments in cogeneration.

The greater part of the mechanisms envisaged in the ReNEP are already being implemented. Following the adoption of Directive 2004/8/EC on the promotion of cogeneration based on useful heat demand in the internal energy market, plans for mechanisms have been adapted to these more detailed requirements for the transposition of this Directive, while the main objectives and orientations regarding the promotion of cogeneration in Slovenia have not changed with the adoption of the Directive.

6.1 Legal basis

The basic acts regulating the position of cogeneration of heat and electricity in Slovenia are:

- Energy Act (official consolidated text, OJ RS No 27/2007)
- Decree on the conditions for obtaining the status of qualified electricity producer (OJ RS, No 29/2001, 99/2001)
- On 19 July 2007 the Government adopted a new Decree on the conditions for obtaining the status of qualified electricity producer, which replaces the previous Decree (at the time of preparation of this report, the new Decree had not yet been published in the Uradni list Republike Slovenije, Slovenia's official journal). This Decree assumes all the criteria for defining high-efficiency cogeneration and the method of calculating the quantity of electricity produced by high-efficiency cogeneration as defined by Directive 2004/8/EC and Commission Decision 2007/74/EC.
- Decree on the rules for determining prices and purchasing electricity from qualified electricity producers (OJ RS, No 25/2002)
- Resolution on prices and premiums for the purchase of electricity from qualified electricity producers (OJ RS, No 25/2002, 8/2004, 75/2006)

- Decree on the issuing of guarantees of origin of electricity (OJ RS, No 121/2005). Following the entering into force of the new Decree on conditions for obtaining the status of qualified electricity producer, the issuing of certificates of origin for electricity from CHP will also begin.
- Rules for the operation of the electricity market (OJ RS, No 30/2001, 118/2003)
- Decree on general conditions for the supply and consumption of electricity (OJ RS, No 117/2002, 21/2003)
- Environmental Protection Act (officially consolidated text, OJ RS, No 39/2006)
- Decree on the environmental tax for pollution of the air through the emission of carbon dioxide (OJ RS, No 43/2005, 58/2005, 87/2005, 20/2006)
- Ordinance on the national plan for the allocation of emission coupons for 2005-2007 (OJ RS, No 112/2004, 131/2004, 53/2005); Ordinance on the national plan for the allocation of emission coupons for 2008–2012 (OJ RS, No 42/2007)

6.2 The fixed purchase price system

The main instrument for promoting the cogeneration of heat and electricity is the system of guaranteed purchase prices or premiums for the delivery of produced electricity to the network or autonomous sale on the electricity market. The purpose of the measure is to create, by means of a favourable fixed purchase price set by the Government of the Republic of Slovenia, a favourable environment for the building of new capacities for the use of renewable sources and cogeneration of electricity and heat. The current incentives scheme, which as well as cogeneration of heat and electricity includes incentives for the production of electricity from renewable energy sources, is based on the status of qualified electricity producer (QP), which may be obtained by an electricity producer who produces electricity and heat with above-average efficiency in a process of cogeneration of heat and electricity (CHP, total annual efficiency > 78%), or uses renewable energy sources as input energy and meets the conditions of the Decree on the conditions for obtaining the status of qualified electricity producer.[18]

On 19 July 2007 the Government adopted a new Decree on the conditions for obtaining the status of qualified electricity producer. This Decree replaced the old Decree. It includes important changes in the CHP sphere. The new Decree incorporates fully the efficiencies, primary energy savings and calculation procedures introduced by Directive 2004/8/EC. Moreover it uses the reference values from Commission Decision 2007/74/EC. The conditions for RES conform to Directive 2001/77/EC. The Decree on rules for the setting of prices and the purchase of electricity from qualified electricity producers lays down rules that, for the majority of qualified producers, formulate guaranteed purchase prices to incentivise their development.

[18] Decree on the conditions for obtaining the status of qualified electricity producer (OJ RS, No 29/2001, 99/2001).

