



**THE POTENTIAL CONTRIBUTION OF NATURAL
GAS TO SUSTAINABLE DEVELOPMENT IN
SOUTH EASTERN EUROPE**

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PREFACE

The South East European region does not receive much attention from the European gas community except in relation to transit pipelines. This is probably because – with the exception of Romania – there are few large gas markets in the region. But with Bulgaria and Romania now European Union member states and many others which are parties to the European Energy Community Treaty, we felt it important to commission a study to address the issue of whether and how gas could contribute to sustainable development for the countries in this region. This paper fills a gap in the gas literature by addressing this issue in two respects: how markets themselves might develop, and how transit infrastructure could facilitate (or impede) well-functioning markets and sustainable development. Some of the conclusions may be surprising to some in that they focus on non-conventional, small scale, region-specific approaches to market development featuring new technologies such as CNG shipping. This emphasis on niche applications goes against the conventional approach of large scale power generation development which is characteristic of most EU gas market analysis. Some other conclusions in respect of transit pipelines also run counter to conventional wisdom.

This is the OIES Gas Research Programme's first publication on south east Europe and can be seen as filling an important geographical gap in our work between Yesim Akcollu's study of Turkey, Philip Wright's book on the UK and Heiko Lohmann's study on Germany all published in 2006. We were very fortunate to have persuaded Aleksandar Kovacevic to write this study for us. His intimate knowledge and enthusiasm for the countries of the region, their energy systems, and potential energy technology development, is clear on every page of the study. The case which he makes for a "turnaround" towards sustainable energy development is difficult to dispute.

Jonathan Stern

March 2007

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1. Executive Summary

- The energy resources of South East Europe (SEE) are below the European average. Energy intensity throughout the region is higher than the world average and several times greater than the OECD average. However, most of the region's exports are energy intensive goods that create difficult problems for the terms of trade and the quality of economic development.
- The economies of the region could be classified as foreign aid dependent since all of them have low employment of labor and capital and large trade deficits while exchange rates remain relatively stable.
- Governance performance, the rule of law, property rights and transparency are all insufficient, despite certain improvements during recent years.
- Due to the deterioration of indigenous energy resources (forests, lignite, natural gas and crude oil), to seasonal and weather related fluctuations, to low utilization rates of available capital and to poor management, current energy sector trends are not sustainable. The Multilateral Treaty on a SEE Energy Community with the EU provides a framework for improvement that has not yet been incorporated into everyday business practice.
- Infrastructure development planning for the energy sector is based on a continuation of a long established historical pattern which is, for the most part, unsustainable. The prevailing development paradigm is likely to cause further deterioration in the quality of governance although it may lead to favorable nominal indicators of monetary stability and budget deficits. Its continued application could postpone the emergence of a rule of law and appropriate property rights required for sustainable development.
- If lack of rule of law and poor governance persist, local players could take advantage of government control over the massive gas transit infrastructure which is projected to be built through the region to extract rents through bilateral bargaining with investors. That is likely to threaten European supply security and the utilization of this infrastructure.
- This study contrasts the conventional development paradigm with a 'turnaround scenario' in which the gradual development of gas infrastructure is used to enhance physical openness, employment and the emergence of rule of law throughout the region, at the same time as supporting transition towards a more sustainable and efficient energy system.
- Complex interrelations between natural gas infrastructure and local consumption including obsolete mode of consumption such as conventional HoB (heat only boiler) based district heating systems and emerging uses such as gas powered heat pumps are analyzed to demonstrate scale of the required changes.
- The final part of the paper undertakes a very general planning exercise, presenting a map of possible new infrastructure and demand projections. Contrary to conventional wisdom a turnaround scenario should accept that, in the absence of continued costly government subsidies, a decline of natural gas demand is virtually inevitable over the next few years, followed by more sustainable growth. At the end of a ten-year transition period, consumption would be based on the efficient and competitive use of natural gas as an important component in the efficient use of all indigenous resources (water, biomass, lignite, waste and geothermal heat) and communal and housing costs would be minimized.

- Modern CNG shipping technology could be suitable to transport natural gas from the eastern to the western shores of the Black Sea. Since it does not require massive onshore coastal infrastructure, sunk costs remain minimal and at the same time it would have very favorable effects on security of supply, flexibility and gas-to-gas competition. The flexibility of this shipping mode allows various political and security risks to be avoided. The distances involved in CNG shipping across the Black Sea means that it is competitive with any (southern, northern or subsea) pipeline route. Finally, shipping capacity could be fine tuned according to the availability of gas and/or demand requirements that corresponds with sequential development of pipeline infrastructure in the SEE, in other words relatively small step-by-step growth in pipeline capacity in line with growing needs.
- All in all, the sequential development both of shipping capacity and of pipeline infrastructure should be considered more suitable and economical for the SEE than the construction of one or two huge transit pipelines with their massive up-front costs and risks.

2. Introduction: The Energy Scene in South Eastern Europe

South East Europe remains the most underdeveloped region in Europe in terms of energy and energy governance. The region's energy endowment is well below the European average. It is naturally dependent on imports and limited indigenous resources such as hydro, lignite and biomass. Eventual sustainable use of these indigenous resources requires considerable improvements in governance, which is deficient throughout the region.

Shortage of governance capacity and shortage of suitable energy supplies create a complex vicious circle of poverty and insecurity. The region remains vulnerable to both internal and external shocks in the energy sector that quickly spread through entire economy to cause downward swings of considerable magnitude. This persistent risk affects the entire structure of the energy sector, the economy and the everyday lives of ordinary people. Most families maintain a number of different means for space heating, and fuel reserves or social contacts to support them in the case of emergency or sudden change of energy supply circumstances. For a large proportion of families, maintaining a small family forest (usually about half a hectare of low quality, short lifespan wood) remains the ultimate form of energy security. A black market in fuel wood and lignite quickly adapts to circumstances, and informal energy security social networks take advantage of poor governance of state owned forests and poor enforcement of property rights in relation to privately owned forests and agricultural biomass.

An immediate consequence of prevailing energy patterns is deforestation. Although official statistical systems cover only a fraction of fuel wood harvesting and use, there is no doubt that the region is exposed to deforestation and erosion beyond any other area in Europe outside of the CIS.

As electricity and natural gas become increasingly available in local energy markets, most of the population continues to use solid fuels, supplementing them with available network energy if and when its prices are favorable compared with the marginal costs of depleting solid fuel reserves. This pattern creates considerable peaks due to demand overreaction in response to extreme weather or price changes.

The bulk of network energy customers are located in larger cities where housing and industry were built under a planned economic system. In the absence of appropriate energy markets, energy supply to these customers should be subsidized and the Government should remove any supply risks. Since housing efficiency standards are poor, network energy has to cope with cold weather and socially created demand peaks. The planning system provided a suitable framework for adjustments of the social system to the capabilities of the energy infrastructure; but newly acquired commercial freedoms (such as the private ownership of apartments, the emergence of urban real estate markets, a more commercial economy and greater mobility requirements) have created difficult challenges for the energy industry.

The objective of this study is to explore two different scenarios regarding how the energy industry throughout South East Europe (SEE) could adapt to new realities:

1. a ‘business as usual’ scenario in which the capabilities of the energy sector are increased without making any significant contribution to sustainable economic development; and
2. a ‘turnaround scenario’ that aims to change the industry to enhance economic development and good governance throughout the region.

Geographically, SEE is located between two parts of the world both of great importance in the world energy economy: one is the Black Sea region and Central Asia with their rich energy resources and the other is western and central Europe, an area of high energy demand. The eventual large scale transfer of energy from east to west will require a huge energy transport infrastructure which is bound to interact with local energy markets and local development patterns. The value of the expected annual energy flows to western and central Europe are possibly larger than the industrial production or even the GDP of most SEE countries. International firms likely to be involved in the development of such infrastructure could easily have annual revenues comparable to national GDPs in SEE. The ‘scenarios’ of development in the SEE countries will be profoundly influenced by the interactions between their economies and the vast expected energy infrastructure projects. In addition, the security and the cost of the energy supply to western and central Europe will be partly determined by which of the possible ‘scenarios’ of development is followed by the SEE countries.

2.1. South East Europe: Jurisdictions and Geography

South East Europe, or the Balkans, for the purpose of this study comprises the following jurisdictions: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR Macedonia, Romania, Serbia and Montenegro and the United Nations Interim Administration Mission in Kosovo (UNMIK).

Kosovo province is under UNMIK in accordance with UN Security Council Resolution 1244 of 1999. The data and tables used in this study are based on international sources that treat Serbia, Montenegro and Kosovo as one entity. Therefore, the accuracy of some of the data is questionable. It is quite likely that that real costs or problems are more difficult than might be concluded from the available data.

As shown in Figure 1, SEE is located between the Black Sea and Mediterranean. It includes the Adriatic coast and the Black Sea coastal area and continental shelf; these coastal areas are separated by the Dinaric Mountains in the southwest and the Balkan/Carpathian mountains in the northeast. The River Danube with its catchment areas (the rivers Drava, Tisza, Sava, Morava and Prut) crosses the region from West to East connecting the central Panonian plane with the Black Sea. Other, smaller rivers flow into the Adriatic Sea (Neretva, Moraca, Bojana) or the Ionian Sea (Vardar).

Figure 1: Map of South East Europe



The region has a moderate climate with mild winters in the areas with lower altitudes where most of population and economic activity are located. However, short periods of severe cold are possible lasting up to 30 days.

2.2. Diversity of energy balances and common concerns

Following tables provide basic insight into energy patterns throughout the SEE.

Table 1: Basic energy data on South East Europe

Country	Population	GDP	Energy Production	Net Imports	TPES	Electricity Consumption	CO ₂ Emissions
	Million	Billion 1995 USD	Mtoe	Mtoe	Mtoe	TWh	Mt
World	6195.66	35317.65	10305.74	-	10230.67	14701.24	24101.83
OECD	1145.06	28435.02	3847.06	1563.62	5345.72	9212.82	12554.03
Albania	3.15	4.03	0.77	1.17	1.94	4.49	3.88
Bosnia and Herzegovina	4.11	6.89	3.32	1.18	4.32	7.86	15.22
Bulgaria	7.97	13.70	10.54	9.02	19.02	30.20	41.84
Croatia	4.47	24.29	3.71	4.92	8.22	13.73	19.65
FYR Macedonia	2.04	4.95	1.51	1.20	2.54	5.65	8.02
Romania	22.30	36.01	28.41	8.79	36.98	45.20	90.78
Serbia and Montenegro	10.63	16.87	10.88	5.29	16.17	32.18	48.88
SEE	54.67	106.74	59.14	31.57	89.19	139.31	228.27

TPES= Total primary Energy Supply
M toe = Million Tons of Oil Equivalent
TWh = Tera Watt Hour
Source: International Energy Agency (IEA) 2005.

Table 2: Basic Energy Indicators of South East European Countries

Country	TPES/Pop	TPES/GDP	Elec.Cons./Population	CO ₂ /TPES	CO ₂ /Pop	CO ₂ /GDP
	Toe/capita	Toe/000 1995 USD	KWh per capita	T CO ₂ /toe	T CO ₂ per capita	Kg CO ₂ /1995 USD
World	1.65	0.29	2373	2.32	3.89	0.68
OECD	4.67	0.19	8046	2.35	10.96	0.44
Albania	0.62	0.48	1427	2.00	1.23	0.96
Bosnia and Herzegovina	1.05	0.63	1912	3.52	3.70	2.21
Bulgaria	2.39	1.39	3792	2.20	5.25	3.05
Croatia	1.84	0.34	3075	2.39	4.40	0.81
FYR Macedonia	1.25	0.51	2770	3.15	3.94	1.62
Romania	1.66	1.03	2027	2.46	4.07	2.52
Serbia and Montenegro	1.52	0.96	3027	3.02	4.60	2.90
SEE	1.63	0.84	2548	2.56	4.18	2.14

TPES= Total Primary Energy Supply

M toe = Million Tons of Oil Equivalent

TWh = Tera Watt Hour

Source: International Energy Agency (IEA) 2005.

Croatia is the only country in the region whose basic energy indicators are comparable to average world values, although they are still lower than the OECD average. Other countries and the region as whole are significantly more energy intensive than the world as a whole and to the OECD. Carbon usage is also much higher than the world and the OECD averages.

There is a trend towards increasing transport-related oil product use, caused by a large inflow of passenger vehicles and the corresponding growth of consumption of liquid fuels, although there is no increase in commercial activity. Liquid fuels, crude oil and passenger cars are important contributors to the foreign trade account deficits of the SEE countries.

The method of calculating GDP (the sum of nominal profits and value added) is intended for relatively normal commercial economy. If an economy receives monetary inputs (for example from aid, remittances or the export of natural resource) it can increase the import of consumer goods far beyond its exports of manufactured goods or services and these imported goods could be sold out at a profit. that profits will be included in GDP calculations although they make no contribution of to welfare. In these circumstances, nominal GDP ceases to be good measure of welfare.

One general feature of SEE countries is that they are exporters of energy-intensive goods (aluminum, copper, steel, rubber, sugar and petroleum products) despite their very low energy efficiency levels and their limited natural resource endowment.

The ecological characteristics of the region show clear indications of unsustainability, as is shown in table 3.

Table 3: The 1999 Ecological Footprints of SEE countries

Country	Population in millions (1999)	Ecological Footprint in global hectares	Biocapacity in global hectares	Domestic Ecological Deficit/Remainder in global hectares
WORLD	5,978.7	2.3	1.9	-0.4
Albania	3.1	1.0	0.8	-0.2
Bosnia and Herzegovina	3.8	1.1	1.1	0.1
Bulgaria	8.0	2.4	1.8	-0.5
Croatia	4.7	2.7	2.1	-0.6
FYR Macedonia	2.0	3.3	1.5	-1.8
Romania	22.5	2.5	1.4	-1.1
Serbia and Montenegro	10.6	2.1	1.2	-0.9

Source: Wackernagel et al. 2002.

Some economic indicators for the region are shown in Table 4. In terms of employment and industrial output the region remains below its 1989 levels, even though inflation is largely under control. All countries run sizeable foreign account deficits.

Table 4: Various economic indicators of SEE Countries

Country	Albania	B&H	Bulgaria	Croatia	Romania	S&M	FYRoM
Real GDP/NMP, 2003 (Indices, 1989=100)	123.6	314.0	87.3	91.0	92.4	49.9	81.4
Real total consumption expenditure, 2002 (Indices, 1989=100)	-	-	87.2	125.3	118.0	-	...
Real gross fixed capital formation, 2002 (Indices, 1989=100)	-	-	113.7	204.9	150.8	-	...
Real gross industrial output, 2003 (Indices, 1989=100)	28.0	13.5	51.4	66.2	52.5	38.7	46.3
Total employment, 2002 (Indices 1989=100)	63.9	62.5	68.2	83.1	84.4	79.0	54.2
Employment in industry, 2002 (Indices, 1989=100)	63.1	44.7	43.0	55.8	55.7	60.2	51.3
Consumer price indices, 2003 (Annual average, percentage change over preceding year)	2.7	0.2	2.3	2.2	15.4	9.6	1.1
Balance of merchandise trade (Billion dollars)	-1.159	-.2024	-2.209	-5.815	-3.988	-4.045	-0.536

Source: Economic Commission for Europe 2004.

