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Suggested Reviewers:

*** Response to Reviewers DB**

Reviewer 1: is missing
Reviewer 2: Almost all suggestions are accepted, most in full and few partially. Detail response is included in PDF as marked text. Yellow text is changed from previous text (new in text), ~~and red is deleted (as you recommended~~). I am familiar with notation MCM, BCM etc, and your recommendation is accepted in full. Usually I do not use this notation because in some literature your MCM is mmcm, and 1000 m3 is mcm, etc. Also in my language billion is 1000 times larger unit compared to American billion. Your billion is our milliard. In some English books milliard also exist as notion. Also, I made mistake with Druzdba pipeline. Of course, this is oil pipeline. Source of this error is from the text of Schafer (2008) where he referred to Drudzba as gas pipeline. I thought that two Drudzda pipelines exist. But this is my mistake. My country is also former communist country as well USSR, and Drudzba (Friendship) was a name common for many things, as well as Unity, etc. Also, thank your for grammatical changes in my text. As a nonnative English speaker I am not sure where to put for example at where on etc.

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Serbian gas sector in the spotlight of oil and gas agreement with Russia

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Abstract: The Russian natural gas industry is the world's largest producer and transporter of natural gas. This paper identifies the benefits for Serbia as transient country to European Union for Russian natural gas through South Stream gas-line in the current political context of implementation of gas agreement. On the other hand, according to the Agreement on Stabilization and Integration to European Union, Serbia is obligatory to implement reforms in energy sector and its energy policy must be in accordance with the European Union policy. Republic Serbia has produced and consumed natural gas domestically since 1952, but has always been net importer. Strategy of Energy Development in Serbia and especially National Action Plan for the Gasification on the Territory of Republic of Serbia dedicated special attention to gas economy development in respect with expected contribution in efficient energy use and environmental policy protection in the country.

Keywords: Natural gas; Serbia; South Stream pipeline

1. Introduction

Republic Serbia[1] is a country in Southeastern Europe, covering the central part of the Balkan Peninsula ~~and the southern part of the Pannonia plain,~~ between Montenegro, Albania, Macedonia, Bulgaria, Romania, Hungary, Croatia and Bosnia and Herzegovina. ~~Serbia is situated at the intersection of Pan-European Corridors Nr. 10 and Nr. 7 linking Europe and Asia. The river Danube runs throughout Serbia (588 km). Belgrade is the capital of Serbia and with a population of 1.6 million; it is the country's administrative, economic and cultural centre. The Republic of Serbia is a democratic state of Serbian people and all its citizens.~~

Natural gas is a preferred as fuel for domestic heating. ~~because it is abundant and relatively clean burning. It is extensively used to power electricity grids, to provide heat energy in consumer residences, and for the manufacture of plastics and fertilizer.~~ The strategy for heating of dwellings in urban areas of Serbia, since the communist period, had been made to favour district heating systems. Today, most of these plants use gas as main fuel. Nowadays, individual usage of gas through natural distribution network is also available in many towns in Serbia. For example, the consumer area of Belgrade is being supplied with thermal energy by district heating system consisting of 15 heating plants, which use gas (83% = 265 Mcm/year) and crude oil as an auxiliary fuel. This consumption is equal to annual production of natural gas in Serbia. During the recent crises with transit of gas through Ukraine in January 2009, all Belgrade heating plants

[1] For some details see appendix 1

were switched to axially, liquid fuel. Some heating plants in Serbia does not have technical possibilities to substitute gas as operating fuel and these towns such Novi Sad and Kraljevo had no heating several days. Serbia does not have even marginal reserves in underground storage, and with minor indigenous production of gas, without help from underground storages from Hungary, Austria and Germany situation could be dramatic. In spite of that, according to the energy strategy, the heat supply for the most Serbian households will be provided by some sort of natural gas heating. The goal is not to use solid or fuel heating, especially not electric energy. This goal will be difficult to achieve because Serbia has only one route for natural gas supplying from Russia, through Ukraine and Hungary. Second branch via the bottom of the Black Sea and through Bulgaria will of strategic value for Serbia. South Stream pipeline offers secure supply for a long time and as a transit pipeline to the western Europe, make of Serbia transit country with great incomes from transit taxes.

In 2007, the natural gas consumption of 27 European Union member states was 505 Bcm~~$\cdot 10^9\ m^3$~~, the current value being about 100 billion US$ (Schaffer, 2008). Moreover, natural gas consumption in most of Europe is projected to increase at about 1.5% per year for the next 25 years (Schaffer, 2008). Europe's vulnerability lies in the fact that a significant fraction of its natural gas is imported from Russia. From 1978 to 2002 the relative changes in residential consumption of natural gas, electricity, petroleum products and coal were 133.5%, 74.3%, -35.2% and -85.2%, respectively (Asche et al, 2008). In other words, the residential natural gas consumption has more than doubled over the period, while some other energy carriers have experienced a decline. Under a

broad energy deal signed by Serbia and Gazprom (Russian gas enterprise) in January 2008, Gazprom was to take 51% of NIS (Naftna Industrija Srbije; eng. Serbian Petroleum Industry), which owns the Novi Sad and Pančevo refineries and the Petrol distribution network, and was to build the Serbian leg of the planned 10-15 Bcm South Stream gas pipeline.

Main points of the situation in Serbian gas sector from the period before ratification of gas treatment with Russia, relevant for this paper is shown in the book of Brkić (2006) available only in Serbian and some aspects of the future of Russian gas and Gazprom is shown in the book of Stern (2005)[2].

2. Energy and economy scope of Serbia

In the 1990's during the civil war in former Yugoslavia, Serbia's energy system suffered from a serious lack of maintenance and high outages. Stagnation in energy sector took place in the period from 1990 to 2000 as a result of United Nation sanctions and blockade under UNSC Resolution 757. NATO's ~~(North Atlantic Treaty Organization)~~ bombing of Serbia in early 1999. finally devastated the energy sector. Direct war damage in oil and gas infrastructure is estimated at 650 million US$[3]. In 2000-05 there was a major rehabilitation of the sector's infrastructure, with the help of financing from the European Union and international financial institutions.

[2] detail literature survey is shown in appendix 2
[3] EIU Country Profile 2000; Yugoslavia (Serbia-Montenegro), p. 28 - The Economist Intelligence Unit Limited 2000

2.1. Economy in Serbia

Serbia started real transition process in 2000. From then it has run successful reforms. Prior to these changes, the Serbian economy and energy sector had been subjected to the well-known unfavorable conditions (Knott, 1999) such as civil war in former Yugoslavia, UN sanctions and blockade under UNSC Resolution 757, world record in hyperinflation in 1993, NATO military campaign in 1999, undemocratic regime before 2000, difficult situation in the south province of Kosovo and Metohija, problem in functionality of former union with Montenegro, many Serbian refugees exiled from Croatia and from Kosovo and Metohija, etc. During that period, technical performance of energy infrastructure considerably deteriorated, while the economic capability to secure energy supply, reliable and efficient operation, and regular energy system maintenance, had considerably declined. Energy companies have been too far from financially sustainable operation. Among those reforms are reforms in energy sector. Energy sector is one of the largest sectors of Serbia's economy comprising of a power system; coal production; district heating system; oil and gas production and import; and it accounts for more than 10% of GDP (Table 1). Oil and gas sector in Serbia is very dependent on import (about 80%).

Serbia's economic structure continues to shift gradually away from agriculture and industry, and towards services, following an established pattern of more developed economies. In 2005 industry accounted for an estimated 28% of GDP and agriculture

15%, with services making up the remaining 57%. Serbia has a significant manufacturing sector that includes industries such as chemicals, textiles, car production, furniture and food-processing. The large agricultural sector is expected to remain important.

2.2. Energy in Serbia

The Serbian economy is still extremely energy-intensive. This is a legacy of its communist-era industrial structure and of post-communist policies that, for a long time, gave firms and households little incentive to economize on energy use. Reform of the energy sector is reasonably far advanced by south-east European standards. The Serbian Energy Regulatory Agency (AERS) and the Serbian Energy Efficiency Agency are independent regulatory authority but their independence has yet to be fully tested.

2.2.1. Energy profile of Serbia

Before March 1999 Yugoslavia was self-sufficient in electricity produced from coal and hydropower, and electricity normally covered 75% of the total centrally supplied energy needs of Serbia (gas and oil cover the remaining 25% of demand). ~~In 1999 total electricity output was 34500 GWh, compared with 40600 GWh in 1998. Coal output was 31.4 million tonnes, compared with 44.1 million tonnes in 1998; most of this was lignite (updated values are shown in Table 2). Domestic electricity production in 2005 was 31600 GWh.~~ The sector is dominated by state-owned monopoly EPS

(Elektroprivreda Srbije; eng. Electric Power Industry) with central office in Beograd, which accounts for more than 80% of total output of primary energy and 95% of electricity generation. Total installed capacity in gas fueled co-generation power plants owned by EPS is 353 MW in power plants fuelled by oil or gas (Table 2). EMS (Elektromreže Srbije; eng. Serbian Power Transmission Company) as a separate entity (before 2005, part of EPS) is authorized for electric power transmission, transmission system management and electric power market management. Both of them (EPS and EMS) are in 100% ownership of the Republic of Serbia. Transformation of oil and gas industry is done according to the same law[4].

Energy consumption per capita is highly correlated with GDP per capita (Afgan et al., 1998). Some market structure and the pricing of electricity and natural gas are shown in the paper of Knittel (2003).

Most oil production is undertaken in the north of Serbia, where some 14500 bpd (about 2300 m^3 per day) of crude oil are produced, covering 33% of domestic consumption. The sector of oil and gas was dominated by state-owned monopoly NIS with central office in Novi Sad (Figure 1). New enterprise Srbijagas with central office in Novi Sad is founded by Serbian government according to the reorganization from October 2005. Gas sector was previously part of NIS. This company is ~~obliged~~ responsible for transport, storing, distribution and trading of natural gas. Previously this issue was covered by two firms; NIS Energogas with central office in Beograd and NIS Gas with

[4] Energy law, 2004. Official Gazette of Republic of Serbia 84/04, 23.07.2004

central office in Novi Sad (both was part of NIS). According to the Energy Law, from October 2005, old NIS has been split into two major sectors: oil (new NIS and Transnafta) and gas (Srbijagas) (Figure 1).

Figure 1. Transformation of oil and gas subjects in Serbia

New NIS is authorized for petroleum the sector, and Srbijagas for the gas sector. Both of them (NIS and Srbijagas) are in still in 100% ownership of the Republic of Serbia, but 51% of NIS soon will be sold to ~~Russians~~ Russia for over 400 million US$ in cash and 500 million US$ in investment. Serbia has hired international auditors (Deloitte & Touche) to evaluate value of NIS, but this issue is linked with South stream pipeline and any separate discussion is not possible. Note that, Romania, Hungary and Slovenia had all initially been regarded as possible South Stream transit routes before it was decided to build the line through Serbia. If the route were changed through Romania, Serbia would lose around 200 million US$ per year in transit tariffs. Auditors earlier proposed a privatization program for NIS that reportedly recommended holding an international tender, but Serbia rejected the idea and signed an accord with Gazprom.

Serbia requires up to 3.6~~·10^{9} m^{3}~~ Bcm of gas annually. Natural gas reserves of Serbia are estimated ~~on~~ at 24.07~~·10^{9} m^{3}~~ Bcm. Domestic production covers about 30% of total supply. Russia covers more than 60% of Serbia's gas demand, leaving Serbia heavily dependent on Gazprom, which has in the past cut off supplies owing to non-payment of debts. Gas is used by the industry and by the domestic users (mostly in the north of the country, where gas reserves are concentrated) and by thermoelectric power plants for

heating. Serbia has some 2000 km of gas pipelines, and gas is seen as one of the main sources of energy for the future (Table 2). Its share in the country's energy consumption is expected to increase from 15-20% in the mid-1990's to 30% by 2020, with the number of domestic users rising to 500 000. During sanctions in 1990's the state-owned gas and oil company, NIS, stopped searching for domestic gas reserves, owing to lack of funds. Prospecting, which requires an annual investment of 100 million US$, resumed in 1996 on a limited scale.

Compared to all of the fossil fuels, natural gas is a minor pollutant (Dinca et al., 2007). It burns without a solid residue and has the least coefficient of CO_2 emission of about 56 kg/GJ (which is significant considering the limitations imposed by the Kyoto Protocol). Strategy for CO_2 emissions in a residential sector in Japan is shown in the paper of Ashina and Nakata (2008). This study is valuable because strategy for reduction of CO_2 emission do not exist in Serbia. Due to the European obligation to reduce greenhouse gas emissions in the framework of the Kyoto Protocol, the trend towards the use of natural gas is expected to continue in the future.

Worldwide emission of carbon dioxide ~~for world~~ is 27245 million tonnes annually. Serbia with emission of 53.32 million tonnes annually as ranged as 55 among 207 sovereign states[5]. With 5.07 t CO_2 per capita, Serbia is ranged as 77 in 2004 (former Yugoslavia 5.7 t CO_2 per capita in 1990., and 3.9 t CO_2 per capita in 1991.). With increasing of substitution of other fuels with gas, Serbia's incomes from trading of CO_2 quotas will increase also in the future (Stankeviciute et al., 2008, Duić et al., 2005).

[5] Available from: http://millenniumindicators.un.org/unsd/

2.2.2. Energy legislation in Serbia

Serbia started establishing the new legal, institutional, and regulatory framework for the energy sector in order to create a viable and efficient energy market environment through licensing, pricing, and energy services control by an independent regulatory body. The new Energy Law was enforced in 2004. Serbian Energy Sector Development Strategy by 2015 was adopted by the Serbian National Parliament in May 2005[6]. The Energy Law contributes to harmonization with the European Union requirements and with accepted principles concerning establishing of regional energy market, because they respect main requirements of the following documents: European Energy Charter, Directive 2003/54/EC, Directive 90/547/EEC, Decision of the European Parliament and the Council 1254/96/EC, Directive 91/296/EEC, Directive 90/377/EEC, Directive 2003/55/EC (Gas Directive). The law comprises the following activities: electricity production, transmission, distribution, selling and trading, managing with electricity market, oil derivates production, transportation, distribution, selling and trading, natural gas transportation, storage, distribution, selling and trading, heat energy production, distribution, delivering to tariff costumers, managing with district heat network. Principles of this law are: quality and organization of energy supply for consumers under consideration of environmental protection, stabile and sustainable development of energy activities, energy efficiency, liberalization of energy market, ensuring non-discriminated approach to all subjects on the liberalizing energy market, open access to

[6] Energy Strategy, 2005. Strategy of Development in Sector Energy of up to 2015, Official Gazette of Republic of Serbia, 23.05.2005.

all energy systems and energy supply networks, priority for renewable energy sources and environmental protection.

The main state authorities involved in the Serbian energy sector are the following:

(a) Ministry of Mining and Energy

Charged by Republic of Serbia with governmental affairs regarding: electricity power sector, geology and mining sector, oil and gas sector, general energy sector (communal energetic, municipality), energy balance of Republic of Serbia, provision of conditions for the operation of Public Enterprises under its jurisdiction. Ministry of Energy and Mining is in charge of Governmental energy policy making, preparation and adoption of energy legislation, secondary legislation and regulation.

(b) Ministry of Science and Technological Development

Responsible for research and science institutions. The Ministry manages National Energy Efficiency Programs which are applied by the integrated efforts of the research and scientific institutions (institutes, faculties) or jointly by industries and research and scientific institutions.

(c) Serbian Energy Regulatory Agency (AERS)

Established in June 2005. The Agency was established as a regulatory body for performing the following tasks: enhancing and directing the development of the energy market in accordance with the principles of non-discrimination and effective competition, monitoring the implementation of regulations and energy systems operating codes, harmonizing the activities of energy entities in providing regular supply of energy and services to customers and ensuring their protection and equal treatment.

The Agency is an independent legal entity that is independent of any government authorities as well as independent of users of their products and services. The Agency is administered by the Council of the Energy Agency. The activities of the Energy Agency are determining tariff systems for calculating electricity and natural gas prices for tariff customers, as well as tariff systems for access to and utilization of electric power transmission and distribution system, determining tariff methods for calculating electricity and natural gas prices. The Energy Agency adopted a methodology for determination of tariff elements.

(d) The Serbian Energy Efficiency Agency

Originally founded by Government Decree and started its operation in 2002. According to the Energy Law from 2004 and with financial support from the European Agency for Reconstruction, it was re-established in 2004 and thus has been operating as separate republic organization. The operation of the Agency is financed through the budget of Serbia and as well as by European Union donations. The Energy Efficiency Agency is based on improvement of conditions for energy and energy products conservation, as well as efficiency increases in energy conservation in all sectors of consumption. For the creation 1$ of GDP, Serbia spend 3 kWh of electricity power. Croatia and Slovenia spend less than 1 kWh, while Greece, Italy and Austria even less, under 0.5 kWh for the creation 1$ of GDP (Jednak, 2008).

Also, in September 2008, Serbia's parliament ratified two documents of great importance for the country's future: Stabilisation and Association Agreement (SAA) with the European Union (Serbia hopes to join the European Union by 2014), and the

other is an energy agreement with Russia signed in Moscow in late January (Watkins, 2008). The second one was backed by all major Serbian political parties and won 214 votes out of the 250. The agreement stipulates the construction of a 400 km Serbian section of the South Stream gas pipeline that will transport natural gas from Russia to the European Union via Serbia. A gas underground storage Banatski Dvor, will also be built.

3. Natural gas sector in Serbia before implementation of Russian agreement

Gas utilization in Serbia has started half century ago. Serbia has produced natural gas domestically since 1952, but the intensive development of consumption and the gas pipeline system in Serbia started by the import of natural gas from former USSR in 1978 (Brkić, 2008a). The program of introducing gas pipelines, approved in the year 1973, enabled the import of natural gas from former USSR in 1978 as well as intense development of gas pipeline system of Serbia.

3.1 Production, transport and demands

Increasing of natural gas share in fulfillment of energy demand has been a strategic target in Serbian energy policy for a long time. Gas consumption in Serbia showed tendency for continuous growth until 1989 when the greatest consumption was reached, and since then it was declining and rising in turn. Total consumption of gaseous fuels (natural gas) in 1990 amounted to 2.75 Bcm ~~10^9 m^3~~. The share of gaseous fuels in total consumption was equal to 13%, i.e. 17% in final energy consumption. The basic

characteristic of natural gas consumption in the 1990's is that gas was mostly used in industry as a fuel, in chemical industry as a raw material and increasingly as an energy fuel for heating plants, while household consumption was relatively small. Natural gas share in final energy consumption is still relatively small compared to most of the European countries, resulting in growth of electricity consumption for domestic heating, for preparing of hot water for households and for cooking. ~~and the requirements of low temperature processes~~. Share of electricity production with natural gas as a fuel is negligible (2.8%).

Industry play dominant role in Serbian gas consumption (65.6%). Only northern part of country (Banat and Bačka) has complete gas infrastructure and full ability to use natural gas in household sector. In the rest of the country natural gas in is used in systems for centralized heating, so that overall share of natural gas for heating and household demands is about 31.6%.

Gas field Mokrin (Figure 2) is the biggest field in the country with daily production of 452 tcm ~~000 m^3~~.