The network system operator is responsible for the purchase of all electricity from qualified producers connected to its network.[19] Producers may sell part or all of their energy independently, and in this case they are eligible for the payment of a premium set by the Government, equivalent to the difference between the expected annual market price of electricity and the fixed purchase price. All costs incurred by the system operator through the purchase of this electricity or the payment of premiums are covered from a supplement to the price for the use of networks. The QP concludes a 10-year contract with the network system operator for the sale of electricity.[20]

Prices for qualified producers, as determined by the Government Decree[21], differ in accordance with the technologies, the size of units and the type of primary energy used, with the result that 10 classes of purchase prices are defined for the cogeneration of heat and electricity. The applicable purchase prices are shown in Fig. 16. The QP is entitled to payment for all electricity offered at the purchase price set by the Government. In the case of independent sale or own use of electricity, the QP is entitled to the payment of 100% or 30% of the premium respectively. An exception to this rule is cogeneration in industry and services, where only cogeneration units with a power of up to 1 MWe are eligible for the guaranteed purchase price, but only for surpluses of produced electricity. They are not entitled to premiums. A QP may choose a uniform or dual-tariff calculation of the purchase price and premium. For industrial heating plants the dual-tariff calculation is obligatory. The purchase price and premium are reduced by 5% in the case of connection of the power plant to a transmission network. Likewise the purchase price or premium is reduced by 5% after five years of operation and in cases where power plants have received additional subsidies the purchase price or premium is reduced by 5% for every 10% of non-refundable investment subsidies received (with regard to the total investment value).

Support for qualified producers is collected as a supplement to the network charge. Each year, electricity users in Slovenia pay the following for support to cogeneration: at the transmission tension level: € 6 994 million; at the distribution tension level: €5 348 million – giving a total of € 12 342 million of support to cogeneration in 2006.

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19 Energy Act (official consolidated text) /EZ-OCT1/ (OJ RS, No 26/2005).

20 Rules for the operation of the electricity market (OJ RS, No 30/2001, 118/2003).

21 Decree on the rules for determining prices and purchasing electricity from qualified electricity producers (OJ RS, No 25/2002).

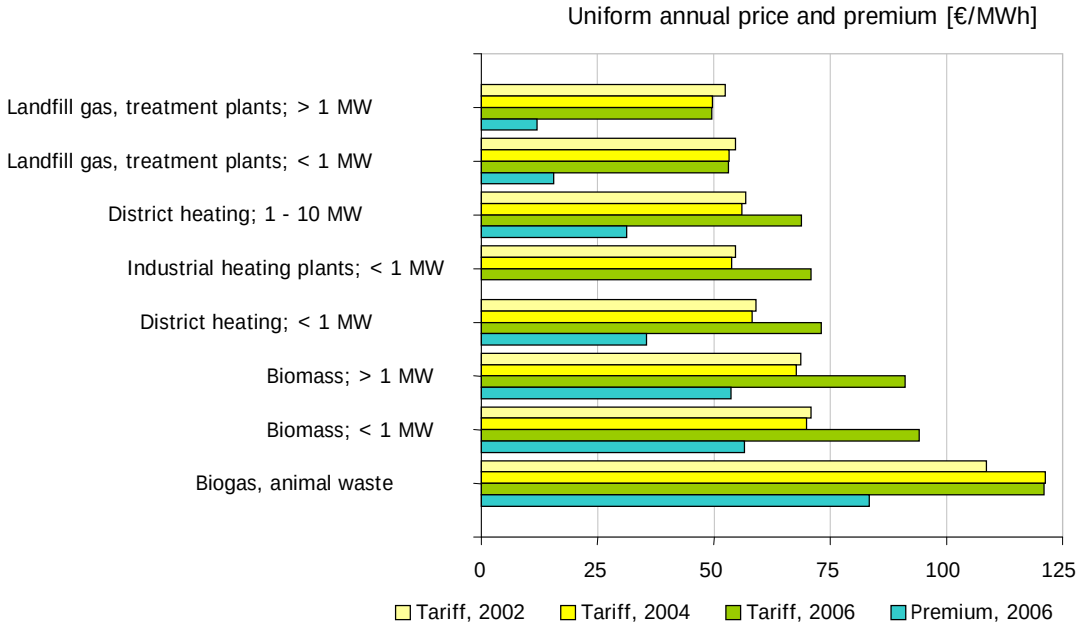

Fig. 16: Prices and premiums for the purchase of electricity from CHP[22]