In economic terms, while there are differences between countries, the region as a whole is an example of a foreign aid dependent economy. The relative stability of exchange and inflation rates is based predominantly on foreign currency inflows, export of energy intensive commodities and political arrangements which produce short-run but unsustainable financial inflows. Consequently all countries experience considerable variations in real GDP, as demonstrated later in Figure 10). This monetary situation is a mutated form of ‘Dutch Disease’ since the appreciation of the domestic currency effectively prevents employment both of labour and of domestic means of production. It is somewhat unusual for ‘Dutch disease’ to be seen in countries with such limited natural energy resources. However, foreign aid has permitted these jurisdictions to subsidize energy prices and facilitate both retail consumption and export of energy intensive commodities.

Table 5, on carbon dioxide emissions by sector, demonstrates the relative prevalence of public electricity generation and heat production as well as road transportation as compared with industry in all the SEE countries.

Table 5: Carbon dioxide emissions by sector

Country	CO ₂ Emissions by Economic Sector (million metric tons) 1999			
	Industry	Residential	Road Transportation	Public Electricity and Heat
Albania	0.4	0.2	0.6	0.1
Bosnia and Herzegovina	0.2	...	0.8	2.6
Bulgaria	9.7	1.4	5.2	22.2
Croatia	3.7	2.1	4.1	4.5
FYR Macedonia	0.9	0.3	1.1	6.2
Romania	18.9	6.1	7.4	35.7
Serbia and Montenegro	7.4	0.1	4.2	26.1

Source: World Resources Institute 2003.

Croatia is a not inconsiderable producer of crude oil and natural gas. Its energy infrastructure is well diversified with a gas distribution network and a major regional crude oil pipeline that provides access to the open sea. Electricity generation is based on co-generation plants and a share of a nuclear plant located in Slovenia. Professional organizations are well established and there is concentrated action directed towards improving energy efficiency.

Serbia is major consumer of domestic lignite and fuel wood that are obtained at low extraction/harvesting efficiency and with high unit costs. There are more than 40 district heating systems in the country based on simple boiler technology as mentioned elsewhere in this text. Due to its large lignite based power generation, Serbia is one of largest sources of sulphur dioxide in Europe. Gas distribution is limited to northern parts of the country and the suburbs of Belgrade. Domestic production of crude and natural gas is declining and supplies a minor part of domestic needs. Two oil refineries are connected with the oil pipeline via Croatia to the Adriatic Sea. There is no significant use of the Danube waterway for energy purposes. Professional associations, although they have over a century of tradition, are now weak and have little influence on governance in the energy sector.

Romania contains natural reserves of crude oil, natural gas and lignite, all of which are sizeable but declining. It is transit country for natural gas from Russia to Greece and Turkey. The use of fuel wood is widespread. The energy sector, which includes thermal power plants, refineries and district heating systems, operates at relatively low efficiency and with aging capital stock.

Bulgaria's energy security was based on a large nuclear power plant in Kozloduy (scheduled for decommissioning) and SEE's largest oil refinery (in Burgas), as well as gas transits. Reserves of lignite in Maritza basin are utilized in plants with relatively old technology, although they are undergoing some renovations. The use of fuel wood is considerable, while through the tax system the inherently uneconomic district heating systems are subsidized, a burden which falls disproportionately on the poor.

Bosnia and Herzegovina imports small amounts of oil products and natural gas. Coal and lignite power plants, as well as massive fuel wood use, play an important role in domestic energy supply. There are important hydro resources permitting lucrative electricity export with possibilities of future expansion.

FYR of Macedonia has made exceptionally intensive use of its available assets in the energy sector (the refinery and district heating in Skopje, a Thermal Power Plant in Bitola and a number of smaller hydro power plants). The country is concerned about a long term shortage of energy and energy resources. Fuel wood use is widespread and extensive. Shortage of lignite will in the medium term make the use of the Bitola Plant more problematic.

Kosovo has not been able to make use of available lignite based power plants near Pristina even to regional standards. Energy supply is based on fuel wood harvesting and import as well as import of LPG and oil products as well as electricity when possible. There are considerable lignite deposits in Kosovo.

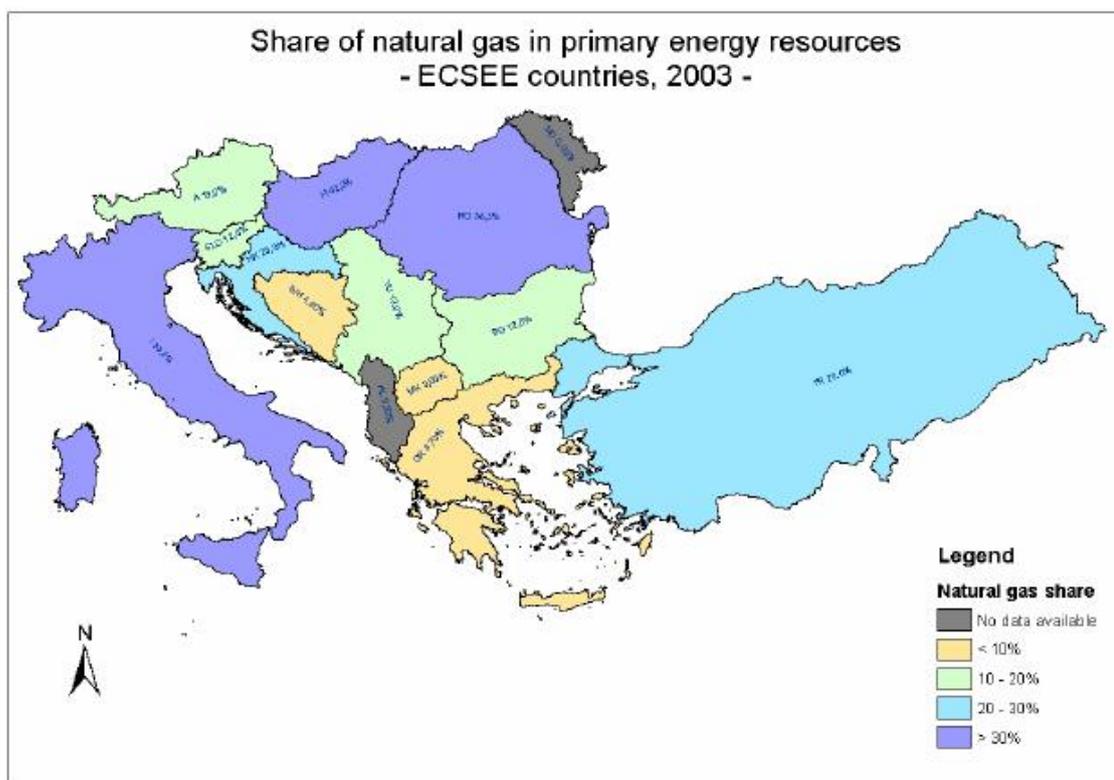
Montenegro experiences shortages of electricity despite its two large hydropower plants and superb hydro resources. Its small lignite deposits are difficult to utilize. Inefficient use of fuel wood dominates the residential energy market. Montenegro is an importer of oil products and LPG.

Albania's economic growth is seriously constrained by the shortage of energy services. Its hydropower plants are intended to use the country's hydro resources (whose use is restricted to certain periods of the year due to high levels of porosity) and to supplement domestic resources of crude oil and fuel wood as well as imports. With international assistance, the country plans to develop its energy infrastructure if possible within a context of regional integration.

Further details on natural gas use in SEE countries are mentioned in the pages which follow and some projections are made in Chapter 2.2.5.

Natural gas at present provides a relatively small part of the energy supply to SEE countries. Only Romania and Croatia where there is significant, though declining, domestic production use natural gas to a degree comparable to the European average. However, natural gas production in all the currently producing SEE countries is scheduled to undergo a sharp decline in forthcoming years. Figure 2 shows the shares of natural gas in primary energy supply of the SEE countries in 2003.

Figure 2: Share of Natural Gas in Primary Energy Resources, 2003



Source: Tambone and Ascari 2005.

2.2.1. Natural Gas Physical Infrastructure

The SEE is covered by three separated natural gas systems:

- Croatia is served by its separate system with relatively small capacity connections with Hungary, Slovenia and Italy. Domestic production is still the dominant source of gas although imports are increasing in volumes and relevance.
- Romania, Bulgaria and Macedonia receive Russian supplies via Moldova and Ukraine (the Trans-Balkan route).
- Serbia and Bosnia are supplied with gas from Russia via Hungary and Ukraine.

**Figure 3: Existing Natural Gas Infrastructure and Short-term Development Plans
Natural Gas Transit Pipelines in Romania and Bulgaria**



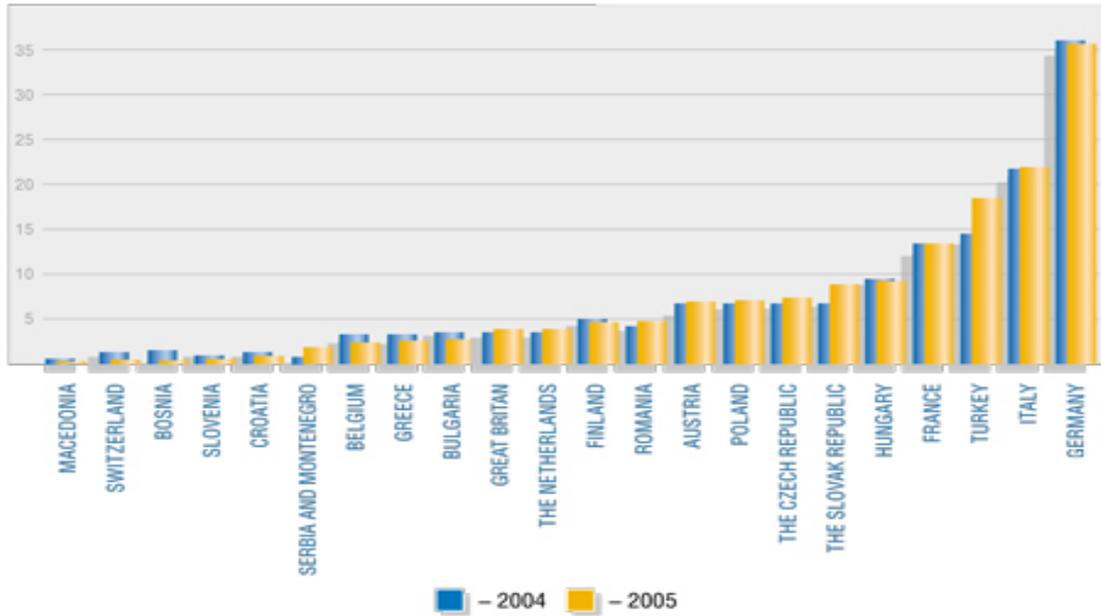
Source: Merkulov 2005.

Natural gas is delivered to Romania and Bulgaria (and consequently Greece, Turkey and Macedonia) through Ukraine and Moldova where a compressor station is located near the City of Tirasopol. The difficult political situation in Moldova creates some insecurity in the supply of gas via this crucial piece of infrastructure.

The rate of dependency of each ECSEE country on its main gas supplier is shown in the following map (Figure 5).. It should be noted that Kosovo, Montenegro and the coastal areas of Croatia, as well as most rural areas except those in Romania, are not supplied with natural gas. Most official trans-border supplies are regulated by long term contracts with take or pay clauses.

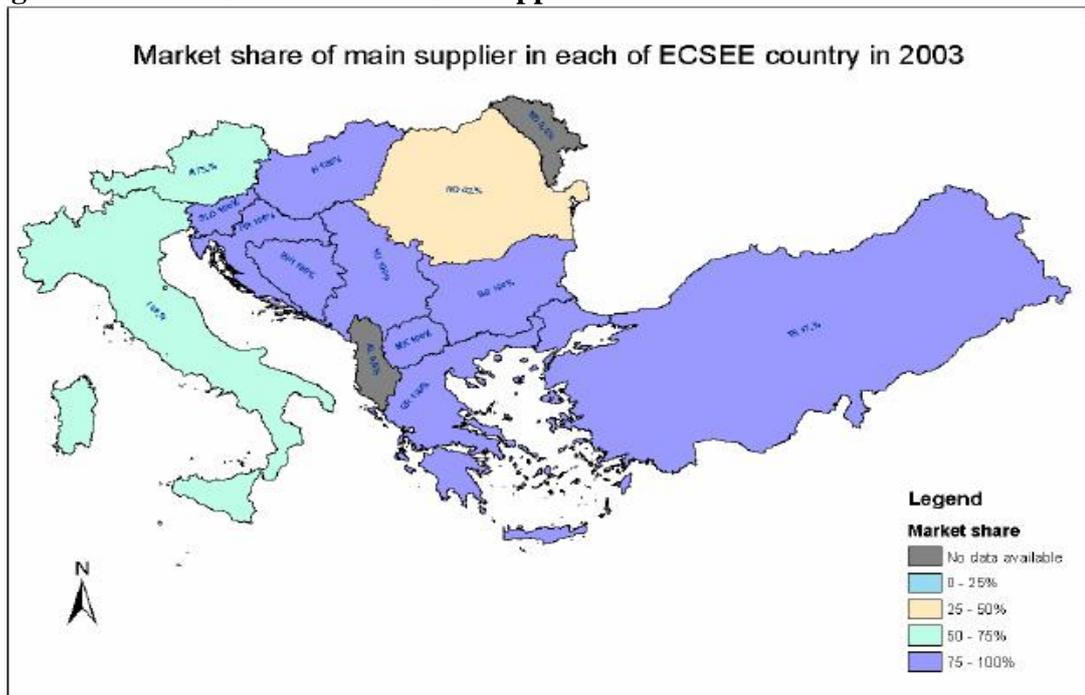
Figure 4: Natural gas exports to Europe, 2004–2005

Natural gas exports to Europe in 2005



Source: Gazprom website (www.gazprom.com).

Figure 5: Market Share of Main Gas Supplier



Source: Tambone and Ascari 2005.

2.2.2. Planning and statistics

Available data sets and statistical methodologies in most SEE countries are not sufficient for detailed and satisfactory energy planning. For example, Serbia has not been able to produce complete energy balances for the past few years. Consolidation and separation of energy balances between Serbia, Montenegro and Kosovo remains an ongoing problem. Most national statistics are insufficient when it comes to fuel wood use. The living standard measurement surveys usually fails to include reduction of living space during the winter heating period as well as real fuel wood procurement expenses. The immediate consequence of these shortcomings is an inability both to assess relative energy efficiency of some heating options and to produce viable projections or to factor in the impact of new technologies or price changes.

For example, detailed surveys conducted in Serbia during 2003 reveal a long-term consumption of approximately 11–12 million cubic meters of fuel wood per winter season, while official statistics report only about 2 million cubic meters per year. The difference is of course explained by shortcomings in the official statistical system (the reports of forest engineers, the UN Food and Agriculture Organization, the historical analyses of deforestation trends, anecdotal evidence from the fuel wood shadow market and analyses of the energy efficiency of wood burning appliances). The fact that fuel wood consumption is 5–6 times larger than the official statistics means that the questions of residential energy consumption and the nature of peak demand in network-based energy systems must be view in a completely new light.

The opportunity costs of fuel wood have distinctive characteristics. The size of seasonal reserves of fuel wood are normally based on family experience of how much is necessary to cover consumption during a normal winter. During the course of winter, the fuel wood stock is likely to be progressively depleted as long as outside temperatures are around average for a particular location. As soon as outside temperature drops significantly below average, homeowners expect a more rapid depletion of reserves and consequently the marginal cost of fuel wood increases. Shadow markets respond to temperature in a similar way: during cold days, fuel wood on the open market is likely to become more expensive. A conventional tariff system for network energy does not have such flexibility. Price remains the same regardless of outside temperature. That creates incentives to place an additional load on network energy systems during cold days. Obviously, devices for this additional consumption are likely to be the cheapest available and, of course, the least efficient. The infrastructure cost of such practices is enormous. The network energy systems, that need to provide capacity for this additional load, are therefore likely to have idle capacity for most of the year and power generation infrastructure is likely to be underutilized. Gross utilization times for base load thermal power plants throughout SEE are lower than elsewhere in Europe.

