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Towards a Balkan gas hub:
the interplay between pipeline gas, LNG and renewable energy in South East Europe

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It took well over two years to complete this paper. During that period, South Eastern Europe became interesting due to its persistent security of supply problem and a lot of literature and discussions have been made available to the author. A number of new political initiatives (Berlin Process, CESEC, Energy Union) have been launched. The author is grateful to colleagues from the Vienna Institute for International Economics, CEPS, European Climate Foundation, the Energy Community Treaty Secretariat, the RCC, the Belgrade Security Forum and a range of industry professionals for opportunities to discuss various aspects of this work. Howard Rogers and Jonathan Stern of the Oxford Institute for Energy Studies made comments, and provided patience and support toward finalization of the paper. David Sansom designed the original maps presented in the paper. The author is grateful to John Elkins for his detailed comments and edits.

Preface

The OIES Natural Gas Programme has published four previous papers on South Eastern European gas, two of which were by Aleksandar Kovacevic. This paper addresses the potential for the region to evolve to a situation where a more diverse set of gas supply options established a degree of competition through gas on gas pricing and an emergent trading activity.

The paper by necessity is context-rich. Gas sector participants, observers and academics will be aware of the challenges facing gas market and infrastructure development in South Eastern Europe due to market size, lower per capita GDP compared with North West Europe and the small average size of national gas markets (and hence pipeline infrastructure lacking economies of scale). The author's description of the energy mix (including lignite to a significant degree) and the complex interaction between gas-fired district heating, wood burnt as domestic fuel and hydro in a region where temperature and rainfall are both volatile and unpredictable raises additional challenges. In addition, the continued dominance of state owned suppliers and system operators and poor levels of governance create further barriers to transparency and commercial investment in the energy sector.

Against this perhaps inauspicious backdrop, the author details possible routes by which competing supply could achieve an initial level of market opening. In addition to pipeline supply, small scale LNG penetration into the Black Sea and its major navigable rivers create possible options.

Although gas demand growth is unlikely to be significant in the region, it is the unsustainable nature of the existing energy mix which will begin to catalyse change, followed by the penetration of supply seeking a competitive but cost reflective margin over European traded market prices.

Howard Rogers

Oxford
November 2016

1. Executive Summary

South Eastern Europe (SEE) is served by an opaque energy market. Market transparency is constrained by executive government control over statistical and other regulatory institutions, the deterioration of professional associations and limits to public participation. Governments are deeply involved in commercial transactions, which discourages innovation and market development, and are focused on (natural resource and transit) rent seeking. The rule of law, including enforcement of international legal compacts, is arbitrary and constrained. There are massive barriers to entry.

Domestic energy production (gas, crude, fuel wood, lignite and hydro) facilitates a system of subsidies that are intended to maintain the economic and social status quo. Lignite, gas and crude resources are poor in quality and/or productivity of extraction. This subsidy based regime is only competitive during periods of high international energy prices. In a low price environment, the resource rent turns negative and environmental impacts increase as governments soften control of environmental constraints in lignite extraction and combustion as well as crude and gas processing.

Crude and gas from the Russian Federation dominates the SEE import portfolio. Russian companies control oil refineries in Romania, Bulgaria, Serbia and Bosnia. Gazprom is the main gas supplier to the entire region and the only producer of domestic gas (and oil) in Serbia. Its gas export is associated with a network of subsidiaries, resellers, agents and sponsorships that are granted special rights in their respective countries of operation. This system is supported by the availability of “on demand” credit resources that contribute to the soft budget constraint and facilitate the operation of low efficiency district heating systems, emergency power generation and inefficient (fertilizer, etc.) industries. It is, however, critical for the security of residential heat and food supply. This formal and informal network of control goes way beyond monopolistic market behavior and constitutes an effective “stick and carrot” government capture system.

In this governance context, and if the current supply and demand structure remains, SEE will have an increased energy security risk due its exposure to a disruption in gas supply via Ukraine.

Governments are granted significant credit resources from sovereign creditors. Soft budget constraint and the fragility of the remaining domestic energy resources create fertile ground for destructive entrepreneurship to create and promote projects. Government’s project prioritization is taken into consideration by international institutions despite the actual quality of governance or project credentials. The probability that some Government-backed projects are going to be funded creates uncertainty for any (competing or complementary) commercial projects. Uncertainty on actual enforcement of international compacts (Energy Community Treaty, climate change, etc.) creates an additional layer of risk.

SEE energy supply is carbon intensive above the EU average. As demonstrated in Chapter 5.2 (and 3.4.1), Greece (followed by the rest of region) consumes more lignite per capita than any other country in the World. Once a reservoir of European biodiversity the region is now exposed to massive environmental impacts and deforestation that already impacts water regimes, and increases risks of flooding and droughts - further exposing the region to climate change risks. Furthermore, there is very little (if any) ambition to contribute to climate change mitigation based on the national submissions to the UNFCCC Paris conference.

“Destructive entrepreneurship” is evidenced by the range of lignite based power generation projects being promoted across the region. Project promoters have taken every opportunity to circumvent environmental regulations, increase the cost of closures, abandon environmental investment, conceal the reality of low productivity, ignore the human health impacts, persuade international creditors to grant funds and infiltrate and influence government structures. The ability of lignite mines to periodically manipulate overburden removal rates and influence the weighted average cost of energy (WACE) is a critical soft budget constraint mechanism. However, the depletion of economic lignite resources, aging plant and infrastructure, liberalization of electricity markets and EU environmental regulations have created a ‘perfect storm’ that now threatens the lignite-to-power industry. Taking into account that lignite provides about 2/3 of power to the region, the prospect of phasing out lignite within the next 8-10 years creates a massive security of supply challenge. This energy supply gap could be addressed by the increased supply of natural gas which has attracted the attention of various suppliers. The substantial security risks resulting from a massive shift from lignite to gas without the adequate change of governance patterns and gas market formation are hardly affordable within the current strategic framework.

Energy demand in SEE is sensitive to weather patterns to a greater degree than in the rest of Europe. It is also subject to the enforced credit terms and liquidity related to actual enforcement of payments for natural gas, electricity or oil products as well as various separate barter arrangements or cross subsidies. The volatile availability of hydro power impacts the weighted average cost of energy (WACE) as hydro power is focused on supplying local markets regardless of the opportunity cost. Consequently, utilization rates of available infrastructure and power generation capacity fluctuate wildly around a very low weighted average. Low WACE is mirrored in a low retail price of electricity that creates an effective barrier to entry for new investments and energy efficiency improvements.

This problem is magnified by a high weighted average cost of capital (WACC) for commercial transactions. Bad governance is key to simultaneously (1) constraining the adequate use of existing infrastructure, (2) promoting resource-destructive new infrastructure, (3) confusing public policy and (4) maintaining a high WACC. Together with other uncertainties and barriers to commercial investments, persistent bad governance in this region deprives the rest of Europe of alternative oil and gas supply options as well as any meaningful competition in energy intensive industries (physical openness and transportation) and the use of Balkan hydro resources to respond to intermittency to facilitate renewable energy elsewhere in Europe. Being aware of its affiliation with the Russian oil and coal export interests, the incumbent gas supply monopoly has an interest, the means, experience and opportunity to maintain current governance arrangements in this part of Europe.

In contrast, the European Union (EU) is looking toward this region as an option to improve its security of gas supply and diversify its supply portfolio. This encourages local expectations of transit rents and is based on the assumption that the region may host the following: Southern Gas Corridor, North-South Gas Interconnection and Central/South Eastern Electricity Interconnection. There are more overlapping energy transit projects being considered than in any other region in Europe.

This paper sets out a realistic roadmap that is able to overcome existing barriers and provide the desired level of security of supply:

1) Gas consumption that does not yield positive economic returns is to be phased out by energy efficiency, use of renewable energy and opening to international markets. This is sufficient to eradicate the immediate security of supply risks and establish a framework for the commercially sound use of gas;
2) Flexible Black Sea & Balkans (BS&B) Gas Hub through the improved use of existing infrastructure and
3) BS&B Gas Hub facilitates gas trade with the rest of Europe that promotes more efficient use of gas, market opening, industrial restructuring and increased renewable energy integration – all beyond the expectations indicated in various current strategic documents. A BS&B Gas Hub is envisaged as a private commercial undertaking in order to increase the liquidity at BS&B Gas Hub and attract commercial supplies from the Black Sea basin.

This Roadmap intends to unlock improvement in the quality of governance, commercialize WACE, decrease WACC, reduce uncertainties and facilitate investments. Economies will benefit from the better utilization of dormant capital, improved liquidity and hardening of budget constraints.

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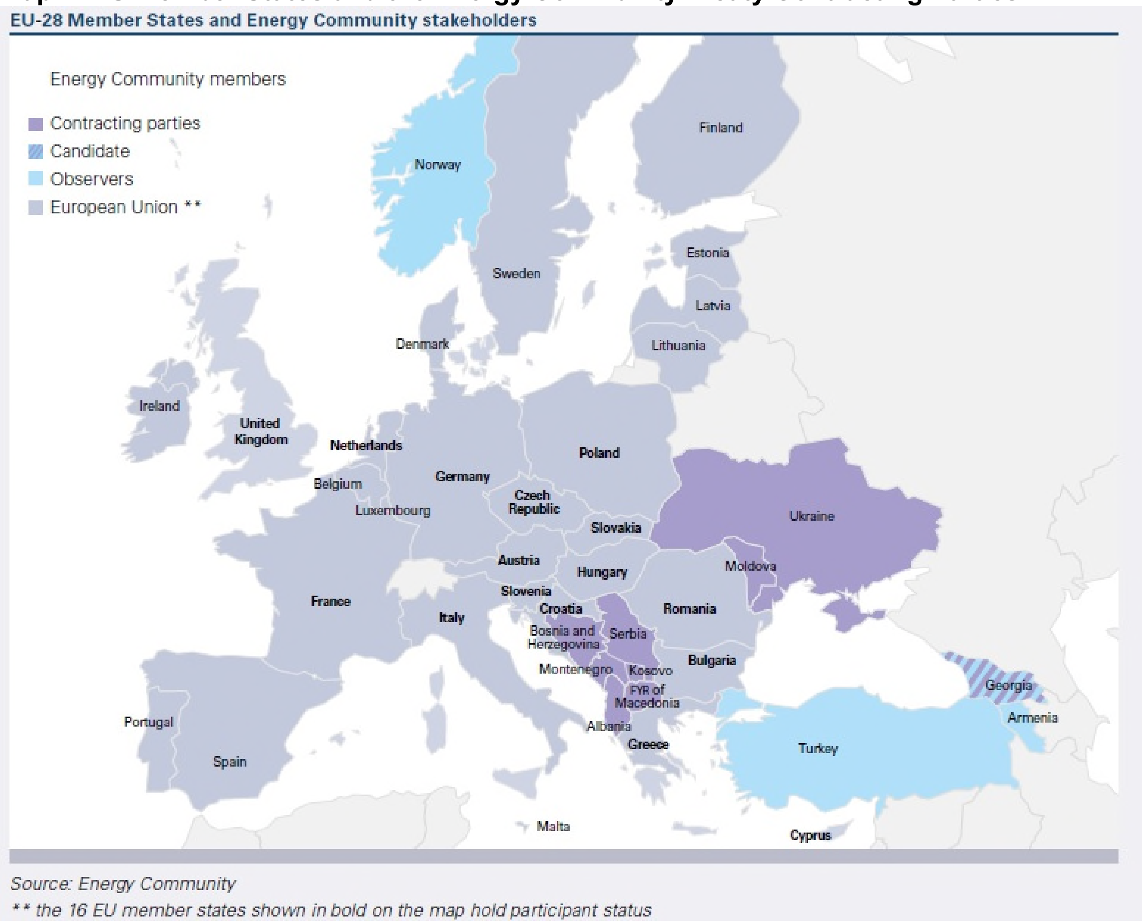
2. Introduction

South East Europe is a distinct energy market within the European region. It could contribute diversity to the European energy market not only in terms of access to distant energy resources but in terms of the nature of energy supply, conversion and use. Its potential contribution to European security of energy supply goes way beyond physical volumes of energy that may transit across this region.

Map 1: EU Member States and the Energy Community Treaty Contracting Parties

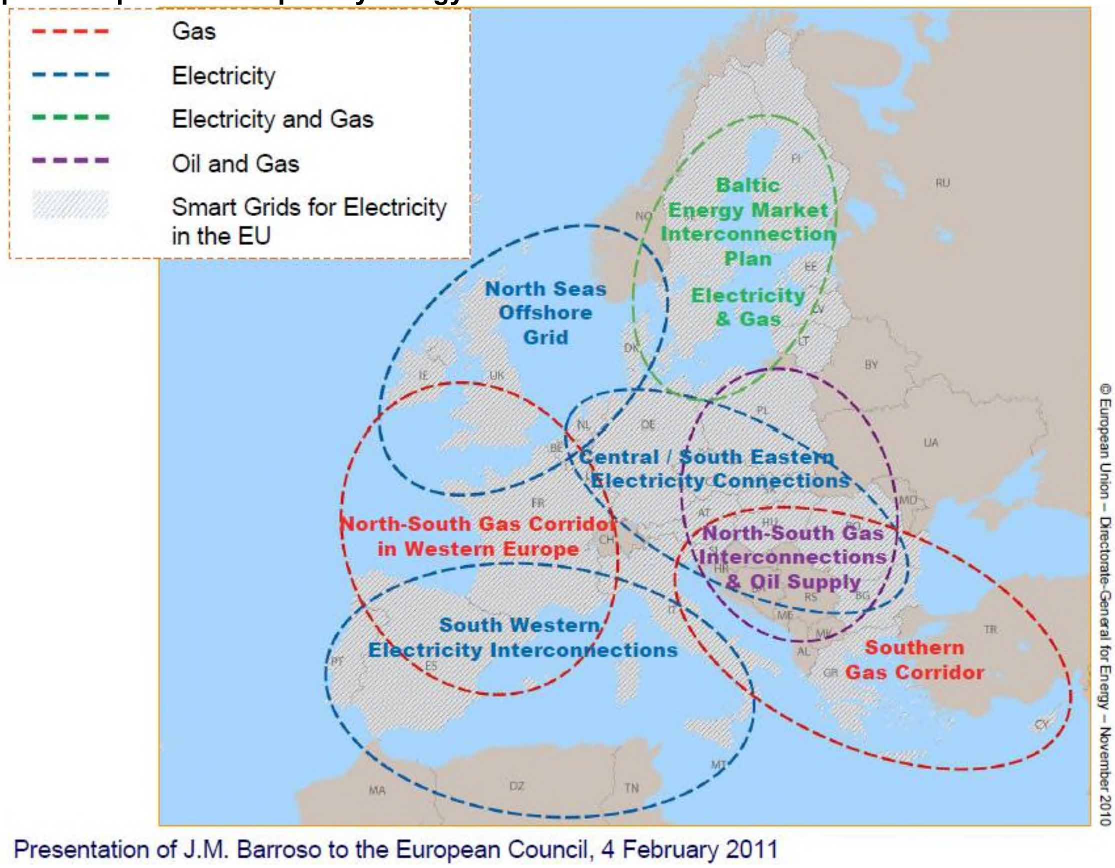


Source: EuraCoal, Coal industry across Europe, 5 Edition, 2013, page 60

Almost all South Eastern Europe (SEE) jurisdictions (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo, FYR Macedonia, Montenegro, Romania, Serbia, Slovenia and Turkey) envisage themselves becoming a gas and /or electricity hub in one or another context[1]. This is the only geographical area in Europe that hosts three overlapping EU energy corridors: Central/South Eastern Electricity Connection, North-South Gas Interconnections & Oil Supply and Southern Gas Corridor.