Figure 2-Serbian oil and gas fields

Main gas pipeline enables gas import from Russia via Hungary and has the capacity of 6.1 Bcm~~ $\cdot 10^9$ m^3~~ on annual basis, 5.34 Bcm~~ $\cdot 10^9$ m^3~~ of which is transported to territory covered by Srbijagas while the remaining 760 Mcm~~ $\cdot 10^6$ m^3~~ is transported to Bosnia and

Herzegovina. Gas transmission pipelines in Serbia (Figure 3) of total length 2160 km are property of Srbijagas. The gas pipe-line system links all of the gas fields in north of Serbia with consumers and provides the import of natural gas from Russia via Hungary (Figure 3). Also, this system is used for the transit of natural gas to Bosnia and Herzegovina. ~~Today the backbone of the gas pipeline system in Serbia consisted of the main gas pipeline Horgoš - Gospođinci - Batajnica - Velika Plana - Paraćin - Pojate - Niš with a large loop comprising: main gas pipeline Senta - Mokrin - Elemir - Pančevo - Smederevo - main gas pipeline (Velika Plana), with branches Gospođinci - Novi Sad - Beočin, Gospođinci - Elemir - Banatski dvor, Batajnica - Šabac - Loznica - Zvornik, Batajnica - Pančevo, Batočina - Kragujevac - Kraljevo,Pojate-Kruševac and Bresnica - Čačak - Gornji Milanovac - Užice (Figure 3).~~

Figure 3. Serbian gas pipelines

Natural gas taken over at the receiving station in Horgoš as well as gas from local gas fields is transported by main pipelines. These pipelines are manufactured with diameters from 220 mm to 762 mm (8 5/8" to 30"). Design pressure in main gas pipelines is max 50~~·10^5 Pa~~ bar, but due to the absence of maintenance of pipeline maximal operating pressure is below 30~~·10^5 Pa~~ bar which is enough because the gas-line has favorable large diameters in the composition of the pipeline. Development of municipal distribution networks for natural gas is proportional to the increase in consumption. The existing gas pipeline system covers 30% of municipalities in Serbia. Stagnation i.e. decline in consumption took place in the period from 1990 to 2000 as a result of UN sanctions and

blockade under UNSC Resolution 757, so that minimum consumption equal to 1.088 Bcm ~~$\cdot 10^9 m^3$~~ was achieved in 1993, and since then it was gradually rising but has not exceeded the one from 1990 so far (Figure 4).

Figure 4. Annual indigenous production and demands of natural gas in Serbia

Being the only importer of natural gas, Srbijagas provides the total quantity for over 170,000 gas consumers in Serbia. This company presently has 50,000 direct consumers (remote heating systems, industrial consumers, distributors with own distribution network, etc.). Natural gas is expected to have an increasingly important role to play in the provision of energy over time because of its relatively favourable ~~favorable~~ environmental impact. Substantial new investment in distribution networks will be required to meet space-heating needs as electricity prices are adjusted. Natural gas is expected to be the primary substitute for electric-based heating either through district heating in densely populated areas or individual boilers in the rest of the country (Brkić and Tanasković, 2008). Extension of gas distribution networks could be offered to private investors. Natural gas consumption is expected to have the biggest rate of growth due to substitution of other energy sources and predicted requirement increase. It is expected to reach about 6 Bcm ~~$\cdot 10^9 m^3$~~ per year in 2020, and share of total energy consumption to reach approximately 20%, which is the level in developed European countries. Network expansion to new distribution areas is a policy aim of the Government.

However, demand growth depends also on the competitiveness of gas with other fuels. Based on the quantities of energy required to heat a 60 m² flat, the annual energy costs of gas would be cheaper than storage electric heating and district heating in Belgrade and Novi Sad for any type of housing. With gas prices recently increased for 50%, the annual energy costs of using natural gas for heating would only be lower than those of direct electric heating (in any type of housing) and of district heating only in typical modern (i.e. better insulated) apartment blocks (Brkić and Tanasković, 2008). However, once the up-front costs of a gas connection and boiler are factored in, gas would not be competitive with district heating (Brkić and Tanasković, 2008). It may be more financially attractive than direct heating, but customers that could afford the up-front costs of gas heating would probably be more likely to invest in electric storage heating, which has lower annual energy costs when current electricity prices are compared with the recently increased gas prices. However, the prices of district heating are not set at their economic levels (due to subsidization by municipally-owned district heating companies). Furthermore, district heating is burdened with problems of non-payment, the inability to disconnect non-paying customers, and large inefficiencies throughout the chain from heat production through to final use (Brkić, 2006). The general absence of metering of individual households' consumption and the lack of individual controls leads to inefficiencies such as opening windows to control temperature. The inefficiencies are not reflected in district heating prices. Electricity prices have increased significantly in recent years, but they are probably still not at their true economic levels. Academic engineering research in Serbia indicates that district heating is more economic the higher the density of the heat load, because heat losses are proportionately

lower over shorter distances and the capital costs of the heat distribution network are proportionately lower(Brkić, 2006; Brkić and Tanasković, 2008). Large central boiler plants may have proportionately lower capital costs than small boilers due to economy of scale advantages over small boilers. Nevertheless, total energy losses from district heating systems are higher than the losses from gas distribution, heat distribution networks tend to be as expensive or more expensive than gas distribution networks covering the same area and large central boiler plants that are required for district heating no longer have a significant efficiency advantage over good quality small gas boilers. Therefore, even in a relatively dense urban area where construction of a new district heating plant or extension of an existing system might be expected to be economic, it might still be more economic to deliver gas. Since it is almost always uneconomic to have competing gas and district heating networks, in new areas, the responsible party should carry out a comparison of the costs of district heating and direct gas supply. Based on the results, it should announce a clear policy towards one or the other. According to Energy Law from 2004, the Energy Agency is responsible ~~obliged~~ for tariffs and prices in natural gas sector. Agency has proposed tariffs and prices Serbian Government for final approval ~~adoption~~.

3.2 Underground gas storage in Serbia

Selected place for gas underground storage facility is the Banatski Dvor depleted gas reservoir in Banat with present capacity up to 800 Mcm~~.10^6 m^3.Currently is in the final stage the construction of underground storage in Banatski Dvor .One of the major costs~~

~~were for re-inject the cushion gas into the reservoir in order to compensate gas used to meet demand during economic sanctions in 1990's.~~ The final phase in construction of underground gas storage Banatski Dvor is underway. The biggest expense in this phase is the purchase of gas which will be injected as a gas pillow thus compensating the gas spent during UN sanctions in 1990. The exploitation has not been terminated in time so a portion of reservoir is flooded and the question is if it would be at all possible to extract the water out of the porous expanse which was previously filled with gas. Such over-depleted fields have filled with underground water. Srbijagas has long-term plans for future gas storage increasing the total to 1.8 Bcm~~$\cdot 10^9$ m^3~~ the Banatski Dvor depleted reservoir (or even up to 10 Bcm in the future). Since natural gas is largely used for heating, consumption is subject to a significant seasonal swing. In Serbia approximately two-thirds of the gas is consumed during winter (October–March). Residential sector consume about 90% of their overall gas during the winter period. For local gas providers, it is therefore not uncommon to have daily peaks in gas delivery in the winter amounting to more than ten times the delivery on a summer day. This strong seasonal consumption profile requires flexibility on the supply side. In Serbia, there are two main sources of flexibility: production which is decreasing and import from Russia which is increasing. Imports from remote sources (like Russia) is enough for domestic needs, but problem is in the low daily peak capacities of transit pipeline in Hungary during the very severe winter days (Figure 5). Serbia's pipeline has enough capacities, but problem is in the Hungarian side. Introduction of underground storage in the Serbia's system, will solve the problem and cause constant high utilization of pipeline without daily

oscillations during season. With realization of South stream pipeline this problem will be solved definitively.

Figure 5. Annual profile of average daily gas consumption each month by sector

However, since the indigenous production will decrease and will have to be replaced by less flexible imports, more flexibility has to come from the second source, namely, gas storage facilities. ~~New transit line, branch of South Stream pipeline from other Bulgarian side will increase performance of the entire Serbian gas system.~~ The new direction of gas supply from Bulgaria will increase the stability of Serbian gas system. At this moment, only one gas supply direction is present, the one going from Russia via Ukraine and Hungary which if highly unreliable. Access to storage is regulated since it serves similar purposes to the balancing of energy in electricity markets: market entry without access to flexibility is very difficult. Thus, in order to open the gas market to competition, it is very important to ensure that entrants have access to storage. In Article 19 of its Gas Directive, the European Union therefore has established third-party access to storage in order to facilitate downstream competition in the gas market. While the Gas Directive also allows for regulated third-party access, most member countries so far have opted for the alternative, namely, negotiated third-party access. ~~Significant of this first, even so small underground storage Banatski Dvor, is huge for Serbia.~~ The importance of the first gas storage, however modest it is, is of crucial importance for Serbia keeping in mind that Serbia cannot count on domestic production and excluding the transit via Ukraine for its unreliability. For example, in north-western Europe,

flexible indigenous production has to be replaced by less flexible imports from far distant fields. The additional flexibility has to be provided by gas storage facilities. While this will cause few problems in the mid-term, beyond 2015–20, a significant storage gap will arise. Höffler and Kübler (2007) project the gap to increase to about 10.2 Bcm ~~·10^{9}m^{3}~~ in storage working gas volume by 2030, even without strategic stock obligations. With such obligations, the gap in storage working gas volume will increase to 19.6 Bcm ~~·10^{9}m^{3}~~ (5% of non- European Union imports) or 29 Bcm ~~·10^{9}m^{3}~~ (10% of non- European Union imports).

Gas demand in Serbia over the decade from 2005 to 2015 is difficult to project in part because annual consumption in the past two decades has varied so widely, from a high of nearly 3 Bcm ~~·10^{9}m^{3}~~ in 1988 down to about 1 Bcm ~~·10^{9}m^{3}~~ in 1993, up to about 2.5 Bcm ~~·10^{9}m^{3}~~ in 1997. ~~and down again to about 1.5·10^{9}m^{3} in 1999 and 2000.~~ In the first half of the current decade a more steady demand growth has resumed at about 8% per annum. However, there are a number of challenges, including a small number of large industrial customers with financial difficulties with very large arrears in gas payments. Srbijagas is projecting demand of about 4 Bcm ~~·10^{9}m^{3}~~ in 2015, with a range of plus or minus 0.5 Bcm ~~·10^{9}m^{3}~~ for optimistic or pessimistic cases. In the ‘neutral’ case with moderate economic growth and some efficiency improvements, gas demand scenario projects about 3.7 Bcm ~~·10^{9}m^{3}~~ by 2015. This incremental demand, of a little over 1 Bcm ~~·10^{9}m^{3}~~, is rather small in relation to the volumes usually required to economically justify a new pipeline. For this reason, it is of interest to Serbia to see if additional transit volumes to neighboring countries could be realized.

Serbian gas demand is supplied from indigenous production and imports from Russia delivered via Ukraine and Hungary, as mentioned above in the text. Srbijagas buys from Gazprom at the Ukraine-Hungary border and pays a transit fee to MOL (Hungarian oil and gas company) for transport across Hungary to Horgoš on Serbia's northern border. The gas pipeline network is oldest and most developed in northern Serbia, partially developed in central Serbia and hardly developed at all in southern Serbia. The flow of domestically produced gas and imported gas is basically from north to south through a linear-radial pipeline system. Indigenous gas production in Serbia has now declined to very low levels, from around 600 Mcm~~$\cdot 10^6 m^3$~~ per year in the late 1990s to about 230 Mcm~~$\cdot 10^6 m^3$~~ in 2004. This is less than 10% of Serbia's gas demand. Recent discoveries of gas in central Serbia are relatively small. Therefore, the proportion of domestically produced gas is expected to decline further as Serbia's gas demand grows and production continues to decline. In the absence of major new gas discoveries, Serbia will need to import almost all of its gas needs in future.

The transit price through Hungary is determined by a formula, which was producing a price of about 19US$ per tcm ~~1000 m^3~~ in 2004. The transportation fee paid to MOL under the contract is determined by a formula indexed to five items, which are, in descending order of their weighting factors: gas network equipment costs taken from a published index; the gas price in the MOL-Gazprom contract; inflation in the previous year in the SDR economies (The Special Drawing Rights economies are Japan, the United States, the United Kingdom, and the Euro zone); average gross earnings in

Hungary in the sector relevant to pipeline construction; the price of cold rolled sheet steel (Gasification Study, 2004). In contrast with the relative low gas price comparing to other countries, the transit price was quite high. ~~(Table 4).~~

~~Table 4. Gas price vs. transit costs~~

Price of natural gas is in correlation with price of crude oil ~~and today is higher than shown in table 4~~ (Movassagh and Modjtahedi, 2005; Brown and Yücel, 2008; Trapmann 2008; Ghouri, 2006; Samsam Bakhtiari, 2002; Hartley et al, 2008).

The contract is for a capacity of 3.8 Bcm~~ $\cdot 10^9$ m^3~~ per year but MOL has agreed each year to allow Srbijagas to nominate its annual volumes on a year-ahead basis. Srbijagas is then required to pay the transit price for each unit of gas delivered and to pay 80% of the price for any units short of the annual nominated quantity. Units in excess of the nominated annual quantity are charged at the transit price with no penalties applied. Under these arrangements, the daily maximum quantity has been reduced slightly from the amount in the master contract, and this limit is strictly enforced. The daily maximum quantity is 10 Mcm~~ $\cdot 10^6$ m^3~~ (compared with 10.4 Mcm~~ $\cdot 10^6$ m^3~~ in the master contract). When averaged over the entire year, demand in Serbia is about 6 Mcm~~ $\cdot 10^6$ m^3~~ per day — well within the contracted capacity under the transit contract with MOL. But peak daily demand is the critical factor, not annual average demand. Peak daily demand is already hitting the contract maximum of 10 Mcm~~ $\cdot 10^6$ m^3~~ per day. With declining indigenous production and no gas storage in Serbia, Srbijagas is now on the threshold of a supply crisis, whereby it will be unable to supply all gas demand on the coldest winter

days. Srbijagas has started to manage consumption. For example, the fertilizer plant has been asked and has agreed to change from a winter-only to a summer only production schedule. Also, due to the import constraint, there were five or six days last winter when the district heating company in Belgrade was asked to switch to fuel oil so that gas supply could be interrupted. This reduced demand by just under 3 Mcm~~$\cdot 10^6\ m^3$~~ per day. This meant over two hours of interruption to heat supply during the fuel change-over and costs for cleaning the boilers after running on fuel oil. Serbia urgently needs gas storage to allow gas demand on winter peak days to be met with the current daily import constraint (question of underground storage will be solved according to agreement signed by Russia). Storage would allow Srbijagas to improve its management of its customers' large seasonal demand swing with a flatter annual import profile. To achieve a near flat import profile with the current seasonal demand profile and annual imports at about 2 Bcm~~$\cdot 10^9 m^3$~~ per year of demand will require 0.6 Bcm~~$\cdot 10^9 m^3$~~ of working storage capacity. European Union recommended practice is that 90 days (three months) of gas be stored for reliability purposes. To store three winter months of gas supply in Serbia for increased reliability would require another 0.54 Bcm~~$\cdot 10^9 m^3$~~, for a total of 1.14 Bcm~~$\cdot 10^9 m^3$~~. If annual consumption in future reaches 5 Bcm~~$\cdot 10^9 m^3$~~ per year, and if the seasonal demand profile is the same as now, 1.88 Bcm~~$\cdot 10^9 m^3$~~ of seasonal storage capacity would be required to flatten the annual import profile. Adding three winter months storage would raise this to 2.25 Bcm~~$\cdot 10^9 m^3$~~. Serbia is estimated to have technical potential storage facilities of between 4 and 6 Bcm~~$\cdot 10^9 m^3$~~ (Gasification Study, 2004).

Large scale underground storage, such as Banatski Dvor, are usually constructed in depleted gas, gas-condensate deposits, oil deposits with gas cap and oil reservoirs. Partly depleted gas reservoirs are usually the best candidates for converting into storage because this considerably decreases the costs relating to gas, gas cushion and gas cushion formation. In estimation of the suitability of a certain oil or gas reservoir for converting to gas storage, the geological and physical reservoir properties are considered, such as: the size of initial reserves, depth of reservoir formation, petro-physical reservoir properties, type and quality of elevated rock layer, presence of tectonics, reservoir surface and form, mode of operation during gas production, pressure and temperature in the reservoir, the remaining gas reserves, i.e. hydrocarbons, technical conditions of the wells, conditions of reservoir production development, conditions of ground installations and distance from the main gas pipeline, i.e. from the consumer load centres (the closer the better).

A significant scope of oil geological research works in the territory of Serbia has been performed in the last 55 years. The result of these works is a relatively high degree of research data in the Pannonian region. The scope of works carried out in central Serbia is considerably smaller and so the research data is not nearly as extensive. The best results have been achieved in the regions of Banat and middle Bačka. According to the Naftagas 50th Anniversary Monograph, the following have been carried out so far:

- 40869 km of seismic researches,
- 2028 oil and gas drilled wells or over 3 million meters.
- 99 oil and gas fields with 272 reservoirs have been discovered.

- 39.5 million tons of oil and 29.3 billion m^3 of natural gas have been produced.

Gas fields represent about 50% of the total number of discovered oil and gas fields, oil fields about 40%, gas–condensate deposits 5% and CO_2 gas deposits the remaining 5%. As regards the size of the discovered fields, the Velebit, the Mokrin and the Kikinda oil and gas fields can be classified as medium size fields, compared with the reservoirs in the Pannonian Basin and even partially compared to the European scale. Small fields are in the majority. Out of the total number of fields, about 60% have a surface area under 2 km² and about 24% of the discovered oil and gas fields have a surface area larger than 3 km² and only the Mokrin field has a surface area exceeding 50 km². Former NIS Jugopetrol-nafta (NIS Naftagas-podunavlje) carries out oil and gas exploration in the region of Central Serbia. The best results were obtained in the region of Podunavlje and Velika Plana (Markovac). Two oil and gas fields and one gas field have been discovered in the region of Podunavlje so far. The Sirakovo and the Bradarac-Maljurevac oil and gas fields are under production and can be classified as smaller oil fields. About 200 000 tons of oil have been produced so far. The discovered Ostrovo gas field is being researched. Future research programs plan research works in several locations in the region of Podunavlje where there are indications of possible gas reservoirs in the location of Staro Selo in the region of Velika Plana where there were earlier indications of gas reservoirs. To make a program of oil geological research works in order to discover gas reservoirs, it is considered that gas reservoirs present a potential underground storage and, for that reason, the efforts are made to collect as much data as possible required to estimate reservoirs. Accordingly, the discovery of several suitable locations for underground gas storage is being expected in central Serbia.

Several research projects had been proposed in the past, but final decision is storage will be in depleted gas reservoir in Banatski Dvor:

- The first project includes the estimation of depleted reservoirs or reservoirs in the advanced stage of exploitation in order to find ways to build a storage with capacity of up to one billion m³ of gas. Several reservoirs would be processed by this project, including: Srbobran, Tilva, Begejci, and Međa.
- The second project would include the study of several reservoirs in the complex of the Mokrin oil and gas field where it could be expected that several possibilities would be found to build storage with capacity of 2 to 4 billion m³. This project is a serious candidate for the transit storage.
- The need to have storage in the vicinity of the consumer centres requires a third project. This would include the study of smaller gas fields undiscovered as yet or those which are under the production, with a view to converting them into storage. This project would seek reservoirs having initial gas reserves of up to 600 Mcm ~~million m³~~. This project also includes exploration in central Serbia where establishing storage is important in order to upgrade the reliability of the transmission system. This kind of storages can be of great values in Serbian system having regard that Serbia has no even marginal storage capacities especially in the time of crises. Illustrative is the crises with transit through Ukraine in the beginning of 2009.

In Europe, the deregulation process of natural gas markets is based upon the liberalization of services to consumers on the one hand, and the third party access to the network infrastructures on the other hand according to the EU Directives on Gas liberalization (1998/30/CE) in order to introduce competition on the national natural gas markets (Esnault, 2003). In fact, the EU Directives on Gas liberalization (1998/30/CE and 2003/55/CE) have recommended the definition of non-discriminatory third party access and tariff rules for storage facilities. Good review of gas storage issues in Italy is available in the paper of Bonacina et al (2009).

4. South Stream pipeline; Chance and Obligation for Serbia

South Stream project is envisaged by Gazprom and its partner, Italy's Eni, as a 30 Bcm ~~$\cdot 10^9 m^3$~~ annual capacity pipeline in two branches running from Russia under the Black Sea to Bulgaria and on into Europe, with operations starting in 2013 (or in 2015). Often described as a "rival" to Nabucco, the South Stream line would run from Russia, across the seabed of the Black Sea to Bulgaria, there to bifurcate: one arm westward via Greece to Italy and another arm northward to Serbia with possible continuation into Central Europe. The main line to Bulgaria is projected to carry 30 Bcm ~~$\cdot 10^9 m^3$~~ of Russian-delivered gas annually, but branch through Serbia will carry 10-18 Bcm ~~$\cdot 10^9 m^3$~~ annually. From Varna, Bulgaria, the south-western route would continue through Greece and the Ionian Sea to southern Italy. The north-western pipeline will run through Serbia, and Hungary to Austria ending at the Baumgarten gas storage facility (Figure 6).

Another option is that the north-western route would run through Slovenia to northern Italy.