Historically, populist governments have been concerned about the security of supply and the level of comfort provided by network energy systems. Such concern prompted the creation of very large reserve capacities throughout the energy system to cope with demand peaks and potential interruptions.

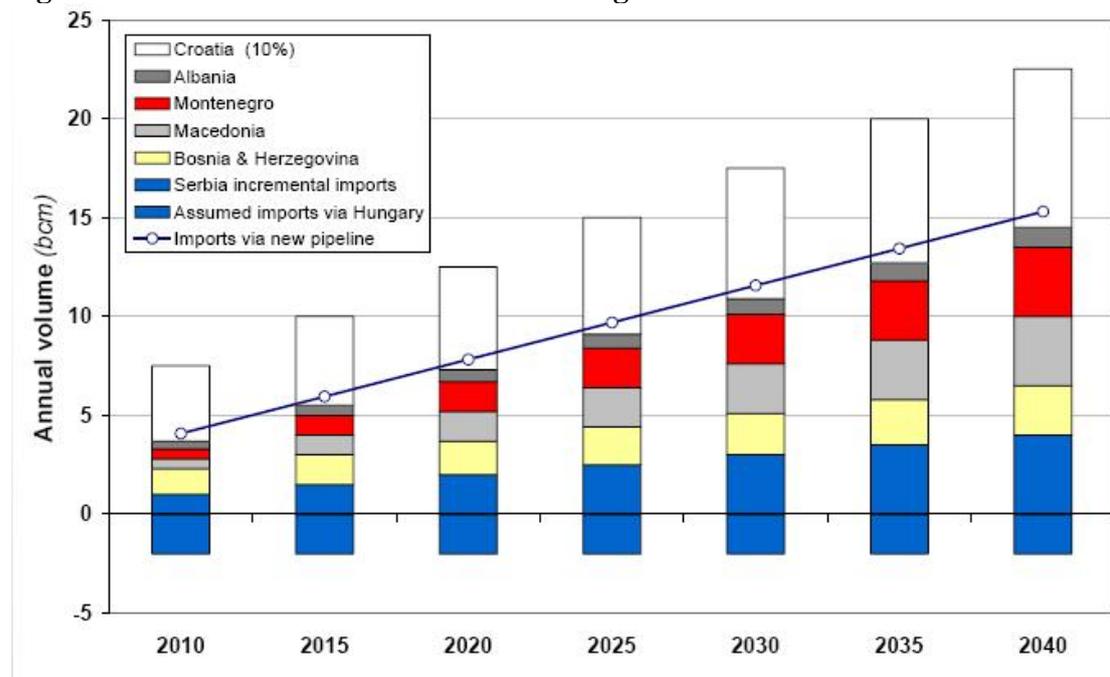
Furthermore, where governments are weak, network energy systems are often multiplied. To cope with the governance risk, the population tends to connect to more than one network system and over-develop connection capacity so that one energy network could eventually replace supply from another. Where available, the shadow market for solid fuels combined with extensive reserves, generates confidence beyond that which could be provided through network systems under a weak government.

A common feature of new apartment blocks connected to district heating networks is that they are also equipped with a high capacity (tri-phase) connection to the electricity network. Surveys reveal that more than half of apartments connected to district heating networks are supplied by electric heating appliances. In this way they maintain a reserve system of heating, reflecting a lack of confidence in the district heating network.

When regular technical modeling is applied to such circumstances, the obvious technical energy efficiency of network energy leads to a conclusion that there is indeed considerable market penetration opportunity or growth potential.

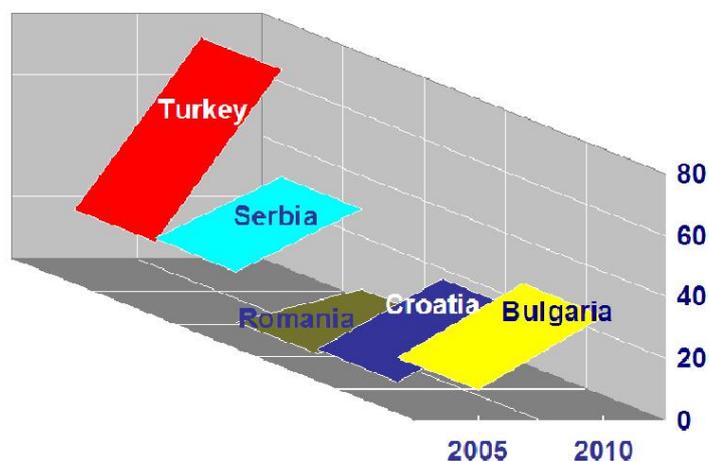
Figures 6 and 7 represent some of these planning exercises.

Figure 6: Conventional estimation of natural gas demand in Western Balkan Countries



Source: Tubin 2005.

Figure 7: Conventional estimation of natural gas demand in Serbia, Romania, Croatia and Bulgaria



Source: Tambone and Ascari 2005.

Duplication of various network capacities, excessive peak demand and competition between more secure options (solid and liquid fuels) devastate the economics of network energy. As a result, operators demand excessive connection fees for the extension of networks. This practice requires difficult collective bargaining as network operators need the participation of a viable number of subscribers to extend the network to a new region.

The existence of network systems affect land usage so that new construction is concentrated in urban areas where the development of natural gas networks faces competition with district heating systems and high capacity electricity networks.

2.2.3. Trends in Gas Consumption

Gas consumption trends are likely to change in SEE. As the share of industrial consumption is relatively limited, the most important changes are likely to occur in district heating, fertilizers and sugar production with an eventual spread to residential demand.

District heating systems in SEE are not only less efficient than their Western European or Scandinavian counterparts, but they provide heating services to a less efficient housing stock and use original fuel instead of waste heat or renewable energy. Since they are designed for exceptionally low temperatures they are characterized by chronic overcapacity, and yet there is no suitable framework for serious restructuring these systems. However, with growing cost pressures from increasing international prices of natural gas and crude oil and the decline of domestic production of natural gas, as well as a more strict application of ToP clauses, governments will be pressed to rethink district heating policies. Some indicators of the performance of district heating systems are shown in Tables 6 and 7 below.

However, widespread subsidies at both national and municipal levels, as well as political ties between the ruling political elites and the customer base in urban areas effectively covers this endogenous trend toward more sustainable district heating.

Table 6: Performance Indicators for District Heating Distribution Systems

	Unit	Central and Eastern Europe and the Former Soviet Union	Western Europe
Customer heat consumption (annual energy use/space heated)	Kwh/m ³	70 to 90	45 to 50
Distribution losses	% of heat supply	15 to 25	5 to 10
Change of circulation water (annual make-up water volume/network water volume)	Refills per year	10 to 30	1 to 5
Production losses	% of fuel energy	15 to 40	5 to 15

Source: Meyer and Mostert 2000.

Table 7: District heating restructuring progress in the SEE countries (as of Spring 2004)

Country	Bulgaria	Croatia	FYR Macedonia	Romania	Serbia and Montenegro
Unbundling DG/CHP from electricity sector	↓	↓	↓	↓	↓
Establishment of a regulator	↓	↓	↓	↓	↓
Municipalization	↓	↓	↓	↓	↓
Reducing cross-subsidies	↓	↓	↓	↓	↓
Increased tariffs for captive customers	↓	↓	↓	↓	↓
Cost+ pricing for captive, market pricing for industrial customers	↓	↓	↓	↓	↓
Budget allocation for the poor elimination of producer subsidies	↓	↓	↓	↓	↓
Competition among DH/CHP suppliers; regulated access to heat grids	↓	↓	↓	↓	↓
Profitability	↓	↓	↓	↓	↓
Investing into efficiency, metering, expansion, information technologies	↓	↓	↓	↓	↓
Privatization, private–public partnerships	↓	↓	↓	↓	↓
Equal level playing field DH: gas CH: electricity	↓	↓	↓	↓	↓
Internalization of external benefits	↓	↓	↓	↓	↓
Urban planning	↓	↓	↓	↓	↓
Reduced density of regulation	↓	↓	↓	↓	↓

Source: Brendow 2004.

Most countries in SEE continue to produce fertilizer which remains the largest single industrial gas consumer. This is of special importance for areas with substantial agricultural production (Serbia, Romania, Bulgaria and Croatia). But growing opportunity costs and declining domestic production are likely to prevent further subsidy of this activity based on domestic gas production because of a number of ongoing trends identified by Abram and Forster (2005):

‘Western European¹ production of ammonia decreased tremendously in the last 10-15 years with the exception of Belgium and Germany, potentially due to their closeness to the oil & gas deposits,² and efficient plants with strong distribution networks. Central and Eastern Europe, including former Soviet Republics, show rather mixed results. Poland, particularly in 2003, produced more due to successful restructuring of the chemical industry leading to efficiency improvements. Ukraine since its independence in 1991 has been producing around 4,5 million short tons of ammonia annually. Its strength comes from its cheap natural gas, and could easily be increased if the plants were upgraded in terms of machinery and/or general capacity. Ukrainian neighbor, Russia, has been also one of the biggest producers of ammonia, again due to low natural gas prices in that country, but also because of some recent industrial upgrades. Its production increased 40 percent from the low in 1998. Countries such as Hungary, Romania or Bulgaria have cut down their production by at least 50 percent since the mid-80s due to uncompetitive status of their chemical industries after the downfall of communism, and their failure to make the transition. Finally, states such as Lithuania, Czech Republic, and Ireland have kept steady low production.

From a historical perspective, the general trend seems to be the relocation of production towards countries where the price of natural gas is lower such as Asia, Eastern Europe, Middle East, and Latin America. This transfer comes at the expense of North America and Western Europe.’³

Under the terms of the Danube convention, both Russia and Ukraine are allowed to use the Danube navigation route. However, the Russian Federation is no longer a Danube country and its long term access to the Danube is limited to relatively inefficient river-to-sea-going ships. Taking into account its ongoing restructuring (including changes in the relations between Russia and Ukraine in the wake of much higher natural gas prices) the Russian fertilizer sector will, by means of appropriate fleet development, be able to increase its market share of the fertilizer market along the Danube. That will place heavy pressure on the other fertilizer industries in SEE and on associated gas consumption. However, this potential change, which could affect as much as 10 percent of current consumption, is not visible yet.

¹ Particularity in France, Italy and the U.K.

² Germany and the Netherlands countries have around 42% of the natural gas reserves of Western Europe.

³ ‘The most significant gains in production capacity during the 10 year period (1992–2002) were in Asia. China share of the world capacity has increased to 19 from 17 percent.³ In the rest of Asia, the percentage of total world capacity has increased to 19 from 15 during the same period. Significant contributors to the increase were India and Indonesia. Europe’s ammonia production capacity dropped during this period to 14 percent from 19 percent of the world total. Significant declines occurred in Eastern Europe after the dissolution of the Soviet Union. Some of the last efficient plants were closed, and some plants did not have enough financial support to operate. Production capacity in Western Europe declined as well-to 8 percent from 11 percent of the world total. Ammonia production capacity in the United States has increased to 18400 short tons in 2002 from 16,700 short tons in 1970, although it fluctuated quite a bit during this time.’ (Abram and Forster, 2005, pages 20–21).

Table 8: Comparative analyses of fertilizer production in countries reachable by competitive water transport from Russian fertilizers production areas.

Country	1976	1980	1990	2003	% Annual Growth 1976–2003	% Annual Growth 1980–2004	% Annual Growth 1990–2005	% Capacity Utilization 2002
Russia	NA	NA	NA	12,200	NA	NA	NA	79
Romania	2,224	3,014	2,400	1,582	-1.21	-2.65	-1.72	34
Italy	1,634	1,873	1,609	637	-3.31	-4.40	-3.79	78
Bulgaria	1,235	1,109	1,756	430	-3.69	-3.87	-5.69	34
Turkey	122	247	500	387	4.21	1.90	-1.06	53
Croatia	NA	NA	NA	354	NA	NA	NA	64
Hungary	942	1,066	594	311	-3.88	-5.00	-2.66	73
Greece	319	303	345	165	-2.33	-2.50	-3.02	25

Source: Abram and Forster 2005.

The domestic production of fertilizers based on the processing of natural gas is only made viable through government subsidies. Even so, it is too costly for many farmers, and so demand remains small and agricultural production does not improve. The import of fertilizer from Russia would in principle be more efficient but it is impeded by the policy of maintaining the transport infrastructure on the Danube in a poor state, thus making the cost of importing prohibitive.

Table 9 demonstrates the trend:

Table 9: Agriculture and Food

Country	Average production of Cereals		Average Cereals Crop Yields		Variation in Domestic Cereal Production (% variation from mean) 1992-2001	Net Trade of Cereals (imports-exports) as a Percent of Consumption 2000	Average Meat Production Per Capita		Irrigated Land as a Percentage of Total Cropland 1999	Average Annual Fertilizer Use		Average Daily per Capita Calorie Supply Kilocalories, 1999	
	000 Metric Tons 1999-2000	Percent Change since 1989-1991	Kg Per Hectare 1999-2001	Percent Change since 1989-1991			Kg Per Person 1999-2001	Percent Change Since 1989-1991		Kg/ha of Cropland 1997-1999	Percent Change since 1987-1989	Total	From animal Products
EUROPE	393,862	...	4,187	...	5	(5)	70	...	8	78	...	3,230	906
Albania	558	(30)	2,622	0	11	41	21	37	49	19	(87)	2,717	733
B&H	1,112	...	3,034	...	17	36	7	...	0	50	...	2,960	413
Bulgaria	5,016	(43)	2,696	(35)	14	(7)	60	(29)	18	36	(82)	2,847	679
Croatia	2,889	...	4,355	...	7	(13)	28	...	0	141	...	2,617	495
France	63,527	10	7,088	14	7	(90)	109	7	11	249	(20)	3,575	1,353
FYRoM	598	...	2,711	...	12	19	17	...	9	68	...	2,878	489
Romania	14,687	(20)	2,569	(17)	16	2	51	(25)	27	31	(77)	3,254	742
Serbia & Montenegro	7,716	...	3,518	...	14	(11)	81	...	1	51	...	2,805	946
USA	334,554	14	5,824	27	7	(32)	133	17	13	111	16	3,754	1,050

Source: World Resources Institute 2003.

The sugar industry is an example of how new technology can increase energy efficiency in food processing. After the recent privatization of most food processing industries and rising energy prices, SEE countries are now entering a period in which these industries will need to adapt rapidly by applying new technologies or go out of business. Moreover, the EU has started a reform process to reduce excess sugar beet capacity.

In the case of the sugar industry (and many other food processing industries), not only is energy consumption per unit of output declining through the application of new technology but energy is sourced from industrial waste / biomass. This trend is likely to phase out natural gas as a main fuel in these industries into more appropriate role of fuel of choice for mechanical drives and heat pumps.