[1] See for example: https://www.stratfor.com/the-hub/elusiveness-south-east-european-natural-gas-hubs ; http://www.europeanenergyreview.eu/emerging-gas-hubs-in-southeast-europe-and-the-east-med-a-reality-check/ ; http://www.eiranews.com/volume-3-issue-4/greece-as-key-gas-hub-in-southern-europe-but-then-russia-is-unavoidable/ ; as well as: Bulgartransgaz: Concept of establishing of regional gas hub in Bulgaria - projects TRA-N-593, TRA-N-594, TRA-N-5921 (http://www.bulgartransgaz.com/files/useruploads/files/PCI_Public_info_Hub_ENG_July_final.pdf) ; Morena Skalamera, The Russian Reality Check on Turkey's Gas Hub Hopes, POLICY BRIEF / JANUARY 2016, Harvard Kennedy School, Belfer Center.

Map 2: European Union: priority energy infrastructure



Source: Barroso, J.M. (http://ec.europa.eu/europe2020/pdf/energy_en.pdf), page 13.

Currently gas is mainly delivered under long term contracts at prices linked to oil prices, while minimal gas volumes are traded at market prices. Minimal gas-to-gas competition and infrastructure adjustments emerged in the region during and after the January 2009 gas supply crisis. Several new gas pipeline options have been proposed for the region over a period of more than 30 years. These include projects of massive volume and scale (South Stream, Turkish Stream), extraordinary scope and financing requirements (NABUCCO, Cyprus-Greece, White Stream, LNG Croatia, etc.) or moderate dimensions (TANAP, TAP, ITGI, etc.) as well as an almost indefinite number of gas interconnections some of which have been harmonized as the Western Balkans Gas Ring. Almost all such proposals intended to supply gas demand outside of this region – mostly in the rest of Europe.

Review of available publications on these projects reveals that:

1) there is little confidence in immediate gas demand growth across South Eastern Europe,
2) projects are justified by security of supply, diversification or transit risks on alternative routes toward the wider European market and
3) not on competitiveness of particular routes or gas sources versus LNG transport or other commercial considerations,
4) while there is little justification for how these new projects may outcompete existing supplies or supply routes to the wider European market.

The rationale and arguments for such projects are not as commercial as one may expect, and are very much grounded in expectations and could be summarized as follows:

- If incumbent Russian supplier(s) (or the Ukrainian transit provider) choose to void existing supply routes through Ukraine, existing demand in Central Europe is to be served via a new route that may have even higher transport costs (and transit fees).

- Existing customers in Europe may abandon their historical confidence in security of supply contracted with an incumbent supplier and desire to diversify their supply portfolio even at higher supply costs.
- If any of these changes materialize, SEE countries expect to charge transit fees that would be sufficient to cross-subsidise uneconomical use of gas including some small gas-to-power projects. There is an expectation that the subsidized cost of gas may also attract some industrial investments.
- European Union and International Financial Institutions may be persuaded to provide soft financing for transit projects in order to accomplish objectives such as security or diversity of supply. It is to be noted that persuasion (or deception) of this scale requires persistent suppression of commercial supply options.
- Transit of gas toward the rest of Europe and sunk costs are perceived as arguments for arranging concessions (soft payment terms, customer discrimination) in transit countries beyond eventually contracted transit fees.
- If any of these projects mature to implementation, investments and construction activities would improve local economic performance in the short term, push GDP up and provide ground for further sovereign debt and Government spending.

These arguments include bad governance, no adequate rule-of-law and pure protection of property rights as given and persistent while being based on an assumption that new transit routes are going to be secure and reliable even if these circumstances persist. Available theoretical literature and case studies indicate that introduction of large scale transit fees and large scale construction works financed by external public funds is likely to cement bad governance that is, in turn, likely to put security of supply via that infrastructure at risk. This paper examines these contradictions in more detail and considers more commercial alternatives.

The paper thus addresses the following questions:

1) Balkan energy markets: supply, demand, inter-fuel competition and pricing – to what extent are current arrangements sustainable?

2) Projected gas demand and proposed gas supply/infrastructure project proposals: to what extent do these make sense?

3) Is gas to gas competition in the Balkan region – between different sources of pipeline gas, and between pipeline gas and LNG – likely? How would this correspond with other forms of energy and might this create a hub (or hubs) in the region which could have a wider European impact and/or would existing European hubs impact on pricing in the region?

4) What would be the benefit of a gas market in the Balkans in the context of gas-for-transport and gas-with-renewables that may be of interest for more mature gas markets?

3. South East Europe Gas Market

South Eastern Europe remains Europe's most polluting and least energy efficient region in relative terms and compared to its GDP. It is energy intensive but it is also intensive in CO_2 per unit of used energy. Its energy (and in particular electricity) consumption per capita is in line with the World average but far below the OECD average. Consequently its primary energy use per unit of GDP is exceptionally high even in the World context. We should also note that its current nominal GDP is not sustainable as it is facilitated by enormous trade deficits, financial support and a complex system of subsidies as well as relative physical barriers to entry for international competition.

Table 1: Basic Energy Indicators (2012)

Region/ Country/ Economy	Population	GDP	GDP (PPP)	Energy prod.	Net Imports	TPES	ELEC Cons.[a]	ELEC Emissions.[b]
	million	billion 2005 USD	Billion 2005 USD	Mtoe	Mtoe	Mtoe	TWh	Mt Of CO_2
World	7 037	54 588	82 901	13 461	-	13 371[c]	20 915	31 734[d]
OECD	1 254	39 490	39 202	3 869	1 543	5 250	10 145	12 146
Albania	3.16	11.22	25.69	1.67	0.39	2.07	6.14	3.83
Bosnia and Herzegovina	3.83	12.88	28.20	4.52	2.21	6.67	12.54	21.22
Bulgaria	7.31	33.85	88.95	11.78	6.83	18.35	34.79	44.30
Croatia	4.27	44.95	68.29	3.45	4.39	7.92	16.30	17.19
Greece	11.09	208.22	234.49	10.43	19.44	26.55	61.13	77.51
Macedonia (FYR)	2.11	7.32	19.63	1.52	1.44	2.97	7.64	8.69
Montenegro	0.62	2.88	6.59	0.71	0.37	1.06	3.36	2.30
Kosovo*	1.81	5.26	13.20	1.75	0.65	2.37	5.17	8.00
Romania	20.08	117.14	239.84	27.19	7.93	34.92	52.24	78.97
Serbia	7.22	27.85	69.95	10.78	3.98	14.46	31.58	44.09
Slovenia	2.06	38.25	50.29	3.56	3.64	7.00	13.94	14.63

[a] Gross production + imports – exports – losses.
[b] CO_2 emissions form fuel combustion only. Emissions are calculated using the IEA's energy balances and the Revised 1996 IPPCC Guidelines.
© TPES for world includes international aviation and international marine bunkers as well as electricity and heat trade.
[d] CO_2 emissions for world include emissions from international aviation and international marine bunkers.
TPES= Total Primary Energy Supply
Source: IEA, Key World Energy Statistics (2013)

Table 2: Complex Energy Indicators (2012)

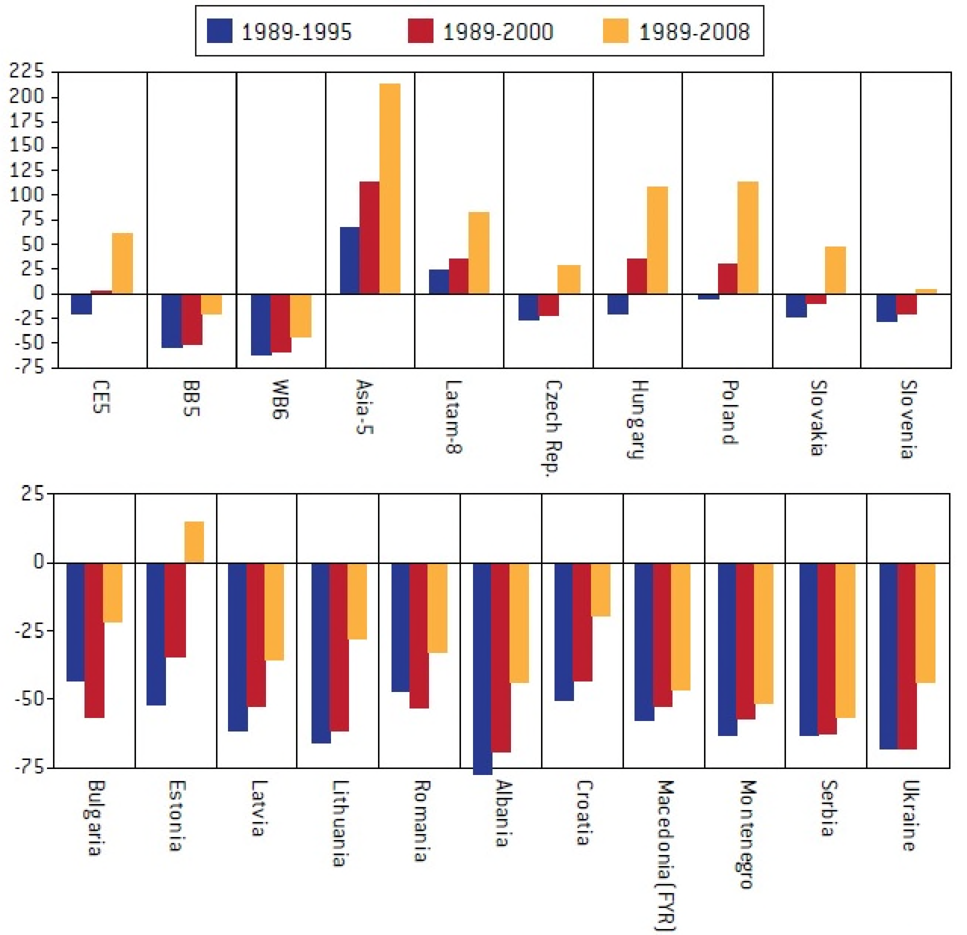
Region/ Country/ Economy	TPES/ Pop.	TPES/ GDP	TPES/ GDP (PPP)	Elec. Cons/ pop.	CO_2/ TPES	CO_2/ pop.	CO_2/ GDP	CO_2/ GDP (PPP)
	toe/ capita	toe/000 2005 USD	toe/000 2005 USD	kWh/ capita	t CO_2/ toe	t CO_2/ capita	kg CO_2/ 2005 USD	kg CO_2/ 2005 USD
World	1.90	0.24	0.16	2 972	2.37	4.51	0.58	0.38
OECD	4.19	0.13	0.13	8 089	2.31	9.68	0.31	0.31
Albania	0.66	0.18	0.08	1 943	1.84	1.21	0.34	0.15
Bosnia and Herzegovina	1.74	0.52	0.24	3 271	3.18	5.54	1.65	0.75
Bulgaria	2.51	0.54	0.21	4 762	2.41	6.06	1.31	0.50
Croatia	1.85	0.18	0.12	3 819	2.17	4.03	0.38	0.25
Greece	2.39	0.13	0.11	5 511	2.92	6.99	0.37	0.33
Macedonia (FYR)	1.41	0.41	0.15	3 625	2.93	4.13	1.19	0.44
Montenegro	1.71	0.37	0.16	5 412	2.16	3.70	0.80	0.35
Kosovo*	1.31	0.45	0.18	2 860	3.38	4.43	1.52	0.61
Romania	1.74	0.30	0.15	2 602	2.26	3.93	0.67	0.33
Serbia	2.00	0.52	0.21	4 371	3.05	6.10	1.58	0.63
Slovenia	3.40	0.18	0.14	6 778	2.09	7.11	0.38	0.29

Source: IEA, Key World Energy Statistics (2013)

Industrial production (and therefore industrial energy demand) dropped across the Central Europe and South East Europe (CESEE) region[2] during 1989-2008. That left Central Europe with significant capacity surplus in power generation and oil refining that was available to facilitate exports and formation of new industry. As a consequence, Central European countries were able to exceed 1989 industrial production levels by 2008. Residential consumption in these countries was and still is covered by gas supply and district heating.

[2] In this context CESEE includes all countries listed by country or cumulated in CES and WB6 indications in the Figure 1. That is somewhat different than elsewhere in the text where South East Europe also includes Greece that exhibited somewhat different demand patterns.

Figure 1: Industrial production, cumulative change



Source: IMF International Financial Statistics, World Bank World Development Indicators and wiiw Annual Database incorporating national statistics, Eurostat. Note: the starting year for Ukraine is 1990. Asia-5 = Asia-6 (see Box 1.1) without Taiwan.

