

EUSUSTEL

European Sustainable Electricity; Comprehensive Analysis of Future European Demand and Generation of European Electricity and its Security of Supply

WORK PACKAGE 1

County-wise Analysis

Subtask 1.13.d

SLOVENIA

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1. Energy-related and socio-economic analysis: past, present and future

1.1. Factual information

1.1.1. Geography & population

Slovenia is with is 20273 km², 2 x 10⁶ inhabitants and approximately 760000 households a rather small country in Eastern Europe. It has a short coastal strip at the southwest (46.6 km), an alpine mountain region, adjacent to Italy and Austria and mixed mountains and valleys with numerous rivers to the east. Heights vary from 0 to 2864m.

On the coast side, Slovenia has a Mediterranean climate, which evolves to a continental climate with mild to hot summers and cold winters at the plateaus and valleys in the east. On an average, there are 2045 hours of sunshine.

1.1.2. Economy

Among all the transition economies of Central Europe, Slovenia has the largest GDP¹ per capita. Its GDP is around 28 x 10⁹ EUR and the GDP per capita ratio is at 60% of its level for EU-15. The services are responsible for the highest share (61%), industry for 36% and agriculture for 3%.

1.1.3. Energy

The industrial sector of Slovenia is particularly dynamic; this explains why industrial energy consumption is steadily representing 30% of total final energy demand. Electricity demand grows (3.5% per year in the short term) faster than total final energy demand, but at a rate which is lower than the growth of GDP. Electricity use per capita is particularly high in Slovenia; it is expected to further increase and reach a level higher than the average at the EU-15. Slovenia has a steadily rising primary energy demand and its primary energy intensity [energy/GDP] is above the European average.

Slovenia has limited domestic fossil fuel resource, mainly lignite which is used both for heat and electricity production. The domestic production of lignite covers 95% of its total consumption, but the growth prospects are poor given the limited resources of lignite and its very low quality, in terms of calorific value and its sulphur and ash content.

¹ A list with abbreviations can be found at the end of this document.

The production of natural gas is negligible and Slovenia depends for 99.5% on imports (Russia 59%; Algeria 37%, Austria 4%). But as Slovenia is connected to the most important international networks (Russia and Algeria) and as it is an important transit country, concluding long term supply contracts is not likely to become an issue. Gas consumption of NG is considerably increasing (+ 10.6% from 2002 to 2003 [13]). In the natural gas market², Geoplin is the sole supplier of gas to industrial customers on the transmission net and to the distribution companies.

The Minister of Economic Affairs is the overall responsible for the energy sector planning.

The main energy balances and indicators are summarised in the table below (based on baseline scenario from [1]).

[PJ] ³	2000	2005	[PJ]	2000	2005
Gross Inland Consumption (=TPES)	274.68	288.54	Final Energy Demand (TFC) by Sector	192.78	207.48
Solids	55.02	42.42	Industry	60.48	67.2
Oil	102.9	111.3	Residential	49.14	49.56
Natural gas	36.54	50.82	Tertiary	25.2	26.88
Nuclear	52.08	51.24	Transport	57.96	64.26
Electricity	-4.62	-3.78	Final Energy Demand (TFC) by Fuel	192.78	207.48
Renewable energy forms	33.18	36.54	Solids	4.2	3.78
Net Imports	145.32	162.96	Oil	96.18	103.32
Import Dependency [%]	52.9	56.4	Gas	25.2	31.92
Energy Intensity Indicators (1990 = 100)			Electricity	37.8	40.74
Industry (Energy on Value Added)	102.5	93.4	Heat	8.4	8.4
Residential (Energy on Private Income)	147.6	126.4	Other	21.42	19.74
Tertiary (Energy on Value Added)	143.0	125.3			
Transport (Energy on GDP)	121.3	112.6			

1.1.4. Electricity

The report on the energy sector by the Energy Agency [13] gives an overview on the electricity situation in 2003. Between 2002 and 2003, electricity consumption has increased by 4.3%. This growth has gone together with a change in the structure of consumption, with a peak of 2785 MW in the summer. Slovenia produces 12.5 TWh and has a total consumption of 11.8 TWh. It exported in 2003 3846 GWh. Since April 2003, Slovenia has become a net importer, as a consequence of an agreement between Slovenia and Croatia to jointly operate the Slovenian nuclear power plant (with a 50-50 production share).

² Liberalisation process takes gradually place between January 1st 2003 and July 1st 2007. Depending on the annual consumption, customers become eligible to freely choose their supplier.