Table 10: Energy efficiency in the sugar refining industry

Before and after		
	Old plant	New plant
Natural gas usage	75 GJ/year	38 GJ/year
Water supply	308 m ³ /day	215 m ³ /day (estimate)
Cooling water	2000 m ³ /day	40 m ³ /day
Cooling water energy	42 GJ/day	0.84 GJ/day
Trade waste	360 m ³ /day	53 m ³ /day
Flue gas emissions	250 m ³ /min	132 m ³ /min
PM ₁₀ emissions	30-35 g/m ³	2-4 g/m ³

Source: Energy Efficiency and Conservation Authority, New Zealand 2003.

Residential consumption of natural gas in SEE is based on relatively inefficient appliances (for example, the stoves generally in use operate at 30 percent efficiency compared with 90 percent efficiency for modern boilers in Western Europe). Residential consumers of natural gas tend to be more cautious about energy consumption when gas is metered and billed properly. However, given a long period of relatively low natural gas prices, general insecurity about government policies and energy prices, along with declining employment and incomes, consumers are reluctant to invest in energy efficient solutions. Coping strategies can involve the use of solid fuels supplemented by natural gas to meet peak demand and this puts a strain on the natural gas network and threatens the return on capital invested in network infrastructure.

Once knowledge of new efficient heating solutions spreads and government policies promote their adoption, the retail market for natural gas is bound to change and to become more sustainable. As their income grows more consumers may be able to afford gas, while more efficient technologies for the household use of gas will become available to them. When local markets for these technological options are opened, larger scale use of gas should facilitate the growth of employment and incomes. This will be a change from the current situation in which insecurity of supply and high connection and supply costs (combined with limited employment opportunities) are disincentives for the growth of the retail market for natural gas.

The obvious choice of efficient heating technology, however, is heat pumps and in these natural gas faces competition with electricity. Electricity powered heat pumps are already widely

available in the market at relatively modest prices from a variety of vendors. Gas powered pumps are still a rarity and could very well be a more expensive alternative. As a consequence, the eventual spread of natural gas distribution to the retail energy market throughout SEE is limited both because for poor families fuel wood and opportunity fuels (waste) make natural gas unaffordable and uncompetitive and for more affluent households by the availability of electric heat pumps which provide effective competition to natural gas based heating solutions. Furthermore, the relatively small number of better off families and absence of large areas of affluent housing arrangements within urban and suburban areas make the development of natural gas distribution networks in parallel with existing electricity networks too luxurious a solution. As most households in a particular settlement are unable to pay for connection, or their consumption is likely to be too small to justify connection, the utilization of the network is likely to remain low since network services would be delivered to only a few customers in the relevant area. Both connection fees and network service costs are likely to remain very high even by Western European standards.

Taking into account these endogenous forces, it could be concluded that the current level of natural gas consumption is not sustainable without a massive subsidy to gas consumption in district heating systems, fertilizer production, the food industry and the extension of gas distribution networks. Subsidizing these end uses is still the prevailing practice throughout SEE, and local and municipal administrations are pledged to preserve these practices. However, maintaining subsidies and failing to apply new technologies for much longer can only have devastating effects on social security and economic development. The consequence will be a continual shortage of affordability of energy in general and of natural gas in particular.

Conventional estimates of natural gas demand based on trends and 'business as usual' development of the gas industry are not suitable for projecting future natural gas development in the SEE region.

The transition to a sustainable energy market in SEE could take ten years. The destruction of existing energy patterns and the emergence of new efficient practices within a suitably enabling environment are likely to go hand in hand. However, international monetary or credit assistance based on the promise of increasing government rents by maintaining existing policies could prolong this transition process for many years. The decline in indigenous natural gas production is creating pressure for rent seeking and is provoking an active search for sources to finance additional gas supplies to fill the gap. Such a course will preserve unsustainable practices and the energy inefficiency which they lead to, while increasing future transition costs.

Clearly, the region is now at a turning point between business-as-usual preservation of current patterns and a move towards a more sustainable, and commercially rewarding development pattern.

Further financing will be required to cover a dramatic increase in the costs of seasonal and weather related fluctuations in natural gas demand (and electricity demand) including storage capacity, creation and maintenance of excess network capacity. A further consequence of a decline in indigenous gas production could be the imposition of an additional load on existing transmission capacities inside the region. But it is not likely that private investment would fund storage projects and gas stocks if such assets might be nationalized in the case of a supply

emergency. In addition, the availability of domestic or foreign public subsidized financing could further impede an improvement of governance.

2.2.4. Policy making and governance – relevance of the EU ‘acquis’ and external financing

The SEE region appears to be relatively disadvantaged in terms of physical openness. Major routes from the central development axis (along the Sava and Danube rivers) toward the open sea and so to international trade are blocked or constrained by insufficient or diminished infrastructure, low port productivity, high trans-shipment costs, obsolete international regulation (dating back to the Danube convention of 1946) and local political tensions. Physical openness is a major precondition for the emergence of good governance and the enforcement of property rights.

An argument common in published literature is that physical openness (trade infrastructure) facilitates the entrance of new competitors by reducing barriers to entry for large volume/small margin competitors that generate employment and investments and lessen opportunities for corruption. At the opposite extreme, small volumes passing through insufficient infrastructure are associated with large trading margins and weak competition. Opportunities for corruption and government capture become greater so the probability of governance failures increases.

Physical openness cannot be replaced by ‘nominal openness’, defined by various rules and regulations including international trade liberalization and eventually lower custom duties. However, a lot has been done in by SEE countries to ensure the ‘nominal openness’ of the region. In later stages, when physical openness eventually take pace, this nominal process could prove beneficial and there might be a motive for true enforcement of this advanced regulatory framework. Without ‘physical openness’ the nominal regulatory framework cannot be properly applied.

Enforcement of these international regulations differs from jurisdiction to jurisdiction and there are no convincing and detailed reports about their actual application. A good example is the benchmarking system established in context of formation of the SEE Energy Community (see www.seerecon.org/energy); such benchmarking is based on the fact that some administrative institution (agency etc.) is established but its actual performance and outcomes are not considered.

The SEE jurisdictions have made considerable progress in ‘nominal openness’ during recent years. Table 11 provides evidence on international regulations that have already been adopted throughout the region. However, ‘physical openness’ remains insufficient and physical flows of goods and services are still below their levels of the 1980s. For example, insufficient transport capacity along the River Danube and the high price of natural gas make the production of fertilizers in the region very expensive. This provides the small number of trading companies and importers that manage to deliver fertilizers at right moment from competitive sources in the Black Sea region with a considerable profit margin. Political affiliation then becomes the most lucrative investment for such companies who use their political influence to prevent restructuring in both the natural gas and the fertilizer industry.

Table 11: SEE countries' status regarding major international legal compacts

No.	Name of International Agreement	Jurisdiction								
		Albania	B&H	Bulgaria	Croatia	FYRoM	Romania	Serbia	Montenegro	UNMIK Kosovo
1.	Energy Charter Treaty (ECT)	+	+	+	+	+	+	-	-	-
2.	WTO	+	-	+	+	+	+	-	-	-
3.	CISG	-	+	+	+	-	+	+	+	+
4.	SEE Energy Community Treaty	+	+	+	+	+	+	+	+	+
5.	INOGATE	+	-	+	+	+	+	+	+	+
6.	Aarhus Convention	+	-	+	+	+	+	-	-	-
7.	PRTRs	-	+	+	+	+	+	+	+	+
8.	UNFCCC	+	+	+	+	+	+	+	+	+
9.	Kyoto Protocol	+	-	+	+	+	+	-	-	-
10.	Convention on Long-range Transboundary Air Pollution	-	+	+	+	+	+	+	+	+
11.	Protocol to Abate Acidification Eutrophication and Ground-level Ozone	-	-	+	-	-	+	-	-	-
12.	Convention on Civil and Political Rights	+	+	+	+	+	+	+	+	+
13.	UN Convention on biological diversity	+	+	+	+	+	+	+	+	+
14.	BioSafety Protocol	-	-	+	+	+	+	-	-	-
15.	UN Convention on Cimbat Disergification	+	+	+	+	+	+	+	+	+
16.	Stokholm Convention (Persistent Organic Pollutants)	+	+	+	+	+	+	+	+	+
17.	Number of Municipalities involved in Local Agenda 21 (2001)	7	1	22	20	...	12	20		
18.	OECD	-	-	-	-	-	-	-	-	-
19.	Status Toward EU Partnership	Potential Candidate Country	Potential Candidate Country	Acceding Country Jan 2007	Candidate Country	Candidate Country	Acceding Country Jan 2007	Potential Candidate Country	Potential Candidate Country	Potential Candidate Country
Country		Albania	B&H	Bulgaria	Croatia	FYRoM	Romania	Serbia	Montenegro	UNMIK Kosovo

+* - signing status: (+) signed and ratified, (-) not signed, (+*) signed while still not in power

CISG – UN Convention On Contracts for the International Sale Of Goods

PRTRs – Protocol on Pollutant Release and Transfer Registers (Aarhus Convention protocol)

Source: compiled by the author from official international sources.

Being effectively cut off from international markets and open sea trade, the SEE region is oriented toward trade with the EU and the Russian Federation. Since natural gas and other fuels continue to dominate trade with the Russian Federation, the terms of trade are sensitive to international prices of crude oil. If oil prices continue to increase over time, the terms of trade between SEE and the Russian Federation will become increasingly unfavorable to the SEE. Goods from SEE face international competition in the Russian market including, of course, competition from efficient EU industries assisted by economies of scale. At the same time, energy intensity and inefficiency limit the competitiveness of SEE industry. Insufficient physical and infrastructure links prevent the SEE from making use of its natural advantage – proximity to the Black Sea and Central Asian markets – and consequently realizing the only potential that the region has to lower transport costs.

Therefore the EU emerges as a critical determinant of development of the SEE. Relations between the SEE countries and the EU are developing in two parallel processes. The first is an accession process that includes political and fiscal stabilization, reforms, legal harmonization and most especially development of the SEE Energy Community with the EU support. Establishment of the natural gas market incorporating the EU utility ‘acquis’ is now legally binding in the SEE Energy Community. The second is EU transport infrastructure planning that is being extended to include the SEE. A system of Trans-European Networks including energy networks is a much more difficult issue. For natural gas the system defines three main corridors for major transit pipelines⁴ (as shown in Figure 8).

However, there is considerable discrepancy between the impacts of these two EU-related processes on SEE natural gas developments. Extending an advanced and market oriented legal framework to SEE is accompanied by infrastructure development proposals that are designed to supply established markets in the EU almost without reference to local market development and ‘physical openness’.

⁴ For more details to the Constanza–Trieste route or a brief summary on the planned Turkey–Greece interconnection (2007) and the Greece–Italy connection see IEA/SEC 2002 and 2004.

Figure 8: Transit corridors for natural gas to EU markets



Source: Mediterranean Energy Observatory, European Commission

Note: the SCP–Baku/Erzurum pipeline was completed during finalization of this report; the Iran–Turkey connection exists but the Iraq–Turkey one does not; the Turkey–Greece interconnection is due to be completed in 2007.

What immediately attracts attention is that the central and northern routes traverse mountainous areas that are not densely populated and have little economic activity. Except for Kosovo, where considerable demographic growth should be taken into consideration, these two routes cross some of the most difficult mountains in the Balkans (see Figure 1). Individual countries will require additional gas infrastructure on their own if they are to arrange for any useful access to gas from these lines. The southern route is irrelevant for this study as it bypasses the region. However, it might to some extent influence the economics of the central route.

The northern route is progressing with a project named NABUCCO. Its relatively high costs (in comparison to similar projects) are normally justified by the large volumes that are to be transported along the route. However, even if the required quantities become available immediately upon construction of the line, development will remain sensitive to the bargaining power of transit and supplying countries as well as the latent decrease in prices or economic rents for supply via the northern routes. Within those limitations, and taking into account enormous up-front investments and fixed costs, both routes will provide local authorities with important bargaining power that could bring about adverse, and even violent, outcomes in regions like Kosovo, Southern Serbia and Bosnia.

As a part of its global transport routes diversification strategy, Gazprom is considering infrastructure developments (gas storages and pipeline links) in the SEE region. Recent announcements and adjustments in Gazprom business holdings in the region suggest that the company is considering bypassing Ukraine and arranging gas deliveries to the Balkans via Turkey or via another sub-sea line crossing the Black Sea. Gazprom is also considering gas deliveries to northern Italy via the Balkans. The President of the Russian Federation announced that the Burgas–Alexandropulis oil pipeline could be supplemented by a gas line allowing

additional deliveries to Greece and further one to Italy. In addition, Gazprom is considering investments in storage capacity in Serbia.

2.2.5. Emerging Trends in Natural Gas Demand

If transit infrastructure is planned in such a way as to provide SEE with competitive natural gas (in comparison with the EU) and facilitates physical openness and sustainable development, a new and more sustainable demand for natural gas could emerge. Three forces could especially affect demand growth: first, the demand for conventional retail services of natural gas in areas of dense population and economic activity such as Kosovo and the Adriatic Sea coastal areas; second the use of natural gas to facilitate both more efficient exploitation of indigenous energy sources (lignite, heat pumps, biomass) and seasonal solutions (heat storages as well as communal services (municipal waste, water supply); and third, a considerable improvement in the economics and availability of biomass resulting from a shift in domestically produced fertilizers (based on imported natural gas) towards the import of more affordable fertilizers where a fall in gas demand from the fertilizer industry is will be accompanied with strong competition from biomass as an energy source.

Conventional Natural Gas demand

Natural gas networks could be gradually extended to areas where its conventional use could be beneficial. One such area is Kosovo. The high housing density and demographic growth rates in this area require sustainable energy solutions rather than the further degradation of surrounding forests and lignite deposits. Any new energy solution, however, would only succeed if it is commercially viable in comparison with LPG and wood; that would require setting adequate price levels and enforcing the payment of bills. And it would also need to be easily applicable to a variety of uses (for instance, cooking, space heating and small-scale commercial use). Another opportunity is along the Adriatic coast of Croatia and Montenegro where an enormous stock of capital (infrastructure, airports, water supply, tourist accommodation, communal service infrastructure) is idle during winter periods due to a lack of energy.

Urban Heating Solutions

District heating systems in Romania, Bulgaria, Bosnia, Serbia and Macedonia are a heavy burden on public finances. Very low utilization of infrastructure (only about 1000 hours a year) prevents positive returns on capital and even regular maintenance requires support from public funds. Because of these very low levels of organizational efficiency, compounded by conversion inefficiency district heating systems account for a considerable and inordinate part of final energy in SEE countries (for which the basic data are provided in Table 12).

Table 12: Basic Economic, Energy and Heat Data for SEE Economies, 2002

Country	Population (million)	GDP (billion 1995 \$)	GDP (PPP) (Billion 1995 \$)	Total primary Energy Supply (Mtoe)	Net Imports (Mtoe)	TPES/Pop. (toe per capita)	Heat Prod. (TJ)	Final Heat Consumption/ Pop. (MU per capita)	Final Heat Consumption /Pop. (MJ per capita)	Share of Heat in TFC (%)
Albania	3.15	4.03	13.46	1.94	1.17	0.61	787	184	58	0.2
Bosnia and Herzegovina	4.11	6.89	22.38	4.36	1.18	1.06	6,416	6,416	1,560	5.2
Bulgaria	7.97	13.70	51.06	19.01	9.02	2.38	49,751	36,009	4,520	9.0
Croatia	4.47	24.29	39.45	8.22	4.92	1.84	12,104	9,733	2,179	3.7
FYR Macedonia	2.04	4.95	11.65	2.54	1.19	1.24	6,586	5,696	2,794	9.0
Romania	22.30	36.01	128.62	36.97	8.78	1.65	156,463	111,594	5,004	10.9
Serbia and Montenegro	10.63	16.87	40.94	16.16	5.29	1.52	21,100	21,100	1,984	4.9

Source: OECD/International Energy Agency 2004.