Figure 6. Competing gas pipeline route from Caspian region and Russia to European Union

The South Stream pipeline project was announced on June 2007, when Italian energy company ENI and Russian Gazprom signed in Rome a memorandum of understanding of construction this pipeline. On November 2007, Gazprom and ENI signed in Moscow an agreement about establishing a joint project company for the commissioning of the marketing and technical feasibility studies of the project. On January 2008, Gazprom and ENI registered in Switzerland the joint venture South Stream AG equally owned by the two companies. The agreement between Russia and Bulgaria on the Bulgaria's participation in the project was signed on 18 January 2008. It was agreed to set up an equally owned company to build and operate the Bulgarian section of the pipeline. The agreement was ratified by Bulgarian Parliament on July 2008. According to this agreement Bulgarian and Russian share in joint project will be equal. But Serbian agreement provides the establishment of a joint venture with 51% owned by Gazprom and 49% owned by Serbia to carry out a feasibility study and build and operate the Serbian section of the pipeline with capacity of at least 10 Bcm of natural gas. Note that under this agreement Serbia will also sell 51% of NIS to the Russian side. The first agreement between Russia and Serbia was signed even before announcement of the South Stream project. On December 2006, Gazprom and Serbian state-owned gas

company Srbijagas agreed to study building a gas pipeline running from Bulgaria through Serbia. The Russian company already controls Jugorosgas, which in turn controls the main Pojate-to-Niš pipeline. On January 2008, Russia and Serbia signed an agreement to route a northern pipe of South Stream through Serbia and on 25 February 2008, an agreement to create a joint company to build the Serbian section of the pipeline and large gas storage facility near Banatski Dvor in Serbia, was signed. At the same day, Russia and Hungary agreed to set up an equally owned joint company to build and operate the Hungarian section of the pipeline. Like in Bulgarin case, the two sides, Russia and Hungary agreed to set up a equal joint venture to build the stretch of line passing through Hungary and 1 Bcm ~~$10^9 m^3$~~ of underground gas storage. Hungary's Mol is also a member of the consortium developing the Nabucco gas pipeline, which plans to deliver Caspian gas to Europe. Bulgaria is also involved in Nabucco project. The Hungarian deal coincided with the signing of a deal between Gazprom and Serbia's Srbijagas. The agreement stipulates the creation of a joint venture to complete a feasibility study, as well as the construction and use of a gas pipeline through Serbia with capacity of at least 10 Bcm ~~$10^9 m^3$~~ as part of the creation of the South Stream gas pipeline system. An integrated intergovernmental agreement on the South Stream project and the Banatski Dvor underground gas storage facilities in Serbia was signed on January, the same day that Gazprom's oil arm, Gazprom Neft, signed a deal on the terms of acquiring a controlling 51% stake in Serbian NIS for 400 million €. But it appears to be facing problems concluding the NIS deal, as Serbia wants a higher price. International auditors Deloitte & Touche appraised NIS at 3.48 billion US$. NIS controls around 60% of Serbia's oil market, operates two refineries but does not operate

the crude supply pipeline to Croatia (Figure 1). New firm, Transnafta, operates all major oil pipelines in Serbia. The proposed agreement between Russia and Serbia includes Gazprom's offer to ensure the long-term security of gas supplies to the country, with Gazprom and Srbijagas, the state-owned gas-infrastructure firm, to develop storage and distribution assets. The Serbia's government offered Russia's Gazprom the chance to buy into state petrochemicals firm HIP-Petrohemija (Figure 1), one of Serbia's biggest exporters. The offer of a stake in HIP-Petrohemija could pave the way for a compromise. But, estimated price for NIS seems not so important. They point out that the agreement makes Serbia part of the South Stream gas pipeline project, which promises not only energy stability for the country but also significant revenues from transit of natural gas to Europe.

On April 2008, Russia and Greece signed an intergovernmental agreement on cooperation in the construction and operation of the Greek section of the South Stream. ~~There is some rumors~~ Schaffer (2008) claims that main route of South Stream leads through Romania, and that Serbian route is alternative. According to Schaffer (2008) Serbia is actively cooperating with Russia in planning a South Stream pipeline extension, but it is unlikely to transit through Serbia and the essence of the pact between Belgrade and Moscow is that Gazprom will guarantee long-term gas supplies to Serbia.

The agreement of Russia and Serbia has provided Russian company Gazprom with extremely favourable terms of work in Serbia. In the fact, agreement gives great opportunities for both sides. It acquired the state NIS cheap and got advantages in

admission to the Serbian area of future South Stream gas pipeline (Figure 6). On the other hand, gas agreement with Russia provides long term of stability in the sense of energy for Serbian side.

If executed, the project would set back the energy security objectives of the European Union and the United States on two major counts. First, it would preempt markets targeted by the Nabucco project, cementing a Russian monopoly on some of them and breaking into new ones, and increasing the overall level of European dependence on Russian-delivered gas. And, second, it would use this pipeline to carry gas from Central Asia via Russia, thus preempting Turkmen and other gas volumes and strengthening Russia's monopoly on Central Asian gas, despite western intentions to demonopolize that situation also. In this context, Russia is trying to capture Serbia's entire energy sector at one stroke. The Russian government and Gazprom propose to set up three Russian-controlled joint companies - one for oil and two for gas - on Serbia's territory, with some ramifications into the Republic of Srpska within Bosnia and Herzegovina. Russians claim that Serbian gas and oil fields are also included in this price, but Serbian side claims that these fields remain in the formal property of Serbia with Russian obligation to pay a rent.

European gas demand will rise from presently 540 Bcm~~ $\cdot 10^9 m^3$~~ to around 800 Bcm~~ $\cdot 10^9 m^3$~~ in 2030 (Goldthau.2008). As more than 50% of overall European imports originate from Russia, fears have been expressed that the Russia could use energy resources as a foreign policy tool. ~~In spite of the widely discussed~~ Gazprom has

permanent transit problem with Ukraine and possible with Belarus. Before the crises in the beginning of 2009, prize for the gas intended for the Ukraine market was 135US$ per tcm and for Belarus 100US$ per tcm (Parthasarathy, 2008). From 2010 price for Ukraine will be equalized with European (more than 400US$). Simultaneously, transit taxes for Russian gas intended for other countries will be increased. For example, now Russian gas for Serbian become property of Serbian side in the border of Ukraine and Hungary. Transit through Ukraine is Russian obligation and there is no tax for the Serbian side for the transit through Ukraine. On the contrary, Serbia has separate contract with Hungarian MOL for transit through Hungarian territory and for possible usage of storage capacities in Hungary. ~~can be believed that sufficient export transportation capacity to Europe will not be any problem during the next decade,~~ Russia's Energy Strategy[7] through 2020 estimates total exports to Europe by 2015 to be somewhat lower than 160 Bcm~~$\cdot 10^9 m^3$~~. The already existing export pipelines through Ukraine (Urengoy-Uzgohorod and Soyoz) and the Yamal-Europe (after Yamal peninsula in Russia) corridor through Belarus can carry 168 Bcm~~$\cdot 10^9 m^3$~~ of gas to Europe annually (Figure 6). A partial overlap of South Stream and Nabucco does not, therefore, create a redundancy or possible oversupply but actually improves Europe's security of supply. (Roginsky and Minina, 2008; Brkić, 2008a). ~~This circumstance can only improve the European security of supply.~~ Europe is in need of an increasing number of energy links, which is why the European Union is committed to the Nabucco project. It was in Europe's interest to diversify its energy sources and supply routes. The 14 billion US$ South Stream pipeline is expected to annually pump 30 Bcm~~$\cdot 10^9 m^3$~~ of

[7] Russia's Ministry of Energy, 2003. Energy Strategy of Russia for up to 2020

Central Asian gas to southern Europe. Estimated investment in this project possible will be increased up to 20 billion US$ (Anonymous, 2008). ~~Serbia, Hungary and Greece joined the project, already involving Italy and Bulgaria, earlier this year. Hungary is a shareholder in the European Union–backed Nabucco pipeline, aimed at bringing gas from Central Asia to Europe while bypassing Russia.~~ But it also signed up to Russia's South Stream gas pipeline project earlier this year, prompting United States concerns that Hungary may sideline the European Union project, which is aimed at reducing Europe's energy reliance on Moscow. Evaluation of natural gas supply options for south-east and central Europe is shown in the paper of Afgan et al. (2007a, b, 2008). In these papers Nabucco project is slightly better rated compared to South stream pipeline. But, according to Schaffer (2008), Russian dominance of the Eurasian natural gas delivery system has put the independence of the European foreign policy at risk. Although Europe is struggling to counteract the threat, Russia appears to be winning the game. Russia's stranglehold already has acquired 25% of the European market. Moreover, it is installing four new pipelines, and plans to increase its market share substantially (Figure 6). In response, Europe is building or planning three new pipelines. Mavrakis et al (2006) in their paper examined the supply potential of whole south corridor with supplying sources from Azerbaijan, Turkmenistan, Iran and Iraq, which is of significant values for the joint European Union and U.S. endeavor especially because Nabucco project could be reconsidered in absence of real gas providers in the middle East (Feller, 2008).

5. Conclusions

Natural gas ~~consumption~~ is the fastest growing primary energy source in Serbia. New oil and gas agreement, sign with Russia, ~~which natural gas industry is~~ the world's largest producer and transporter of natural gas ~~(with proved gas reserves of $47000 \cdot 10^9 m^3$, with annual production of $580 \cdot 10^9 m^3$ per year and with transit to European Union of $115 \cdot 10^9 m^3$ per year through Nord stream, South stream, Yamal and Drudzba pipeline)~~, will transform Serbia from an import only country to a transit country for Russian gas (Brkić, 2008a). Through South Stream pipeline, with planed transport capacities of 30 Bcm~~$\cdot 10^9 m^3$~~ per year scheduled to start in 2013, will be transported almost one quarter of entire export of Russian natural gas to European Union. Branch through Serbia will transport 10-15 Bcm~~$\cdot 10^9 m^3$~~ annually, and Serbia expect income of about 200 million US$ per annum from transit fees. According to that, natural gas in Republic Serbia is expected to be the primary substitute for electricity based heating either through district heating in densely populated areas or individual boilers in the rest of the country (Brkić and Tanasković, 2008). Extension of the gas networks is extremely important for Serbia's overall energy and environment strategy and should preferably be undertaken by private investors. An increase in the share of natural gas energy is the strategic option and the consumption should increase at the highest rate as the result of substitution of other fuels and increased demand. In Serbian towns, there are still dilemmas whether it is better to build a natural gas or a district heating system (also mostly gas fueled) in the light of the shortage of funds, (un)available fuels, habitat culture and many social and economic aspects of the use of a particular form of energy. Basically, the application of gas supply systems for households requires coordinated development of gas and district heating system under the local conditions. It is made imperative by the investment and

operation economics and the need to conserve and save energy and such long-term analyses should be conducted in all cities where there are possibilities to use natural gas, especially because the domestic solid fuels has not found broader application in centralized district heating systems due to environmental reasons. That is why in the future Serbian authorities must search for faster development and utilization of natural gas in these regions of a town, where the local conditions allow the same. But, before all Serbia has to prepare enough capacity in underground facility Banatski Dvor and to start with injection of gas during the following summer.

Today, Serbian NIS as well as Srbijagas, is good example of big post-communist enterprise with too many inefficient employees. Government strategy is to keep all existing working positions. This leads to increasing of inefficiency and also to the highest unemployment rate among of almost all European countries (Table 1). Young highly educated population is the main victim of these circumstances. Today, before selling of NIS to Russian partner is practically impossible to be hired in NIS or Srbijagas, even for high educated experts. Informal prohibition for hiring and also for dismissing from a job exists from 2002. Also, all jobs in petroleum and gas explorations and exploitations are under NIS jurisdiction. There is no place for other private domestic or foreign services companies in this kind of business. All exploitation fields are in government's property and price for crude oil and gas are formed by government decrees according to recommendations from the Serbian Energy Regulatory Agency (AERS). All oil and gas fields in the country are under jurisdiction of NIS. Monopoly is complete. Mining tax for NIS is only 3% and licence for monopoly is free for

government owned firms since the communist era. Of course, price of crude oil in world's market are irrelevant in relation between NIS and government. International price of crude oil has major role for final price of fuel for vehicles relevant only for final consumers. General conclusion is that future owner from Russia will have to manage large scale of reforms in the NIS and to try to increase simultaneously performances of entire system. Note that NIS is the biggest firm in Serbia. Top management in both firms, NIS and Srbijagas, is set according to political agreements among main political parties in Serbian governments. Members of top management are also high politicians, and highest figures are almost by the rule former or future ministers.

All Russian gas supplies through Ukraine were shut down early in the beginning of January 2009 in a further escalation of the pricing dispute, leaving some EU and Balkan countries, with no gas supplies from Russia in conditions of very cold winter. The reason for this crisis is the combination of fundamental changes in Russia, Europe and in the gas business itself. Although Europe accounts for almost 20% of world's annual consumption of gas, its own reserves represent less than 2% of known world's reserves, and Russia as largest exporter provides 26% of Europe's demands for gas (Feller, 2007a). We have to notice, that natural gas is a key factor for lowering of CO_2 emission and it has additional value after Kyoto. Today, main questions in relationship between Europe and Russia considering gas, are; is there available gas in Russia to supply Europe in the future, is the existing routes for supplying secure and reliable and what alternatives exist to diversify Europe's routes for supplies of gas or even better to say of gas sources. Today, the pipelines through Ukraine have enormous significant with

annual capacity of 120 Bcm comparing to 30 Bcm of Belarus lines. Something about 62.7% of Russian gas imports to Europe are through territory of Ukraine and Belarus (Parthasarathy, 2008). Ukraine has now gas debt of about 600 million US$, and from 2010 will have to pay price for gas equal as rest of Europe. Under these circumstances Russia has to insure stability of her own gas import, and on the other hand Europe has to diversify her own routes for supply. To avoid that gas tariff dispute with Ukraine and eventually with Belarus, Russia will build two new pipelines to EU, one South Stream to Bulgaria via Black Sea, and second to Germany via Baltic Sea. The Nabucco pipeline has also good chance for success despite of a lack of concrete deals with gas supplier. According to Feller (2007b), Gazprom outmaneuver EU in the Nabucco project by signing supply agreements with non-Russian suppliers of gas, such as Turkmenistan. But both project, the Nabucco and the South Stream, if will be executed, will secure Europe's security of supply (Brkić, 2008a).

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Appendix 1-About Serbia

Serbia is independent republic from 2006 (before in union with Montenegro, and before 1991. one of the six Yugoslav republic with Macedonia, Montenegro, Croatia, Bosnia and Herzegovina, and Slovenia). Serbia has two autonomous provinces; 1. Vojvodina in the north and, 2. Kosovo and Metohija in the south-west of the country. Autonomous Province of Kosovo and Metohija is under the United Nation Mission in Kosovo (UNMIK) administration in accordance with the United Nations Security Council (UNSC) Resolution 1244 from 1999.

Appendix 2-Survey of literature

In the paper of Sagen and Tsygankova (2008) and in the paper of Spanjer (2007) are shown potential effects on Russian gas exports from different Russian domestic gas prices and production capacities. They also investigate whether a fully competitive European gas market may provide incentives for Gazprom, the dominant Russian gas company, to change its export behavior if Russian prices approach European net-back levels. Gazprom may reduce exports in favor of a relatively more profitable domestic market (Konoplyanik, 2003). As more than 50%-of overall European imports originate from Russia, fears have been expressed that the Kremlin could use energy resources as a foreign policy tool. From the viewpoint of Serbian government strategy, paper of Goldthau (2008) is very interesting. Investigated how higher domestic Russian gas prices enhanced energy efficiency and how increases in non-Gazprom production would

however make it possible for Russia to meet domestic demand and its export commitments for natural gas. ~~Quast and Locatelli (1997)~~ Weisser (2007) investigated in his paper how much gas is available for export for the next 15 to 20 years. ~~Similar studies are done by and Wagbara (2007). Valuable analysis in matter of this paper, but not for South Stream, than only for North Stream pipeline is shown in the study of Lochner and Bothe (2007).~~ Europe's increasing import dependency in natural gas facilitates a number of new infrastructure projects. However, up to now it has always been difficult to assess the full impact of these projects as interdependencies within the whole European gas infrastructure system were hard to predict. Model presented in the paper of Lochner and Bothe (2007) allows such forecasts. To demonstrate the model's capabilities, they examined the effects of the Russian-German Nord Stream (on the bottom of the Baltic Sea) import pipeline with respect to its impact on Europe's infrastructure system, especially volume flows within the grid and the utilization of import pipelines with the respective effect on Europe's gas supply mix. Lochner and Bothe (2007) analyzed a scenario where Russian exports are allowed to increase alongside the capacity increase and one where they are not. Applying a global gas market model, Lochner and Bothe (2009) produce a forecast for global gas supply to 2030 and determine the supplier-specific long-run average costs of gas supplied to three major consuming regions: Europe, the United States and Japan.

Further deregulating the Russian gas sector will be great factor of influence on Serbian gas sector as well as European Union gas supply (Grigoryev, 2007). On the other hand, a complementary model for the European natural gas market is shown in the paper of

Egging et al. (2008) and prospects of the European gas market in the paper of Kjärstad and Johnsson (2007). Future European gas supply in the resource triangle of the Former Soviet Union, the Middle East and Northern Africa, relevant to the subject of this paper is shown in the paper of Remme et al. (2008), and Soviet natural gas exports and the European energy balance during the communist era is shown in the paper of Herbert and Berg (1990). Some aspects of environmental impacts of policy issues for Russian long distance gas transmission pipelines is shown in paper of Lechtenböhmer et al. (2007) and Lelieveld et al. (2005).

Gas usage in urban conditions of towns in Serbia with specific criterions is shown in the paper of Brkić and Tanasković (2008) and in the paper of Brkić (2008b). The paper of Jednak et al. (2008) can be very useful for readers to make complete picture of energy sector in Serbia. This paper (Jednak et al., 2008) deals with electricity reform in Serbia. Further, natural gas future in Croatia is shown in the paper of Karasalihović et al. (2003). This paper can be useful-as well as paper of Vujčić et al. (2000) for comparisons because Serbia and Croatia were been part of one country (former Yugoslavia) for more than seventy years during the 20th century. Only Slovenia of all former Yugoslav republics is today member of EU (Potočnik et al., 2007). Some reviews of natural gas sector of other countries; Turkey (Hacisalihoglu, 2008), Slovakian republic (Rajzinger et al., 1997), Hungary (Anonymous, 1994), Brasil (Mathias and Szklo, 2007), Romania (Dincha et al., 2007), United Kingdom (Lyness, 1970), Italia (Fabbri et al, 2000; Erbetta and Rappuoli, 2008), Greece (Caloghirou et al, 1995) and of regions (Dorian, 2006; Watkins, 2007) can be very useful for the discussion shown in this paper.

Alternative routes for the European supply options are shown in the paper of Critchlow et al. (2008) and in the paper of Smith and Koottungal (2008). A strategic planning model for natural gas transmission networks is shown in the paper of Kabirian and Hemmati (2007). Also, some authors (Kelland, 1994) forecast that gas hydrates will be the fuel for the future, and that can have great impact on Serbian gas future for a long period. Review of international trade in natural gas is shown in the paper of Melamid (1994) and Mazighi (2003, 2004). Three categories of criteria are used in the paper of Thomaidis et al. (2008) to compare natural gas market in the Energy Community Treaty countries (ECT[8]). These criterions are: the natural gas network characteristics

[8] On October 2005, Albania, Bulgaria, Bosnia and Herzegovina, FYROM (Former Yugoslav Republic of Macedonia), Serbia, Montenegro, Romania and the United Nation Mission in Kosovo (UNMIK) on the one hand (contracting parties) and the European Commission on the other, signed a Treaty establishing the Energy Community in south-east Europe (Energy Community Treaty—ECT). The goal of the Energy Community is to establish a common competitive energy market in south-east Europe, based on the standards of the common European energy market. The Energy Community countries will implement the European Acquis Communautaire on energy, environment, competition and renewables, set up a specific regulatory framework permitting the efficient operation of the markets and create a common market without internal frontiers. However, these countries have not restructured their energy sector at the same level. The first step for introduction of competition in an energy market is the deregulation of its wholesale sector, followed by the opening of the entire sector.