The level of the purchase price and premium differ according to the categories of producers, as shown in Fig. 16. The current purchase price mechanism for cogeneration has enabled sufficient support above all for the construction of smaller new cogeneration units in district heating systems (the construction of new units already exceeds projections from the ReNEP), and for the use of landfill gas and biogas. Current support for cogeneration in other activities (above all industry and also the services sector) is insufficient, which confirms the slow development to date. Conditions are also worsening for heating plants in district heating systems, since the guaranteed purchase prices are not suitably adapted to changes in the prices of natural gas. For the time being medium-sized and large industrial heating plants are not yet incentivised at all by the mechanism of guaranteed purchase prices or premiums. The development of CHP in recent years is illustrated in more detail in Chapter 2.2.

6.3 Other mechanisms for promoting CHP in Slovenia

The position of CHP is also defined by other mechanisms.

- A Decree on certificates of origin that transposes the requirements of Directives 2004/8/EC and 2001/77/EC into Slovenia's legal system has been adopted,
- the position of CHP in the electricity market is also regulated by the rules for the operation of the market, which do not oblige smaller units to pay for deviations

22 Resolution on prices and premiums for the purchase of electricity from qualified electricity producers (OJ RS, No 75/2006).

or to announce electricity production schedules. Prices for the use of networks for CHP units under 1 MW are also limited,

- the Energy Act also allowed the direct sale of electricity produced by qualified producers to households even before 1 July 2007, when the market was liberalised in this segment, but the mechanism has not taken off in practice.
- the administrative allocation of emissions coupons within the European emissions trading scheme can place an additional barrier to the development of cogeneration. The specific nature of this technology, which by increasing local emissions reduces local emissions, is taken into account in the allocation of coupons, both for new entrants and for existing plants,
- CHPs are bound by planning obligations: on issue of an energy permit for thermal power plants and heating plants greater than 1 MW, the technical and economic possibilities for cogeneration are assessed. In the case of the construction and planning of large combustion facilities, this obligation is assessed on issue of the environmental permit,
- educational, informative and promotional activities in support of the development of CHP are also carried out, to be financed from budget resources and from European programmes such as Intelligent Energy for Europe and other programmes. Individual research is also carried out.

6.4 Planned measures in the CHP sphere

With the plan for the implementation of Directive 2004/8/EC and the continuation of plans to promote CHP set out in the ReNEP and the Operational programme for the reduction of emissions of greenhouse gases, the following mechanisms are envisaged for the promotion of CHP which will further promote CHP based on useful heat consumption.

The system of guaranteed purchase prices will be overhauled. The new system will be based on similar efficiency criteria to the current system, which are slightly stricter than those required by the Directive. Aid will by now be harmonised with the relevant EC instructions for environmental State aid. These will continue to be aid for current operations. The new incentive scheme will put into effect, more than to date:

- promotion of CHP in all sectors. Current CHP incentives are aimed above all at heating plants in district heating systems and at cogeneration on the basis of renewable energy sources. In industry and general use, incentives are very limited, and despite great potentials in these sectors remain unexploited. The consequence of the difference in incentives are differences in the development of cogeneration in recent years among the sectors. The new system envisages the same CHP incentives regardless of the sector. The level of the incentive will depend only on the size of the units and specific emissions of greenhouse gases,
- orientation towards targets for the reduction of greenhouse gas emissions. Because of obligations under the Kyoto Protocol and the considerable

opportunities that cogeneration offers for the reduction of greenhouse gases, the new incentives will also take into account this aspect in the level of purchase prices. The level of the incentives will also depend on the specific emissions per unit of electricity produced,

- increasing the security of supply. Sufficient capacities for electricity supply in the country are an important factor for the greater security of electricity supply. The new scheme will also encourage cogeneration with a smaller number of operating hours, which will meet the criteria of high efficiency. The incentives for medium-sized and large cogeneration will now be formed from two elements: besides the premium for electricity produced, producers will also be entitled to a power supplement if they reach more than 3000 operating hours a year,
- ensuring encouraging and stable conditions for investments. The incentives will guarantee coverage of the difference between production costs and the market price of electricity. For this reason the model of adapting incentives to changes in fuel prices and electricity prices will also be improved.