There are two parallel strategic paths for improving energy efficiency of district heating systems. One is to conversion efficiency, utilization times and flexibility of heat sources by using locally available fuels (geothermal energy, heat pumps, waste heat from power generation or mechanical drives, solar energy) and making use of both seasonal and short-term heat storages. The other is reducing overall energy demand per square meter of heated space and the sensitivity of demand to winter temperatures.

Lignite-Fired Power Generation

Most lignite fired power plants in the SEE region are approaching a decision point between possible closure and substantial retrofit on the one hand and re-powering on the other. For many plants biomass is the fuel of choice either as a primary fuel or in various co-firing arrangements.

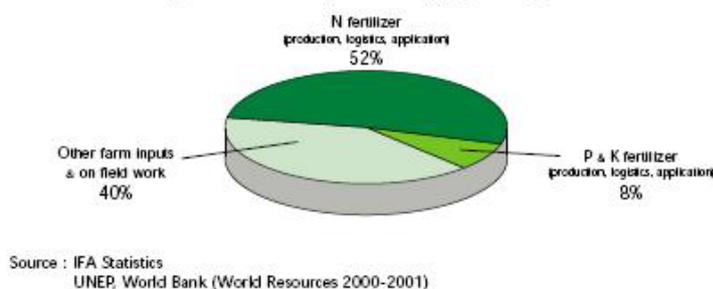
It would be difficult for a lignite-fired plant with relatively old technology to survive as major base load generator without utilization of waste heat, biomass co-firing and supplemental use of natural gas. Natural gas could be used as a fuel of choice to power mechanical drives (fuel handling, circulation pumps, heat pumps, ash handling) wherever waste heat could be utilized. Such a strategy could provide about 1000MWe to the grid and replace a substantial part of the installed capacity of district heating systems throughout the region.

Agriculture, export competitiveness and biomass energy

Agriculture is a potentially viable sector. In order to make agriculture internationally competitive, there is a need to make commercial use of its byproduct, biomass, and to provide inputs at internationally comparable prices. For imports of fertilizers from low cost producers in Russia or Middle East a critical precondition is minimizing transport costs. This requires considerable adjustments in the regulation of navigation along the Danube, the removal of part of the load from existing natural gas infrastructure and the provision of more transit capacity.

Figure 9: Fertilizers: a critical energy input to agriculture

Of all the energy used to produce wheat, approximately 50% is needed to produce, transport and apply nitrogen fertilizers.



Note: N=nitrogen, P=phosphorus; K=potassium.

Source: EFMA (European Fertilizers Manufacturing Association), no date.

Agriculture biomass could emerge as major indigenous energy source with natural gas becoming an enabling fuel for large scale biomass usage. For example, one lignite complex in Serbia could make economic use of nine million tons of agriculture biomass, but would need natural gas to handle such large volumes (see the City of Belgrade case study in the Appendix to this paper).

Inland Waterway Transport

Increased inland waterway transport would require development of a new and more appropriate shipping fleet for which the fuel of choice could be natural gas. This should be considered as a major source of growth for the natural gas industry along the Danube River.

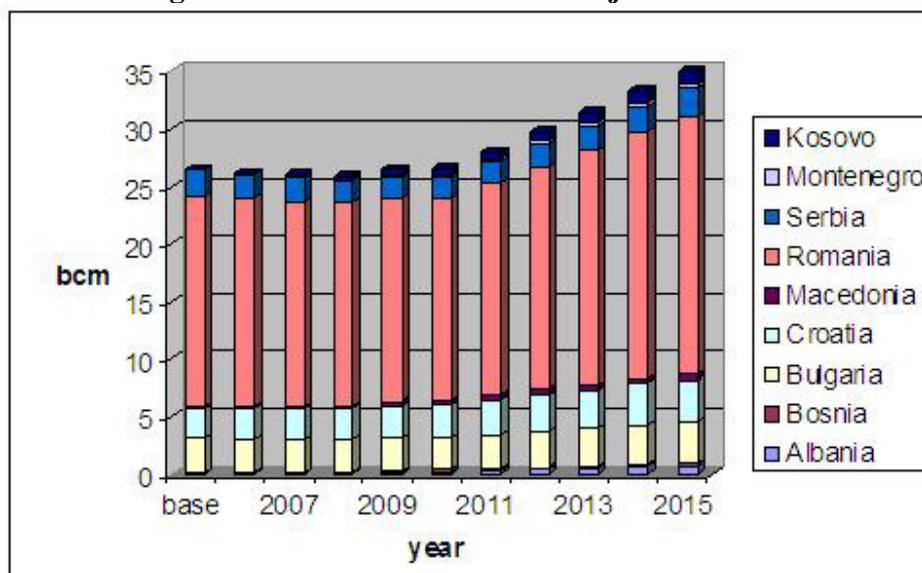
New regulation of navigation rights on the Lower Danube, the Black Sea and rivers in the Russian Federation, Ukraine and Central Asia (for example the comprehensive ‘Black Sea and Central Asia Free Navigation Agreement’) could enhance the transport of fertilizers, hard coal, cereals and oil liquid products, freeing up transit capacities for natural gas, while providing ample opportunities for economic development and sustainable growth.

Water Pumping

Most densely populated areas in the Balkans are short of water, which must be delivered long distances. Water supply systems are among the largest power consumers. Electricity is now used to power mechanical water pumps, circulate water in processing plants and fill reservoirs.

This also implies opportunities which would involve considerable spatial redistribution of sustainable gas demand as well as an increase in that demand. Figure 10 and Table 13 are projections by the author based on the assumption that such changes begin in 2007 and that governments do not grant funds to further subsidize the current unsustainable social model.

Figure 10: Natural gas demand estimations for SEE jurisdictions



Source: author's projections.

Table13: Natural gas demand estimations for SEE jurisdictions

	Base	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Albania	0.03	0.03	0.03	0.03	0.17	0.23	0.29	0.49	0.55	0.75	0.81
Bosnia	0.18	0.18	0.17	0.17	0.16	0.16	0.17	0.18	0.19	0.20	0.21
Bulgaria	2.91	2.87	2.84	2.82	2.80	2.79	2.92	3.07	3.22	3.39	3.56
Croatia	2.64	2.67	2.71	2.76	2.81	2.86	3.01	3.16	3.32	3.48	3.66
Macedonia	0.11	0.10	0.10	0.09	0.43	0.44	0.46	0.49	0.51	0.54	0.56
Romania	18.3	18.07	17.88	17.72	17.60	17.52	18.39	19.31	20.28	21.29	22.36
Serbia	2.22	2.14	2.06	1.98	1.91	1.84	1.93	2.03	2.13	2.24	2.35
Montenegro	0	0.00	0.00	0.00	0.10	0.15	0.20	0.25	0.30	0.35	0.40
Kosovo	0	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86	0.97	1.08
SEE	26.39	26.17	26.00	25.89	26.41	26.53	28.03	29.73	31.36	33.20	34.98

Source: author's projections.

The following specific points related to each SEE country have been taken into account in making these projections:

Albania is not connected to the regional gas infrastructure. Domestic consumption is small. However, there is development of combined cycle power plant that could take advantage of pipeline gas once it becomes available. From 2009, a new power plant (with an additional unit from 2012), as well as the tourist industry, could make use of a regional pipeline along the Adriatic coast.

Bosnia is well supplied with hydro energy, coal and biomass so small district heating systems have a choice to diversify away from natural gas. Small natural gas supplies are likely to be diverted to more commercially viable uses in industry.

Bulgaria could substantially restructure its district heating systems and electricity and fertilizer industries. Environmental problems, inefficiency and financial difficulties could limit the useful

life of currently available facilities and allow the emergence of new uses of natural gas. The transition could last about five years.

Croatia has the most sustainable gas industry in the region despite declining domestic production. Use of available facilities and active development of new and diversified sources of supply are likely to allow sustainable development.

Macedonia could be obliged to consider the use of natural gas for power generation. An obvious opportunity will be cogeneration in its capital city, Skopje, where a large district heating system requires re-powering. This is going to shape gas demand from 2009 onward.

Romania is likely to pass through a very difficult period of restructuring of its district heating services and power and fertilizers industries while facing a decline in domestic gas production. With the adoption of appropriate policies, the decline could be limited and the gas industry could recover in about five years. However, the decline could go much deeper and last much longer.

Serbia is likely to take more time to define and adopt turnaround policies. As a result, problems with its district heating systems and fertilizer industry, along with environmental problems of lignite-fired power plants and the decline of domestic gas production, may only be addressed later.

Montenegro is not connected to regional gas infrastructure and its plans for connection are slow and insufficient. However, the introduction of natural gas to the Montenegro coastal area could facilitate and all-year tourist season and bring substantial benefits for employment, economic development and investment opportunities. Eventual offshore production and its impact on demand are not considered here.

Kosovo is the only region with considerable and growing potential for retail gas distribution due to its demography and to the remittances of Albanians working abroad. Whether the population will embrace modern gas technologies (cogeneration) and restrict use of massive lignite resources until more environmental friendly technologies become available, or whether gas consumption will become more conventionally associated with electricity generation from lignite, remains to be seen.

South East Europe gas demand is likely to go through at least five years of restructuring towards economically sustainable use once sufficient economic pressures for restructuring build up. Inefficient uses (district heating, fertilizers) are likely to disappear and be replaced by commercially viable uses. Winter seasonal demand is likely to decrease. Consequently, some existing pipeline and storage capacity will become available for more lucrative use in transit arrangements. These developments could remove incentives to interfere with transit flows during winter demand peaks.

3. Energy and Economic Development Outcomes

A usual argument is that final energy prices should reflect the ‘marginal costs’ of energy production/conversion. From another perspective energy prices should be comparable to energy prices in countries with sound market systems for similar technologies. Although these ‘rational’ approaches could improve the situation, they are not sufficient: with very low utilization rates of energy infrastructure, over-sensitivity to weather conditions and huge peak demand, marginal costs have to be adjusted upward at least for low capital utilization rates plus costs of excess capacity and stocks, calculated at high domestic interest rates, plus appropriate risk margins.

Taking into account that energy sectors are exceptionally large in comparison with the rest of industry, the capital costs of the energy sector could push the entire economy into an inflationary spiral. The only possible outcome, other than serious restructuring in the energy sector, is massive subsidy in order to sustain any domestic industrial activity.

Current governance practice provides a stage for natural gas infrastructure development and for the economic development outcomes from it. There is ample evidence on the lack of rule of law, insufficient property rights and deficient governance in general in the region. The excessive consumption of fuel wood and the lack of heavy energy investment are common characteristics of countries with weak property rights (See Bohn and Deancon, 1997). The Transparency International rating can be used as a proxy description of this situation (see Table 14).

Table 14: Corruption Perceptions Index

Country Rank*	Country	CPI 2004 score**	Confidence Range***	Surveys Used****
54	Bulgaria	4.1	3.7-4.6	10
67	Croatia	3.5	3.3-3.8	9
82	Bosnia and Herzegovina	3.1	2.7-3.5	7
87	Romania	2.9	2.5-3.4	12
97	Macedonia	2.7	2.3-3.2	7
97	Serbia and Montenegro	2.7	2.3-3.0	7
108	Albania	2.5	2.0-3.0	4

* Country Rank – Rank between 146 countries.

** CPI Score relates to perceptions of the degree of corruption as seen by business people and country analysts and ranges from 10 (very honest) and 0 (very corrupt).

*** Confidence range provides a range of possible values of the CPI score. This reflects how a country’s score may vary, depending on measurement precision. Nominally, with 5 percent probability, the score is above this range and with another 6 percent it is below. However, particularly when only few sources are available, the unbiased coverage probability for the confidence range is lower than the nominal value of 90%.

**** Surveys used refer to the number of surveys that assessed a country’s performance. 18 surveys and expert assessments were used and at least 3 were required for a country to be included in the CPI.

Source: Transparency International 2004.

There is, however, hope that accession to the EU could improve governance patterns in the region by itself, although it might alternatively be argued that a rapid accession to EU is viewed by the

domestic elites as an opportunity for rent-seeking⁵ and further financial assistance rather than a demonstration of ‘European values’. All in all, there is no tangible reason to expect fast and significant improvements without concentrated action of many more players than are involved so far.

3.1. Transit Infrastructure as Natural Resource

Critical for this analysis is an understanding of the economic nature of transit infrastructure. It is a form of natural endowment or natural resource, similar to exploitation of domestic natural resources. Left to themselves, rent-seeking elites will have no incentive to organize exploitation of this resource. However, in case of outside interest, and given that the capital investment required obviously indicates the strength of such commercial interest, domestic elites will quickly organize for rent seeking and bilateral bargaining with foreign investors.

Economic rent negotiated through such bilateral bargaining will be inherently unstable and exposed to frequent re-negotiations.

There will be two immediate outcomes from economic rent negotiated through such process:

- An increase of the “Dutch Disease” problem in domestic economies including: further downward pressure on employment levels; rising barriers to entry for low margin/high productivity entrants; despite maintaining good GDP growth and financial strength.
- Strengthening the “no-rule-of-law” cluster of interests given that rents could be quite unstable and related to international energy (oil and gas) prices as well as the behavior of companies with significant shares of the EU gas market.

Massive transit infrastructures, based on long term take-or-pay contracts effectively prevent entry of new players. They do not contribute to port efficiency or any other transport infrastructure in the region so their impact on eventual physical openness is negligible. Off takes of natural gas from this infrastructure are likely to be used for public district heating systems or (eventually) residential consumption and the impact of these will be negligible as well. From the perspective of infrastructure investors, local offtakers should pay comparable prices to EU end users as these users have to cover economic rents. Gas for local offtake could be priced below end prices only if domestic government decide to transfer some of (its) economic rents to (chosen) domestic entities which is not likely to happen without compensation. Even though SEE countries are now undertaking certain market liberalization this transit infrastructure is not likely to contribute to that process.

3.2. The Economic Impact of Aid and Rents

Both institutional aid and transit infrastructure rents are direct budget revenues. If such external direct budget revenues are relatively large in comparison with the GDP the very existence of such financial inflows is likely to influence the quality of governance and the value added and growth potential of the economy. According to the findings of S. Knack (2000), such inflow is likely to

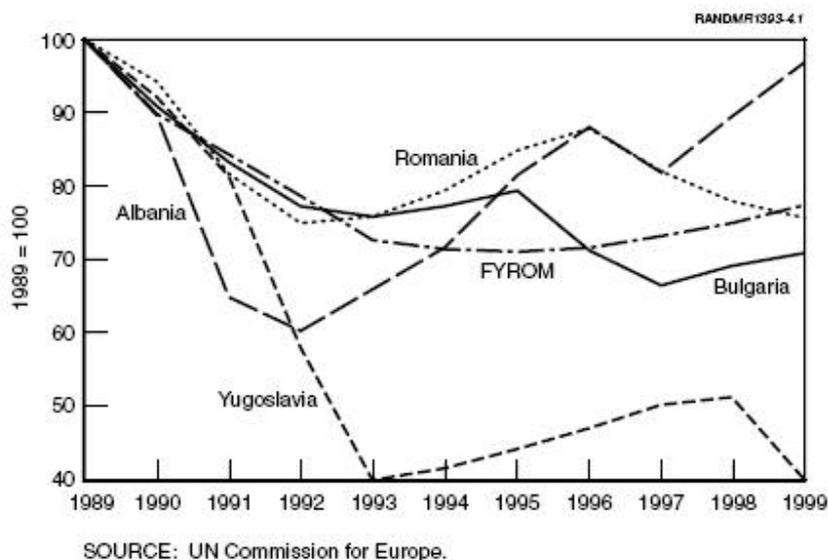
⁵ Throughout the text the phrase ‘rent-seeking’ is understood in the context of recent papers of Joseph Stiglitz (with various co-authors) on transition in Central and Eastern Europe (for example, Hoff and Stiglitz 2002a and 2002b).

contribute to prolongation of the absence rule of law in general and an inadequate property rights situation in particular.