(interoperability with neighboring networks, available capacity of the national pipelines, connection of the system to gas trading hubs), the existing gas regulations (provision of third party access to the network and unbundling of the transmission system operator) and the actual market functionality (market and customer concentration, security and diversification of natural gas supply).

List of footnotes

1. For some details see appendix 1

2. detail literature survey is shown in appendix 2

3. EIU Country Profile 2000; Yugoslavia (Serbia-Montenegro), p. 28 - The Economist Intelligence Unit Limited 2000

4. Energy law, 2004. Official Gazette of Republic of Serbia 84/04, 23.07.2004

5. Available from: http://millenniumindicators.un.org/unsd/

6. Energy Strategy, 2005. Strategy of Development in Sector Energy of up to 2015, Official Gazette of Republic of Serbia, 23.05.2005.

7. Russia's Ministry of Energy, 2003. Energy Strategy of Russia for up to 2020

8. On October 2005, Albania, Bulgaria, Bosnia and Herzegovina, FYROM (Former Yugoslav Republic of Macedonia), Serbia, Montenegro, Romania and the United Nation Mission in Kosovo (UNMIK) on the one hand (contracting parties) and the European Commission on the other, signed a Treaty establishing the Energy Community in south-east Europe (Energy Community Treaty—ECT). The goal of the Energy Community is to establish a common competitive energy market in south-east Europe, based on the standards of the common European energy market. The Energy Community countries will implement the European Acquis Communautaire on energy, environment, competition and renewables, set up a specific regulatory framework permitting the efficient operation of the markets and create a common market without internal frontiers. However, these countries have not restructured their energy sector at the same level. The first step for introduction of competition in an energy market is the deregulation of its wholesale sector, followed by the opening of the entire sector.

Serbian gas sector in the spotlight of oil and gas agreement with Russia

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Abstract: The Russian natural gas industry is the world's largest producer and transporter of natural gas. This paper identifies the benefits for Serbia as transient country to European Union for Russian natural gas through South Stream gas-line in the current political context of implementation of gas agreement. On the other hand, according to the Agreement on Stabilization and Integration to European Union, Serbia is obligatory to implement reforms in energy sector and its energy policy must be in accordance with the European Union policy. Republic Serbia has produced and consumed natural gas domestically since 1952, but has always been net importer. Strategy of Energy Development in Serbia and especially National Action Plan for the Gasification on the Territory of Republic of Serbia dedicated special attention to gas economy development in respect with expected contribution in efficient energy use and environmental policy protection in the country.

Keywords: Natural gas; Serbia; South Stream pipeline

1. Introduction

Republic Serbia[1] is a country in south-eastern Europe, covering the central part of the Balkan Peninsula, between Montenegro, Albania, Macedonia, Bulgaria, Romania, Hungary, Croatia and Bosnia and Herzegovina.

Natural gas is a preferred as fuel for domestic heating. The strategy for heating of dwellings in urban areas of Serbia, since the communist period, had been made to favour district heating systems. Today, most of these plants use gas as main fuel. Nowadays, individual usage of gas through natural distribution network is also available in many towns in Serbia. For example, the consumer area of Belgrade is being supplied with thermal energy by district heating system consisting of 15 heating plants, which use gas (83% = 265 Mcm/year) and crude oil as an auxiliary fuel. This consumption is equal to annual production of natural gas in Serbia. During the recent crises with transit of gas through Ukraine in January 2009, all Belgrade heating plants were switched to axially, liquid fuel. Some heating plants in Serbia does not have technical possibilities to substitute gas as operating fuel and these towns such Novi Sad and Kraljevo had no heating several days. Serbia does not have even marginal reserves in underground storage, and with minor indigenous production of gas, without help from underground storages from Hungary, Austria and Germany situation could be dramatic. In spite of that, according to the energy strategy, the heat supply for the most Serbian households will be provided by some sort of natural gas heating. The goal is not to use solid or fuel heating, especially not electric energy. This goal will be difficult to achieve because Serbia has only one route for natural gas supplying from Russia, through Ukraine and

[1] For some details see appendix 1

Hungary. Second branch via the bottom of the Black Sea and through Bulgaria will of strategic value for Serbia. South Stream pipeline offers secure supply for a long time and as a transit pipeline to the western Europe, make of Serbia transit country with great incomes from transit taxes.

In 2007, the natural gas consumption of 27 European Union member states was 505 Bcm, the current value being about 100 billion US$ (Schaffer, 2008). Moreover, natural gas consumption in most of Europe is projected to increase at about 1.5% per year for the next 25 years (Schaffer, 2008). Europe's vulnerability lies in the fact that a significant fraction of its natural gas is imported from Russia. From 1978 to 2002 the relative changes in residential consumption of natural gas, electricity, petroleum products and coal were 133.5%, 74.3%, -35.2% and -85.2%, respectively (Asche et al, 2008). In other words, the residential natural gas consumption has more than doubled over the period, while some other energy carriers have experienced a decline. Under a broad energy deal signed by Serbia and Gazprom (Russian gas enterprise) in January 2008, Gazprom was to take 51% of NIS (Naftna Industrija Srbije; eng. Serbian Petroleum Industry), which owns the Novi Sad and Pančevo refineries and the Petrol distribution network, and was to build the Serbian leg of the planned 10-15 Bcm South Stream gas pipeline.

Main points of the situation in Serbian gas sector from the period before ratification of gas treatment with Russia, relevant for this paper is shown in the book of Brkić (2006)

available only in Serbian and some aspects of the future of Russian gas and Gazprom is shown in the book of Stern (2005)[2].

2. Energy and economy scope of Serbia

In the 1990's during the civil war in former Yugoslavia, Serbia's energy system suffered from a serious lack of maintenance and high outages. Stagnation in energy sector took place in the period from 1990 to 2000 as a result of United Nation sanctions and blockade under UNSC Resolution 757. NATO's bombing of Serbia in early 1999. finally devastated the energy sector. Direct war damage in oil and gas infrastructure is estimated at 650 million US$[3]. In 2000-05 there was a major rehabilitation of the sector's infrastructure, with the help of financing from the European Union and international financial institutions.

2.1. Economy in Serbia

Serbia started real transition process in 2000. From then it has run successful reforms. Prior to these changes, the Serbian economy and energy sector had been subjected to the well-known unfavourable conditions (Knott, 1999) such as civil war in former Yugoslavia, UN sanctions and blockade under UNSC Resolution 757, world record in hyperinflation in 1993, NATO military campaign in 1999, undemocratic regime before

[2] detail literature survey is shown in appendix 2
[3] EIU Country Profile 2000; Yugoslavia (Serbia-Montenegro), p. 28 - The Economist Intelligence Unit Limited 2000

2000, difficult situation in the south province of Kosovo and Metohija, problem in functionality of former union with Montenegro, many Serbian refugees exiled from Croatia and from Kosovo and Metohija, etc. During that period, technical performance of energy infrastructure considerably deteriorated, while the economic capability to secure energy supply, reliable and efficient operation, and regular energy system maintenance, had considerably declined. Energy companies have been too far from financially sustainable operation. Among those reforms are reforms in energy sector. Energy sector is one of the largest sectors of Serbia's economy comprising of a power system; coal production; district heating system; oil and gas production and import; and it accounts for more than 10% of GDP (Table 1). Oil and gas sector in Serbia is very dependent on import (about 80%).

Table 1. Comparative economic indicators, 2007

source: www.cia.gov	Serbia	Bulgaria	Croatia	Romania	Hungary
Territory (km^2)	88 361	110 910	56 542	237 500	93 030
Population (million)	10.15[a]	7.26	4.49	22.24	9.93
GDP (billion US$)					
-purchasing power parity	77.28	86.71	69.59	247.1	191.7
- official exchange rate	41.68	39.61	51.36	166.0	138.4
GDP per capita (US$)					
-purchasing power parity	10400	11800	15500	11100	19300
-nominal, current prices (IMF 2008)[b]	7054	6849	14414	9953	16343
Real GDP growth (%)	7.3	6.2	5.7	6	1.3
Consumer price inflation (%)	6.8	9.8	4.5	4.8	8
Current-account balance (billion US$)	-6.88	-8.53	-4.85	-23.02	-8.01
Reserves of foreign exchange and gold	14.22	17.38	13.67	39.96	24.05
Exports of goods (billion US$)	8.82	18.44	12.62	40.32	87.77
Imports of goods (billion US$)	18.35	28.67	25.99	64.54	86.88
External debt (billion US$)	26.24[c]	34.88	46.3	74.54	125.9
Unemployment rate (%)	18.8	7.7	11.8	4.1	7.3
Population below poverty line (%)	6.5	14.1	11	25	8.6

[a]including population of autonomous province of Kosovo and Metohija which can be only estimated up to 2 661 045 (United Nation Mission in Kosovo-UNMIK administration in accordance with the United Nations Security Council-UNSC Resolution 1244 from 1999)
[b]from http://imf.org/external/
[c]including Montenegro and UNMIK

Serbia's economic structure continues to shift gradually away from agriculture and industry, and towards services, following an established pattern of more developed economies. In 2005 industry accounted for an estimated 28% of GDP and agriculture 15%, with services making up the remaining 57%. Serbia has a significant manufacturing sector that includes industries such as chemicals, textiles, car production, furniture and food-processing. The large agricultural sector is expected to remain important.

2.2. Energy in Serbia

The Serbian economy is still extremely energy-intensive. This is a legacy of its communist-era industrial structure and of post-communist policies that, for a long time, gave firms and households little incentive to economize on energy use. Reform of the energy sector is reasonably far advanced by south-east European standards. The Serbian Energy Regulatory Agency (AERS) and the Serbian Energy Efficiency Agency are independent regulatory authority but their independence has yet to be fully tested.

2.2.1. Energy profile of Serbia

Before March 1999 Yugoslavia was self-sufficient in electricity produced from coal and hydropower, and electricity normally covered 75% of the total centrally supplied energy needs of Serbia (gas and oil cover the remaining 25% of demand). The sector is

dominated by state-owned monopoly EPS (Elektroprivreda Srbije; eng. Electric Power Industry) with central office in Beograd, which accounts for more than 80% of total output of primary energy and 95% of electricity generation. Total installed capacity in gas fueled co-generation power plants owned by EPS is 353 MW in power plants fuelled by oil or gas (Table 2). EMS (Elektromreže Srbije; eng. Serbian Power Transmission Company) as a separate entity (before 2005, part of EPS) is authorized for electric power transmission, transmission system management and electric power market management. Both of them (EPS and EMS) are in 100% ownership of the Republic of Serbia. Transformation of oil and gas industry is done according to the same law[4].

Energy consumption per capita is highly correlated with GDP per capita (Afgan et al., 1998). Some market structure and the pricing of electricity and natural gas are shown in the paper of Knittel (2003).

Most oil production is undertaken in the north of Serbia, where some 14500 bpd (about 2300 m^3 per day) of crude oil are produced, covering 33% of domestic consumption. The sector of oil and gas was dominated by state-owned monopoly NIS with central office in Novi Sad (Figure 1). New enterprise Srbijagas with central office in Novi Sad is founded by Serbian government according to the reorganization from October 2005. Gas sector was previously part of NIS. This company is responsible for transport, storing, distribution and trading of natural gas. Previously this issue was covered by two firms; NIS Energogas with central office in Beograd and NIS Gas with central office in

[4] Energy law, 2004. Official Gazette of Republic of Serbia 84/04, 23.07.2004

Novi Sad (both was part of NIS). According to the Energy Law, from October 2005, old NIS has been split into two major sectors: oil (new NIS and Transnafta) and gas (Srbijagas) (Figure 1).

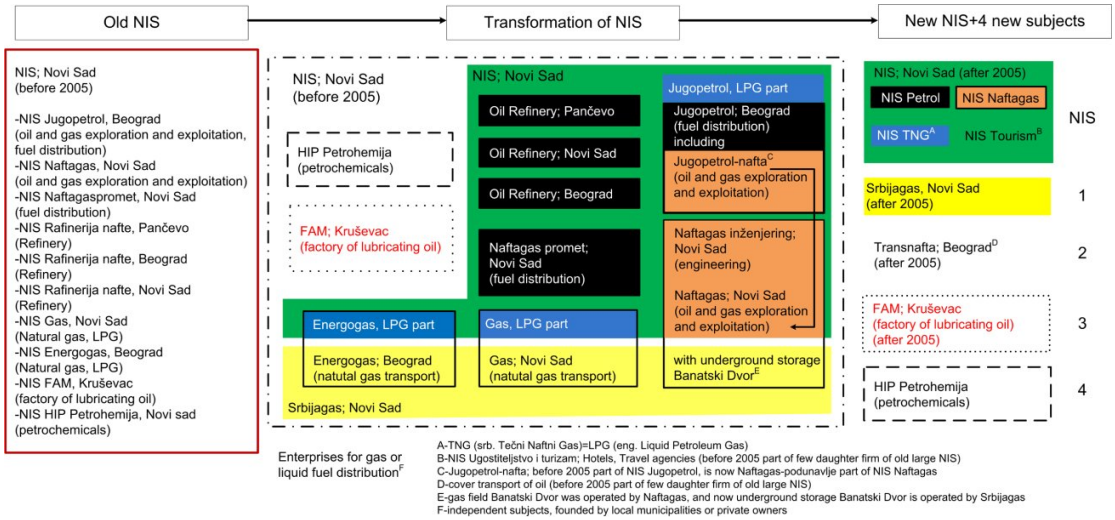

Figure 1. Transformation of oil and gas subjects in Serbia

New NIS is authorized for petroleum the sector, and Srbijagas for the gas sector. Both of them (NIS and Srbijagas) are in still in 100% ownership of the Republic of Serbia, but 51% of NIS soon will be sold to Russia for over 400 million US$ in cash and 500 million US$ in investment. Serbia has hired international auditors (Deloitte & Touche) to evaluate value of NIS, but this issue is linked with South stream pipeline and any separate discussion is not possible. Note that, Romania, Hungary and Slovenia had all initially been regarded as possible South Stream transit routes before it was decided to build the line through Serbia. If the route were changed through Romania, Serbia would lose around 200 million US$ per year in transit tariffs. Auditors earlier proposed a privatization program for NIS that reportedly recommended holding an international tender, but Serbia rejected the idea and signed an accord with Gazprom.

Serbia requires up to 3.6 Bcm of gas annually. Natural gas reserves of Serbia are estimated at 24.07 Bcm. Domestic production covers about 30% of total supply. Russia covers more than 60% of Serbia's gas demand, leaving Serbia heavily dependent on Gazprom, which has in the past cut off supplies owing to non-payment of debts. Gas is used by the industry and by the domestic users (mostly in the north of the country, where gas reserves are concentrated) and by thermoelectric power plants for heating. Serbia has some 2000 km of gas pipelines, and gas is seen as one of the main sources of energy for the future (Table 2). Its share in the country's energy consumption is expected to increase from 15-20% in the mid-1990's to 30% by 2020, with the number of domestic users rising to 500 000. During sanctions in 1990's the state-owned gas and oil company, NIS, stopped searching for domestic gas reserves, owing to lack of funds. Prospecting, which requires an annual investment of 100 million US$, resumed in 1996 on a limited scale.

Table 2. Energy balance in Serbia, 2004[a]

source: www.eia.doe.gov	Oil[b] (bbl/day)	Gas (10^6 m^3)	Coal (10^3 t)	Electricity[f](GWh)	Total
Production	14410	240	41085[c]	35981	-
Import	75630	2100	1013[d]	5975	-
Export	3830	0	117[e]	6248	-
Primary supply	85080	2340[h]	41981	-[g]	-
Total (PJ)	174.77[j]	78.39	408.66	39.63[k]	700.68 PJ
				Primary production from domestic sources: 538.34 PJ	

[a]including Montenegro
[b]bbl-barrel of oil=0.1589 m^3=0.134 toe (1=42 GJ); toe-tonnes of equivalent oil
[c]41013 10^3 t lignite
[d]131 10^3 t hard coal, 270 10^3 t lignite, 612 10^3 t coke
[e]1 10^3 t hard coal, 116 10^3 t lignite
[f]capacity (hydroelectric 2.91GW, thermal 6.40GW)
[g]natural gas=33.5 MJ/m^3
[h]consumption=hydro+thermal (35708 GWh)-losses=30075GWh=108.27 PJ (overlap with coal balance)
[j]per year
[k]only hydroelectric (thermal is included in coal balance)

Compared to all of the fossil fuels, natural gas is a minor pollutant (Dinca et al., 2007). It burns without a solid residue and has the least coefficient of CO_2 emission of about 56 kg/GJ (which is significant considering the limitations imposed by the Kyoto Protocol). Strategy for CO_2 emissions in a residential sector in Japan is shown in the paper of Ashina and Nakata (2008). This study is valuable because strategy for reduction of CO_2 emission do not exist in Serbia. Due to the European obligation to reduce greenhouse gas emissions in the framework of the Kyoto Protocol, the trend towards the use of natural gas is expected to continue in the future.

Worldwide emission of carbon dioxide is 27245 million tonnes annually. Serbia with emission of 53.32 million tonnes annually as ranged as 55 among 207 sovereign states[5]. With 5.07 t CO_2 per capita, Serbia is ranged as 77 in 2004 (former Yugoslavia 5.7 t CO_2 per capita in 1990., and 3.9 t CO_2 per capita in 1991.). With increasing of substitution of other fuels with gas, Serbia's incomes from trading of CO_2 quotas will increase also in the future (Stankeviciute et al., 2008, Duić et al., 2005).

2.2.2. Energy legislation in Serbia

Serbia started establishing the new legal, institutional, and regulatory framework for the energy sector in order to create a viable and efficient energy market environment through licensing, pricing, and energy services control by an independent regulatory body. The new Energy Law was enforced in 2004. Serbian Energy Sector Development

[5] Available from: http://millenniumindicators.un.org/unsd/

Strategy by 2015 was adopted by the Serbian National Parliament in May 2005[6]. The Energy Law contributes to harmonization with the European Union requirements and with accepted principles concerning establishing of regional energy market, because they respect main requirements of the following documents: European Energy Charter, Directive 2003/54/EC, Directive 90/547/EEC, Decision of the European Parliament and the Council 1254/96/EC, Directive 91/296/EEC, Directive 90/377/EEC, Directive 2003/55/EC (Gas Directive). The law comprises the following activities: electricity production, transmission, distribution, selling and trading, managing with electricity market, oil derivates production, transportation, distribution, selling and trading, natural gas transportation, storage, distribution, selling and trading, heat energy production, distribution, delivering to tariff costumers, managing with district heat network. Principles of this law are: quality and organization of energy supply for consumers under consideration of environmental protection, stabile and sustainable development of energy activities, energy efficiency, liberalization of energy market, ensuring non-discriminated approach to all subjects on the liberalizing energy market, open access to all energy systems and energy supply networks, priority for renewable energy sources and environmental protection.

The main state authorities involved in the Serbian energy sector are the following:

(a) Ministry of Mining and Energy

Charged by Republic of Serbia with governmental affairs regarding: electricity power sector, geology and mining sector, oil and gas sector, general energy sector (communal

[6] Energy Strategy, 2005. Strategy of Development in Sector Energy of up to 2015, Official Gazette of Republic of Serbia, 23.05.2005.

energetic, municipality), energy balance of Republic of Serbia, provision of conditions for the operation of Public Enterprises under its jurisdiction. Ministry of Energy and Mining is in charge of Governmental energy policy making, preparation and adoption of energy legislation, secondary legislation and regulation.

(b) Ministry of Science and Technological Development

Responsible for research and science institutions. The Ministry manages National Energy Efficiency Programs which are applied by the integrated efforts of the research and scientific institutions (institutes, faculties) or jointly by industries and research and scientific institutions.

(c) Serbian Energy Regulatory Agency (AERS)

Established in June 2005. The Agency was established as a regulatory body for performing the following tasks: enhancing and directing the development of the energy market in accordance with the principles of non-discrimination and effective competition, monitoring the implementation of regulations and energy systems operating codes, harmonizing the activities of energy entities in providing regular supply of energy and services to customers and ensuring their protection and equal treatment. The Agency is an independent legal entity that is independent of any government authorities as well as independent of users of their products and services. The Agency is administered by the Council of the Energy Agency. The activities of the Energy Agency are determining tariff systems for calculating electricity and natural gas prices for tariff customers, as well as tariff systems for access to and utilization of electric power transmission and distribution system, determining tariff methods for calculating

electricity and natural gas prices. The Energy Agency adopted a methodology for determination of tariff elements.