Besides the change to the scheme of financial incentives for cogeneration, the following activities are also envisaged in order to improve conditions for the development of cogeneration:

- reduction of administrative barriers and simplification of procedures, at the same time ensuring the transparency of conditions designed to promote high-efficiency CHP,
- standardisation of methods for connecting micro and small qualified power plants to the network with regard to the power of the plant (type projects will be produced for such standardised methods, since they are cheaper to implement than individual projects),
- implementation of information and training programmes,
- subsidies for cogeneration feasibility studies,
- further monitoring and control of the effect of opening energy markets to the development of cogeneration, in particular with regard to network charges, system services and other operating costs in the network.

On the basis of the EU strategy for the promotion of cogeneration of heat and electricity and the removal of barriers to its development, which recommends to Member States measures for the promotion of cogeneration and its easier affirmation, a gradual internalisation of external costs and environmental benefits via the introduction of additional fiscal instruments is also to be recommended. Slovenia has already introduced a tax on CO_2 emissions for plants that are not included in trading rights to emit greenhouse gases, but with little effect on the internalisation of external costs from electricity production. A new step towards the realisation of this recommendation was taken at the EU level with the Green Paper on market-based instruments for environment and related policy purposes, and therefore we expect subsequent development in Slovenia too to be connected with this process.

Bibliography

1. Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC.
2. Commission Decision of 21 December 2006 establishing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC of the European Parliament and of the Council (notified under document number C(2006) 6817).
3. EC DG TREN: Analysis and Guidelines for Implementation of the CHP Directive 2004/8/EC, Interim Version – Annex Report III, Draft Guideline on Establishment of National Potentials, Cowi et al., June 2005.
4. CEN/CENELEC, Manual for Determination of Combined Heat and Power, September 2004.
5. Pro Termo, Manual for Calculating CHP Electricity and Heat, 2000.
6. Energy Act /EZ/ (OJ RS, No 79/1999 (8/2000 - amended), 110/2002-ZGO-1, 50/2003 Const. Court Decision: U-I-250/00-14, 51/2004).
7. Resolution on the National Energy Programme /ReNEP/ (OJ RS, No 57/2004).
8. Operational programme for reducing greenhouse gas emissions by 2012, MOP, December 2006 (Government resolution, 20 December 2006).
9. Operational programme for achieving national emissions ceilings for ambient air pollutants (OP-NEC) – Revision of the operational programme for achieving national emissions ceilings for ambient air pollutants from 2005, MOP, 2007 (Government resolution, 4 January 2007).
10. Resolution on prices and premiums for the purchase of electricity from qualified electricity producers (OJ RS, No 75/2006.
11. Decree on the issuing of guarantees of origin of electricity (OJ RS, No 121/2005).
12. Decree on the conditions and procedure for the issuing and withdrawal of a licence to pursue energy activities (OJ RS, No 21/2001, 31/2001, 66/2005).
13. Decree on the rules for determining prices and purchasing electricity from qualified electricity producers (OJ RS, No 25/2002).
14. Rules on the allocation of funds for the promotion of efficient energy use and the use of renewable energy sources (OJ RS, No 49/2003, 38/2005).
15. SURS: Combined Heat and Power Plant statistics in Slovenia, Final report of CHP plant statistics project 2002 for candidate countries of the EU, 2004.