Source: http://bruegel.org/wp-content/uploads/imported/publications/101124_bp_zd_whither_growth.pdf, page 28.

On the contrary, residential demand in Western Balkans shifted to fuel wood and electricity. Massive use of fuel wood for residential heating during cold winter periods, as a consequence of both opportunity and short term price spikes in fuel wood markets, causes spikes in electricity demand[3]

[3] South East Europe is exposed to volatile weather patterns that may create periods of warm and very cold weather during the winter season. Fuel wood (and lignite) from retail market are typically burned in very low efficiency stoves that require significant fuel stocks. Exposed to cold periods, consumers choose between depleting stock with the risk of adequacy to the end of the winter, buying on the open (or grey) market at inflated prices or supplementing with electricity. Default in paying electricity bills during a winter is not likely to result in disconnection. During cold periods, the marginal cost of fuel wood increases while the marginal cost of electricity actually decreases and consumers top up with electricity. IEA (2012), Energy in the Western Balkans, 2008 as well as the World Bank, Stock taking report on energy efficiency in the Western Balkans, 2010 (https://www.energy-community.org/pls/portal/docs/664179.PDF) demonstrate this pattern while Silva and others (http://documents.worldbank.org/curated/en/626211468053973599/pdf/wps4127.pdf) demonstrates the correlation between electricity and fuel wood pricing. During cold periods, cash constrained district heating systems are likely to limit deliveries of heat that prompts their customers to supplement this with electricity. Increased electricity load over distribution grids causes a disproportional increase in network losses that further contributes to a spike in electricity demand. This pattern sets a scene for State-owned-enterprises (SoE) to ask Governments (and international donors) to provide financial support for more power generation capacity.

that effectively consumes the entire export capacity of hydro power from the Western Balkans and all available thermal power capacity. Romania and Bulgaria have been exposed to an entirely new competitive situation by market opening and exposure to international trade as well as competitive pressures in the Black Sea[4]. Therefore, most energy intensive industries – especially electricity intensive industries[5]: aluminium, copper, bauxite, nickel, lead – have been disrupted. This has caused a significant and persistent drop in industrial production, disorganization of production chains and decrease in utilization rates of labour, infrastructure and capital stock.

Governments realized that further industrial development and access to natural resource rents depends on the availability of additional power generation capacity. Consequently, all regional Governments adopted aggressive capacity development programs based on domestic lignite and/or imported gas[6]. It is interesting to note that new lignite-fired capacity and gas-fired capacity is intended to supply the same demand and effectively are in competition: Governments are betting between affordable loans (or bilateral investment arrangements) to develop lignite resources and affordable loans (or bilateral investment arrangements) to bring in large (and cheap or subsidized) gas supplies fed from the gas transit flows toward more mature (and larger) gas markets. As gas demand growth in the rest of Europe is (at best) sluggish, SEE is betting on the re-direction of Russian gas supply from the Ukraine transit route to the SEE transit route.

This complex multidimensional 'hedging' is justified, for a period of time, in terms of politics intended to balance "good" political relations with the EU, the Russian Federation and any other provider of soft loans for lignite-fired power plants such as China or EU. Keeping these options open also avoids any actual commitment to any geopolitical partners or alignment with any conflicting geopolitical interests as well as international compacts including climate change agreements.

In this context EU environmental regulations that affect (new and existing) lignite-fired power plants as well as EU competition and state aid rules are seen as a caveat. While obligations and deadlines have been introduced in the Energy Community Treaty[7] from 2005, no serious activity toward economical (and irreversible) compliance is recorded to date[8].

The energy mix of the South Eastern Europe countries is available at a high cost. Prices of internationally traded commodities (natural gas, coal, oil) are above international market prices due to the land-locked nature of the market and inadequate access to sea borne trade, various political arrangements and inadequate economy of scale.

The use of imported fuels is relatively inefficient: natural gas is predominantly used for district and residential heating (Serbia, Croatia, Bulgaria, Romania, Slovenia, Bosnia and Herzegovina, FYR Macedonia) and fertilizer production (Serbia, Croatia, Bulgaria, Romania) at production efficiency below EU average. Fertilizers are intended for domestic agriculture (that also consumes a significant proportion of liquid fuels) where yields per hectare are far below productivity levels seen in Western Europe (where the geographical and climate situation is less favorable for agriculture)[9] while liquid fuels (diesel) are more expensive than in competitive markets. Utilization rates of transport fleets remain minimal and this is especially the case for passenger cars. Liquid fuels are processed in refineries that are very small[10] and inefficient by international comparison.

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[4] As Black Sea and Central Asia economies turn into competition following disintegration of the Soviet Union and dismantlement of the planning and coordination system.

[5] The same applies to industries that are intensive in gas / petroleum related feedstock such as oil refining, fertilizers, petrochemical, etc.

[6] Western Balkans Energy Strategy and PECI (releases from before 2016) available at www.energy-community.org

[7] http://www.energy-community.org/portal/page/portal/ENC_HOME

[8] It is to be noted that the Energy Community Treaty (EnCT) does not contain any landmarks to control actual achievements of the EnCT material obligations that require longer periods of time. Furthermore, analyses of over 30 annual Progress Reports (critical instrument in the EU accession process) demonstrate that actual enforcement of the EnCT obligations have not been mentioned in any of these Reports within the Rule of Law section.

[9] And also, below yields that were considered standard in the Former Yugoslavia during the 1980s.

[10] A possible exception is the Burgas refinery in Bulgaria that is operated by LUKoil and may achieve a certain economy of scale.

Lignite is a critical source of electricity in Serbia, Kosovo, Bosnia and Herzegovina[11], Montenegro, FYR Macedonia, Greece, Bulgaria and Romania as well as Slovenia. In these countries lignite combustion provides 50 to 90% of domestic electricity generation. Lignite mines generally have low productivity, low utilization rates of major machinery and poor quality natural resources. Almost all countries (with the notable exception of Kosovo) are cross-subsidizing electricity from lignite with hydro power. In most countries, about 25% of electricity is used for domestic hot water heating.

Most of the population relies on fuel wood for space heating and cooking. A typical heating device has extraordinary low energy efficiency. That (together with unreliable district heating services) creates weather-related spikes in electricity demand causing massive reservation of valuable power generation assets and expensive build-up of energy stocks.

The environmental impact of energy industry in SEE is above EU averages in traditional pollutants (SO^2, NOx, dust) while carbon intensity remains very high.

3.1 Demand & Supply

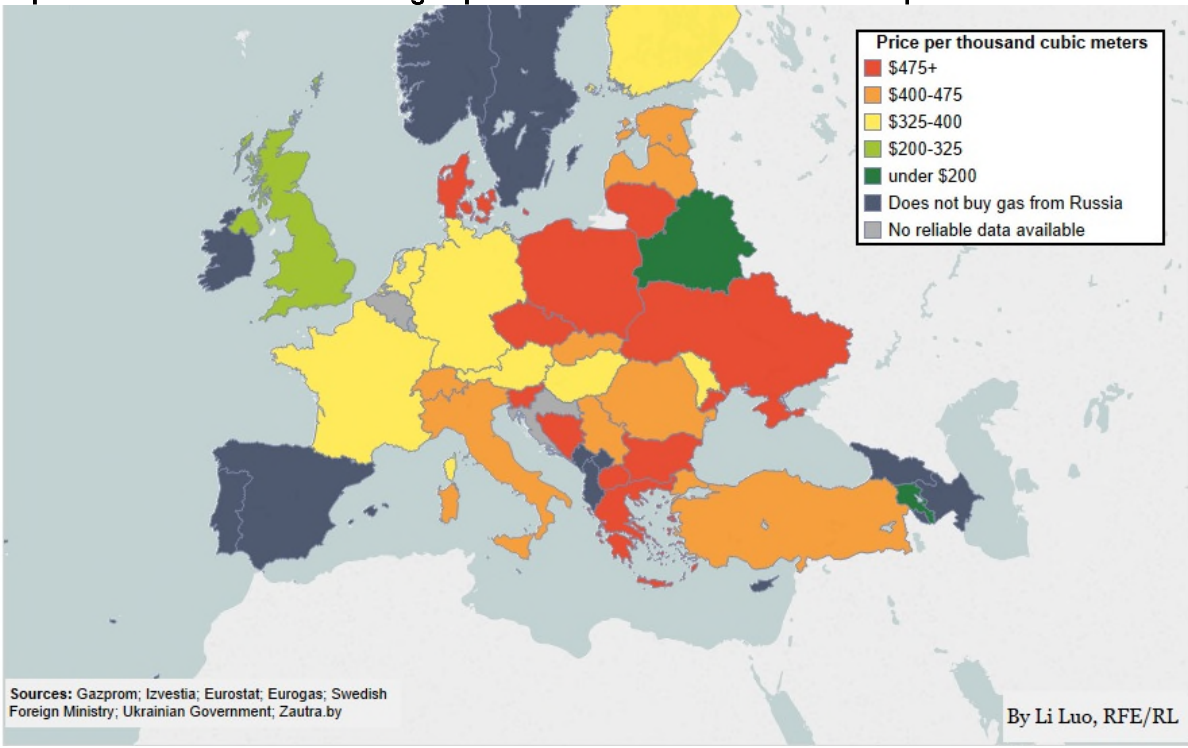
There are three distinguishing gas supply/demand patterns in South East Europe:

- Countries without gas infrastructure where gas consumption is negligible (Albania, Kosovo, Montenegro) and below 1% of Total Primary Energy Supply (TPES),
- Countries with developed gas infrastructure but small (if any) domestic gas production (Bosnia and Herzegovina, Bulgaria, Greece, FYR of Macedonia and Serbia) where gas accounts for 2-14% of TPES; and,
- Countries with considerable gas infrastructure and domestic gas production (Croatia, Romania) where gas supply is over 30% of TPES

Romania accounts for almost 80% of gas production in the region and Croatia produces more than it imports while Gazprom controls domestic production in Serbia. Almost all imported gas is Russian gas sourced from Gazprom. Map 3 indicates natural gas prices in the region in comparison with prices to Western Europe:

[11] Croatia is a net importer of electricity. Its imports provide a market for Bosnia and Herzegovina and Slovenia export potential. Therefore, Croatia security of supply remains associated with the lignite industry in the region.

Map 3: Estimates of the Russian gas prices to various countries in Europe in 2013[12]



Source: http://www.rferl.org/contentinfographics/gazprom-russia-gas-leverage-europe/25441983.html

Table 3 provides details on supply and demand in the region:

[12] There is no transparency on import gas prices to Croatia as the import operation was conducted via the private company PPD that conducted re-sale contracts with Gazprom. Cross subsidy between imported and domestic gas was made available to domestic customers.

Table 3: Natural gas supply and demand in 2013 per country

Energy (000 m3)**	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Greece	Kosovo*	FYR of Macedonia	Montenegro	Romania	Serbia	Total (000 m3)
Production	17842	0	274263	1845237	7105	0	0	0	10528316	517789	13190553
Minimal LNG imports[1]	0	0	0	0	0	0	0	0	0	0	0
Imports	0	199263	2724737	1262974	3959921	0	158763	0	1426500	1839895	11572053
Exports	0	0	0	-373895	0	0	0	0	0	0	-373895
Stock changes	0	0	-75684	59158	-5132	0	-105	0	35000	-72632	-59395
Domestic supply	**17842**	**199263**	**2923316**	**2793474**	**3961895**	**0**	**158658**	**0**	**11989816**	**2285053**	**24329316**
statistical differences	0	0	-31316	0	-25711	0	0	0	211658	0	154632
Transformation	**0**	**61763**	**1180316**	**811211**	**2410974**	**0**	**124868**	**0**	**3375526**	**886421**	**8851079**
Electricity plants	0	13947	2474	2684	2159263	0	0	0	810500	0	2988868
CHP plants	0	0	958789	638447	251711	0	90632	0	1896632	211395	4047605
Heat plants	0	47816	178579	85395	0	0	34237	0	563947	544053	1454026
Oil refineries	0	0	0	0	0	0	0	0	0	0	0
Other transformation	0	0	40474	84684	0	0	0	0	104447	130974	360579
Energy Industry own use	11000	0	32105	235921	20605	0	0	0	767816	155895	1223342
Losses	0	1000	13053	40447	0	0	737	0	158053	15921	229211
Final consumption	**6842**	**136500**	**1666526**	**1700632**	**1504605**	**0**	**33053**	**0**	**7900079**	**1226816**	**14175053**
Industry	6842	67763	930342	429500	657447	0	29658	0	2921368	867026	5909947
Transport	0	0	307026	1895	16421	0	158	0	3421	9237	338158
Residential	0	39842	55026	597789	284553	0	0	0	2992789	213026	4183026
Commercial and public services	0	0	95474	165921	152605	0	3237	0	960526	118474	1496237
Agriculture & Forestry	0	0	25053	20868	0	0	0	0	61237	19053	126211

Fishing	0	0	0	0	0	0	0	0	15553	0	15553
Other non-specified	0	28895	0	0	0	0	0	0	0	0	28895
Non- energy use	0	0	253605	484658	393579	0	0	0	945184	0	2077026
of which chemical /petrochemical	0	0	253605	484658	393579	0	0	0	945184	0*	2077026
Total consumption	**17842**	**199263**	**2892000**	**2788211**	**3936184**	**0**	**158658**	**0**	**12201474**	**2285053**	**24478684**

Source: IEA

* In 2013 Serbia produced 570122 tons of nitrogen fertilizers and 202 000 tonnes of ammonia using natural gas reforming technology. It is mostly likely that natural gas used for this purpose is covered in the energy statistics within industrial demand.

** Energy equivalent of natural gas is calculated at 38GJ (or 10.5556MWh) per 1000m^3 of natural gas. LNG based supply mix may have higher energy content and, therefore, lesser volumes than demonstrated hereby.

[1] Indicates minimal required LNG imports in the liquid form in order to supply specific demand including transport.

3.2 Sustainability of Demand

Gas demand in the SEE at current levels is not sustainable. It is not likely that the current level of demand can withstand competitive pressures from alternative forms of energy as discussed below. The majority of gas consumption is in residential heating in two forms: (1) district heating and (2) direct residential heating.