(d) The Serbian Energy Efficiency Agency

Originally founded by Government Decree and started its operation in 2002. According to the Energy Law from 2004 and with financial support from the European Agency for Reconstruction, it was re-established in 2004 and thus has been operating as separate republic organization. The operation of the Agency is financed through the budget of Serbia and as well as by European Union donations. The Energy Efficiency Agency is based on improvement of conditions for energy and energy products conservation, as well as efficiency increases in energy conservation in all sectors of consumption. For the creation 1$ of GDP, Serbia spend 3 kWh of electricity power. Croatia and Slovenia spend less than 1 kWh, while Greece, Italy and Austria even less, under 0.5 kWh for the creation 1$ of GDP (Jednak, 2008).

Also, in September 2008, Serbia's parliament ratified two documents of great importance for the country's future: Stabilisation and Association Agreement (SAA) with the European Union (Serbia hopes to join the European Union by 2014), and the other is an energy agreement with Russia signed in Moscow in late January (Watkins, 2008). The second one was backed by all major Serbian political parties and won 214 votes out of the 250. The agreement stipulates the construction of a 400 km Serbian section of the South Stream gas pipeline that will transport natural gas from Russia to the European Union via Serbia. A gas underground storage Banatski Dvor, will also be built.

3. Natural gas sector in Serbia before implementation of Russian agreement

Gas utilization in Serbia has started half century ago. Serbia has produced natural gas domestically since 1952, but the intensive development of consumption and the gas pipeline system in Serbia started by the import of natural gas from former USSR in 1978 (Brkić, 2008a). The program of introducing gas pipelines, approved in the year 1973, enabled the import of natural gas from former USSR in 1978 as well as intense development of gas pipeline system of Serbia.

3.1 Production, transport and demands

Increasing of natural gas share in fulfillment of energy demand has been a strategic target in Serbian energy policy for a long time. Gas consumption in Serbia showed tendency for continuous growth until 1989 when the greatest consumption was reached, and since then it was declining and rising in turn. Total consumption of gaseous fuels (natural gas) in 1990 amounted to 2.75 Bcm. The share of gaseous fuels in total consumption was equal to 13%, i.e. 17% in final energy consumption. The basic characteristic of natural gas consumption in the 1990's is that gas was mostly used in industry as a fuel, in chemical industry as a raw material and increasingly as an energy fuel for heating plants, while household consumption was relatively small. Natural gas share in final energy consumption is still relatively small compared to most of the European countries, resulting in growth of electricity consumption for domestic heating,

for preparing of hot water for households and for cooking. Share of electricity production with natural gas as a fuel is negligible (2.8%).

Industry play dominant role in Serbian gas consumption (65.6%). Only northern part of country (Banat and Bačka) has complete gas infrastructure and full ability to use natural gas in household sector. In the rest of the country natural gas in is used in systems for centralized heating, so that overall share of natural gas for heating and household demands is about 31.6%.

Gas field Mokrin (Figure 2) is the biggest field in the country with daily production of 452 tcm.

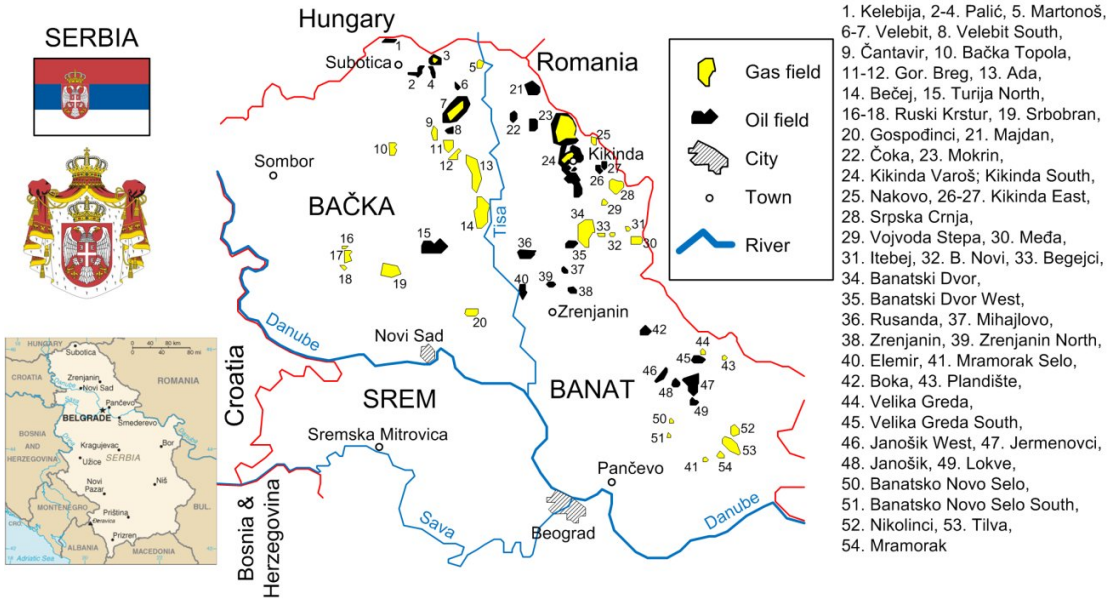

Figure 2 Serbian oil and gas fields

Main gas pipeline enables gas import from Russia via Hungary and has the capacity of 6.1 Bcm on annual basis, 5.34 Bcm of which is transported to territory covered by

Srbijagas while the remaining 760 Mcm is transported to Bosnia and Herzegovina. Gas transmission pipelines in Serbia (Figure 3) of total length 2160 km are property of Srbijagas. The gas pipe-line system links all of the gas fields in north of Serbia with consumers and provides the import of natural gas from Russia via Hungary (Figure 3). Also, this system is used for the transit of natural gas to Bosnia and Herzegovina.

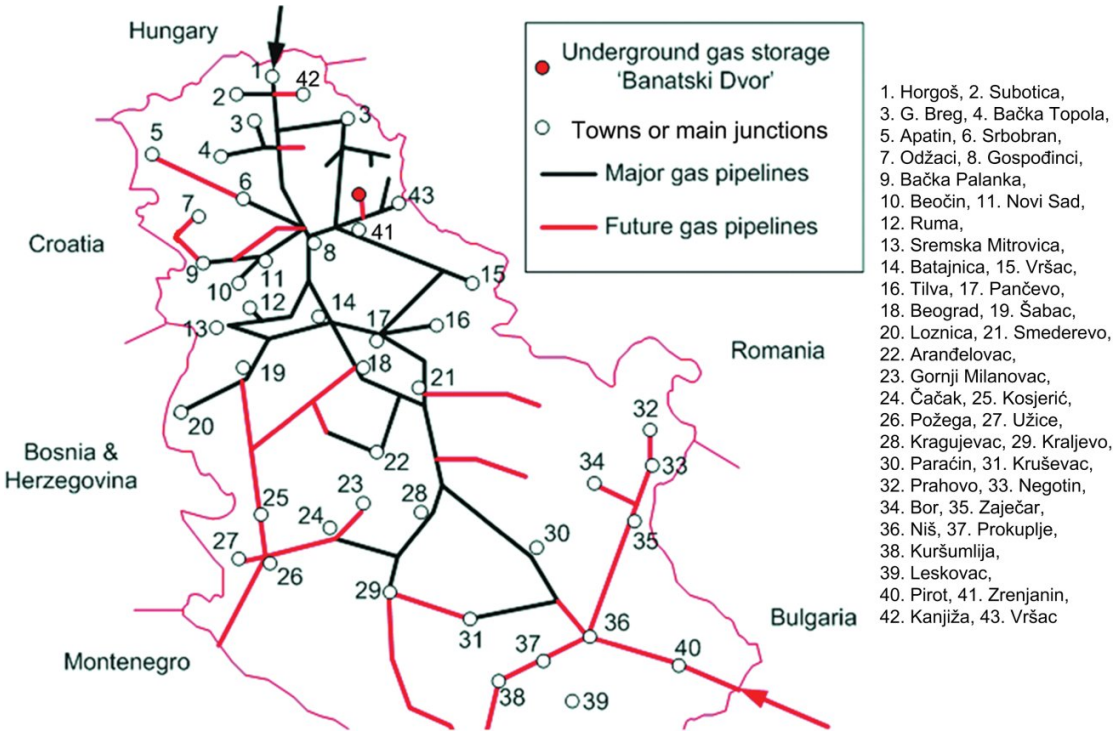

Figure 3. Serbian gas pipelines

Natural gas taken over at the receiving station in Horgoš as well as gas from local gas fields is transported by main pipelines. These pipelines are manufactured with diameters from 220 mm to 762 mm (8 5/8" to 30"). Design pressure in main gas pipelines is max 50 bar, but due to the absence of maintenance of pipeline maximal operating pressure is below 30 bar which is enough because the gas-line has favourable large diameters in the composition of the pipeline. Development of municipal distribution networks for natural

gas is proportional to the increase in consumption. The existing gas pipeline system covers 30% of municipalities in Serbia. Stagnation i.e. decline in consumption took place in the period from 1990 to 2000 as a result of UN sanctions and blockade under UNSC Resolution 757, so that minimum consumption equal to 1.088 Bcm was achieved in 1993, and since then it was gradually rising but has not exceeded the one from 1990 so far (Figure 4).

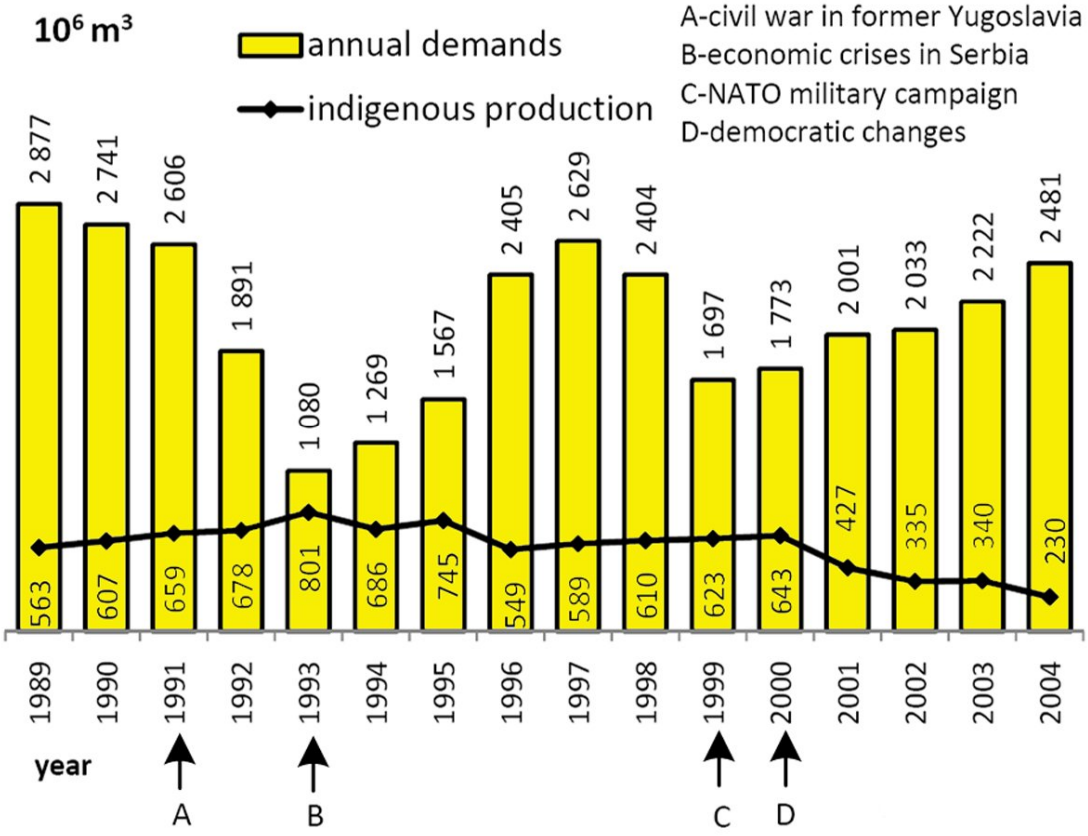

Figure 4. Annual indigenous production and demands of natural gas in Serbia

Being the only importer of natural gas, Srbijagas provides the total quantity for over 170,000 gas consumers in Serbia. This company presently has 50,000 direct consumers (remote heating systems, industrial consumers, distributors with own distribution

network, etc.). Natural gas is expected to have an increasingly important role to play in the provision of energy over time because of its relatively favourable environmental impact. Substantial new investment in distribution networks will be required to meet space-heating needs as electricity prices are adjusted. Natural gas is expected to be the primary substitute for electric-based heating either through district heating in densely populated areas or individual boilers in the rest of the country (Brkić and Tanasković, 2008). Extension of gas distribution networks could be offered to private investors. Natural gas consumption is expected to have the biggest rate of growth due to substitution of other energy sources and predicted requirement increase. It is expected to reach about 6 Bcm per year in 2020, and share of total energy consumption to reach approximately 20%, which is the level in developed European countries. Network expansion to new distribution areas is a policy aim of the Government.

However, demand growth depends also on the competitiveness of gas with other fuels. Based on the quantities of energy required to heat a 60 m² flat, the annual energy costs of gas would be cheaper than storage electric heating and district heating in Belgrade and Novi Sad for any type of housing. With gas prices recently increased for 50%, the annual energy costs of using natural gas for heating would only be lower than those of direct electric heating (in any type of housing) and of district heating only in typical modern (i.e. better insulated) apartment blocks (Brkić and Tanasković, 2008). However, once the up-front costs of a gas connection and boiler are factored in, gas would not be competitive with district heating (Brkić and Tanasković, 2008). It may be more financially attractive than direct heating, but customers that could afford the up-front

costs of gas heating would probably be more likely to invest in electric storage heating, which has lower annual energy costs when current electricity prices are compared with the recently increased gas prices. However, the prices of district heating are not set at their economic levels (due to subsidization by municipally-owned district heating companies). Furthermore, district heating is burdened with problems of non-payment, the inability to disconnect non-paying customers, and large inefficiencies throughout the chain from heat production through to final use (Brkić, 2006). The general absence of metering of individual households' consumption and the lack of individual controls leads to inefficiencies such as opening windows to control temperature. The inefficiencies are not reflected in district heating prices. Electricity prices have increased significantly in recent years, but they are probably still not at their true economic levels. Academic engineering research in Serbia indicates that district heating is more economic the higher the density of the heat load, because heat losses are proportionately lower over shorter distances and the capital costs of the heat distribution network are proportionately lower(Brkić, 2006; Brkić and Tanasković, 2008). Large central boiler plants may have proportionately lower capital costs than small boilers due to economy of scale advantages over small boilers. Nevertheless, total energy losses from district heating systems are higher than the losses from gas distribution, heat distribution networks tend to be as expensive or more expensive than gas distribution networks covering the same area and large central boiler plants that are required for district heating no longer have a significant efficiency advantage over good quality small gas boilers. Therefore, even in a relatively dense urban area where construction of a new district heating plant or extension of an existing system might be expected to be

economic, it might still be more economic to deliver gas. Since it is almost always uneconomic to have competing gas and district heating networks, in new areas, the responsible party should carry out a comparison of the costs of district heating and direct gas supply. Based on the results, it should announce a clear policy towards one or the other. According to Energy Law from 2004, the Energy Agency is responsible-for tariffs and prices in natural gas sector. Agency has proposed tariffs and prices Serbian Government for final approval.

3.2 Underground gas storage in Serbia

Selected place for gas underground storage facility is the Banatski Dvor depleted gas reservoir in Banat with present capacity up to 800 Mcm. The final phase in construction of underground gas storage Banatski Dvor is underway. The biggest expense in this phase is the purchase of gas which will be injected as a gas pillow thus compensating the gas spent during UN sanctions in 1990. The exploitation has not been terminated in time so a portion of reservoir is flooded and the question is if it would be at all possible to extract the water out of the porous expanse which was previously filled with gas. Such over-depleted fields have filled with underground water. Srbijagas has long-term plans for future gas storage increasing the total to 1.8 Bcm the Banatski Dvor depleted reservoir (or even up to 10 Bcm in the future). Since natural gas is largely used for heating, consumption is subject to a significant seasonal swing. In Serbia approximately two-thirds of the gas is consumed during winter (October–March). Residential sector consume about 90% of their overall gas during the winter period. For local gas

providers, it is therefore not uncommon to have daily peaks in gas delivery in the winter amounting to more than ten times the delivery on a summer day. This strong seasonal consumption profile requires flexibility on the supply side. In Serbia, there are two main sources of flexibility: production which is decreasing and import from Russia which is increasing. Imports from remote sources (like Russia) is enough for domestic needs, but problem is in the low daily peak capacities of transit pipeline in Hungary during the very severe winter days (Figure 5). Serbia's pipeline has enough capacities, but problem is in the Hungarian side. Introduction of underground storage in the Serbia's system, will solve the problem and cause constant high utilization of pipeline without daily oscillations during season. With realization of South stream pipeline this problem will be solved definitively.

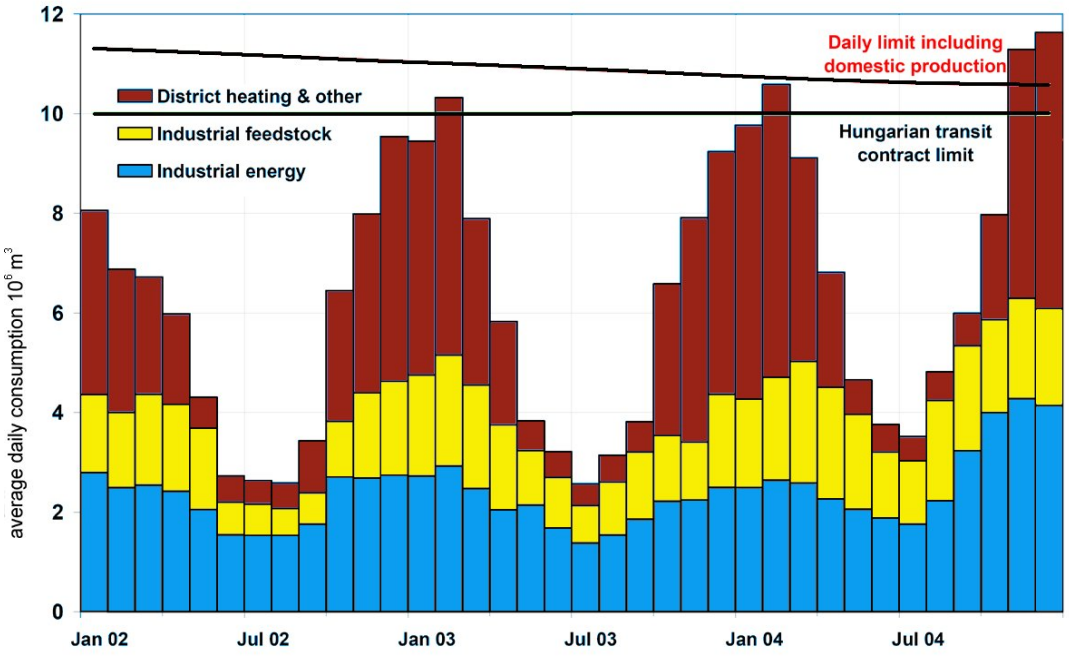

Figure 5. Annual profile of average daily gas consumption each month by sector

However, since the indigenous production will decrease and will have to be replaced by less flexible imports, more flexibility has to come from the second source, namely, gas storage facilities. The new direction of gas supply from Bulgaria will increase the stability of Serbian gas system. At this moment, only one gas supply direction is present, the one going from Russia via Ukraine and Hungary which if highly unreliable. Access to storage is regulated since it serves similar purposes to the balancing of energy in electricity markets: market entry without access to flexibility is very difficult. Thus, in order to open the gas market to competition, it is very important to ensure that entrants have access to storage. In Article 19 of its Gas Directive, the European Union therefore has established third-party access to storage in order to facilitate downstream competition in the gas market. While the Gas Directive also allows for regulated third-party access, most member countries so far have opted for the alternative, namely, negotiated third-party access. The importance of the first gas storage, however modest it is, is of crucial importance for Serbia keeping in mind that Serbia cannot count on domestic production and excluding the transit via Ukraine for its unreliability. For example, in north-western Europe, flexible indigenous production has to be replaced by less flexible imports from far distant fields. The additional flexibility has to be provided by gas storage facilities. While this will cause few problems in the mid-term, beyond 2015–20, a significant storage gap will arise. Höffler and Kübler (2007) project the gap to increase to about 10.2 Bcm in storage working gas volume by 2030, even without strategic stock obligations. With such obligations, the gap in storage working gas volume will increase to 19.6 Bcm (5% of non- European Union imports) or 29 Bcm (10% of non- European Union imports).