The coincidence of mounting aid and rents with decreasing GDP could increase downward pressures on local economic development and employment opportunities. Since growth and employment are prerequisites for improving the energy efficiency of residential and communal systems, then excessive housing costs, district heating, seasonal fluctuations and the underutilization of energy infrastructure all fit together into a system that will be very difficult to dismantle.

Furthermore, it is a situation in which the ability of a government to resist domestic demands for better property rights and rule of law as well as against rival rent seekers will be strengthened. The ability to finance subsidies and preserve the status quo will enable any government to stay in power regardless of its actual performance in terms of employment and prosperity. This outcome runs counter to the findings of Hoff, Horovitz and Milanovic (2005) that frequent changes in office promote the emergence of the rule of law in transition countries. If a government can manage to secure more sources of rent with different economic dynamics (a type of diversification) it can avoid or at least decrease fluctuations in budget revenues which could otherwise generate risky bottlenecks and liquidity problems. Consequently, the possibilities for political change diminish. If a government fails to secure such external inflows it could find itself in difficulties and eventually be replaced. However, this process could be entirely insulated from real achievements in employment and well being (as well as energy efficiency) and the strengthening of the rule of law could be postponed even with frequent changes in government.

Figure 10: Fluctuations of the real GDP in SEE countries



Source: Zanini 2001 p. 75.

In the longer run, in case of emergencies, and depending on the relative size of rents from the present infrastructure compared to other available rents, transit security cannot be guaranteed. Frequent re-negotiations of terms through bilateral bargaining will require political involvement to achieve workable compromise. Therefore, bargaining might involve hidden components such as political concessions, loans, easing of financial conditions, and further assistance that add to insecurity.

4. South East Europe as a gas transit region for supplies to OECD and EU countries – the potential for large scale gas infrastructure

Given its present economic capacity and plans and its prevailing political status quo, the SEE region is scheduled for a downward trend in economic activity and financial performance. This implies also a decline in its capacity to procure sufficient volumes of natural gas to justify any significant gas infrastructure developments. A reduction of international aid could reinforce this trend, although on the other hand an increase of international untied financial assistance could equally strengthen the status quo and provide the financial means for further subsidies to the energy sector, and so lead to a continuation of the current energy intensive system. At the same time such development could strengthen the current problematic governance patterns.

Additional supply is required, as well as a viable expectation of additional infrastructure development and actual infrastructure that could facilitate the physical openness of the region. The only possible valid justification for such infrastructure development would come from natural gas demand in Western Europe. If it is properly designed, new transit infrastructure could contribute to economic development throughout the SEE by lowering barriers to entry, providing alternative supplies, increasing the security of supply and market transparency, improving energy efficiency, lowering communal and housing costs and providing a perspective for sustainable growth.

4.1. Selection of natural gas exit points to EU

It is now well established that natural gas deliveries may be made to European gas markets from Central Asia. The question of where in Europe that gas would be delivered should be further scrutinized in light of recent findings on natural gas demand for power generation (Honoré, 2005), environmental and industrial trends as well as the emergence of gas hubs throughout the continent.

Planning new infrastructure always provides an opportunity for technical optimization and strategic orientation. In order to ensure viability, this infrastructure should be optimized and oriented in such a way as to secure its long-term competitiveness against alternative supply routes that already have considerable market share.

Investment security will be increased by multiple entry points, each serving multiple sub-markets in Western Europe.. Dedicated lines with very high capital investment requirements and fixed costs are too risky even if viable from the point of view of conventional feasibility studies.

Energy consumption in Europe occurs at several distinct locations where density of demand is large and development trends well established. Furthermore, Table 14 shows that trends in gas-fired power generation have been different in individual European economies:

Table 15: Gas-fired electricity generation in OECD countries, 2002 vs.1990

	1990		2002		2002 vs.1990
	TWh	% of total generation	TWh	% of total generation	Average annual % change
Austria	7.73	15.7	10.05	16.7	5.0
France	3.03	0.7	17.12	3.1	15.5
Germany	40.49	7.4	55.90	9.6	2.7
Greece	0.09	0.3	6.73	13.4	43.0
Hungary	4.47	15.7	10.08	27.9	7.0
Italy	39.71	18.6	108.72	39.4	8.8
Switzerland	0.30	0.5	1.03	1.6	10.7
Turkey	10.19	17.7	52.50	40.6	14.6

Source: IEA 2003.

For the purpose of natural gas transit via SEE we can focus on two entry points to European gas markets: Trieste in Italy provides access to northern Italy and interconnection via Switzerland to the German and French gas markets; and the Baumgarten hub near Vienna provides access to Austria and, more distantly, the large (although potentially well supplied) German market, as well as France and Italy.

The last column in Table 15 provides a clear distinction between countries with strong record of developing gas based power generation and those without such a history. Taking into consideration both its current size and growth rate, Italy emerges as the most interesting market for gas in power generation. If transportation efficiency is maximized, Black Sea or Central Asia gas could be competing against alternative supplies in the Italian market.

While competition between these two entry points remains beyond the scope of this work it should be noticed that the actual distance of both points from major potential gas entry points to the SEE region is roughly equal.

Both of these entry points can be served by multiple lines in order to secure supply and diminish chances for bilateral bargaining. Something similar to standard practice in electricity networks could be adopted for this purpose: there is a need for excess transport capacity in order to establish reasonable or appropriate competition among transit options.

4.2. Potential of Natural Gas supply to / via SEE

What is the potential for natural gas supply to the eastern shores of the SEE region? Although Turkey currently has an excess of contracted natural gas to offer to European markets, this is relatively small and will disappear as natural gas demand in Turkey increases.⁶

But in the short term, existing infrastructure with some minor additional connections is available to transport small quantities of gas from Turkey. The quantities envisaged by the NABUCCO project feasibility study – around 25 bcm in 2015 plus another 25 bcm by 2030 – are likely to require additional infrastructure and additional supply available at the eastern coast of the Black Sea.

⁶ For more details see Akcollu 2006.

These additional quantities could be available from following sources:

- additional supplies from Gazprom either through Ukraine or bypassing Ukraine. In the case of additional supplies through Ukraine, improvement of existing infrastructure along the main corridor (Ukraine–Slovakia, Hungary) will be a more favorable solution than additional capacity towards Romania. (Note: in this case there is no diversification of sources or operators.)
- Itera supply from its gas portfolio in Caspian basin.
- other independent producers from the Russian Federation such as LukOil which will produce some natural gas associated with crude oil.
- Turkmenistan, Kazakhstan and Azerbaijan sources delivered to the Black Sea shore or Turkey via the South Caucasus Pipeline.
- Additional supply from Iran and Iraq (from gas fields to be rehabilitated or developed and pipelines yet to be built) via Turkey.

All these sources are subject to considerable uncertainty. Lead times and security of supply could be exposed to political and technical risks. Consequently, transport infrastructure should be developed gradually with as much flexibility as possible.

4.3. Enhancing Transit Capacities of Existing Infrastructure

The first step in this planning exercise is to make use of existing infrastructure opportunities. Sizeable west to east infrastructure exists in Serbia. With minor connections to the Bulgarian network and some local adjustments, this system could be used for transfer of limited quantities of natural gas from Bulgaria to Hungary.

Similarly, the, Romanian system could be connected directly to south Hungary and Serbia. Another small connection could be arranged between Serbia and Croatia and so on. Each step will add to transit capacity and improve security of supply. If accompanied by market liberalization, each step is likely to add to the physical openness of domestic SEE economies.

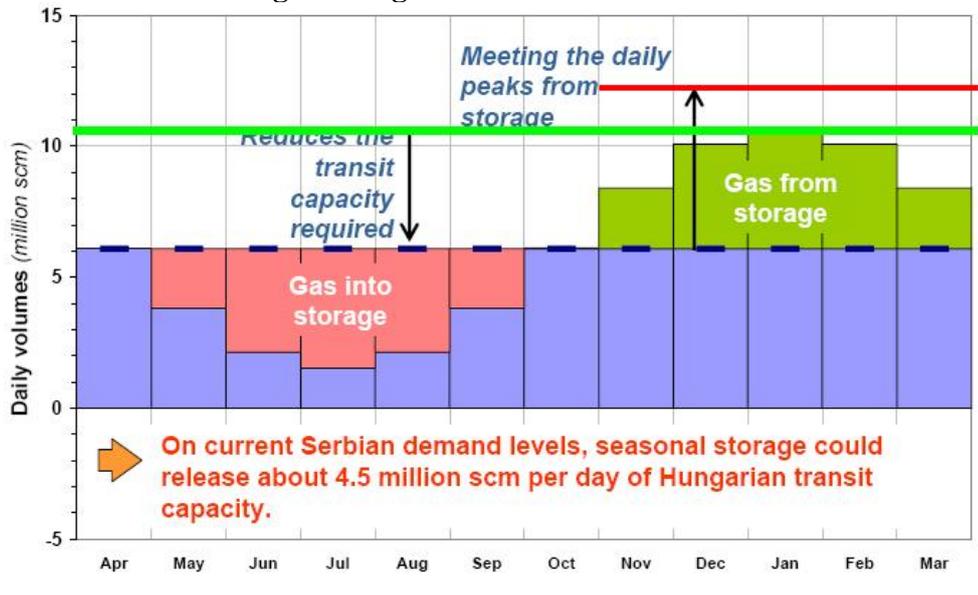
4.3.1. A Remedy for Seasonal Fluctuations

In order to make this infrastructure available and financially viable there is a need to eliminate excessive winter demand peaks. That would allow more supply to go to the more viable and financially attractive market in Western Europe instead of supplying excessive local winter demand. At the same time, it could provide for better use of storage capacities along the routes. At the same time, it is necessary to remove social pressures and incentives to divert gas from transit flows to local use during periods of extreme cold.

4.3.2. Heat storage versus gas storage

Gas storage is a luxury for the SEE economies. With extremely high interest rates, procuring and storing gas at relatively high prices for future use in inefficient district heating systems does not make economic sense. It simply adds to the underutilized stock of capital engaged in the provision of subsidized district heating services. Security of supply arguments are used to justify it but there is no viable market demand capable of paying the full cost of such services.

Figure 11: Calculation of gas storage utilization in Serbia



Source: Tubin 2005.

District heating systems, with their excessive winter demand, could be served at lower cost by substantial seasonal heat storages in form of hot water. If supplied by waste heat from various sources, heat storage provides the needed service at lower cost per unit than underground gas storage (UGS). Furthermore, construction of seasonal heat storage does not require anything more than simple construction technologies and additionally provides employment opportunities to the local workforce. If its size is optimized by increasing the energy efficiency of district heating systems and of the housing stock and if it is attached to waste heat or renewable energy sources, seasonal heat storage could emerge as viable alternative.

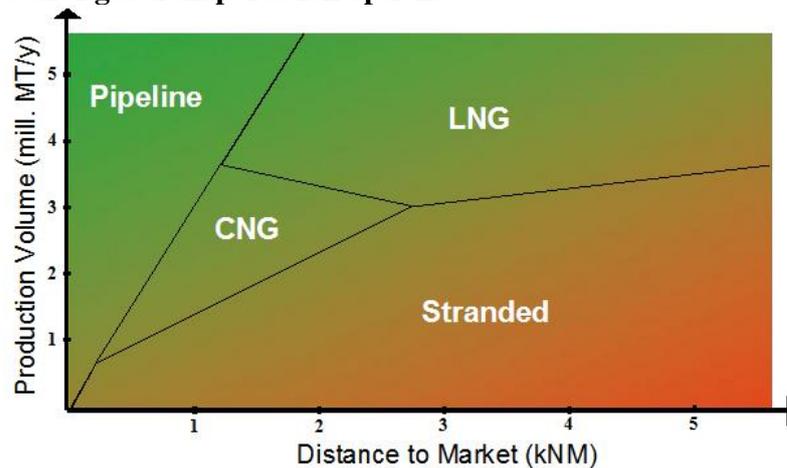
This process could free existing and new storage capacity to provide more security for natural gas transit to Western Europe.

4.4. Black Sea Crossing

The diagonal distance across the Black Sea from west to east is about 1200 kilometers (km) compared with 1600–2000 km along the shore. Potentially the most cost effective natural gas transport system will be advanced compressed natural gas (CNG) shipping technology. Available information provides some reason to conclude that the new technology could be more cost efficient compared with pipeline or conventional LNG transport at distances involved in the Black Sea crossing.

The competitiveness with pipeline options is obvious. In this case kilometer to kilometer comparisons are not appropriate since both shore or subsea pipelines would be longer for the same crossing than the navigation route. The cost competitiveness against pipeline options has increased with the sharp rise in steel prices, since any comparable pipeline will require more steel than a range of ships capable of transporting the same volume of gas.

Figure 12: Natural gas transportation options



Source: CETech: Doha natural gas conference, 2005.

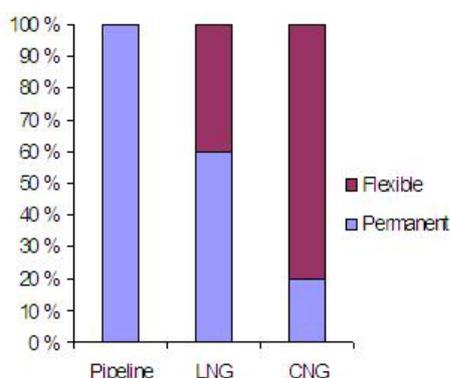
CNG shuttle carrier designs are available from naval engineering companies from USA, Canada and Norway. These designs are now certified or are in various certification stages with ABS and DnV classification registries. A CNG shuttle carrier is akin to a high-pressure gas pipeline packaged into a very standard large container ship with fairly standard safety and control equipment. Despite its volume the ship has a relatively small draught, allowing it to use any standard Black Sea port.

The CNG shuttle carrier is the most expensive component of the CNG transportation chain. Onshore installations require a fairly standard compressor station at the loading port and decompression facility at the unloading point. As one ship is capable of transporting a little less than 20bcm of natural gas at relatively high speed, the theoretical transport capacity for the Black Sea crossing would be about 0.9 bcm per year per ship engaged. By increasing the utilization time, two ships could use the same onshore installations. Assuming three delivery ports and three receiving ports and two ships per route with 1/3 of utilization reserve for shifting loads from one route to another, capacity would be about 5.4 bcm per year. Maximum potential

of this Black Sea route could be estimated to about 54 bcm per year with 63 ships of similar size. Such a transportation system allows considerable flexibility in terms of adjusting to seasonal load factors and different locations over time as markets develop.

Lead times for building the first ship are between three and five years while sufficient shipbuilding capacity is available in the Mediterranean for even more rapid fleet development.