- District heating systems in the region are almost entirely supplied by heat-only-boilers (HoB) or combine heat and power (CHP) plants[13]. Both methods are considered as having low capital expenditure at source while heat distribution networks are equivalent. In many cases, CHP plants are steam cycle plants with limited efficiency of gas-to-power conversion. Taking into account weather patterns in this region and a decrease in conversion efficiency[14] at partial loads, HoB plants are built with more than one boiler in cascade arrangements. Winter temperatures are volatile within a very large range from as low as the minus 20s to the plus 20s °C. As a consequence, equivalent hourly utilization of district heating assets remains limited – well below 1,000 hours per year. That implies a very high cost of district heating per unit of energy[15].
- Residential heating using gas is arranged with fairly low efficiency direct combustion devices and heat-only-boilers. Most of the installations date from the 1980s and reflect efficiency standards from that time. These installations are intended to serve variable demand with little heat accumulation. Partial loads and direct exhaust indicate fairly low conversion efficiency.
- All low temperature gas–to-heat applications are exposed to the competition of locally available fuelwood, waste heat from industrial (and power generation) facilities, ambient heat pumps and geothermal heat. There is already pressure from customers looking to disconnect from district heating networks and customers that are not able to afford adequate heat comfort[16].
- Consequently, gas demand is weather-sensitive well beyond the sensitivity patterns in other parts of Europe and utilization rates of gas infrastructure remain limited. Local gas companies use soft budget constraint opportunities to obtain funding for underground gas storage projects to support peak demand. However, this support is expensive and not affordable[17] by local customers[18] and district heating companies.

[13] Some of these plants are steam cycle only (CHP Novi Sad and CHP Zrenjanin in Serbia) while most of the plants are fairly outdated combined cycle solutions with suboptimal efficiency.

[14] Most of the district heating and gas heating professionals in the region reference direct gas-to-heat conversion efficiencies at maximal loads to justify investments in these installations. However, real efficiencies at partial loads are more accurate estimate of actual (First Law of Thermodynamics) efficiency. Second Law of Thermodynamics losses in quality of energy or exergy are mostly neglected. These opportunity costs imply that heat prices have to reflect lost revenues from avoided electricity generation from natural gas. It is to be considered that electricity is at least four times more valuable product that implies value destruction of 2.7 times value of consumed gas.

[15] Buildings connected to district heating in former Yugoslavia are usually not supplied with gas distribution and there is no intensive variable ventilation of properties that result from typical arrangements in the former Soviet Union and occasionally elsewhere in Central Europe. However, ventilation standards still allow weather dependent ventilation that undermines efficiency of space heating arrangements with district heating. Therefore, inefficiency is not as intensive as demonstrated in the Annex 2 first column but may be very close to it during cold and somewhat windy periods.

[16] The standard prescription is installation of control valves and heat metering devices that allow customers to reduce comfort and switch off heat to some rooms and reduce living space during cold periods. Although, this strategy may work in individual houses it causes adverse consequences if applied to standard socialist style panel buildings where heat installations are designed to heat a building as a common thermal body and use the thermal storage potential of the building itself. That increases volatility of demand and creates further variability of load that decreases boiler conversion efficiency.

[17] Customers that are more affluent are typically able to afford more energy efficient buildings and acquire superior heating services using heat pumps or other choices. Countries from the former Yugoslavia have a strong engineering legacy and the market is very well supplied with all internationally known heat pump vendors. Anecdotal evidence suggests that exhibition areas at gas conferences in the region are mostly populated by heat pump vendors and service providers. Further evidence demonstrates that new gas distribution investments sponsored by the Serbia National Investment Plan remain unsubscribed and dormant.

- Heat-only-boiler (HoB) plants are vulnerable to competition with waste heat[19], geothermal or biomass energy[20].

A significant share of industrial gas demand is attributed to fertilizer plants in Romania, Bulgaria, Serbia and Croatia. These plants are exposed to strong international competition[21] and/or government protection or subsidy. Gas demand in oil refineries is motivated by compliance to the EU fuel standards (EURO 5) and reforming of natural gas to supply hydro desulphurization (HDS) units. Following their strategic (or political) alignment refineries are predominantly using relatively heavy crude while lacking (economically viable) complexity and economy of scale of modern oil refineries.

Comparing Table 3 (Natural gas supply and demand in 2013 per country) and Table 12 bellow (Projected natural gas supply and demand in 2025 per country) demonstrates the size and scope of current demand destruction potential and the formation of entirely new demand patterns.

3.2.1 Gas market frontiers: Cities of Sarajevo and Nis

Sarajevo (Bosnia and Herzegovina) and Nis (Serbia) are cities populated with somewhat less than half a million people each and located at the end of a gas pipeline system flowing from Hungary through Serbia toward these two centres of demand. Both are supplied by large scale district heating systems fueled by natural gas. Both cities were large industrial centres before the beginning of 1990s.

In 1976 the World Bank considered investment in gas supply infrastructure to the City of Sarajevo[22] in order to moderate excessive air pollution in the narrow and windless valley of the Miljacka River located at over 500m altitude and prone to low winter temperatures. After the 1990s war and heavy damage to infrastructure, gas supply was restored[23]. During the January 2009 gas supply crisis, the city was exposed to the risk of losing its heat supply and the EU/EnCT emergency supply mechanism was enacted to moderate this difficult situation. Its gas consumption during the crisis period was several times beyond its winter demand despite severe demand shedding and following its weather sensitivity patterns.

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[18] It is interesting to indicate residential customers that are using fuel wood as their main fuel and supplementing with electricity. Their fuel wood use is arranged with direct air vented light heating/cooking stoves with very low efficiency. They are forced to consume excessive volumes of fuel wood and exposed to indoor pollution and health risks. Their consumption patterns are accounted as renewable energy consumption in national energy statistics. That creates perverse initiative in governments to preserve these inefficient patterns and avoid energy efficiency improvements in this sector in order to preserve the level of renewable energy use in the context of their renewable energy obligations in the EnCT. Low efficiency of fuel wood use prompts gas market analyses such as https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3758164/192E17AC7BED4BDEE053C92FA8C0D198.PDF to identify opportunities for dispersion of gas distribution infrastructure. It is to be considered that even if the low income population is able to invest, it is going rather to invest in very efficient wood stoves and use locally available fuel than in gas connection and appliances. The failure of public policy to provide people with efficient choices and maintain appropriate forestation cannot be considered as genuine justification to invest in gas distribution services.

[19] The following publication demonstrates an opportunity to convert the largest DH system in the region (Belgrade DH with almost 40% of total DH capacity in Western Balkans): https://www.unece.org/fileadmin/DAM/ie/se/pdfs/cmm/sess7dec/cct/Kovacevic_BiomassCo-Firing.pdf

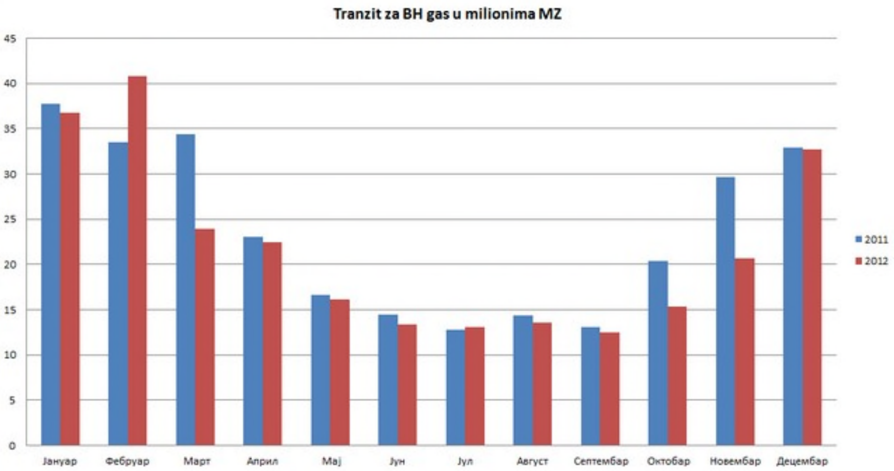
[20] In 2011-2012 USAID sponsored a feasibility study on conversion of 15 small and medium size DH systems from natural gas, coal and HFO to biomass of geothermal heat. Results indicate IRR nearing 20%. The World Bank study from 2010 (https://www.energy-community.org/pls/portal/docs/664179.PDF) demonstrates massive potential to convert entire DH capacity to renewable energy in various forms with positive returns and even without subsidies.

[21] The Black Sea region is considered among the largest fertilizer markets in the World with more competition envisaged if Azerbaijan materializes plans for further production capacity. Transport of fertilizers to the Danube area is to be expected as soon as the river becomes regularly open for river-to-sea shipping.

[22] http://documents.worldbank.org/curated/en/1976/05/734673/yugoslavia-sarajevo-air-pollution-control-project

[23] http://www.worldbank.org/projects/P044391/emergency-natural-gas-system-reconstruction-project?lang=en

Figure 2: Monthly gas transit from Serbia to Bosnia and Herzegovina[24]



Source: SerbiaGas (http://www.srbijagas.com/o-preduzecu/delatnost/transport/tranzit-prirodnog-gasa-kroz-srbiju.66.html)

Following the increase in gas and gas transit prices in recent years, residents of Sarajevo shifted away from gas and gas-fired district heating toward fuel wood and local lignite. The population density in Sarajevo today is well above the density during the 1970s when the problem was identified and solved. During the last few winters the city effectively returned to pollution levels[25] of the period before the introduction of natural gas infrastructure.

In 1996 the Government of Serbia granted gas pipeline development rights to the Gazprom subsidiary in Serbia – YugoRosGas – to extend the gas pipeline from Batocina in central Serbia to Nis and beyond to the Bulgarian border. That prevented third parties form accessing the same route and eventually build adequate infrastructure. A consortium of Serbian companies took an obligation to obtain permits, acquire land rights, build a pipeline and hand it to a JV Company. The size of the pipeline was adjusted to financial capacity and access to pipes at the time of the Yugoslavia conflicts and sanctions. It was not considered as a major transit link between Central Europe and Turkey/Greece. Conversion of the City of Nis district heating system became a critical anchor load for the project. At that time the import of oil products was limited by Serbian legislation and heavy fuel oil was priced above the Mediterranean market[26]. Nevertheless, only 5% of private consumers were actually connected to the gas grid. Nis District heating company found itself between a gas fuel option (supplied by Gazprom via its subsidiary in Serbia, YugoRosGas) and a heavy fuel option (supplied by Oil industry of Serbia majority owned by GazpromNeft). Both fuel options are available at extraordinary transport costs. This situation is accompanied by a further increase in complexity of district heating infrastructure and metering. It sparked protests from district heating consumers and a massive increase in disconnection requests[27].

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[24] Figures include gas supply to industry in Zvornik on the Serbia–Bosnia border and steel works in Zenica that are not season-sensitive.

[25] http://www.euronews.com/2015/12/28/sarajevo-smog-as-air-pollution-takes-its-toll/ ; http://www.bosniatoday.ba/sarajevo-air-pollution-alert-issued-again/ ; http://www.dailymail.co.uk/wires/ap/article-3372061/Bosnia-Sarajevo-schools-close-pollution.html ; http://www.cbc.ca/news/world/smog-air-pollution-cities-1.3383313

[26] http://www.politika.rs/scc/clanak/121402/%D0%A2%D0%BE%D0%BF%D0%BB%D0%B0%D0%BD%D0%B5-%D0%B1%D0%B8-%D1%83%D0%B2%D0%BE%D0%B7%D0%BD%D0%B8-%D0%BC%D0%B0%D0%B7%D1%83%D1%82 Chairman of Association of private oil traders claims 100USD per ton price difference.

[27] http://www.politika.rs/scc/clanak/332407/%D0%9D%D0%B8%D1%88%D0%BB%D0%B8%D1%98%D0%B5-%D0%BF%D1%80%D0%BE%D1%82%D0%B5%D1%81%D1%82%D0%BE%D0%B2%D0%B0%D0%BB%D0%B5-%D0%B8%D1%81%D0%BF%D1%80%D0%B5%D0%B4-%D1%82%D0%BE%D0%BF%D0%BB%D0%B0%D0%BD%D0%B5

3.3 Security of Supply

As a consequence of inadequate diversification of supply and poor efficiency in energy use in sectors that are critical for the wellbeing of population (district heating, fertilizers, food processing), this region remains exposed to external shocks. Its energy security is inadequate while measures to maintain security of supply are modest and extraordinarily expensive. Governments have failed to introduce policies (energy efficiency, weatherization, renewable energy) to eradicate energy poverty and moderate weather-related electricity (and gas) demand spikes. The typical policy response is the addition of capacity and the further decrease of capacity utilization rates. The most striking example is the reservation of the massive hydro power accumulation to cover winter power demand peaks (caused mostly by inefficiency and poor reliability of heating options[28]) that causes massive opportunity costs of using these resources for the wider European market. That also deprives Europe of a critical flexibility resource to enhance renewable energy use.

Security of gas supply depends on security of supply contracts and eventual diversion of gas supply to priority costumers. For example, the Belgrade district heating system in Serbia is considered a priority customer of utmost importance to the owners of the gas transmission system in Serbia (Government of Serbia). During the period of peak demand, it is likely that some industrial customers will be deprived of supply.

Following the Russia – Ukraine gas crisis of 2009 and more recent conflicts in Ukraine as well as tensions between the EU and the Russian Federation, several studies on vulnerability in the event of disruption of gas supply via the Ukraine route have been published. Almost all studies focus on supply routes and take gas demand/consumption as given. In most cases gas demand is even considered independently from the rest of energy supply structure in a particular country. In most analyses, South Eastern Europe is identified as the most vulnerable territory in Europe. ENTSO-G data that are used in most of these analyses does not take into consideration the nature, sustainability and efficiency of gas demand[29]. The assumption is made that gas demand is the result of genuine commercial development and is economically justified. Unfortunately, that is not the case in South Eastern Europe where demand is historically built upon political priorities.

To make the case more interesting, the on-going economic crisis tends to reduce industrial gas demand and preserve subsidized non-commercial demand. That makes relative weather sensitivity of demand even more difficult and effectively decreases infrastructure utilization rates. The market is undersupplied with underground gas storage (UGS) capacity.