Gas demand in Serbia over the decade from 2005 to 2015 is difficult to project in part because annual consumption in the past two decades has varied so widely, from a high of nearly 3 Bcm in 1988 down to about 1 Bcm in 1993, up to about 2.5 Bcm in 1997. In the first half of the current decade a more steady demand growth has resumed at about 8% per annum. However, there are a number of challenges, including a small number of large industrial customers with financial difficulties with very large arrears in gas payments. Srbijagas is projecting demand of about 4 Bcm in 2015, with a range of plus or minus 0.5 Bcm for optimistic or pessimistic cases. In the 'neutral' case with moderate economic growth and some efficiency improvements, gas demand scenario projects about 3.7 Bcm by 2015. This incremental demand, of a little over 1 Bcm, is rather small in relation to the volumes usually required to economically justify a new pipeline. For this reason, it is of interest to Serbia to see if additional transit volumes to neighboring countries could be realized.

Serbian gas demand is supplied from indigenous production and imports from Russia delivered via Ukraine and Hungary, as mentioned above in the text. Srbijagas buys from Gazprom at the Ukraine-Hungary border and pays a transit fee to MOL (Hungarian oil and gas company) for transport across Hungary to Horgoš on Serbia's northern border. The gas pipeline network is oldest and most developed in northern Serbia, partially developed in central Serbia and hardly developed at all in southern Serbia. The flow of domestically produced gas and imported gas is basically from north to south through a linear-radial pipeline system. Indigenous gas production in Serbia has now declined to

very low levels, from around 600 Mcm per year in the late 1990s to about 230 Mcm in 2004. This is less than 10% of Serbia's gas demand. Recent discoveries of gas in central Serbia are relatively small. Therefore, the proportion of domestically produced gas is expected to decline further as Serbia's gas demand grows and production continues to decline. In the absence of major new gas discoveries, Serbia will need to import almost all of its gas needs in future.

The transit price through Hungary is determined by a formula, which was producing a price of about 19US$ per tcm in 2004. The transportation fee paid to MOL under the contract is determined by a formula indexed to five items, which are, in descending order of their weighting factors: gas network equipment costs taken from a published index; the gas price in the MOL-Gazprom contract; inflation in the previous year in the SDR economies (The Special Drawing Rights economies are Japan, the United States, the United Kingdom, and the Euro zone); average gross earnings in Hungary in the sector relevant to pipeline construction; the price of cold rolled sheet steel (Gasification Study, 2004). In contrast with the relative low gas price comparing to other countries, the transit price was quite high.

Price of natural gas is in correlation with price of crude oil (Movassagh and Modjtahedi, 2005; Brown and Yücel, 2008; Trapmann 2008; Ghouri, 2006; Samsam Bakhtiari, 2002; Hartley et al, 2008).

The contract is for a capacity of 3.8 Bcm per year but MOL has agreed each year to allow Srbijagas to nominate its annual volumes on a year-ahead basis. Srbijagas is then

required to pay the transit price for each unit of gas delivered and to pay 80% of the price for any units short of the annual nominated quantity. Units in excess of the nominated annual quantity are charged at the transit price with no penalties applied. Under these arrangements, the daily maximum quantity has been reduced slightly from the amount in the master contract, and this limit is strictly enforced. The daily maximum quantity is 10 Mcm (compared with 10.4 Mcm in the master contract). When averaged over the entire year, demand in Serbia is about 6 Mcm per day — well within the contracted capacity under the transit contract with MOL. But peak daily demand is the critical factor, not annual average demand. Peak daily demand is already hitting the contract maximum of 10 Mcm per day. With declining indigenous production and no gas storage in Serbia, Srbijagas is now on the threshold of a supply crisis, whereby it will be unable to supply all gas demand on the coldest winter days. Srbijagas has started to manage consumption. For example, the fertilizer plant has been asked and has agreed to change from a winter-only to a summer only production schedule. Also, due to the import constraint, there were five or six days last winter when the district heating company in Belgrade was asked to switch to fuel oil so that gas supply could be interrupted. This reduced demand by just under 3 Mcm per day. This meant over two hours of interruption to heat supply during the fuel change-over and costs for cleaning the boilers after running on fuel oil. Serbia urgently needs gas storage to allow gas demand on winter peak days to be met with the current daily import constraint (question of underground storage will be solved according to agreement signed by Russia). Storage would allow Srbijagas to improve its management of its customers' large seasonal demand swing with a flatter annual import profile. To achieve a near flat

import profile with the current seasonal demand profile and annual imports at about 2 Bcm per year of demand will require 0.6 Bcm of working storage capacity. European Union recommended practice is that 90 days (three months) of gas be stored for reliability purposes. To store three winter months of gas supply in Serbia for increased reliability would require another 0.54 Bcm, for a total of 1.14 Bcm. If annual consumption in future reaches 5 Bcm per year, and if the seasonal demand profile is the same as now, 1.88 Bcm of seasonal storage capacity would be required to flatten the annual import profile. Adding three winter months storage would raise this to 2.25 Bcm. Serbia is estimated to have technical potential storage facilities of between 4 and 6 Bcm (Gasification Study, 2004).

Large scale underground storage, such as Banatski Dvor, are usually constructed in depleted gas, gas-condensate deposits, oil deposits with gas cap and oil reservoirs. Partly depleted gas reservoirs are usually the best candidates for converting into storage because this considerably decreases the costs relating to gas, gas cushion and gas cushion formation. In estimation of the suitability of a certain oil or gas reservoir for converting to gas storage, the geological and physical reservoir properties are considered, such as: the size of initial reserves, depth of reservoir formation, petro-physical reservoir properties, type and quality of elevated rock layer, presence of tectonics, reservoir surface and form, mode of operation during gas production, pressure and temperature in the reservoir, the remaining gas reserves, i.e. hydrocarbons, technical conditions of the wells, conditions of reservoir production development, conditions of

ground installations and distance from the main gas pipeline, i.e. from the consumer load centres (the closer the better).

A significant scope of oil geological research works in the territory of Serbia has been performed in the last 55 years. The result of these works is a relatively high degree of research data in the Pannonian region. The scope of works carried out in central Serbia is considerably smaller and so the research data is not nearly as extensive. The best results have been achieved in the regions of Banat and middle Bačka. According to the Naftagas 50th Anniversary Monograph, the following have been carried out so far:

- 40869 km of seismic researches,
- 2028 oil and gas drilled wells or over 3 million meters.
- 99 oil and gas fields with 272 reservoirs have been discovered.
- 39.5 million tons of oil and 29.3 billion m^3 of natural gas have been produced.

Gas fields represent about 50% of the total number of discovered oil and gas fields, oil fields about 40%, gas–condensate deposits 5% and CO_2 gas deposits the remaining 5%. As regards the size of the discovered fields, the Velebit, the Mokrin and the Kikinda oil and gas fields can be classified as medium size fields, compared with the reservoirs in the Pannonian Basin and even partially compared to the European scale. Small fields are in the majority. Out of the total number of fields, about 60% have a surface area under 2 km² and about 24% of the discovered oil and gas fields have a surface area larger than 3 km² and only the Mokrin field has a surface area exceeding 50 km². Former NIS Jugopetrol-nafta (NIS Naftagas-podunavlje) carries out oil and gas exploration in the region of Central Serbia. The best results were obtained in the region of Podunavlje and

Velika Plana (Markovac). Two oil and gas fields and one gas field have been discovered in the region of Podunavlje so far. The Sirakovo and the Bradarac-Maljurevac oil and gas fields are under production and can be classified as smaller oil fields. About 200 000 tons of oil have been produced so far. The discovered Ostrovo gas field is being researched. Future research programs plan research works in several locations in the region of Podunavlje where there are indications of possible gas reservoirs in the location of Staro Selo in the region of Velika Plana where there were earlier indications of gas reservoirs. To make a program of oil geological research works in order to discover gas reservoirs, it is considered that gas reservoirs present a potential underground storage and, for that reason, the efforts are made to collect as much data as possible required to estimate reservoirs. Accordingly, the discovery of several suitable locations for underground gas storage is being expected in central Serbia.

Several research projects had been proposed in the past, but final decision is storage will be in depleted gas reservoir in Banatski Dvor:

- The first project includes the estimation of depleted reservoirs or reservoirs in the advanced stage of exploitation in order to find ways to build a storage with capacity of up to one billion m^3 of gas. Several reservoirs would be processed by this project, including: Srbobran, Tilva, Begejci, and Međa.
- The second project would include the study of several reservoirs in the complex of the Mokrin oil and gas field where it could be expected that several possibilities would be found to build storage with capacity of 2 to 4 billion m^3. This project is a serious candidate for the transit storage.

- The need to have storage in the vicinity of the consumer centres requires a third project. This would include the study of smaller gas fields undiscovered as yet or those which are under the production, with a view to converting them into storage. This project would seek reservoirs having initial gas reserves of up to 600 Mcm. This project also includes exploration in central Serbia where establishing storage is important in order to upgrade the reliability of the transmission system. This kind of storages can be of great values in Serbian system having regard that Serbia has no even marginal storage capacities especially in the time of crises. Illustrative is the crises with transit through Ukraine in the beginning of 2009.

In Europe, the deregulation process of natural gas markets is based upon the liberalization of services to consumers on the one hand, and the third party access to the network infrastructures on the other hand according to the EU Directives on Gas liberalization (1998/30/CE) in order to introduce competition on the national natural gas markets (Esnault, 2003). In fact, the EU Directives on Gas liberalization (1998/30/CE and 2003/55/CE) have recommended the definition of non-discriminatory third party access and tariff rules for storage facilities. Good review of gas storage issues in Italy is available in the paper of Bonacina et al (2009).

4. South Stream pipeline; Chance and Obligation for Serbia

South Stream project is envisaged by Gazprom and its partner, Italy's Eni, as a 30 Bcm annual capacity pipeline in two branches running from Russia under the Black Sea to Bulgaria and on into Europe, with operations starting in 2013 (or in 2015). Often described as a "rival" to Nabucco, the South Stream line would run from Russia, across the seabed of the Black Sea to Bulgaria, there to bifurcate: one arm westward via Greece to Italy and another arm northward to Serbia with possible continuation into Central Europe. The main line to Bulgaria is projected to carry 30 Bcm of Russian-delivered gas annually, but branch through Serbia will carry 10-18 Bcm annually. From Varna, Bulgaria, the south-western route would continue through Greece and the Ionian Sea to southern Italy. The north-western pipeline will run through Serbia, and Hungary to Austria ending at the Baumgarten gas storage facility (Figure 6). Another option is that the north-western route would run through Slovenia to northern Italy.

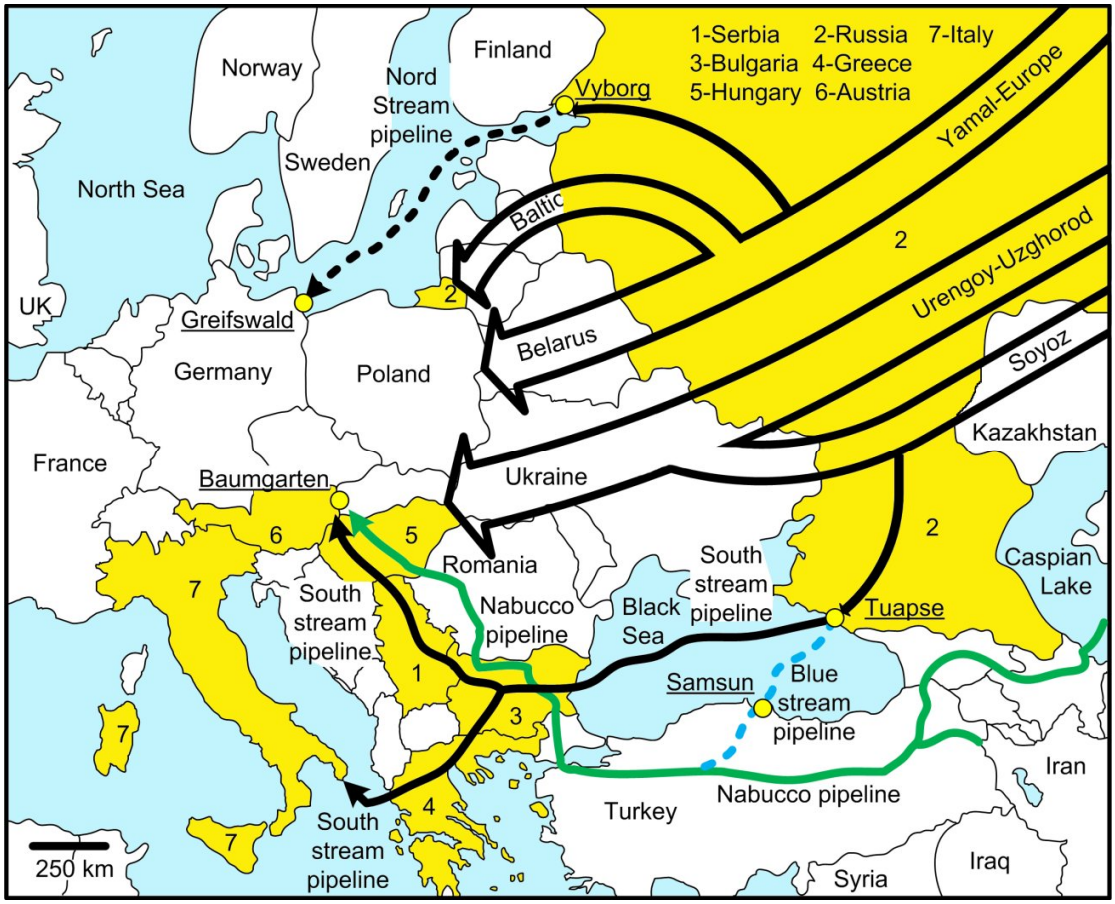

Figure 6. Competing gas pipeline route from Caspian region and Russia to European Union

The South Stream pipeline project was announced on June 2007, when Italian energy company ENI and Russian Gazprom signed in Rome a memorandum of understanding of construction this pipeline. On November 2007, Gazprom and ENI signed in Moscow an agreement about establishing a joint project company for the commissioning of the marketing and technical feasibility studies of the project. On January 2008, Gazprom and ENI registered in Switzerland the joint venture South Stream AG equally owned by the two companies. The agreement between Russia and Bulgaria on the Bulgaria's

participation in the project was signed on 18 January 2008. It was agreed to set up an equally owned company to build and operate the Bulgarian section of the pipeline. The agreement was ratified by Bulgarian Parliament on July 2008. According to this agreement Bulgarian and Russian share in joint project will be equal. But Serbian agreement provides the establishment of a joint venture with 51% owned by Gazprom and 49% owned by Serbia to carry out a feasibility study and build and operate the Serbian section of the pipeline with capacity of at least 10 Bcm of natural gas. Note that under this agreement Serbia will also sell 51% of NIS to the Russian side. The first agreement between Russia and Serbia was signed even before announcement of the South Stream project. On December 2006, Gazprom and Serbian state-owned gas company Srbijagas agreed to study building a gas pipeline running from Bulgaria through Serbia. The Russian company already controls Jugorosgas, which in turn controls the main Pojate-to-Niš pipeline. On January 2008, Russia and Serbia signed an agreement to route a northern pipe of South Stream through Serbia and on 25 February 2008, an agreement to create a joint company to build the Serbian section of the pipeline and large gas storage facility near Banatski Dvor in Serbia, was signed. At the same day, Russia and Hungary agreed to set up an equally owned joint company to build and operate the Hungarian section of the pipeline. Like in Bulgarin case, the two sides, Russia and Hungary agreed to set up a equal joint venture to build the stretch of line passing through Hungary and 1 Bcm of underground gas storage. Hungary's Mol is also a member of the consortium developing the Nabucco gas pipeline, which plans to deliver Caspian gas to Europe. Bulgaria is also involved in Nabucco project. The Hungarian deal coincided with the signing of a deal between Gazprom and Serbia's

Srbijagas. The agreement stipulates the creation of a joint venture to complete a feasibility study, as well as the construction and use of a gas pipeline through Serbia with capacity of at least 10 Bcm as part of the creation of the South Stream gas pipeline system. An integrated intergovernmental agreement on the South Stream project and the Banatski Dvor underground gas storage facilities in Serbia was signed on January, the same day that Gazprom's oil arm, Gazprom Neft, signed a deal on the terms of acquiring a controlling 51% stake in Serbian NIS for 400 million €. But it appears to be facing problems concluding the NIS deal, as Serbia wants a higher price. International auditors Deloitte & Touche appraised NIS at 3.48 billion US$. NIS controls around 60% of Serbia's oil market, operates two refineries but does not operate the crude supply pipeline to Croatia (Figure 1). New firm, Transnafta, operates all major oil pipelines in Serbia. The proposed agreement between Russia and Serbia includes Gazprom's offer to ensure the long-term security of gas supplies to the country, with Gazprom and Srbijagas, the state-owned gas-infrastructure firm, to develop storage and distribution assets. The Serbia’s government offered Russia's Gazprom the chance to buy into state petrochemicals firm HIP-Petrohemija (Figure 1), one of Serbia's biggest exporters. The offer of a stake in HIP-Petrohemija could pave the way for a compromise. But, estimated price for NIS seems not so important. They point out that the agreement makes Serbia part of the South Stream gas pipeline project, which promises not only energy stability for the country but also significant revenues from transit of natural gas to Europe.

On April 2008, Russia and Greece signed an intergovernmental agreement on cooperation in the construction and operation of the Greek section of the South Stream. Schaffer (2008) claims that main route of South Stream leads through Romania, and that Serbian route is alternative. According to Schaffer (2008) Serbia is actively cooperating with Russia in planning a South Stream pipeline extension, but it is unlikely to transit through Serbia and the essence of the pact between Belgrade and Moscow is that Gazprom will guarantee long-term gas supplies to Serbia.

The agreement of Russia and Serbia has provided Russian company Gazprom with extremely favourable terms of work in Serbia. In the fact, agreement gives great opportunities for both sides. It acquired the state NIS cheap and got advantages in admission to the Serbian area of future South Stream gas pipeline (Figure 6). On the other hand, gas agreement with Russia provides long term of stability in the sense of energy for Serbian side.

If executed, the project would set back the energy security objectives of the European Union and the United States on two major counts. First, it would preempt markets targeted by the Nabucco project, cementing a Russian monopoly on some of them and breaking into new ones, and increasing the overall level of European dependence on Russian-delivered gas. And, second, it would use this pipeline to carry gas from Central Asia via Russia, thus preempting Turkmen and other gas volumes and strengthening Russia's monopoly on Central Asian gas, despite western intentions to demonopolize that situation also. In this context, Russia is trying to capture Serbia's entire energy

sector at one stroke. The Russian government and Gazprom propose to set up three Russian-controlled joint companies - one for oil and two for gas - on Serbia's territory, with some ramifications into the Republic of Srpska within Bosnia and Herzegovina. Russians claim that Serbian gas and oil fields are also included in this price, but Serbian side claims that these fields remain in the formal property of Serbia with Russian obligation to pay a rent.

European gas demand will rise from presently 540 Bcm to around 800 Bcm in 2030 (Goldthau.2008). As more than 50% of overall European imports originate from Russia, fears have been expressed that the Russia could use energy resources as a foreign policy tool. Gazprom has permanent transit problem with Ukraine and possible with Belarus. Before the crises in the beginning of 2009, prize for the gas intended for the Ukraine market was 135US$ per tcm and for Belarus 100US$ per tcm (Parthasarathy, 2008). From 2010 price for Ukraine will be equalized with European (more than 400US$). Simultaneously, transit taxes for Russian gas intended for other countries will be increased. For example, now Russian gas for Serbian become property of Serbian side in the border of Ukraine and Hungary. Transit through Ukraine is Russian obligation and there is no tax for the Serbian side for the transit through Ukraine. On the contrary, Serbia has separate contract with Hungarian MOL for transit through Hungarian territory and for possible usage of storage capacities in Hungary.