16. Statistical Yearbook of the Republic of Slovenia, SURS, annual publication and SI-STAT database.
17. IJS: Annual energy review for 2004, IJS-DP-9239, 2006.
18. IJS: Annual energy review for 2005, IJS-DP-9467, 2007.
19. Fourth State report to the Conference of the Parties to the UN Framework Convention on Climate Change, MOP, 2006.
20. Statistical Yearbook of the Republic of Slovenia 2005, SURS, 2005.
21. J. Medak, A. Urban•i•, National CHP Potential in Slovenia, Workshop on Cogeneration, Petten, 2007.
22. J. Medak, Soproizvodnja in energetska politika Slovenije, Cogeneration Days, Ljubljana, 2007.
23. D. Stani•i•, H. Šolinc, Soproizvodnja toplote in elektri•ne energije – od ideje do izvedbe, OPET Slovenija, 2002.
24. BHKW – Kenndaten 2005, Module Anbieter Kosten, Energiereferat der Stadt Frankfurt, paper 79A.2, 2005.
25. Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants.
26. Directive 2002/91/EC on the energy performance of buildings
27. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions – A Community strategy to promote combined heat and power (CHP) and to dismantle barriers to its development, COM (97) 514 final.
28. Report of the Commission to the European Council and the European Parliament – An Energy Policy for Europe, COM(2007)1 final.
29. Report of the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, Limiting Global Climate Change to 2 degrees Celsius. The Way Ahead For 2020 and Beyond, COM(2007)2 final.
30. European Council in Brussels, 8 and 9 March 2007 – Conclusions of the Presidency, 9 March 2007, No 7224/07.
31. Commission guidelines on environmental state aid (Off. J. 2001/C 37.)
32. Green Paper on market-based instruments for environment and related policy purposes, SEC(2007)388.
33. World Energy Outlook 2006, IEA (OECD), Paris, published 7 November 2006.

List of abbreviations

DH – District heating
EUROSTAT – Statistical Office of the European Union
EZ – Energy Act
QPP – Qualified power plant
QP – Qualified electricity producer
NEP – National Energy Programme
OP GHG – Operational programme for reducing greenhouse gas emissions
OP NEC – Operational programme for achieving national emissions ceilings for pollutants in Slovenia
RES – renewable energy sources
PES – primary energy saving
ReNEP – Resolution on the National Energy Programme
SLEG – Statistical Yearbook of the Energy Sector
CHP – combined heat and power (cogeneration of heat and electricity)
SURS – Statistical Office of the Republic of Slovenia
GHG – greenhouse gases
EE – energy efficiency
NG – natural gas

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ANNEX 1: Reporting obligations under the Co generation Directive

Analysis of potentials is one of the reporting obligations of Member States under Directive 2004/8/EC, as follows:[23]

- annually on the situation in the cogeneration sector in the country,
- every four years on progress in the development of cogeneration and
- once on analysis of cogeneration potentials.

The contents and deadlines for reporting obligations are shown in Table 11. This study aims to deal with the contents for the analysis of cogeneration potentials required by Articles 10(1), 5(3) and 6(1) and Annex IV.

[23] Article 10, Member States' Reporting
1. Member States shall, not later than 21 February 2006, publish a report with the results of the analysis and evaluations carried out in accordance with Articles 5(3), 6(1), 9(1) and 9(2).
2. Member States shall not later than 21 February 2007 and thereafter every four years, following a request by the Commission at least six months before the due date, publish a report with the result of the evaluati on referred to in Article 6(3).
3. Member States shall submit to the Commission, for the first time before the end of December 2004 covering data for the year 2003, and thereafter on an annual basis, statistics on national electricity and heat production from cogeneration, in accordance with the methodology shown in Annex II.
They shall also submit annual statistics on cogeneration capacities and fuels used for cogeneration.
Member States may also submit statistics on primary energy savings achieved by appl ication of cogeneration, in accordance with the methodology shown in Annex III.

Table 11: Reporting obligation of Member States under Directive 2004/8/EC

Date	*Title of report*	*Content*	*Article of Directive (paragraph)*
21. 2. 2006	**Analysis of potentials and the report**		**10 (1)**
		Review of certification: review of the reliability and accuracy of the certification scheme and mechanisms for achieving them	5 (3)
		Analysis of potentials for CHP : -classifies potentials in accordance with the annexes (IV, I) -estimates useful heat and availability of resourc es -estimates cost efficiencies (PES) from CHP -classifies potentials as market, economic and technical	6 (1,2)
		Assessment of barriers: prices and costs, availability of resources, access to networks, administrative barriers, external costs not taken into account	6 (2)
		Above all: -review of administrative procedures -review of coordination, instructions and dispute resolution	9 (1) 9 (2)
21. 2. 2007 **Four-yearly**	**Progress report**		**10 (2)**
		Increase in the share of high -efficiency cogeneration	6 (3)
Dec. 2004 **Annually**	**Annual statistics**		**10 (3)**
		Production of heat and electricity in cogeneration, capacities and fuel consumption. May also included savings achieved.	10 (3)