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[28] In various residential energy use surveys, district heating customers indicate that they routinely maintain alternative electrical heating devices to cope with service failures and use these devices to improve comfort.

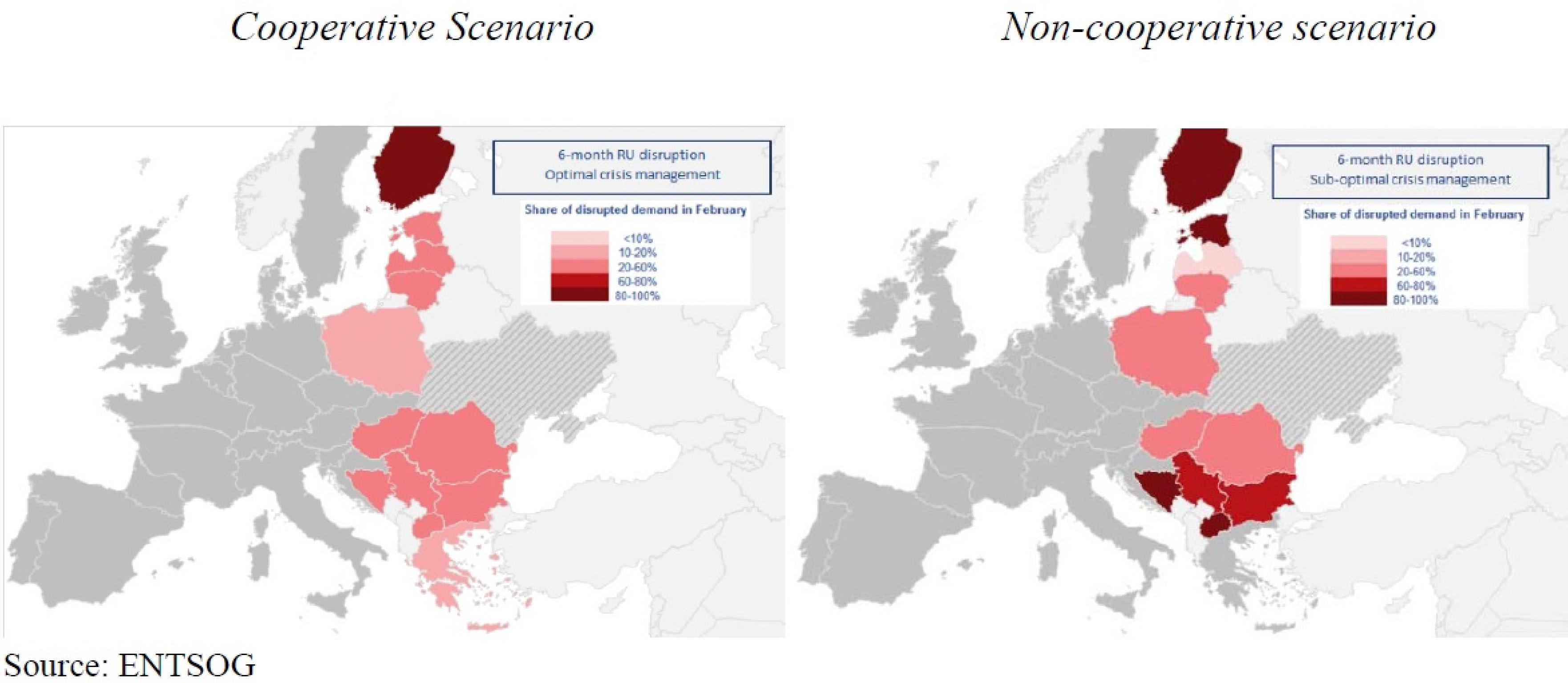
[29] The critical importance of energy efficiency was evident during the gas supply crisis in January 2009: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG17-ThePotentialContributionofNaturalGasToSustainableDevelopmentinSoutheasternEurope-AleksanderKovacevic-2007.pdf

Map 4: Gas and oil transport infrastructure in the SEE[30]

Source: Author compilation using various ENTSO-G, EnCT and Gazprom map

[30] Map 4 takes into consideration infrastructure that is built or where funding is already envisaged from private or public sources.

Map 5: Sample of security of supply analyses[31]



Source: https://ec.europa.eu/energy/sites/ener/files/documents/2014_stresstests_com_en.pdf, page 6.

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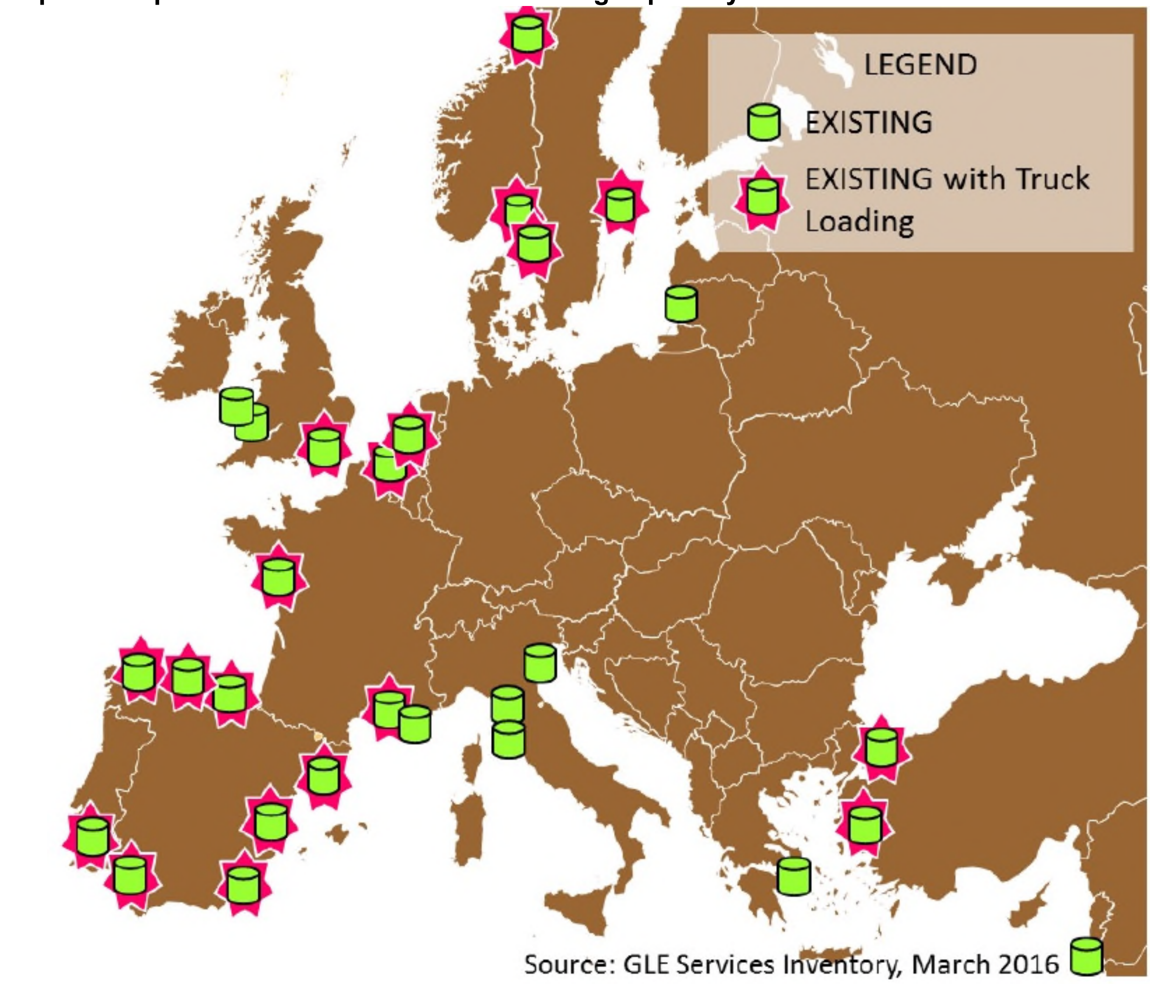
[31] ENTSO-G Maps of likely supply interruptions – before further national measures – in February at the end of the 6-month Russian gas supply disruption scenario in cooperative and non-cooperative scenarios under average winter conditions demonstrate geographical spread of supply problems. More intensive darker shading indicates higher share of disrupted demand with the darkest color indicating 80-100% of demand disrupted.

Industrial customers in the SEE are not provided with many options in the case of gas supply interruption. This region is not served by any LNG terminal with truck, container or rail loading capability. The Marmara Ereglisi terminal in Turkey has[32] modest truck loading capacity of 3x75 cm/hour that is most likely consumed in the domestic market. The density of small scale LNG infrastructure in SEE territory is minimal[33].

The eventual development of a small scale LNG supply chain is also constrained by the lack of re-loading capability at adjacent LNG terminals in the Adriatic and Mediterranean as well as a lack of LNG infrastructure in the Black Sea. Commitment to sizeable LNG re-gas capacity that may facilitate investment in competitive infrastructure seems to be a distant option as it depends on the sustainability of demand and eventual price competition from the incumbent supplier.

Map 6: Europe LNG terminals with truck loading capability

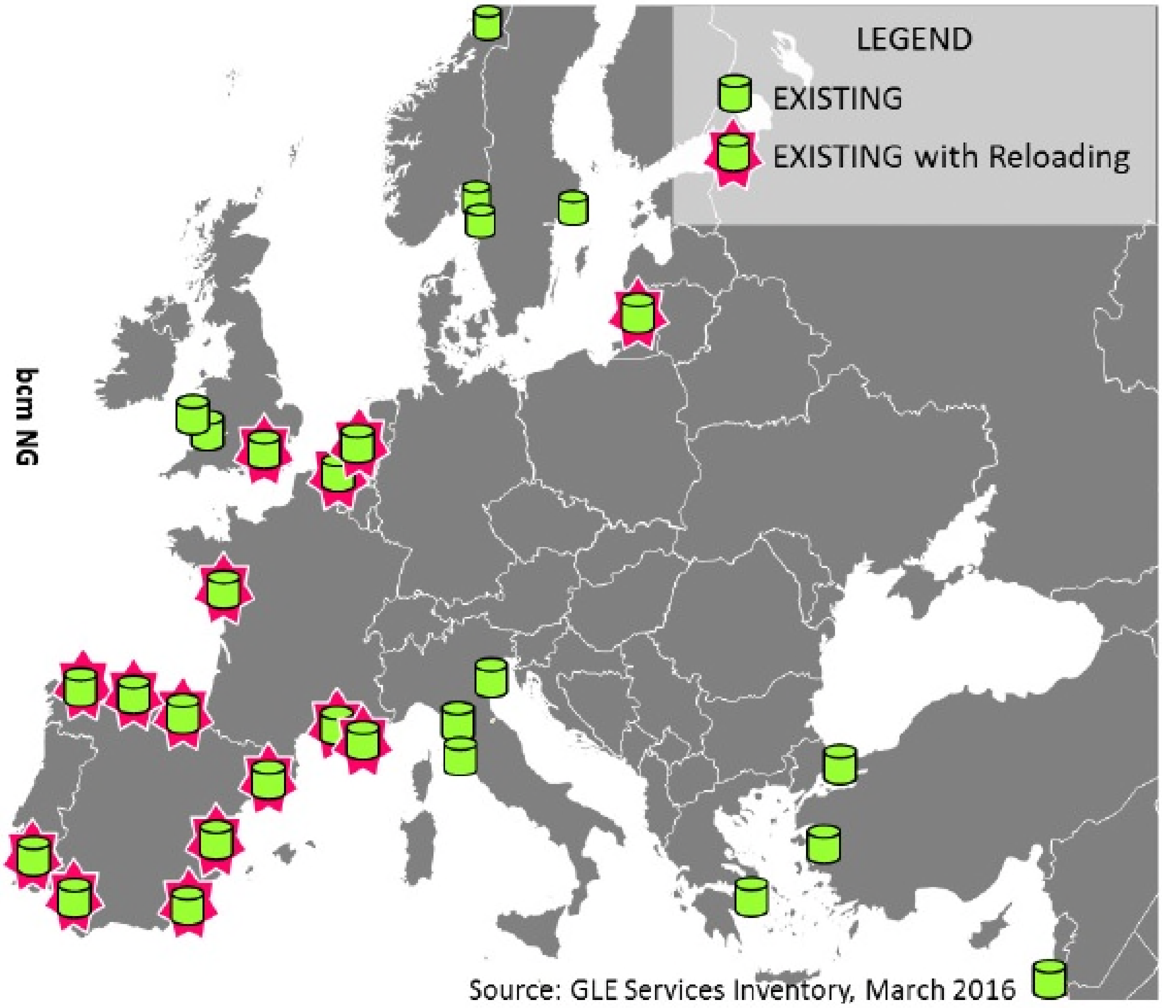


Source: Enriquez, 2015

[32] Louis. I Parada, "Best Practice Policy Guidelines for Small Scale LNG; Truck Loading", presentation, Group of Experts on Gas, UNECE, Geneva, April 22, 2016. Same presentation indicates LNG truck loads delivered from Barcelona LNG terminal (Spain) all the way to Serbia.