Russia's Energy Strategy[7] through 2020 estimates total exports to Europe by 2015 to be somewhat lower than 160 Bcm. The already existing export pipelines through Ukraine (Urengoy-Uzgohorod and Soyoz) and the Yamal-Europe (after Yamal peninsula in Russia) corridor through Belarus can carry 168 Bcm of gas to Europe annually (Figure 6). A partial overlap of South Stream and Nabucco does not, therefore, create a redundancy or possible oversupply but actually improves Europe's security of supply. (Roginsky and Minina, 2008; Brkić, 2008a). Europe is in need of an increasing number of energy links, which is why the European Union is committed to the Nabucco project. It was in Europe's interest to diversify its energy sources and supply routes. The 14 billion US$ South Stream pipeline is expected to annually pump 30 Bcm of Central Asian gas to southern Europe. Estimated investment in this project possible will be increased up to 20 billion US$ (Anonymous, 2008). But it also signed up to Russia's South Stream gas pipeline project earlier this year, prompting United States concerns that Hungary may sideline the European Union project, which is aimed at reducing Europe's energy reliance on Moscow. Evaluation of natural gas supply options for south-east and central Europe is shown in the paper of Afgan et al. (2007a, b, 2008). In these papers Nabucco project is slightly better rated compared to South stream pipeline. But, according to Schaffer (2008), Russian dominance of the Eurasian natural gas delivery system has put the independence of the European foreign policy at risk. Although Europe is struggling to counteract the threat, Russia appears to be winning the game. Russia's stranglehold already has acquired 25% of the European market. Moreover, it is installing four new pipelines, and plans to increase its market share

[7] Russia's Ministry of Energy, 2003. Energy Strategy of Russia for up to 2020

substantially (Figure 6). In response, Europe is building or planning three new pipelines. Mavrakis et al (2006) in their paper examined the supply potential of whole south corridor with supplying sources from Azerbaijan, Turkmenistan, Iran and Iraq, which is of significant values for the joint European Union and U.S. endeavor especially because Nabucco project could be reconsidered in absence of real gas providers in the middle East (Feller, 2008).

5. Conclusions

Natural gas is the fastest growing primary energy source in Serbia. New oil and gas agreement, sign with Russia, the world's largest producer and transporter of natural gas, will transform Serbia from an import only country to a transit country for Russian gas (Brkić, 2008a). Through South Stream pipeline, with planed transport capacities of 30 Bcm per year scheduled to start in 2013, will be transported almost one quarter of entire export of Russian natural gas to European Union. Branch through Serbia will transport 10-15 Bcm annually, and Serbia expect income of about 200 million US$ per annum from transit fees. According to that, natural gas in Republic Serbia is expected to be the primary substitute for electricity based heating either through district heating in densely populated areas or individual boilers in the rest of the country (Brkić and Tanasković, 2008). Extension of the gas networks is extremely important for Serbia's overall energy and environment strategy and should preferably be undertaken by private investors. An increase in the share of natural gas energy is the strategic option and the consumption should increase at the highest rate as the result of substitution of other fuels and increased demand. In Serbian towns, there are still dilemmas whether it is better to build

a natural gas or a district heating system (also mostly gas fueled) in the light of the shortage of funds, (un)available fuels, habitat culture and many social and economic aspects of the use of a particular form of energy. Basically, the application of gas supply systems for households requires coordinated development of gas and district heating system under the local conditions. It is made imperative by the investment and operation economics and the need to conserve and save energy and such long-term analyses should be conducted in all cities where there are possibilities to use natural gas, especially because the domestic solid fuels has not found broader application in centralized district heating systems due to environmental reasons. That is why in the future Serbian authorities must search for faster development and utilization of natural gas in these regions of a town, where the local conditions allow the same. But, before all Serbia has to prepare enough capacity in underground facility Banatski Dvor and to start with injection of gas during the following summer.

Today, Serbian NIS as well as Srbijagas, is good example of big post-communist enterprise with too many inefficient employees. Government strategy is to keep all existing working positions. This leads to increasing of inefficiency and also to the highest unemployment rate among of almost all European countries (Table 1). Young highly educated population is the main victim of these circumstances. Today, before selling of NIS to Russian partner is practically impossible to be hired in NIS or Srbijagas, even for high educated experts. Informal prohibition for hiring and also for dismissing from a job exists from 2002. Also, all jobs in petroleum and gas explorations and exploitations are under NIS jurisdiction. There is no place for other private domestic

or foreign services companies in this kind of business. All exploitation fields are in government's property and price for crude oil and gas are formed by government decrees according to recommendations from the Serbian Energy Regulatory Agency (AERS). All oil and gas fields in the country are under jurisdiction of NIS. Monopoly is complete. Mining tax for NIS is only 3% and licence for monopoly is free for government owned firms since the communist era. Of course, price of crude oil in world's market are irrelevant in relation between NIS and government. International price of crude oil has major role for final price of fuel for vehicles relevant only for final consumers. General conclusion is that future owner from Russia will have to manage large scale of reforms in the NIS and to try to increase simultaneously performances of entire system. Note that NIS is the biggest firm in Serbia. Top management in both firms, NIS and Srbijagas, is set according to political agreements among main political parties in Serbian governments. Members of top management are also high politicians, and highest figures are almost by the rule former or future ministers.

All Russian gas supplies through Ukraine were shut down early in the beginning of January 2009 in a further escalation of the pricing dispute, leaving some EU and Balkan countries, with no gas supplies from Russia in conditions of very cold winter. The reason for this crisis is the combination of fundamental changes in Russia, Europe and in the gas business itself. Although Europe accounts for almost 20% of world's annual consumption of gas, its own reserves represent less than 2% of known world's reserves, and Russia as largest exporter provides 26% of Europe's demands for gas (Feller, 2007a). We have to notice, that natural gas is a key factor for lowering of CO_2 emission

and it has additional value after Kyoto. Today, main questions in relationship between Europe and Russia considering gas, are; is there available gas in Russia to supply Europe in the future, is the existing routes for supplying secure and reliable and what alternatives exist to diversify Europe's routes for supplies of gas or even better to say of gas sources. Today, the pipelines through Ukraine have enormous significant with annual capacity of 120 Bcm comparing to 30 Bcm of Belarus lines. Something about 62.7% of Russian gas imports to Europe are through territory of Ukraine and Belarus (Parthasarathy, 2008). Ukraine has now gas debt of about 600 million US$, and from 2010 will have to pay price for gas equal as rest of Europe. Under these circumstances Russia has to insure stability of her own gas import, and on the other hand Europe has to diversify her own routes for supply. To avoid that gas tariff dispute with Ukraine and eventually with Belarus, Russia will build two new pipelines to EU, one South Stream to Bulgaria via Black Sea, and second to Germany via Baltic Sea. The Nabucco pipeline has also good chance for success despite of a lack of concrete deals with gas supplier. According to Feller (2007b), Gazprom outmaneuver EU in the Nabucco project by signing supply agreements with non-Russian suppliers of gas, such as Turkmenistan. But both project, the Nabucco and the South Stream, if will be executed, will secure Europe's security of supply (Brkić, 2008a).

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Appendix 1-About Serbia

Serbia is independent republic from 2006 (before in union with Montenegro, and before 1991. one of the six Yugoslav republic with Macedonia, Montenegro, Croatia, Bosnia and Herzegovina, and Slovenia). Serbia has two autonomous provinces; 1. Vojvodina in the north and, 2. Kosovo and Metohija in the south-west of the country. Autonomous Province of Kosovo and Metohija is under the United Nation Mission in Kosovo (UNMIK) administration in accordance with the United Nations Security Council (UNSC) Resolution 1244 from 1999.

Appendix 2-Survey of literature

In the paper of Sagen and Tsygankova (2008) and in the paper of Spanjer (2007) are shown potential effects on Russian gas exports from different Russian domestic gas prices and production capacities. They also investigate whether a fully competitive European gas market may provide incentives for Gazprom, the dominant Russian gas company, to change its export behavior if Russian prices approach European net-back levels. Gazprom may reduce exports in favor of a relatively more profitable domestic market (Konoplyanik, 2003). As more than 50%-of overall European imports originate from Russia, fears have been expressed that the Kremlin could use energy resources as a foreign policy tool. From the viewpoint of Serbian government strategy, paper of Goldthau (2008) is very interesting. Investigated how higher domestic Russian gas prices enhanced energy efficiency and how increases in non-Gazprom production would however make it possible for Russia to meet domestic demand and its export commitments for natural gas. Weisser (2007) investigated in his paper how much gas is

available for export for the next 15 to 20 years. Europe's increasing import dependency in natural gas facilitates a number of new infrastructure projects. However, up to now it has always been difficult to assess the full impact of these projects as interdependencies within the whole European gas infrastructure system were hard to predict. Model presented in the paper of Lochner and Bothe (2007) allows such forecasts. To demonstrate the model's capabilities, they examined the effects of the Russian-German Nord Stream (on the bottom of the Baltic Sea) import pipeline with respect to its impact on Europe's infrastructure system, especially volume flows within the grid and the utilization of import pipelines with the respective effect on Europe's gas supply mix. Lochner and Bothe (2007) analyzed a scenario where Russian exports are allowed to increase alongside the capacity increase and one where they are not. Applying a global gas market model, Lochner and Bothe (2009) produce a forecast for global gas supply to 2030 and determine the supplier-specific long-run average costs of gas supplied to three major consuming regions: Europe, the United States and Japan.

Further deregulating the Russian gas sector will be great factor of influence on Serbian gas sector as well as European Union gas supply (Grigoryev, 2007). On the other hand, a complementary model for the European natural gas market is shown in the paper of Egging et al. (2008) and prospects of the European gas market in the paper of Kjärstad and Johnsson (2007). Future European gas supply in the resource triangle of the Former Soviet Union, the Middle East and Northern Africa, relevant to the subject of this paper is shown in the paper of Remme et al. (2008), and Soviet natural gas exports and the European energy balance during the communist era is shown in the paper of Herbert and

Berg (1990). Some aspects of environmental impacts of policy issues for Russian long distance gas transmission pipelines is shown in paper of Lechtenböhmer et al. (2007) and Lelieveld et al. (2005).

Gas usage in urban conditions of towns in Serbia with specific criterions is shown in the paper of Brkić and Tanasković (2008) and in the paper of Brkić (2008b). The paper of Jednak et al. (2008) can be very useful for readers to make complete picture of energy sector in Serbia. This paper (Jednak et al., 2008) deals with electricity reform in Serbia. Further, natural gas future in Croatia is shown in the paper of Karasalihović et al. (2003). This paper can be useful-as well as paper of Vujčić et al. (2000) for comparisons because Serbia and Croatia were been part of one country (former Yugoslavia) for more than seventy years during the 20th century. Only Slovenia of all former Yugoslav republics is today member of EU (Potočnik et al., 2007). Some reviews of natural gas sector of other countries; Turkey (Hacisalihoglu, 2008), Slovakian republic (Rajzinger et al., 1997), Hungary (Anonymous, 1994), Brasil (Mathias and Szklo, 2007), Romania (Dincha et al., 2007), United Kingdom (Lyness, 1970), Italia (Fabbri et al, 2000; Erbetta and Rappuoli, 2008), Greece (Caloghirou et al, 1995) and of regions (Dorian, 2006; Watkins, 2007) can be very useful for the discussion shown in this paper.

Alternative routes for the European supply options are shown in the paper of Critchlow et al. (2008) and in the paper of Smith and Koottungal (2008). A strategic planning model for natural gas transmission networks is shown in the paper of Kabirian and Hemmati (2007). Also, some authors (Kelland, 1994) forecast that gas hydrates will be

the fuel for the future, and that can have great impact on Serbian gas future for a long period. Review of international trade in natural gas is shown in the paper of Melamid (1994) and Mazighi (2003, 2004). Three categories of criteria are used in the paper of Thomaidis et al. (2008) to compare natural gas market in the Energy Community Treaty countries (ECT[8]). These criterions are: the natural gas network characteristics (interoperability with neighboring networks, available capacity of the national pipelines, connection of the system to gas trading hubs), the existing gas regulations (provision of third party access to the network and unbundling of the transmission system operator) and the actual market functionality (market and customer concentration, security and diversification of natural gas supply).

[8] On October 2005, Albania, Bulgaria, Bosnia and Herzegovina, FYROM (Former Yugoslav Republic of Macedonia), Serbia, Montenegro, Romania and the United Nation Mission in Kosovo (UNMIK) on the one hand (contracting parties) and the European Commission on the other, signed a Treaty establishing the Energy Community in south-east Europe (Energy Community Treaty—ECT). The goal of the Energy Community is to establish a common competitive energy market in south-east Europe, based on the standards of the common European energy market. The Energy Community countries will implement the European Acquis Communautaire on energy, environment, competition and renewables, set up a specific regulatory framework permitting the efficient operation of the markets and create a common market without internal frontiers. However, these countries have not restructured their energy sector at the same level. The first step for introduction of competition in an energy market is the deregulation of its wholesale sector, followed by the opening of the entire sector.

Table 1. Comparative economic indicators, 2007

Table 2. Energy balance in Serbia, 2004[a]

List of footnotes

1. For some details see appendix 1

2. detail literature survey is shown in appendix 2

3. EIU Country Profile 2000; Yugoslavia (Serbia-Montenegro), p. 28 - The Economist Intelligence Unit Limited 2000

4. Energy law, 2004. Official Gazette of Republic of Serbia 84/04, 23.07.2004

5. Available from: http://millenniumindicators.un.org/unsd/

6. Energy Strategy, 2005. Strategy of Development in Sector Energy of up to 2015, Official Gazette of Republic of Serbia, 23.05.2005.

7. Russia's Ministry of Energy, 2003. Energy Strategy of Russia for up to 2020

8. On October 2005, Albania, Bulgaria, Bosnia and Herzegovina, FYROM (Former Yugoslav Republic of Macedonia), Serbia, Montenegro, Romania and the United Nation Mission in Kosovo (UNMIK) on the one hand (contracting parties) and the European Commission on the other, signed a Treaty establishing the Energy Community in south-east Europe (Energy Community Treaty—ECT). The goal of the Energy Community is to establish a common competitive energy market in south-east Europe, based on the standards of the common European energy market. The Energy Community countries will implement the European Acquis Communautaire on energy, environment, competition and renewables, set up a specific regulatory framework permitting the efficient operation of the markets and create a common market without internal frontiers. However, these countries have not restructured their energy sector at the same level. The first step for introduction of competition in an energy market is the deregulation of its wholesale sector, followed by the opening of the entire sector.

Figure 1 DB

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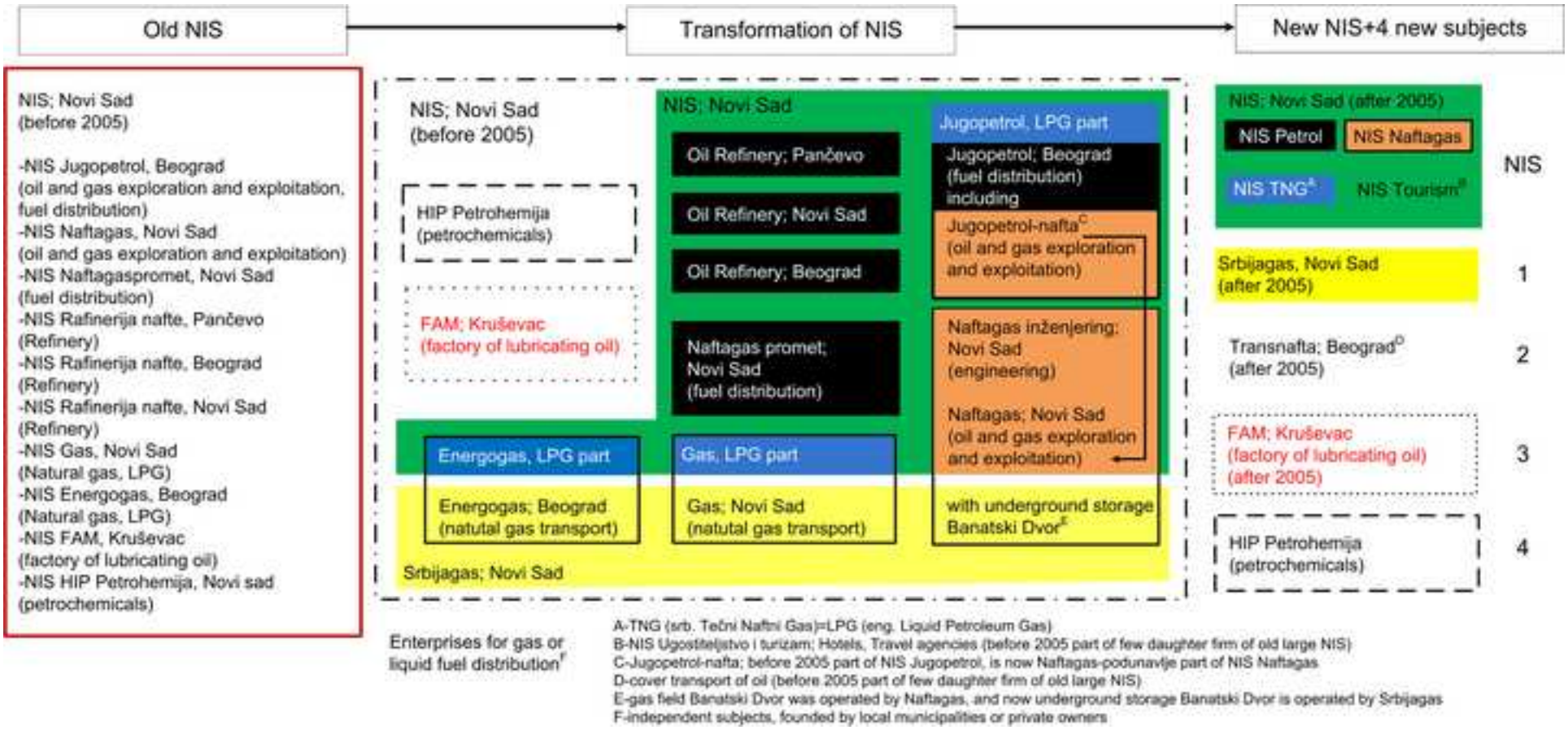

A-TNG (srb. Tečni Naftni Gas)=LPG (eng. Liquid Petroleum Gas)
B-NIS Ugostiteljstvo i turizam; Hotels, Travel agencies (before 2005 part of few daughter firm of old large NIS)
C-Jugopetrol-nafta; before 2005 part of NIS Jugopetrol, is now Naftagas-podunavlje part of NIS Naftagas
D-cover transport of oil (before 2005 part of few daughter firm of old large NIS)
E-gas field Banatski Dvor was operated by Naftagas, and now underground storage Banatski Dvor is operated by Srbijagas
F-independent subjects, founded by local municipalities or private owners