Figure 13: Investments in natural gas transport options



Source: CETech: Doha natural gas conference, 2005

Possible CNG export ports include (see Figure 15):

- Tuapse in the Russian Federation where existing infrastructure delivering gas to the Blue Stream could be used. Possible suppliers: GazProm, Itera, LukOil and other independents.
- Supsa in Georgia where natural gas could be delivered through the existing corridor from Azerbaijan and Turkmenistan. An adequate pipeline should be developed from CSP in Tbilisi to Supsa. Also, the projected development of UGS near Tbilisi could facilitate this development.
- Trabzon in Turkey where natural gas could be delivered from Iran. An adequate pipeline should be developed from South Caucasus Pipeline from Erzurum.

Possible CNG unloading ports include (see Figure 15):

- Constanza in Romania which could be supported by a number of existing and potential UGS near Bucharest,
- Varna in Bulgaria to deliver gas to existing or expanded system of pipelines,
- Burgas in Bulgaria which could deliver gas to existing transmission networks,
- Kiyikoy in Turkey which could support consumption in Istanbul area and eventually deliver gas to Greece.

CNG transportation could provide additional flexibility by arranging for seasonal gas delivery via Mediterranean routes to a terminal at Kavala in Greece which, with planned storage, could receive deliveries from a variety of Caspian countries via Ceyhan on the Turkish Mediterranean coast.

As the most expensive component of this transportation system remains offshore, it does not provide any local political elite with bargaining opportunities. It will provide additional port employment, some competitive electricity generation at the unloading port and economies of scale that could affect other port activities, decrease costs and enhance physical openness.

4.5. SEE Natural Gas Transit Infrastructure

Transport of additional natural gas to western markets requires more transmission capacity than can be made available by upgrading existing infrastructure. It is obviously necessary to minimize investment cost in order to limit the risks which have been explained.

One project which provides an interesting opportunity for comprehensive infrastructure development – a crude oil pipeline from Constanza (Romania) to Trieste (Italy) – is already at an advanced planning stage. It runs along the most cost effective corridor across the Balkans via the most densely populated areas, the largest concentrations of biomass, lignite production, industrial activity and transportation – in other words exactly where the potential demand for natural gas exists, as well as where the major existing or potential storage sites are located..

If this corridor is used for a natural gas pipeline, the outcome is likely to be financially attractive: investment costs of both crude oil and a natural gas pipeline can be lowered by approximately 20 percent. As much as 50 bcm/year of natural gas could be delivered to the closest large-volume market in Northern Italy along an existing corridor already utilized by major crude oil or gas pipelines with minimal changes in altitude (following the Danube and other rivers valleys). This 1310 km line is probably most cost efficient route across the Balkans, taking into account: geography, existing infrastructure, available storage capacities and energy use.

Figure 14: Corridor for the Pan European Oil Pipeline (PEOP)

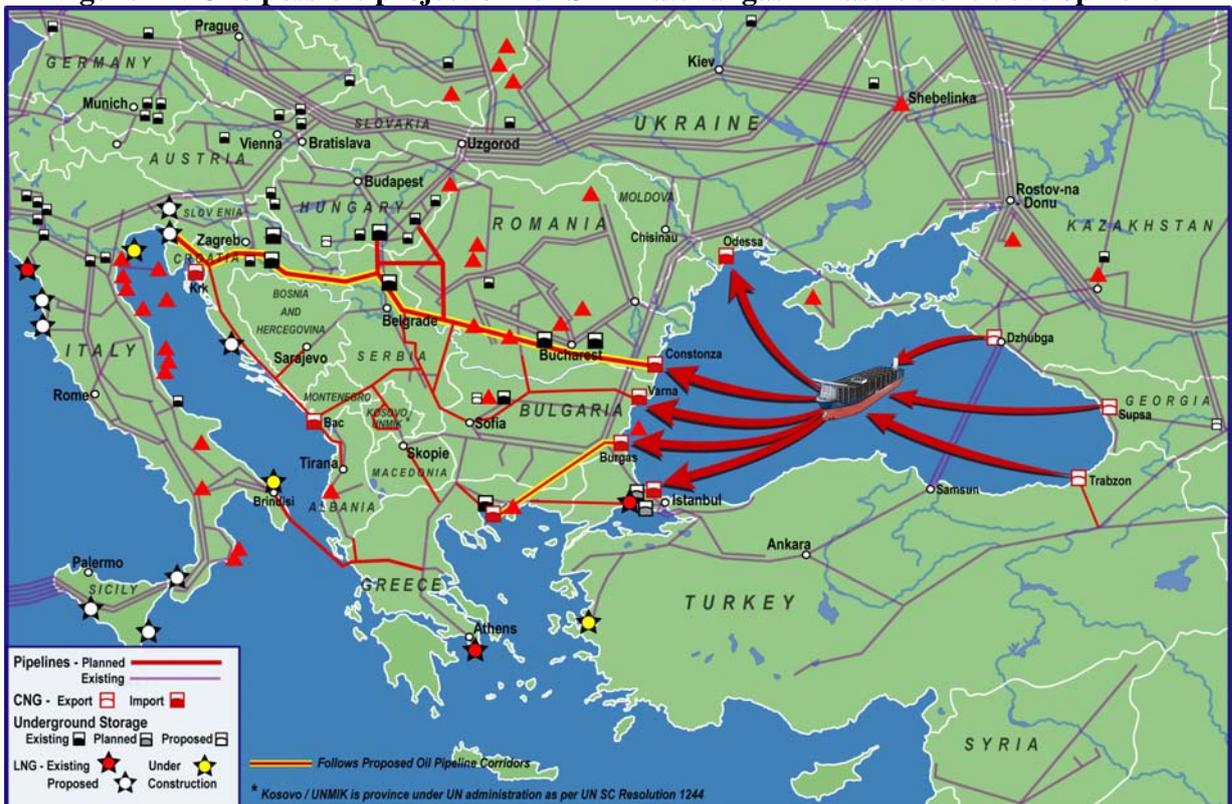


Source: Lepotik Kovacevic and Radun 2005.

Using the existing large diameter pipeline in Serbia, this line could be connected to the Hungarian network (with added investments to allow reverse flow) close to the Baumgarten hub. Such a line could be built in sections, at the same time as a crude oil pipeline. Each section would take into consideration local needs and could immediately become operational.

An overview of this planning exercise can be seen in Figure 15 which summarizes the conclusions, options and criteria described above. The main pipeline routes follow favorable geographic corridors towards large volume gas markets. There is an alternative to each route while CNG shipping across Black Sea and underground storage capacity throughout the region would allow load shifting between routes. Taking into account a possible decline in local demand and the flattening of winter peaks, existing infrastructure could be used for transits of about 10bcm per annum; additional elements can be added to increase capacities as commercially required. The map in Figure 15 shows the infrastructure that might be developed over 10–20 years or more. Gradual development and maintenance of considerable excess capacity as well as careful follow up of developments in governance, gas demand and infrastructure in transit countries, could ensure the availability of infrastructure by minimizing political interference and costs. Furthermore, such infrastructure development will include all areas with development potential throughout Balkans, providing genuine development opportunities and improving utilization rates of locally available capital.

Figure 15: One possible projection for SEE natural gas infrastructure development



Source: produced by author to illustrate argument in the text.

These infrastructure proposals will progressively meet the requirements specified in the paper by McDaniel and Neuhoff (2002) on auctions of gas transmission access. They will provide multiple entry points, and provide correct price signals for attracting external finance.

4.6. Gas development as a win-win energy solution for both SEE and OECD/EU

While it requires more detailed mathematical modeling and fine tuning, the strategy proposed here combines the interests of major suppliers, transmission operators and investors and gas consumers both in SEE and the rest of Europe. It will promote greater physical openness, market transparency and diversification of supply sources, routes and operators. At the same time it will reduce barriers to entry for the most important SEE industries and create pressure for the rule of law and better property rights throughout SEE. It naturally provides slightly lower gas transport costs for SEE supplies while providing market based security of supply to the rest of Europe.

More detailed mathematical modeling might suggest separation of some economic rents arising from the auction process into a SEE energy efficiency fund that would support transition of some major energy consuming sectors.

Sources of Growth

The SEE region could acquire the following major sources of economic growth:

- rapid improvement of energy efficiency of district heating and other communal systems that will decrease living costs and contribute to urban sustainability;
- elimination of seasonality from the utilization of major infrastructure and enhance the return on capital throughout the region;
- the emergence of internationally competitive agriculture throughout the region;
- enhancement of employment as well as physical openness.

A pre-condition for these developments will be the establishment of strong and independent institutions for policy making, regulation, energy efficiency and energy services, to develop and implement energy reforms based on clear and ambitious strategy. Better governance and respect for the rule of law could be another benefit.

5. Conclusions and Recommendations

This study should be considered as a preliminary attempt to sketch out and analyze a number of options for moving natural gas from producers to potential consumers, improving sustainability and security in South Eastern Europe. Substantial research is required to further scrutinize both these and other more conventional recommendations and solutions. There are too many unknown, or insufficiently known, components involved in the development of large scale natural gas infrastructure. There is a need for well coordinated research with the participation of various international players.

The development proposed here attempts to avoid both general economic and political problems (such as the Dutch disease, political clientism, government capture, insensitivity to social requirements and seasonal swings) and problems of transit security familiar from the experience of major transit corridors across Central and Eastern Europe.

Instead of relying solely on regulatory and nominal frameworks, more durable physical security – such as multiple transit routes, availability of storage and flexible shipping solutions competition between routes – are proposed to create a truly commercial regulatory framework. Much of this research was completed as the problems in gas delivery from the Russian Federation to Europe via Ukraine were unfolding in early 2006. This has helped exporters and importers to better understand the problems of large scale pipeline transit. In a way, it made lessons described hereby more obvious. Prudent investment policy could take into consideration the role of infrastructure in the host country as well as its development outcomes.

There is considerable body of literature on relations between physical openness and the quality of government in particular country. Nominal openness is taken into consideration within the framework of the SEE Energy Community treaty with the EU and the wider EU regulatory framework. Unfortunately, that is not sufficient to ensure the quality of governance as a major determinant of economic development. Such a framework could help once modernization is underway as a consequence of physical infrastructure developments and the collapse of district heating services and the fertilizer and power industries based on the old energy paradigm. In any case, these two developments should be considered as part of the same solution.

Finally, there has been much discussion about the possible role of Gazprom in gas infrastructure development beyond Russian territory. There is a common agreement that Gazprom has emerged as a major commercial player. But Gazprom is sensitive to political risks and transit costs. Competitive development of infrastructure throughout SEE and shipping across the Black Sea could be considered an opportunity for Gazprom to play a more commercial role, facing greater competition but reducing political risks.

6. Appendix: Three local case studies illustrating potential patterns of gas usage:

City of Sofia – sustainability of natural gas use in conventional district heating.

The City of Sofia district heating system has undergone massive restructuring and upgrading. The process was based on conventional wisdom, comprised of the following elements: better energy efficiency of boilers, better insulation, pre-insulated pipes for hot water distribution and heat metering at the point of use. Many improvements have been completed at a very high level of technical sophistication.

However, the system is viable only for wealthier consumers; for average households it is subsidized and unaffordable. The cost of natural gas has until now been low, because of Bulgaria's role as a transit country for Russian gas to the fast growing Turkish and Greek markets. Upgrading and greater efficiency will lower fuel costs ever more, but poor utilization rates, the increased amount of capital tied up, the lack of heat storage and flexibility mean that even an upgraded system remains unsustainable. The fact is that for a mere 1000 hours a year more sophisticated systems and more capital are employed to burn natural gas to produce hot water than electricity which is worth four times as much.

City of Nis – inter-relationship between the introduction of natural gas for residential users with fuel wood and existing district heating systems.

The City of Nis in Serbia is served by a combination of district heating for downtown/new planned settlements and solid fuels for separate houses in suburbs. The energy efficiency of both systems is very low even in conventional terms: losses in boilers and district heating networks are still high despite considerable investments during recent years while fuel wood is used in light heating stoves with about 21 percent efficiency. As a measure to reduce the burden of district heating subsidies on the municipal budget, the City administration was advised by the Government to convert boilers from heavy fuel oil to natural gas. Although pollution was somewhat reduced, rising natural gas prices and continued low utilization rates increased the financial burden. The investment in conversion was proved to be irrelevant over last winter when the district heating company replaced outstanding debt to its oil supplier with similar debts to its gas supplier. To make things worse, winter gas shortages forced the City administration to finance fuel oil supplies on an emergency basis.

A simple calculation has shown that saving in fuel wood by simple replacement of light heating stoves with masonry stoves in Nis suburbs would be sufficient to supply energy to the district heating system of the city. Furthermore, if, as a result of the future building of large district size wood waste-burning boilers, a commercial demand for waste wood develops, this could provide incentives for the introduction of masonry stoves. As burning of solid fuels is recognized as a major source of pollution in the municipality, this development could be beneficial for environment and health. Given certain price levels for gas, fuel wood, fuel oil and district heating services, use of fuel wood can be considered sustainable. The role of natural gas would be limited to power circulation pumps for the district heating network.

City of Belgrade/Lignite complex in Obrenovac – potential use of natural gas in conjunction with indigenous fuels

This is an example of the complex use of natural gas to facilitate sophisticated conversion of conventional lignite-fired power plants, lignite mines and district heating networks to co-fire biomass and provide sustainable urban heating solution to the City of Belgrade. The role of natural gas is limited to circulation pumps, powering heat pumps, start up fuel for lignite burning boilers, biomass handling and peak electricity. (See A. Kovacevic, 'Re-Thinking Obrenovac Lignite Complex', <http://www.unece.org/ie/se/pp/csdcct.html>).

7. References and bibliography:

- Abram, Aleksander and D. Lynn Forster: A primer on Ammonia, Nitrogen Fertilizers, and Natural Gas Markets; The Ohio State University, September 2005 (<http://aede.osu.edu/resources/docs/pdf/KP90MS9C-3H54-C92J-73LB0HTNNCBAF66G.pdf>).
- Agrium inc.: Economics of Nitrogen Fertilizer and Crop Production, Information Bulletin, March 2001 (www.agrium.com).
- Akcollu, F. Yeşim: 'Major Challenges to the Liberalization of the Turkish Natural Gas Market', Oxford Institute for Energy Studies, November 2006 (www.oxfordenergy.org).
- Albouy, Yves and Nadia Nadifi: 'Impact of Power Sector Reform on the Poor – A Review of Issues and the Literature', ESMAP, UNDP/World Bank, Washington DC, May, 1999.
- Alhren, Rudiger and William Thompson: 'Sacrificing Stability', *Moscow Times*. July 2004.
- Babović M. and S. Cvejić: Strategije opstanka domaćinstava Srbije u 2002, CPA/CPS, Oct 2002.
- Bohn, Henning and Robert T. Deacon: 'Ownership Risk, Investment and the Use of the Natural Resources', Department of Economics, University of California, Santa Barbara, February 1997.
- Bothe, David and Andreas Seeliger: 'Forecasting European Gas Supply Selected results from EUGAS model and historical verification', Institute of Energy Economics, University of Cologne, August 2005.
- Brendow, Klaus: 'Gas in South-East Europe – a Business Perspective', European Business Council Energy Committee; Working Group on Natural Gas Markets, Berlin, April 2002.
- Brendow, Klaus: 'Restructuring DH/CHP in Central and Eastern Europe: Analyses and Action', World Energy Council, 2003.
- Brendow, Klaus: 'District Heating and Gas in Central and Eastern Europe: From partnership to Competition? European Business Council, Energy Working Committee, Berlin, April 2003.
- Brendow, Klaus: 'Restructuring and Regulating District Heating and Cogeneration in Transition Economies', World Energy Council, Geneva/London, 2004.
- Brown, Ian: 'The Internal Electricity (54/2003) and Gas Market (55/2003) Directives', European Agency for Reconstruction, October 2005.
- Brown, Ian: 'Treaty establishing an Energy Community', European Agency for Reconstruction, October 2005.
- Buckley, Robert and Kate Owens, 'The Role of Housing Reform in Stability and prosperity in South Eastern Europe', lecture at The World Bank Stability Pact Meeting, Paris, April, 2003.
- Caria, Francesco: 'The Italian Virtual Trading Point (PSV)', IEA/ Eurogas Workshop, Paris, June 2005.
- Clinch, J. Peter and John D. Healy: 'Quantifying the Severity of Fuel Poverty, its Relationship with Poor Housing and Reasons for Non-investment in Energy-saving Measures in Ireland', Dept. of Environment Studies, University College, Dublin, 2002.
- DFID: 'Making Connections: Infrastructure for Poverty Reduction', Consultation Paper, DFID, 2002 (www.dfid.gov.uk).