[33] Small Scale LNG Map 2015, GIE (http://www.gie.eu/download/maps/2015/GIE_SSLNG_2015_A0_1189x841_FULL_wINFOGRAPHICS_FINAL.pdf)

Map 7: Europe LNG terminals with re-loading capability



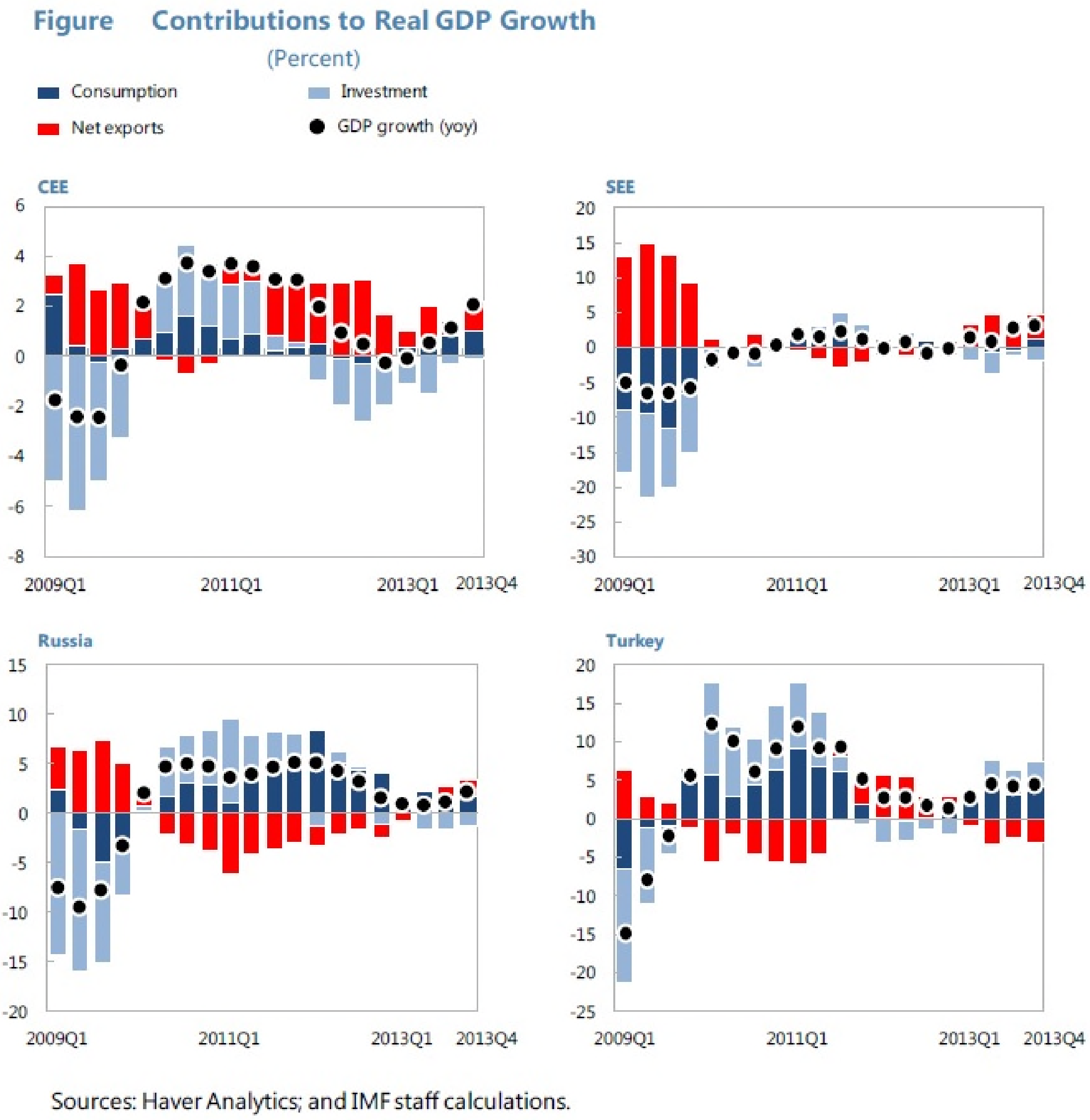
Source: Enriquez, 2015

It is to be considered that those most affected by insecure gas supply are actually the least commercially sustainable gas uses: district heating, residential heating and fertilizer production. These consumers require a comprehensive system of subsidies to remain in operation. Subsidies provided by cross subsidy with domestic gas production and by soft credit from incumbent gas supplier seem to be indispensable. As domestic gas production in Croatia and Serbia declines, these countries will grow more dependent on soft credit from incumbent suppliers if they aim to retain unsustainable gas uses.

3.4 Economic Crisis

Following the economic crisis in 2008/2009 countries in SEE lost real GDP growth:

Figure 3: Contributions to real GDP growth



Source: compiled from IMF, (https://www.imf.org/external/pubs/ft/reo/2014/eur/eng/pdf/ereo0414.pdf) page 6.

Major sources of growth (FDI and foreign financing of trade deficits) have reversed as a consequence of the crisis while new sources of growth have not emerged. Countries are forced to re-finance their outstanding debts mostly by Euro Area (EA) cross border loans to their general governments[34].

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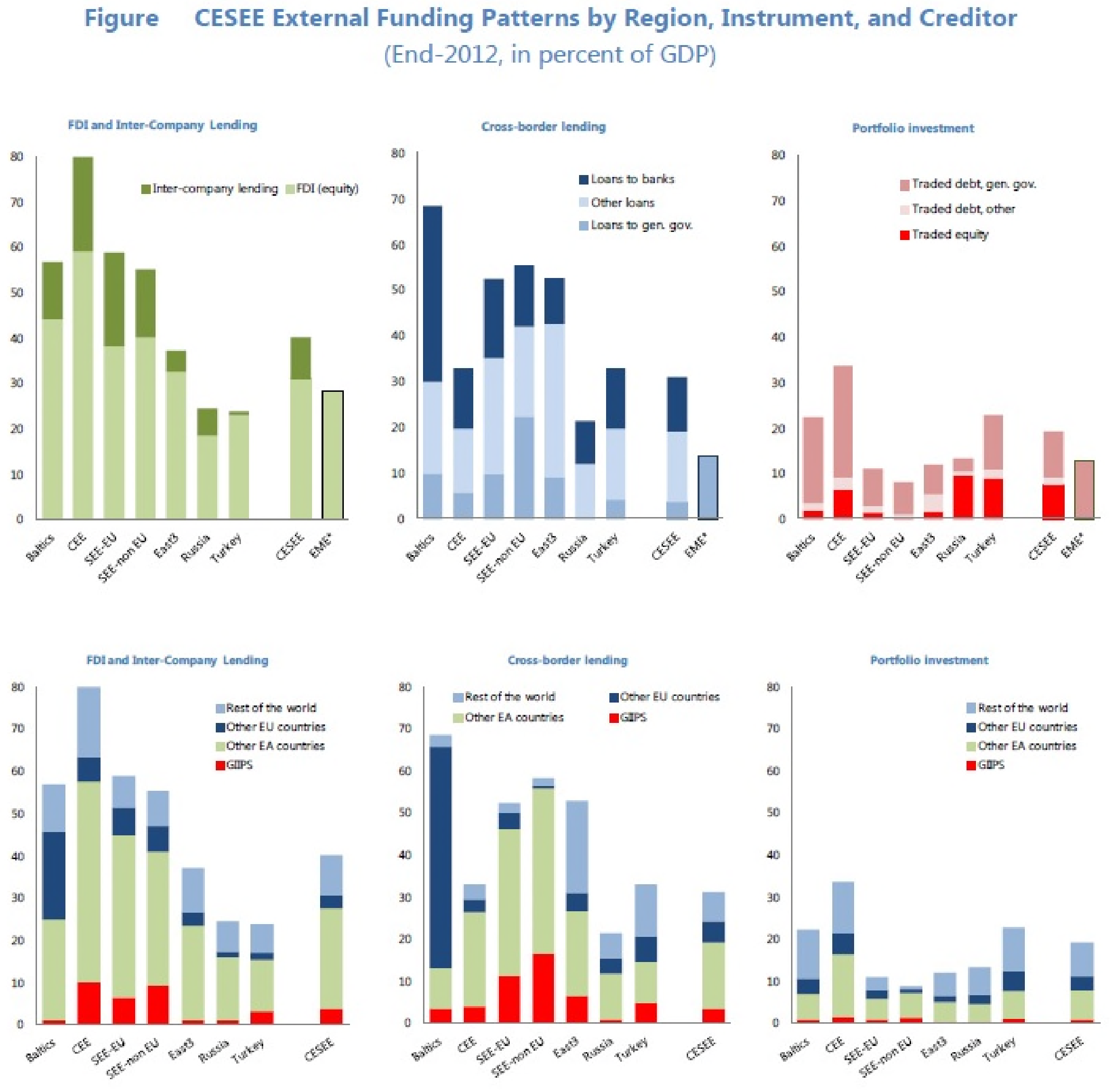
[34] That in particular includes loans from Greece and Italy - part of GIIPS (Greece, Italy, Ireland, Portugal and Spain).

Figure 4: CESEE External funding patterns by region, instrument and creditor

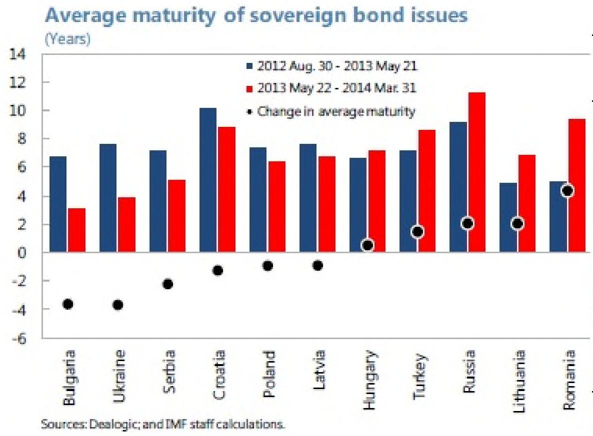


Source: IMF (https://www.imf.org/external/pubs/ft/reo/2014/eur/eng/pdf/ereo0414.pdf), page 16.

General government financing needs displace the commercial economy from the financial market and turn Governments into the main commercial players overall. Regional Governments also typically launch large privatization programs that may – in the near future – include their energy assets[35]. Governments are also open to ANY external investment that increases the inflow of foreign currency and strengthens exchange rates. Note that outstanding loans are mostly denominated in foreign currency.

[35] There is very little consideration of the rapid deterioration of the value of main energy assets: oil refineries, lignite-fired power plants or district heating installations that results from changes in technology or international competitive pressures.

Figure 5: Maturity and currency denomination of sovereign bond issues



Currency of Denomination

	Period 1		Period 2		Change in the share of non-local currencies
	Local	Non local	Local	Non local	
Bulgaria	86	14	97	3	-12
Croatia	0	100	32	68	-32
Hungary	47	53	55	45	-8
Latvia	11	89	8	92	2
Lithuania	37	63	50	50	-13
Poland	77	23	76	24	1
Romania	60	40	53	47	7
Russia	100	0	34	66	66
Serbia	0	100	0	100	0
Turkey	88	12	69	31	18
Ukraine	40	60	62	38	-22
Montenegro	n.a.	n.a.	0	100	n.a.
Average	49	51	54	46	1

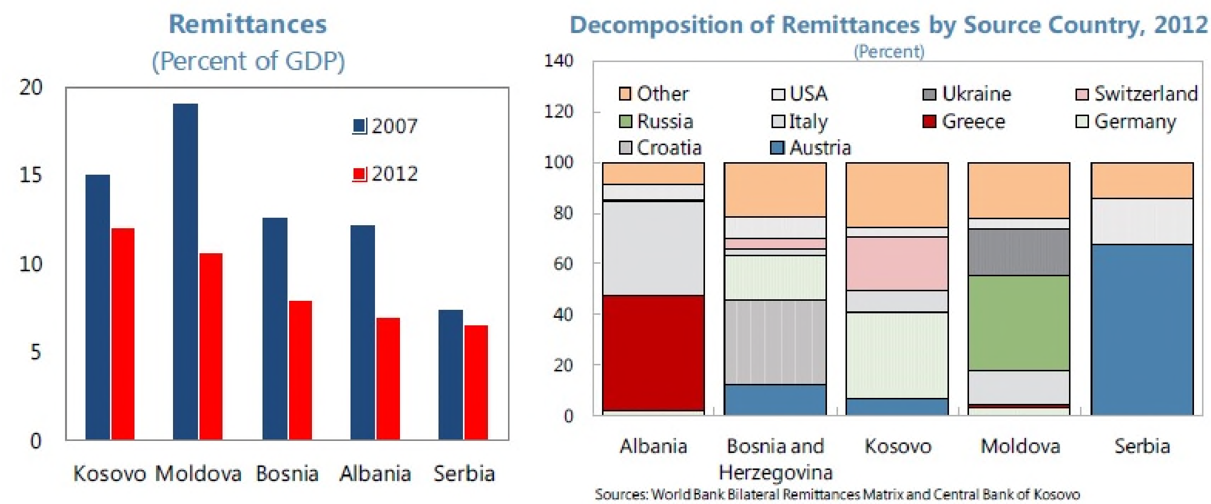
Sources: Dealogic; and IMF staff calculations.

Note: Period 1 = 2012 Aug. 30 – 013 May 21
Period 2 = 2013 May 22 – 2014 Mar. 31

Source: IMF (https://www.imf.org/external/pubs/ft/reo/2014/eur/eng/pdf/ereo0414.pdf) page 59.

… while remittances[36] are dependent on the economic situation in host countries:

Figure 6: Remittances as share of GDP and by source country



Source: IMF, (https://www.imf.org/external/pubs/ft/reo/2014/eur/eng/pdf/ereo0414.pdf) page 48.

Following the increase in transit capacity of the Suez channel and the development of massive commodity industries (aluminium in Saudi Arabia and Arab Emirates, oil refineries, fertilizers, LNG, steel, etc), the inflow of containerized industrial goods from India and the Far East has increased[37] threating industrial output and current employment in CESEE. As a consequence, the region is not only affected by the financial crisis but is also approaching massive change in its competitive position

[36] Note strong dependency of remittances to Serbia on Austria and to Albania on Greece.

[37] CNOC of China acquired the right to build and operate a container terminal in the Port of Patras and first container trains start approaching CESEE demand centres. Similar investments are on the way to ports in Croatia, Greece and Montenegro.

and, most likely, a massive shift in its industrial and employment structure. Consequently, the economic crisis is accompanied by a long term trend that changes industrial structure and that affects industrial gas demand.

The synthetic outcome of the decline in remittances, the decrease in employment and salaries, low energy efficiency and high costs of fuels, is energy poverty: most of the population spends over 10% of disposable income on energy services: to procure fuel, mitigate inadequate security of supply and cope with environmental pollution and health impacts. That limits domestic demand for other goods and services and creates a strain on GDP formation and fiscal revenues. It is increasingly difficult for SEE countries to cope with external shocks (climate events, floods, energy supply shocks, energy price shocks) and provide a subsidy to inefficient energy services and gas consumers including district heating systems and fertilizer producers.