³ Based on conversion 1toe = 42 x 10⁹ J

The liberalisation of the Slovenian electricity market started in April 2001 with the free choice of supplier for customers with a connected capacity of more than 41 kW at one point of supply. In the beginning, this opening for eligible customers was only formal and until 2003 conditions hardly changed. The eligible customers only represented 1% of the customers, but they used 70% of the 1993 electricity consumption. Other customers (residential, households...) were not free to choose their supplier, but there was a guaranteed supply of electricity (= tariff customers). Since July 1st 2004, all customers, except for households, have become eligible. From July 1st 2007, all customers become eligible.

Slovenia has 3 main production sources: nuclear ($\pm 40\%$), hydro ($\pm 21\%$) and fossil ($\pm 36\%$). Nuclear energy has been developed within the ex-Yugoslavian state. Following the recent agreements, the generation of the nuclear plant of 660 MW located in Slovenia is shared between Slovenia and Croatia. There are 8 production companies and some of them are grouped in the "Holding Slovenske elektrane" (HSE [8]). Electricity production in Slovenia is market-based. Only some ancillary services and some services required for the TSO are regulated. The Energy Agency states that the reliability of the production is ok, but it emphasises on the transmission and distribution capacity, which is a potential limitation of the reliability of supply⁴.

Regarding future power capacities, it is expected that incremental power needs will mainly be covered through new gas-firing power plants. The lignite power capacity is expected to remain stable, as the concerns about the environmental consequences are likely to exclude its expansion from the policy agenda.

Since 2001, the Energy Agency of the Republic of Slovenia [12] is the independent regulatory body for liberalising the energy market, opening up and licensing the market for newcomers, ensuring fair competition, dispute settling... Another important task is to regulate the mandatory public services. Some of these services are the operation of the transmission and distribution network, the overall organisation of the electricity market and the supply of electricity to customers that are not eligible to freely choose their supplier (= tariff customers). The determination of the network charges (for the use of the transmission and distribution network by eligible customers), the tariff system for the tariff customers, the "use-of-network" price and the prices for the ancillary services is also a responsibility of the regulator. A last main task of the regulator is the issuing of the RECS-certificates⁵.

Elektro-Slovenia (ELES) [11] is the Slovenian transmission system operator. This public company, which is 100% state owned, has to manage the Slovenian electricity power system on the 110, 220 and 400 kV-level and has to ensure an undisturbed and reliable supply. As a part of this job, it has to maintain and develop the transmission network and perform ancillary services. Other tasks are the balancing between the forecasts and the real consumption, the purchase of electricity to cover the losses and the selling and buying of the "preferential electricity" (as will be explained further on).

⁴ TSO and DSO's have made important investments between 2003 and 2005

⁵ RECS = Renewable Energy Certificate System; cost-effective and reliable way of certifying the electricity production by RES in Europe

On the distribution level, there are 5 different companies. They are responsible for 3 separated public services. The first one is the distribution of electricity, the second one is the operating of the distribution network, which includes the maintenance, the development and the construction of the grid, and the one is to ensure supply to tariff customers (besides the supply to eligible customers and producers of electricity).

As Slovenia operates one nuclear power plant, it has a regulatory body on nuclear affairs. The “Slovenian Nuclear Safety Administration” (SNSA) [10] is responsible for the licensing, safety, waste, environment, protection... of the nuclear installations. Besides that it has to look on and implement the use of the international and domestic legislation and it has to control on non proliferation issues.

The main electricity balances and indicators are summarised in the table below [1].

	2000	2005
Electricity Generation [TWhe]	13.62	14.14
Nuclear	4.80	4.72
Hydro & wind	3.83	4.41
Thermal (incl. biomass)	4.99	5.01
Electricity Generation [Gwe]	2.94	3.21
Nuclear	0.66	0.66
Hydro (pumping excluded)	0.94	1.11
Wind and solar	0.00	0.01
Thermal	1.33	1.43
Of which cogeneration units	0.25	0.27
Open cycle	1.09	1.04
Supercritical Polyvalent/Clean Coal and Lignite	0.00	0.00
Gas Turbines Combined Cycle	0.24	0.37
Small Gas Turbines	0.00	0.02
Fuel Cells	0.00	0.00
Geothermal Heat	0.00	0.00
Average efficiency for thermal electricity production [%]	34.2	36.9

1.1.5. Environmental issues

Due to the Kyoto agreement, Slovenia has to reduce its emissions by 8% by 2008-2012, compared to the base year. For CO₂, CH₄ and N₂O, this base year is 1986, while for F-gases, the base year is 1995. At the end of 2002, Slovenia was 6.9% out of the Kyoto target. The contribution to the CO₂-emissions can be divided as follows: energy sector (78.9%), agriculture (10.2%), waste management (5.4%) and industry (5.2%).