- Donevski, Bozin: 'A Survey of the Energy situation in Macedonia', Faculty of Technical Science, University St. Clement Ohridski, Macedonia, 2000. (Published at International Workshop and Round Table Discussion on the Energy Future of Bosnia and Herzegovina, 15–16 June 2000, Mechanical Engineering faculty, Sarajevo, Bosnia and Herzegovina).
- Dunning, Thad: 'Resource Dependence, Economic Performance, and Political Stability' *Journal of Conflict Resolution*, Vol 49, No. 4, August 2005, 451–482.
- Economic Commission for Europe: *Economic Survey of Europe*, 2004, No.1, United Nations New York/Geneva, 2004.
- Elias, J. Rebecca and David G. Victor: 'Energy Transitions in Developing Countries: A review of concepts and literature', Center for Environmental Science and Policy, Stanford University, 2005.
- Energy Efficiency and Conservation Authority of New Zealand: Case Study 02/03: 'Process upgrade yields sweet savings for sugar refinery', 2003 (<http://www.eecabusiness.govt.nz/empove/case-studies/archive/index.htm#processes>).
- Energy Information Agency (EIA), USA: 'Major Russian Oil and Natural Gas Pipeline projects.' EIA Country Analysis Briefs (www.eia.doe.gov).
- EU Pillar PISG-Energy Office: 'Lignite Mining Development Strategy, Energy Strategy and Policy of Kosovo', 2005.
- European Fertilizer Manufacturers Association: 'Energy Efficiency is Further Increased in the Nitrogen Fertilizer Chain', Brussels, no date (www.efma.be).
- Food and Agriculture Organization of the United Nations: 'Basics of Wood Energy Planning: Regional Wood Energy Development Programme in Asia', FAO, Bangkok, January 2000.
- Ganev, Georgy: 'Bulgaria and Balkan Energy Flows; Energy and the Transformation process in Bulgaria and Romania', Centre for Liberal Strategies, Sofia and Bucharest, January 1999.
- Gochenour, Carolyn: 'District Energy Trends, Issues and Opportunities – the Role of the World Bank', Technical Paper No. 493, World Bank, Washington DC, March 2001.
- Grey, Dale: 'Reforming the Energy Sector in Transition Economies'; World Bank Discussion Papers; Selected Experience and Lessons, 296, World Bank, Washington DC, Aug 1995.
- Gudmundsson, J.S. and M. Mork: 'Stranded Gas to Hydrate For Storage and Transport', International Gas Research Conference, Amsterdam, 2001.
- Han, Stjepan: 'Some Economic Aspects of International Collaboration in the Production and Use of Power with Special Reference to the Southern Part of Central Europe', Fifth World Power Conference, 1956.
- He, Xue-Zong and Frank H. Westerhoff: 'Commodity markets, price limiters and speculative price dynamics', *Journal of Economic Dynamics & Control* 29; 2005, 1577–1596.
- Healy, John D.: 'Housing Conditions, Energy Efficiency, Affordability and Satisfaction with Housing: A Pan-European Analysis', Urban Institute of Ireland, November 2002.
- Hegedus, Jozsef and Nora Teller, 'Management of the Housing Stock in South Eastern Europe', Council of Europe Development Bank, World Bank, Washington DC, 2003.

Hoff, Karla and Joseph E. Stiglitz (2002a): 'After the Big Bang? Obstacles to the Emergence of the Rule of Law in Post-Communist Societies', World Bank, Washington DC, December 2002.

Hoff, Karla and Joseph E. Stiglitz (2002b): 'The Transition Process in Post-Communist Societies: Towards a Political Economy of Property Rights' World Bank, Washington DC, 2002.

Hoff, Karla, Shale Horowitz and Branko Milanovic: 'Political Alternation, Regardless of Ideology, Diminishes Influence Buying; Lessons from Transitions in Former Communist States; Policy Outlook', Carnegie Endowment, January 2005.

Honoré, Anouk: 'Gas Demand in Europe: The Role of Power Sector', Energy Risk Management Seminar, CASS Business School, June 2005.

IEA/SEC: *Natural Gas Transit and Storage in SEE Europe*, Conference Proceedings and Papers, International Energy Agency/Sarkeys Energy Center, The University of Oklahoma, Istanbul, 2002.

International Energy Agency (IEA), *Coming in from the Cold – Improving District Heating Policy in Transition Economies*, 2004.

International Energy Agency (IEA), *Key World Energy statistics*, 2003.

International Energy Agency (IEA), *Key World Energy statistics*, 2005.

International Energy Association (IEA) - Energy Charter Secretariat (ECS), Istanbul gas conferences 2002 and 2004: proceedings and papers, (see www.iea.org).

Jackson, Mary and Nigel Harris: 'Is the European Gas Market Ready for 2007?', *Commodities Now*, December 2003.

Kaufmann Daniel and Kraay Aart: 'Growth without Governance', presentation, World Bank Internet site.

Kaufmann Daniel, Joel S. Hellman and Geraint Jones: 'State Capture, Corruption, and Influence in Transition', Policy Research Working Paper 2444, World Bank, Washington DC, September 2000.

Kaufmann, Daniel and Kraay Aart, 'Governance and Growth: Causality Which Way? Evidence for the World, in brief', World Bank, Washington DC, February 2003 (http://www.worldbank.org/wbi/governance/pdf/growthgov_synth.pdf).

Kaufmann, Daniel, 'Unbundling Governance and Corruption: Some New Empirical Findings and Collective Action Approaches', Lecture for Anti-Corruption Summit, World Bank, Washington DC, 2000.

Keefer Philip, and Stephen Knack: 'Boondoggles and Expropriation: Rent seeking and Policy Distortion when Property Rights are Insecure', Policy Research Paper 2910, World Bank, Washington DC, October 2002.

Kennedy, David: 'World Bank Framework for Energy Trade in South East Europe', World Bank, Washington DC, 2003.

Knack, Stephen: 'Aid Dependence and the Quality of Governance: A Cross-Country Empirical Analysis', World Bank, Washington DC, 2000.

- Lampietti A. Julian and Anke S. Meyer: 'Coping with the Cold: Heating Strategies for Eastern Europe and Central Asia's Urban Poor', World Bank, Washington DC, 2002.
- Le Billon, Philippe: 'The Political Ecology of War: Natural Resources and Armed Conflicts', *Political Geography* 20; 2001, 561–584.
- Lepotic Kovacevic, Branislava and Jelena Radun: 'Advantages of Pan-European Oil Pipeline project and possibilities of its realization', Yugoslavia Association of Oil and Gas (YUNG), Oil Industry of Serbia (NIS), 2005.
- Lindner Ines, Strulik Holger: 'Property Rights and Growth', Hamburg University, Department of Economics discussion paper, October 1999.
- Locatelli, Catherine: 'Changes in Russia's Gas Exportation Strategy: Europe Versus Asia?' LEPII-EPE, CNRS-University of Grenoble II, September 2004.
- Lovei, Laszlo et al.: 'Maintaining Utility Services for the Poor – Policies and Practices in Central and Eastern Europe and the Former Soviet Union', World Bank, Washington DC, March, 2000.
- Maycroft Constultancy Services, 'Gas Hubs Jockey for Position', *Exchanges*, 2006.
- McDaniel, Tanga and Karsten Neuhoff: 'Auctions to gas transmission access: The British experience', CEEPR Working paper, October 2002 (<http://web.mit.edu/ceep/www/2002-007.pdf>).
- Merkulov, Vladimir: 'Supplies to Central European Region and Gasprom's perspective', Budapest Central European gas conference, Budapest; 2005.
- Meyer, A and W. Mostert: 'Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the former Soviet Union', ESMAP Report No. 234, World Bank, Washington DC, Washington DC, 2000.
- Mitra, Sophie: 'A Simple Deterministic Model of the Volatility of Commodity Prices with Storage', Rutgers University, October 2004.
- Neuhoff, Karsten: 'Coupling Transmission and Energy Markets Reduces Market Power', IAEE, January 2004 (http://www.iaee.org/en/students/best_papers/neuhoff_prague_2003.pdf).
- Ninomiya, Yasushi: 'Energy Demand and Economic Development – Japanese Experience over the past 100 years', lecture, Institute for Global Energy Strategies (IGES), 2003.
- Observatoire Méditerranéen de L'Énergie: 'Assessment of Internal and External Gas Supply options for the EU, Evaluation of the Supply costs of New Natural Gas Supply Projects to the EU and an Investigation of Related Financial Requirements and Tools', OME, June 2001 (www.ome.org).
- OECD/International Energy Agency: 'Flexibility in Natural Gas Supply and Demand', 2002.
- OECD/International Energy Agency: 'Coming in from the Cold, Improving District heating Policy in Transition Economies', 2004.
- OECD: *Lessons from the Economic Transition, Central and Eastern Europe in the 1990s*; OECD, 1997.
- Olsen, Alf-Peter: 'Compressed Gas Shuttle Carrier' 5th Doha Conference on Natural Gas, 2004.

- Petovar K. and M. Vujošević: 'The Spatial Plan of the Republic of Serbia', abridged version, Ministry of Construction, Institute of Architecture and Town Planning of Serbia, Belgrade, 1997.
- Pipeline & Gas Journal*: 'Pipeline Construction Scorecard', January 2005.
- Punzo, Lionell F.: 'The Look of Stagnation: Romania's Erratic Transition', University of Siena/CIRJE, December 2001.
- Ringmar, David: 'The European Dependence of Russian Energy', *Natverket Olja & Gas*, September 2005.
- Ritva, Reinikka and Jakob Svensson: 'How Inadequate Provision of Public Infrastructure and Services Affects Private Investment', Policy Research Working Paper, WPS 2262, World Bank, Washington DC, Dec 1999.
- Rodrik, Dani, Arvind Subramanian and Francesco Trebbi: 'Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development'; Working papers, Center for International Development at Harvard University No. 97, October 2002.
- Rosca, Marcel: 'Combined Geothermal and Gas District-heating System, City of Oradea, Romania', Proceedings World Geothermal Congress, 2000.
- Scarborough, Brandon Christopher: 'Natural Resource Rents and Institutional Change', Montana State University, July 2005.
- Seidman, Ann, Robert B. Seidman and Thomas W. Walde, editors: *Making Development Work, Legislative Reform for Institutional Transformation and Good governance*, Kluwer Law International, 1999.
- Snyder, Richard: 'Does Lootable Wealth Breed disorder? A Political Economy of extraction framework', Working Paper No. 312, Helen Kellogg Institute for International Studies at the University of Notre Dame, July 2004.
- Stern, Jonathan: 'Security of the European Natural Gas supplies', Royal Institute of International Affairs, July 2002.
- Stern, Jonathan: 'Gas and Oil Prices: Economic, Logic and Possible Scenarios', Oxford Institute for Energy Studies (presentation for British Energy Association, Army and Navy Club, London), November 8 2005.
- Stigler, J. George: 'The theory of economic regulation', *Bell Journal of Economics and Management Science*; 1971.
- Tambone, Fabio and Sergio Ascari: 'The South East Europe Natural Gas Market', Council of European Energy Regulators, 2005.
- Tarr, David and Peter Thomson: 'The Merits of Dual Pricing of Russian Natural Gas', World Bank, Washington DC, July 2003.
- The Economist* (print edition): 'Ivan at the Pipe', December 2004.
- Toman, Michael and Barbora Jemelkova: 'Energy and Economic Development: an Assessment of the State of Knowledge', Resources for the Future Discussion Paper 03-13, April 2003 (www.rff.org).
- Transparency International: *Annual Report 2004*.

Tsachouridis, Paris and Andreas Chlopoulos: ‘The Impact of the TENs Programme on the Greek Economy’: *American Journal of Applied Sciences* 1 (3), 184–189, 2004.

Tubin, Branka: Serbia: Gasification Study, prepared by ECA, financed by the World Bank, Ministry of Mining and Energy of the Republic of Serbia, 2005 (www.mem.sr.gov.yu).

UNCCD: *Land Degradation in Central and Eastern Europe*, proceedings of the workshop on Land Degradation/desertification in Central and Eastern Europe in the context of the UNCCD, Brussels, May 2000.

Victor, G. David and Nadeida Makarova Victor: ‘The Belarus Connection: Exporting Russian Gas to Germany and Poland’, working paper, Program on Energy and Sustainable Development at Stanford University and the James A. Baker III Institute for Public Policy of Rice University, May 2004.

von Hirschhausen, Christian, Berit Meinhart and Ferdinand Pavel: ‘Transporting Russian Gas to Western Europe – A simulation analysis’, *The Energy Journal* Vol. 26. No. 2, April 2005, 49–68.

Wackernagel, Mathis, Chad Monfreda and Diana Deumling: ‘Ecological Footprint of Nations’, Sustainability Issue Brief, Redefining Progress, Oakland CA, November 2002 (<http://www.rprogress.org/newpubs/2002/ef1999.pdf>).

Walde, Thomas W.: ‘The International Dimension of EU Energy Law and Policy’, Advance Working Paper for forthcoming book on EU Energy Law; 2003 (manuscript obtainable from the author via www.gasandoil.com/ogel).

Willoughby, John and Nick Jones: ‘Improving efficiency in all-electric homes’, CADDET Energy Efficiency Center, 1999.

World Bank Development Research Group: ‘Reducing Air Pollution from Urban Passenger Transport: A Framework For Policy Analysis’, Policy Paper, World Bank, Washington DC, 1998.

World Energy Council: ‘Pricing Energy in Developing Countries’, June 2001.

World Energy Council: ‘Regulating District Heating and Cogeneration in Central and Eastern Europe’, World Energy Council, 2004.

World Resources Institute: *World Resources 2002-2004, Decisions for the Earth, Balance, Voice and Power*, World Resources Institute, Washington DC, 2003.

Zanini, Michele (with contribution from Katia Vlachos-Dengler); ‘The Political Economy of Infrastructure Development in and Around Southeastern Europe’, Chapter 4 in Ian O. Lesser, F. Stephen Larrabee, Michele Zanini and Katia Vlachos, *Greece's New Geopolitics*, RAND, 2001, available at http://www.rand.org/pubs/monograph_reports/MR1393/index.html.

Zayashnikov: Russia-EC: a Strategic Partnership (the gas aspect), Brussels, September 2005.

Web sites containing material on Compressed Natural Gas:

<http://www.transoceanogas.com/>

http://www.touchbriefings.com/pdf/951/knutson_tech.pdf.pdf