3.4.1 Greece's energy mix and its economic crisis[38]

In 2013, Greece's GDP was 26% below that of 2007 (in 2010 prices and exchange rates), imports had dropped by more than 38%, exports by almost 12% and domestic investments by an astonishing 63% which combined with a decrease in private and public consumption of 25.6% and 19.3% respectively[39]. Greek infrastructure investments dropped by 2.4 percentage points of GDP during the period 2006-2012. Historically Greece had been achieving two units of additional GDP for every unit of investment in the country. The drop in investments caused a significant drop in GDP despite efforts to increase exports[40]. Most of its infrastructure development was financed by the Government (15-20%), EU funds (20%+), EIB and Banks (45-50%) and equity (10-15%)[41]. Material intensive investments in transport and energy cover 90% of Greek infrastructure investments. The decrease in investments caused, for example, a drop in domestic cement production of 52% (in 2013 in comparison with 2009)[42].

Facing the drop in domestic investment, Greece made efforts to boost exports but it seems that its export potential reached its maximum at about 32.5% of GDP – way below the EU average of 46.7%. Even with all possible efforts most of its export sectors performed below their respective 1998 levels. The export boost came from shipping services (double in export share) and export of mineral fuels and chemicals (that increased its share by over five times)[43]. That achievement came with the caveat: the unit price of crude oil, petrochemicals and shipping services decreased following developments in international markets. Taking into account the efficiency of oil refineries and shipping services in Greece (in comparison with modern international standards), that entails difficulties with terms of trade[44]. In other words, beside financial crisis, Greece is facing serious structural weaknesses regarding its competitiveness that cannot be covered by foreign loans for infrastructure investments. Looking at a list of projects compiled by PWC in 2014[45], it is obvious that these projects are not going to promote a turn-around in 'business–as–usual' toward long term sustainability. The largest infrastructure projects (gas pipelines, LNG terminals) are dependent on third parties and on highly uncertain demand in the European market. The largest on-going project is the Ptolemaida V lignite

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[38] 3.4.1 is a compilation based on: Kovacevic, A., Pagela P., "Adriatic and Ionian Region: Socio-Economic Analysis and Assessment of Transport and Energy Links", Study, European Parliament, December 2015

[39] Monokroussos, DR. Platon, "Greece – Greek shipping and its contribution to the domestic economy", Eurobank, January 2015, page 2.

[40] Price Waterhouse Coppers (PWC), Infrastructure in Greece report, December 2014.

[41] Ibid.

[42] Ibid.

[43] Monokroussos, DR. Platon, "Greece – Greek shipping and its contribution to the domestic economy", Eurobank, January 2015, page 6.

[44] We may also note the profound impact made by a stream of low-cost shipping services from Greece to the rest of Adriatic Ionian Region and strong competitive pressures it creates to ports, transport infrastructure and economic sectors in these countries.

[45] Presented at Price Waterhouse Coppers (PWC), Infrastructure in Greece report, December 2014.

fired power plant that is likely to lock-in carbon intensive power generation in Greece for decades and expose the country to serious risks. That plant is intended to replace some older and less efficient plants, which at first seems to be an improvement but the lock-in effect may well exceed the positive effects of better energy efficiency. Furthermore, Greece pledges to retain its remaining lignite power industry using “economic austerity” as an excuse. In Greece, total greenhouse gas emissions increased from 1990 to 2009 and somewhat decreased afterwards mostly due to economic slowdown[46]. The largest source of energy in Greece is imported crude oil (and oil products) that fuels most space heating and essential services in the Greek islands. It is not likely, that this economy will turn[47] to a sustainable development path without physical intervention in its power generation asset portfolio and its transportation assets. Such a change requires a considerable turnaround in national energy and transport policy that is not justified without support from the immediate neighborhood – the SEE[48].

4. Strategic competition

There are several aspects of strategic competition that interplay in the SEE gas market. The most critical strategic competition aspect is competition for demand in order to make use of fossil fuels within a climate change-constrained fossil fuel budget[49]. That directly impacts on the crude oil, natural gas, steam and coking coal submarkets as well as markets for energy-intensive goods such as fertilizers, aluminium, steel, agriculture products, etc.

The Russian Federation appears to be the largest exporter of crude oil, natural gas, steam and coking coal as well as fertilizers, steel and agriculture products to SEE. Taking into account the nature of state control over exports of crude oil and natural gas in the Russian Federation these two energy commodities are to be considered in concert as a form of Dixit–Stiglitz monopoly[50]. This complex monopoly position is exposed to international competition while it provides substantial benefits to the Russian economy[51]. Major competitors from the Middle-East[52] are now accompanied by growing competition from emerging and growing USA exports[53].

Low cost crude oil and natural gas supply to its domestic economy provide the Russian economy with competitive advantage in the export of fertilizers and grain. The Black Sea is the major international nitrogen fertilizers export hub. Its dominance over Ukraine[54] (as well as Romania and Bulgaria[55]) in

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[46] IEA, Energy Policy Review of Greece, 2011

[47] This approach complements other economic analyses such as: Schrader, Klaus; David Bencek; Claus-Fridrich Laaser, “Greece: How to Take a Turn for the Better”, Kiel Policy Brief 83, Kiel Institute for the World Economy, January 2015.

[48] For example, major deployment of the solar energy in Greece (that is likely competitive option) is going to be much easier and more compelling investment case if accompanied with major development of hydro pump storage potential in Western Balkans.

[49] See: Christophe McGlade & Paul Ekins, “The geographical distribution of fossil fuels unused when limiting global warming to 2C”, Research Letter, Nature, Volume 517, January 8, 2015

[50] A combination of lower fixed costs, higher marginal costs and more elastic demand for crude on one hand and higher fixed costs, lower marginal costs and less elastic demand for natural gas is described in Dixit A.K. and Stiglitz J.E., “Monopolistic Competition and Optimum Product Diversity” The American Economic Review, June 1977, p 297-308

[51] Recent presentation by Dr. Tatiana Mitrova, “The EU-Russia Energy Relations”, EU ENERGY LAW & POLICY, conference by CLAEYS-CASTEELS, Brussels, 9-10 FEB 2016; provides a comprehensive overview of the relative importance of the crude oil and natural gas exports for the Russian economy (slide 2) as well as evidence of the magnitude of Saudi competition with Russian oil in Central Europe (slide 3).

[52] http://oilprice.com/Energy/Crude-Oil/Saudis-Planning-For-A-War-Of-Attrition-In-Europe-With-Russias-Oil-Industry.html ; http://www.bloombergview.com/articles/2015-10-16/saudi-arabia-s-oil-war-with-russia

[53] http://www.api.org/news-policy-and-issues/us-crude-oil-exports

[54] Although Ukraine was able recently to arrange some gas imports from alternative sources (to cover its most urgent needs), these imports are small in volume and far from the price competitiveness that may allow Ukraine fertilizer and grain markets to rebound.

gas supply has allowed Russia to emerge as a leading exporter of both fertilizers and cereals[56] both in the Black Sea area and internationally.

Russian natural gas pipeline exports are further exposed to competition from growing LNG markets. LNG becomes competitive with pipeline gas at distances of about 2,000km (1,258 miles), which makes most Russian gas exports to Central Europe vulnerable to LNG competition[57] if and when the cost of LNG technology decreases further. The following table demonstrates the distances of some major ports in Europe from major export regions:

Table 4: Distances of LNG import terminals from selected LNG export ports

Export ports:	Corpus Christi (USA)		Qatar	
Import terminals:	Nautical miles	days	Nautical miles	days
Swinojusce (Poland)	6445	15.0	8101	18.8
Amsterdam (Netherlands)	6179	14.3	7254	16.8
Rijeka (Croatia)	7330	17.0	4966	11.5
Istanbul (Turkey)	7629	17.7	4493	10.4

Source: Author calculation based on http://ports.com/

Not only is LNG technology becoming cheaper[58] but its geographical coverage is also increasing following advances in floating LNG technology, which provides opportunities to deploy floating LNG production to places where large scale land-based liquefaction plants may be uneconomical or too risky. The distances from the SEE to likely sites for Floating LNG (FLNG) installations are minimal: the Black Sea and the North Eastern Mediterranean are among the attractive FLNG locations in proximity to SE Europe[59].

Sales of crude oil, petroleum products and natural gas into Central Europe are exposed to risks of market decline in the case where these markets are exposed to competition in energy intensive goods or lower employment. This applies to growing market penetration from Far East (China, South Korea), India and other markets via SEE ports to Central European markets.

The critical strategic impediment to external competition to comprehensive Russian economic interests in the Central Europe is the use of available transport infrastructure in South Eastern Europe and the eventual development of efficient new infrastructure. Assuming the multitude of possible infrastructure investments, availability of investment funds[60] and variety of existing infrastructure, the only way to influence both the use of existing and emergence of new infrastructure is to impact the

[55] Gas supply dominance over Croatia and Serbia is combined with fertilizer exports along the Danube to dominate these markets and extend control over the local agriculture sector. Dominance is further strengthened by GazpromNeft control over oil and gas production, refining and retailing in Serbia, its growth into the Bosnia, Kosovo, and Romania markets, cooperation with Zarubezhneft in Bosnia and the strong entry of SberBank of Russia into food retail markets in Serbia, Bosnia, Croatia and Slovenia.

[56] http://apps.fas.usda.gov/psdonline/circulars/grain.pdf, http://www.ibtimes.com/international-wheat-market-russia-set-become-largest-exporter-crop-us-farmers-hurt-2297010

[57] The shortest distance from Russia's gas sources to the export market is by way of the Nord Stream pipeline with 917km on shore and 1,222km off shore distances totalling 2,139km.

[58] See recent GOLAR LNG presentation (slide 9) at http://hugin.info/133076/R/1904990/677798.pdf

[59] https://store.rivieramm.com/ugc-1/1/14/0/planned_flng_projects_infographic.jpg ; http://www.osjonline.com/news/view,floating-lng-orders-overtake-fpso-orders_41486.htm

[60] Significant investment funds are made available to the Western Balkan countries through the Western Balkans Investment Framework that combines various international financial institutions and the EU. However, these funds are almost exclusively directed with the consent of host governments: http://www.wbif-ipf.eu/index.php?page_id=321. Chinese export credit funds are somewhat more flexible as these funds are accompanied by a private equity investment vehicle (http://cee-equity.com/) . However, the majority of available funding is conditioned by the host government consent and/or guarantee.

quality of governance[61]. Compared with gains from "no effective infrastructure in SEE" strategy, the eventual cost of maintaining pure quality of governance appears very reasonable[62]. To make the opportunity even more attractive, the majority of costs[63] may be offset by profits from commercial or upstream activities in the SEE itself. At the same time, the strategy has to provide for the maintenance (or even increase) in gas import dependency in target countries in order to maintain effectiveness of distribution of soft budget constraints using discrimination between gas consumers as a main mechanism.

The network of local subsidiaries and partners[64] that are directly or indirectly controlled and that also operate various cross border activities as well as a network of sponsorships, suppliers and partners further downstream as well as capacity to provide attractive employment opportunities to local elite, serves this strategic goal in a very cost effective way.

In conjunction with the traditional weaknesses of local governance structures enabling a soft budget constraint environment[65] and taking into account the relative size of energy activities within weak domestic economies as well as control over critical activities (such as district heating in a capital city or the only national fertilizer producer), these activities are to be considered as key ingredients for the persistent deficit of institutional capacity in these countries. The immediate consequence is an increase in barriers to entry for external (and potentially efficient) investors, an increase in sunk costs and risks as well as an increase in the Weighted Average Cost of Capital (WACC). Host governments are in control of domestic and foreign institutional investment resources that are, by definition, available at a lower cost of capital than various commercial sources of capital. It is relatively easy for Government sponsored project promoters to outpace commercial projects. Commercial projects are also exposed to uncertainty about the eventual implementation of Government sponsored projects that have obvious advantageous access to capital that is not necessarily accompanied by appropriate implementation capacity. Government sponsored projects are uncertain due to the lack of adequate implementation capacity as well and the uncertainty of political cycles.

[61] Well known theoretical framework indicates that misallocation of investments is inevitable feature of bad governance structure and not an incidental or occasional omission. See: James Robinson, Ragnar Torvik: White elephants, Journal of Public Economics, No 89, 2005, p. 197-210

[62] This is consistent with the Dewatripont, M., Roland G., "Soft budget constraint, transition and financial systems", ECARE, Universite Libre de Brussels and CEPR, September 1999

[63] http://foreignpolicy.com/2016/04/15/the-budding-autocrats-of-the-balkans-serbia-macedonia-montenegro/ ; http://www.euractiv.com/section/central-europe/news/bulgarian-gas-wars-uncover-hidden-gazprom-strategies/; http://www.euractiv.com/section/energy/linksdossier/the-energy-conundrum-in-bulgaria-and-greece/#ea-accordion-issues; http://www.euractiv.rs/english/8294-gas-sector-serbias-weak-point-on-eu-road; http://serbia-energy.eu/serbia-gas-holding-company-srbijagas-depths-becoming-public-dept-restructuring-process-expected-says-bajatovic-ceo/;

[64] See: Joseph Stiglitz: The Role Of Exclusive Territories In Producers' Competition, Working Paper No. 4618, National Bureau of Economic Research, Cambridge, January 1994

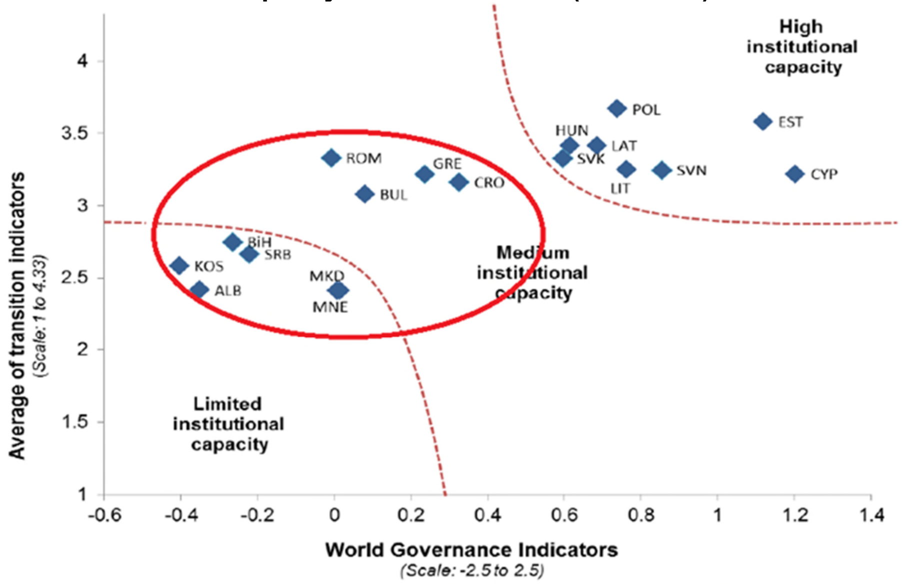
[65] Manipulation of overburden removal in open pit lignite mines and external costs of lignite use is another massive source of soft budget constraint capacity. It will be explored in more detail in the Chapter 5.2.