Figure 2 DB

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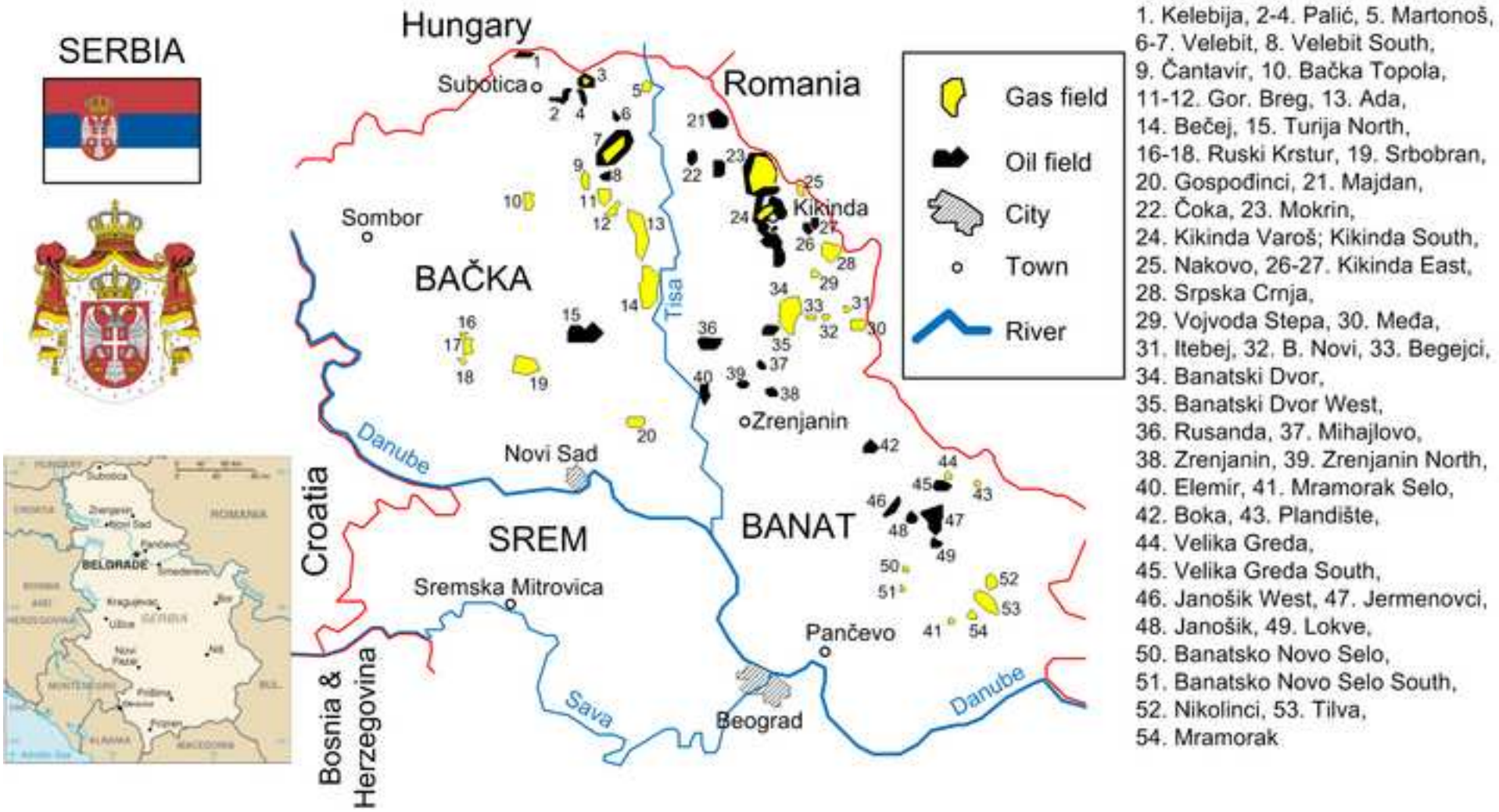

Figure 3 DB

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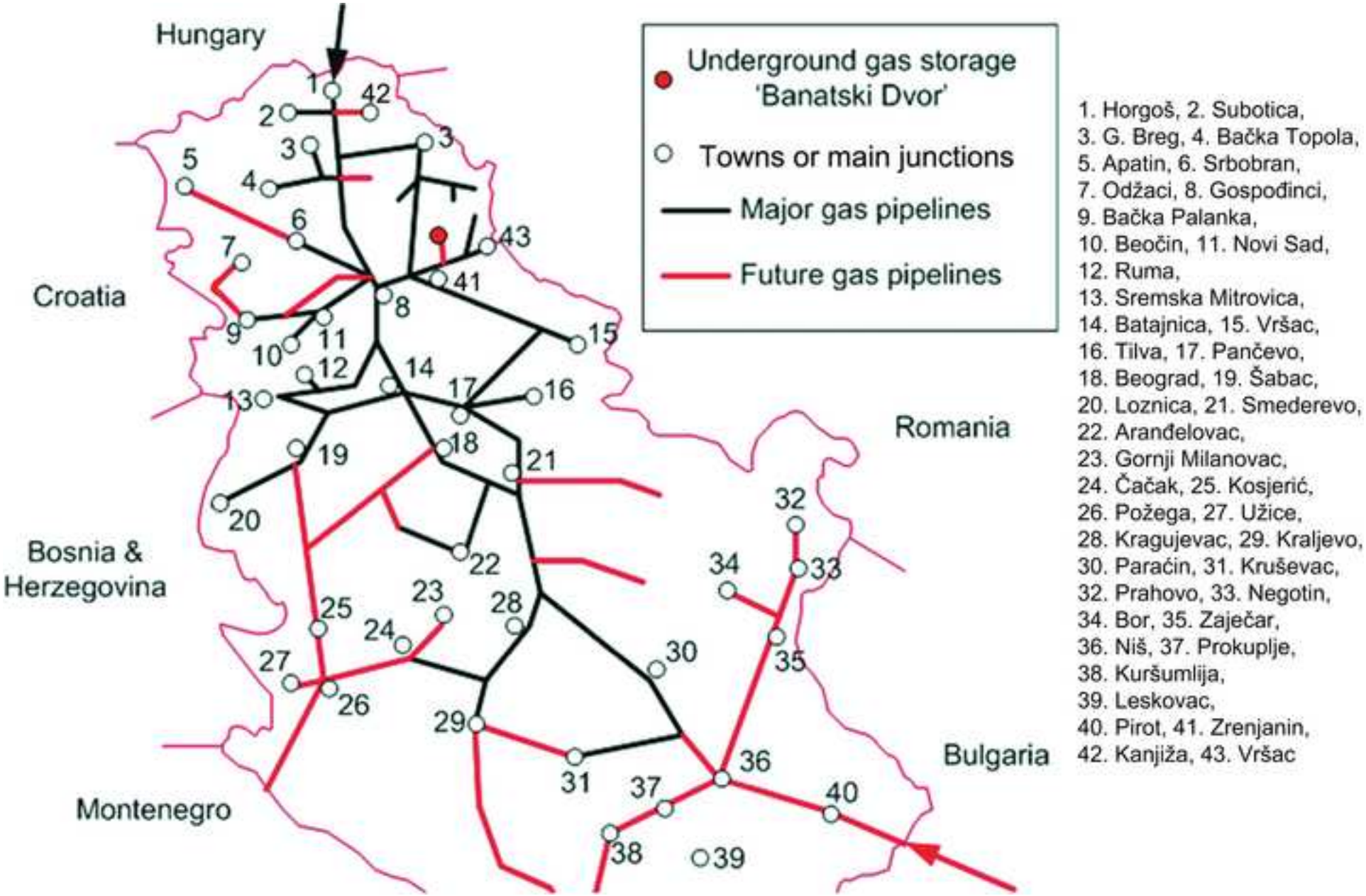

Figure 4 DB

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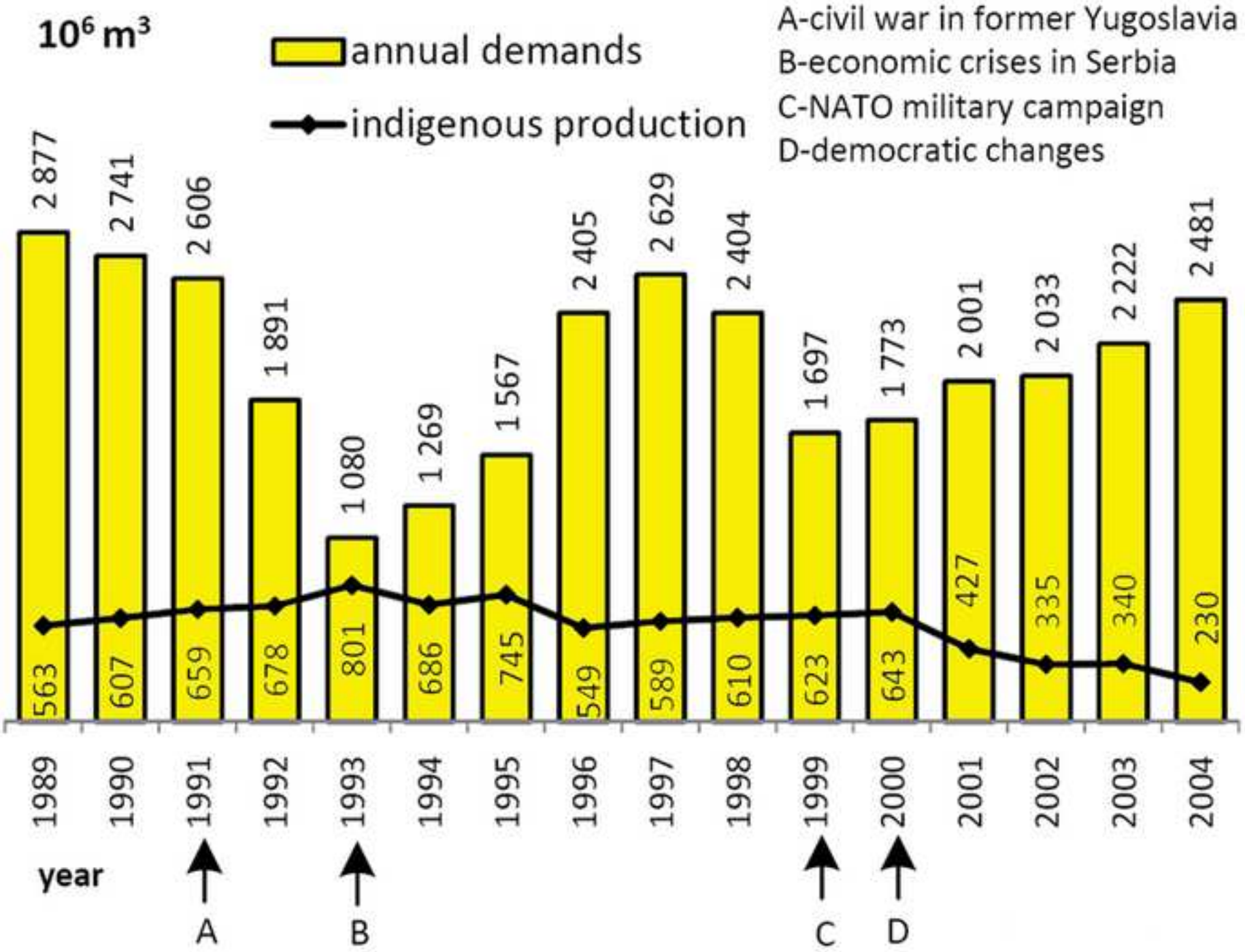

Figure 5 DB

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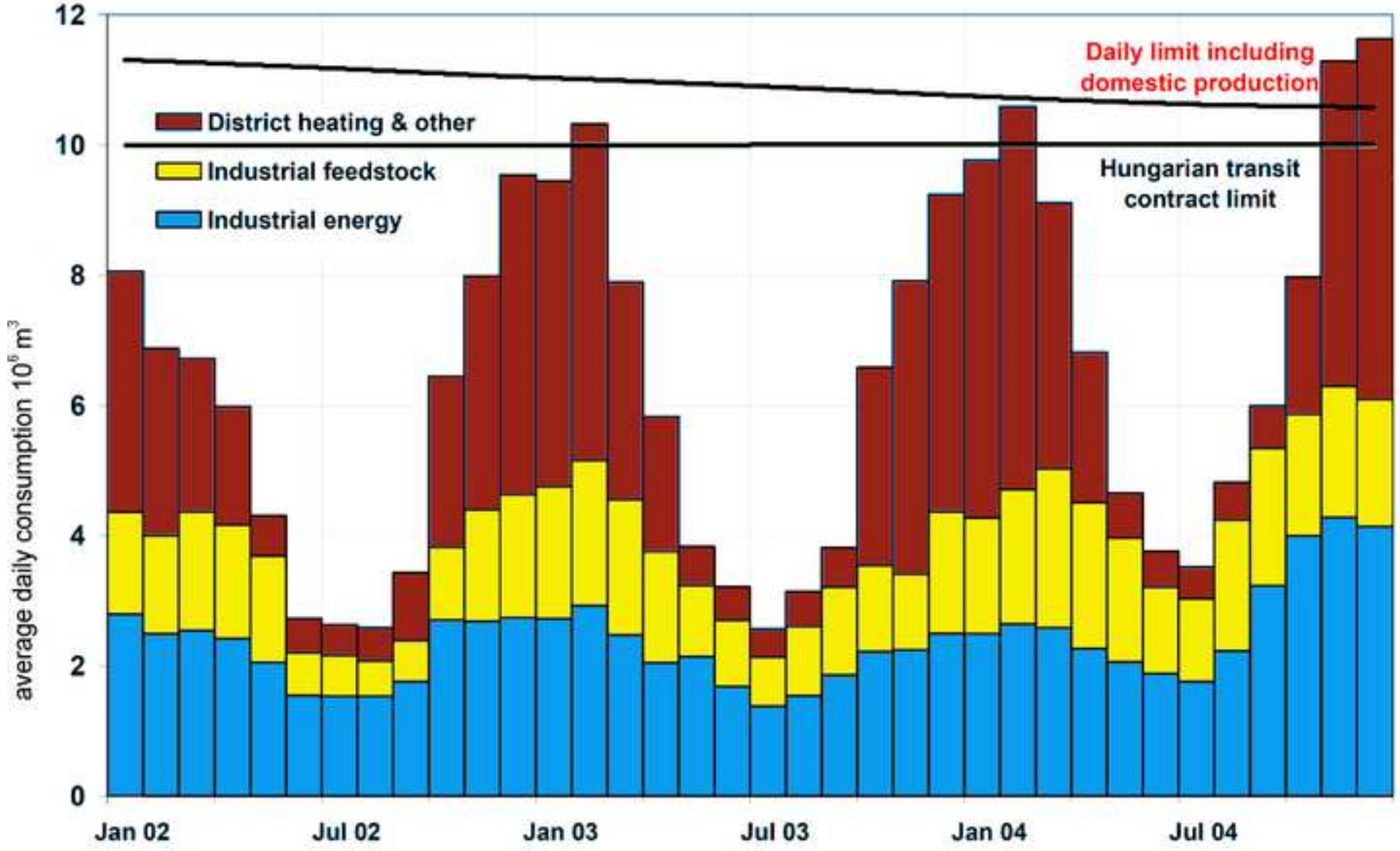

Figure 6 DB

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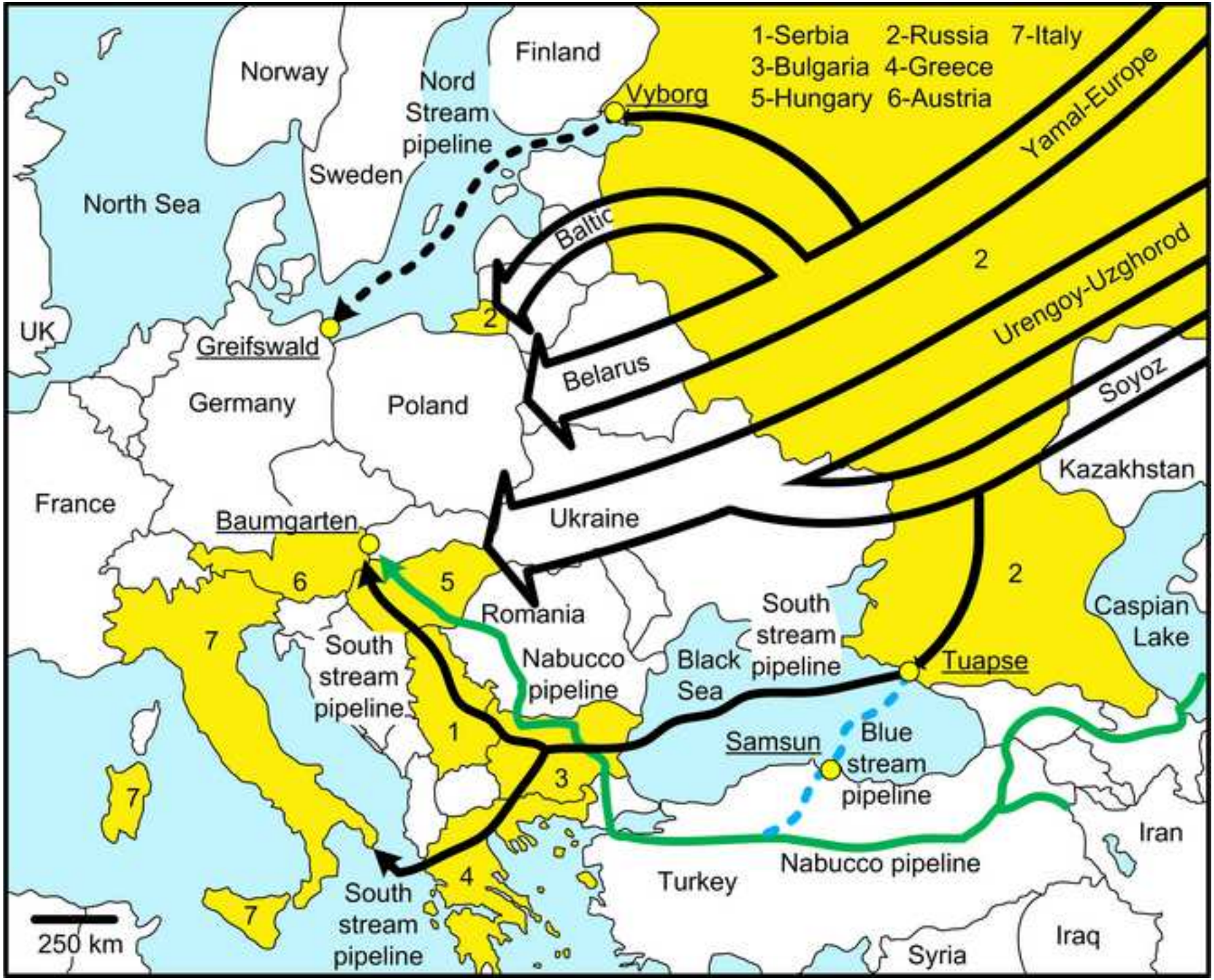

Table 1 DB

Table 1. Comparative economic indicators, 2007

source: www.cia.gov	Serbia	Bulgaria	Croatia	Romania	Hungary
Territory (km^2)	88 361	110 910	56 542	237 500	93 030
Population (million)	10.15[a]	7.26	4.49	22.24	9.93
GDP (billion US$)					
-purchasing power parity	77.28	86.71	69.59	247.1	191.7
- official exchange rate	41.68	39.61	51.36	166.0	138.4
GDP per capita (US$)					
-purchasing power parity	10400	11800	15500	11100	19300
-nominal, current prices (IMF 2008)[b]	7054	6849	14414	9953	16343
Real GDP growth (%)	7.3	6.2	5.7	6	1.3
Consumer price inflation (%)	6.8	9.8	4.5	4.8	8
Current-account balance (billion US$)	-6.88	-8.53	-4.85	-23.02	-8.01
Reserves of foreign exchange and gold	14.22	17.38	13.67	39.96	24.05
Exports of goods (billion US$)	8.82	18.44	12.62	40.32	87.77
Imports of goods (billion US$)	18.35	28.67	25.99	64.54	86.88
External debt (billion US$)	26.24[c]	34.88	46.3	74.54	125.9
Unemployment rate (%)	18.8	7.7	11.8	4.1	7.3
Population below poverty line (%)	6.5	14.1	11	25	8.6

[a]including population of autonomous province of Kosovo and Metohija which can be only estimated up to 2 661 045 (United Nation Mission in Kosovo-UNMIK administration in accordance with the United Nations Security Council-UNSC Resolution 1244 from 1999)
[b]from http://imf.org/external/
[c]including Montenegro and UNMIK

Table 2 DB

Table 2. Energy balance in Serbia, 2004[a]

source: www.eia.doe.gov	Oil[b] (bbl/day)	Gas (10^6 m^3)	Coal (10^3 t)	Electricity[i](GWh)	Total
Production	14410	240	41085[c]	35981	-
Import	75630	2100	1013[d]	5975	-
Export	3830	0	117[e]	6248	-
Primary supply	85080	2340[h]	41981	-[g]	-
Total (PJ)	174.77[j]	78.39	408.66	39.63[k]	700.68 PJ
				Primary production from domestic sources: 538.34 PJ	

[a]including Montenegro
[b]bbl-barrel of oil=0.1589 m^3=0.134 toe (1=42 GJ); toe-tonnes of equivalent oil
[c]41013 10^3 t lignite
[d]131 10^3 t hard coal, 270 10^3 t lignite, 612 10^3 t coke
[e]1 10^3 t hard coal, 116 10^3 t lignite
[f]capacity (hydroelectric 2.91GW, thermal 6.40GW)
[g]natural gas=33.5 MJ/m^3
[h]consumption=hydro+thermal (35708 GWh)-losses=30075GWh=108.27 PJ (overlap with coal balance)
[j]per year
[k]only hydroelectric (thermal is included in coal balance)