The main balances and indicators concerning the CO₂-emissions are summarised in the table below [1].

	2000	2005
CO₂-emissions [Mt of CO₂]	14.1	14.2
Electricity and Steam production	5.4	4.7
Energy Branch	0.1	0.1
Industry	2.3	2.6
Residential	1.4	1.4
Tertiary	1.0	1.0
Transport	4.0	4.4
CO₂-emissions Index (1990 = 100)	128.7	129.8
Carbon intensity [t of CO₂/toe of GIC]	2.15	2.07
CO₂-emissions/Capita [t of CO₂/inhabitant]	7.08	7.18
CO₂-emissions to GDP [t of CO₂/MEUR '00]	0.7	0.6
Carbon Intensity indicators		
Electricity and Steam production [t of CO ₂ /MWh]	0.33	0.28
Final energy demand [t of CO ₂ /toe]	1.88	1.92
Industry	1.58	1.63
Residential	1.16	1.21
Tertiary	1.65	1.60
Transport	2.89	2.89

2. Policy

2.1. General framework

Although liberalisation is going on in the energy markets, it is difficult to implement real competition in the electricity and gas market [13]. There are several reasons for that. First of all, as Slovenia is a rather small country, the market has only a small size. A second reason can be found in the structure of the production sources and the market participants and another reason are the limited cross-border capacities. A last reason is the role of the state, as it acts as the majority stakeholder in all the important segments in the energy markets (especially the electricity market). The state owns 100% of HSE, and HSE has majority stakes in all the producing companies which are in the holding. ELES, the TSO, is 100% state-owned as well is one of the two Slovenian coalmines. These four reasons are not favourable for implementing real competition.

As in the other former central planned economies, Slovenia has a historical disturbed price setting. This is why a good, transparent price policy in the liberalised market is very important (e.g. high enough tariffs are necessary for investments in the grid [13]). In the past, network charges did not cover the cost, nowadays transport and distribution charges have to change annually to reach a competitive level. In 2003, prices for households were up to 30% lower than average European prices and prices for eligible customers were 6% lower than EU-average. Between 2003 and 2005, prices increased 15%.

To ensure the transparency and the competitiveness of the market, all parties have the obligation to publish all the necessary data, like market operations, prices, conditions... Another way to overview the competition rate is the use of indicators. For the electricity side, the first one maps the main producers. In Slovenia there are 3 main producers which have together a share of more than 95% of the electricity production and separately produce more than 5%. A second indicator maps the imports and exports via the transmission network and a last one the supply of electricity to eligible customers (8 suppliers overall, from which 6 with a share of 5%).

Two components determine the total price of the electricity. First of all, there is the price for the production of the electricity, depending on the production method. Secondly, there is the price for the use of the network [12]. This latter contains 2 parts. The first part is the network charge, determined by the regulator and which covers the eligible costs of management, the operation, maintenance and development of the grid, the technical losses, the provision of the public services, the ancillary services (performed by TSO, but paid by all users)... The second part is a supplement determined by the government to cover the costs of the Energy Agency, RES-subsidies... In the end, the final price of the electricity is the sum of those several components. For tariff customers, this price is completely regulated, contrary to the price for eligible customers, which is partly regulated, partly market-based.

2.2. Electricity policy

Since January 1st 2003, the electricity market is opened (both national as cross-border trading). But as there are only 2 large players, which are using complete different production technologies, there is almost no competition [13]. NPSK produces nuclear-based electricity and delivers only base-load, while HSE produces thermal- and hydro-based electricity and act on base-load, overnight, hourly, balance and ancillary markets.

In Slovenia, electricity is mostly traded on the retail market, for purchase and sale to the end user. For large customers and distribution companies, domestic and import contracts are used, very often on an annual base. Trade on the daily market happens at the electricity exchange which is run by Borzen, a subsidiary of ELES, and established on March 28th 2001 [9]. This exchange mainly trades in base-load product in the day-ahead market and acts on the wood/biomass market. As there is a lack of liquidity in the Slovenian electricity market, only 3% of the Slovenian electricity consumption (~ 400 MWh) passes by the exchange.

2.3. Environmental policy

Slovenia faces three major environmental challenges. The SO₂-emissions are the major Slovenian environmental problem [7]. This is due to the intensive use of coal. The goal is to decrease those emissions by 70% by 2010. This can be done by fuel switching (this process can already be seen by the increase in the use of NG), flue gas desulphurisation and the change from domestic high sulphuric coal to imported coal.

The second challenge is the reduction of the CO₂-emissions in the framework of the Kyoto protocol. Besides domestic measures (like an exemption for the CO₂-emission tax for high efficient cogeneration and the use of biomass/-gas), Slovenia counts on the flexible mechanisms to reach the targets. It sees emission trading as the most important measure to reduce the emissions in a cost effective way. Besides that, Joint Implementation-projects can improve the technological penetration of the Slovenian economy. Clean Development Mechanisms are an option as well.

To stimulate sustainable electricity production, Slovenia has developed a system of preferential dispatch [13]. In this system, electricity – that is fulfilling the further mentioned constraints - can be sold at guaranteed prices. Those prices are higher than the open market prices and the difference is covered by a subsidy. The network operator is obliged to buy all the supported forms of electricity. This system is funded by a part of the “use-of-network-tariff”. Two types of electricity production are eligible. First of all, electricity producers who produce more than 15% of their electricity with domestic resources. And secondly, there are the environmental friendly production methods: all RES-technologies, cogeneration and fossil-based production with high efficiency power plants. Large hydro power plants (>10 MW), heat production (> 10 MW) and industrial heat production (> 1 MW) are not eligible. Producers who fulfil the constraints become “qualified producers” and have the advantage of the system of the preferential dispatch.

In 1993, the share of RES to electricity production was only 0.7%. The goal is to bring this share to 6% by 2010 (without large hydropower) [5]. To promote the domestic use of RES, different measures can be taken. Besides financial incentives (like attractive loans for environmental and RES-projects), regulations and agreements, market based energy prices, with the internalisation of social and environmental costs are very important to stimulate investments in RES. Energy consulting, education, awareness building and a sectoral approach can enhance the RES-conscience and potential.

Slovenia is well endowed with renewable energy resources, mainly hydro and biomass. Hydro is already exploited at a significant degree. Electricity generation from renewable sources approaches 28% (25% from hydro). Energy from hydro may increase by 20% in the future, under reasonable costs.. The large power plants can grow in capacity and the small ones can become more efficient. Since a lot of those installation are outdated (some survived World War II), there is a lot potential in renovating those plants.

There is a significant unexploited potential of biomass, especially in relation to forestry and wastes. More than 3000 GWh may be generated from biomass plants under reasonable costs. The potential for wind power is significant only in some specific locations for which the economic potential in the long term is estimated at 600-700 MW.

Wind power is currently little used and with the available wind characteristics with speeds in the lower range from 1.7m/s to 4.5 m/s, potential is rather low. The situation is more or less the same for solar energy. It is currently little used and potential is poor. Even more, important use of solar energy is strongly related to energy storage, so a lot of research has to be done.

Both bio-energy as geothermal energy have potential, but not that much for electricity production. Their advantages can be found in the heating sector.

Cogeneration and heat supply is an important sector for Slovenia, given its considerable experience in related infrastructure and technology. The share of cogeneration in electricity generation is expected to exceed 40%, whereas the share of co generated heat exceeds 75%.

The last challenge is the amelioration of the energy efficiency. Since 1996, the goal is to ameliorate the energy efficiency by 2% per year for the next 15 year [5]. The “Agency for Efficient Use of Energy” promotes the efficient use of energy and the use of RES and cogeneration by giving advice, offering financial support, encouraging investments, developing programs, drawing up standards and regulations... to households, the public sector, the industry... A lot of the abovementioned measures have benefits for third challenge as well.

3. Bibliography

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4. Abbreviations

DSO – Distribution System Operator
ELES - Elektro-Slovenia
GDP – Gross Domestic Product
GIC – Gross Inland Consumption
HSE - Holding Slovenske elektrane
NG – Natural Gas
PP – Power Plant
RECS - Renewable Energy Certificate System
RES - Renewable Energy Sources
SNSA - Slovenian Nuclear Safety Administration
TFC – Total Final Consumption
TPES – Total Primary Energy Supply
TSO – Transmission System Operator