Table 5: Some Gazprom local partners and subsidiaries

Country	Gazprom investment or longer term partner	Activities of the company
Albania	n.a.	
Bosnia and Herzegovina	BH Gas	Gas import and trade
	Gas-RES	Gas infrastructure development
	Zarubezhneft of Russia	Oil refining and retail Upstream exploration with GazpromNeft of Serbia
Bulgaria	Topenergo	Gas trading and transport
	Overgas Inc. AD Owns : OVERGAS Engineering, Gastec BG,Vestitel BG and Overgas Capital AD	Holding company
	Overgas	Gas trading
Croatia	PPD	Gas re-sales, Trade in LPG,
	LNG Croatia	Cooperation contract on LNG / CNG retailing in Croatia
Greece	Prometheus Gas	Marketing and construction
	Unknown corporate entity	Tolling petroleum refining
Macedonia (FYR)	Makpetrol GAMA	Gas trade and transmission
	Sintez Group of Russia	Gas-to-power & District heating in the City of Skopje
Montenegro	n.a.	SerbiaGas present in LPG market
Kosovo*	unknown	GazpromNeft present in petroleum product retail market
Romania	WIEE Romania SRL	
	WIROM Gas S.A.	
	GazpromNeft of Serbia	Upstream exploration
Serbia	YugoRosGas	Gas transmission and distribution Exclusive gas import
	ProgresGasTrading	Trading
	NIS-GazpromNeft	Gas and oil upstream production Oil refining and retail, Tax collection
	RT Gas	Trading gas to industrial consumers, Bartering
	SerbiaGas	UGS JV company with GazProm Distribution of soft loans to gas consumers Partner in the JV company South Stream Serbia

Source: Author research

Figure 7: Institutional capacity of SEE Countries (2014 data)



Source: Authors' calculations, EBRD Assessment of Transition Challenges, and the World Bank's World Governance Indicators.

Source: Sanfey, et al. (EBRD, January2016)

Government involvement in project development imposes specific "obsolescence" risks on private developers. Once a private developer reveals its technical solutions in the public domain, that solution may be used or misused by government-sponsored developers to implement a competing project or to block the implementation of private intentions. Consequently, private developers are forced to obstruct public access to their special knowledge. Government-sponsored projects are based on publicly available and consequently "second best" knowledge. This serves incumbent suppliers very well as it prevents efficient commercial competition.

Governments tend to promote project solutions with exaggerated costs[66]. Both Governments and their international creditors tend to consider the short term impacts of project implementation on employment, GDP formation and on the appreciation[67] of domestic currency. Government is also in a position to offer a regulatory environment that accepts an actual (inflated) cost of capital to justify public subsidies for renewable energy projects or price regulation. It may relax environmental regulations to offset a higher cost of capital or higher-than-necessary investment costs. This provides an opportunity for "destructive entrepreneurship" in project promotion especially if external project costs are only visible in the future, such as climate change risks.

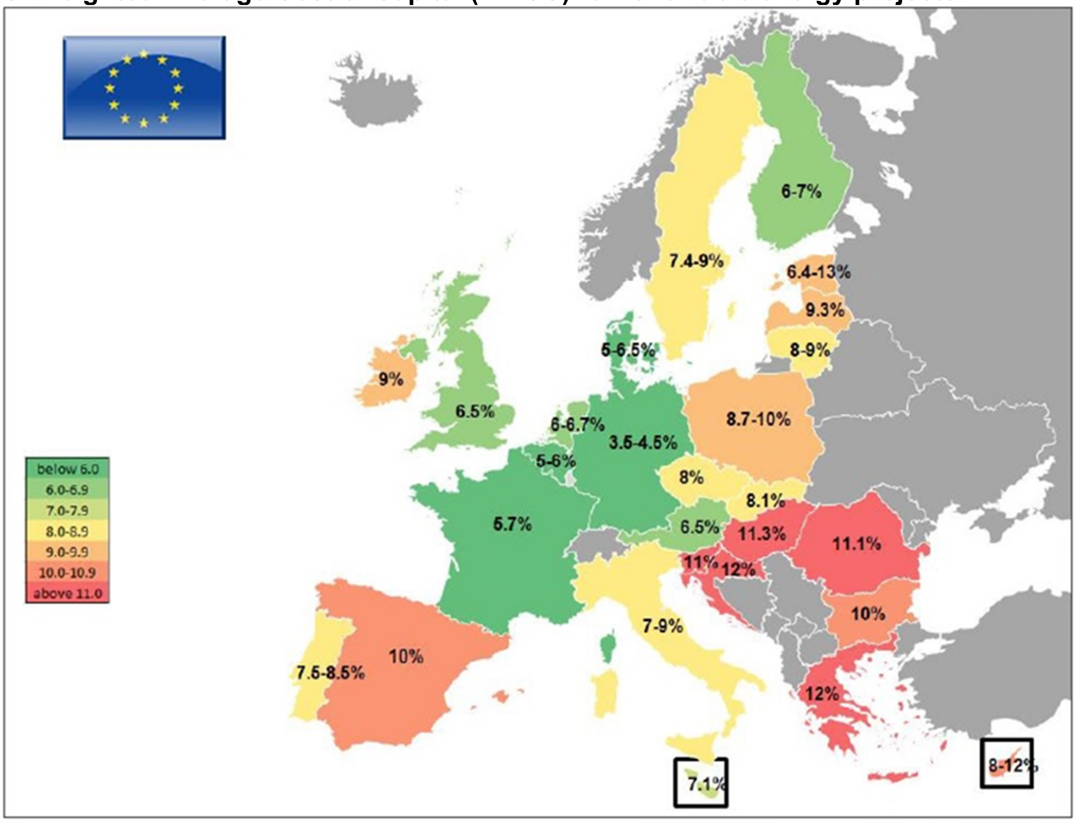
This situation provides an opportunity for the incumbent monopoly to exercise "normal" monopolistic behavior in the rest of Europe. As effective competition is constrained by means of increased political risks, bad governance patterns and inflated WACC that constrain use of transit infrastructure and

[66] The history of the extraordinarily expensive land-based LNG terminal on Krk Island in Croatia demonstrates a project bid designed to increase barriers to entry and sunk costs and serve the incumbent supplier while making a bid for large public investment. See: http://arhiva.portalnovosti.com/2012/05/e-on-pretekao-vladu-za-dvije-godine/

[67] If domestic currency is exposed to inflationary pressures due to soft budget constraint, currency appreciation due to inflow of foreign currency intended for infrastructure project implementation may be calibrated to maintain a stable nominal exchange rate. The eventual failure to manage that equilibrium increases currency risks while eventual successful management impacts dynamics of project implementation and physical uncertainty related to the particular project.

physical openness, price formation in geographically adjacent markets may support the maintenance of market share and maximising profits. Depending on the relative WACC, the incumbent player may threaten potential newcomers (competitors, investors in competing infrastructure) with its capability to react with downward price[68] adjustment that may make investments in competing infrastructure obsolete.

Map 8: Weighted Average Cost of Capital (WACC) for renewable energy projects



Source: DiaCORE Project (http://www.ecofys.com/files/files/diacore-2016-impact-of-risk-in-res-investments.pdf), page 2.

Taking into account the coordinated nature of the Dixit–Stiglitz monopoly framework the eventual successful competitive challenge should affect both monopolized commodity markets at the same time. This requires coordination that is not usual among commercial players. From another perspective, business community institutions[69] – if established - may successfully counteract corruption and bad governance.

This market structure is to be considered as an effective barrier to entry from Mediterranean markets into Central European gas hubs. Existence of this barrier prevents market entry for LNG and other gas intensive products as well as modern (cost competitive) gas technologies into Central Europe. This creates a deliberate distortion to oil products pricing that is used in long term gas contract (LTC)

[68] Various Russian authors note this capability. See for example: Anna Galkina, "Transformations of the European gas market and Russian gas export strategy", presentation, The Energy Research Institute of the Russian Academy of Sciences, Moscow, May 30, 2016 or https://www.oxfordenergy.org/wpcms/wp-content/uploads/2015/09/NG-102.pdf

[69] Dixit, A., "How Business Community Institutions Can Help Fight Corruption" Version of March 11, 2015 downloaded from the Author Web page.

oil indexation. It also deprives the European market of an effective means of balancing electricity markets and the deployment of renewable energy. In the absence of this barrier to entry, hub pricing is likely to prevail over LTCs[70] and become a far better mechanism to harmonize energy markets between gas and renewable energy.

4.1 EU Southern Corridor and North-South Axis

These two corridors form the core of the EU strategy to improve security of gas supply and facilitate market liberalization. Taking into account the distance to alternative sources of gas, it is considered that the North-South Axis is more interesting for the supply of gas from SEE to Central Europe than vice versa. It justifies the eventual development of a gas hub in the SEE by providing access to more developed gas markets in the Central Europe. However, the development of gas infrastructure in the Baltic Sea[71] competes with the eventual development of the Southern Corridor.

The Southern Corridor, however, is intended to deliver gas from various South East sources to Europe. This includes gas from the Caspian basin, the Levant, Iran, Iraq and from the Mediterranean LNG market. Most of these potential suppliers (Levant, Cyprus, Israel, Iran, Azerbaijan) may consider LNG trade options against pipeline supplies to Europe. The recent decrease in LNG technology costs and growth of LNG markets (in size, volumes, geographical coverage, liquidity) indicate that most exporters may prefer to export LNG.

The main component of the Southern Gas corridor is the TAP/TANAP[72] gas system, whose aim is to transport gas via Turkey to Europe. It is considered that TAP/TANAP will contribute to European security of supply once (and to the extent that) its overall capacity exceeds the capacity of Russian gas supply to Turkey. The general interruption of Russian gas supply to Europe is most likely to affect the supply to Turkey via Ukraine (and likely via Blue Stream), creating a shortage in the Turkish market beyond the capacity of Caspian supplies in the foreseeable future. However, TAP provides interesting trade and seasonal arbitration opportunities and is to be considered good value for money for exporters[73] and investors. However, the relatively narrow set of supply options limits the potential of this gas infrastructure to facilitate the development of a gas hub. The Southern Gas corridor remains predominantly a strategic infrastructure development compact intended to supply gas from the LNG (Mediterranean, Black Sea) market toward Central Europe. Its effective use is going to require the establishment of a specific gas hub in the SEE in order to optimize gas supply from various sources.

4.2 Gas Pipelines across the Black Sea?

South Stream (or Turkish Stream) is the most complex pipeline system planned for the region[74]. Strategic aspects of the South Stream project are provided in Map 9:

[70] This is an additional argument to the debate from 2013 on oil indexation in LTCs in favor of hub pricing. See: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/02/Hub-based-Pricing-in-Europe-A-Response-to-Sergei-Komlev-of-Gazprom-Export.pdf

[71] The North Stream gas pipeline with its extensions may increase available gas volumes at the Baltic Sea coast to well over 70bcm/year.

[72] http://www.tap-ag.com/

[73] Even in case of emergency gas may be sold to the Turkish market with a premium.

[74] Although White Stream (http://www.white-stream.com/) seems equally demanding in technical terms, it is much smaller in volume and strategic consequences and far less advanced toward implementation and financing while remaining equally vulnerable to competition from the cross-sea shipping option

Map 9: New gas pipeline options in Europe

Source: http://aea-al.org/lng-in-europe-an-overview-of-european-import-terminals-in-2015/

The South Stream Project undermined the potential economy of scale and standardization for the option to introduce a CNG (or new technology LNG) shipping market[75] in the Black Sea[76]. Consequently, South Stream will transit the Black Sea (in one or another way) and deliver gas to the Balkans. Its outcomes are going to be dependent on the market forces it will face in the Balkans. In its current design, the South Stream project, assumes "no trading market in the Balkans" with a desire to terminate at the existing Central European Gas Hub (CEGH) in Austria. However the possibility of a "trading market in the Balkans" option cannot be excluded.

4.3 Turkey gas corridor

The Turkey gas corridor[77] encompasses at least two supply options for the Balkans:

- Bi-directional flow between Turkey and Bulgaria[78]
- The TANAP – TAP pipeline system to deliver Azerbaijan gas to the Western Balkans and Italy[79]. TAP is accompanied by the Adriatic–Ionian pipeline intended to connect TAP in Albania with the existing (and developing) pipeline system in Croatia.

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[75] As indicated in NG17 (https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG17-ThePotentialContributionofNaturalGasToSustainableDevelopmentinSoutheasternEurope-AleksanderKovacevic-2007.pdf) and later by IEA, "Energy in the Western Balkans".

[76] At one time, president Putin requested comparative analyses of undersea pipeline and shipping options that were probably limited an LNG option. Although details of the comparative analyses are not known, the outcome – selection of the pipeline option – is known. Analysts obviously relied on information available in the public domain and were suspicious of the cooperative option (the only one to create appropriate economies of standardization) while Gazprom naturally chose the highest capex options. As a consequence, Gazprom stepped back from competitive market formation in the Black Sea (that had a potential to influence its domestic market) and took a high cost defensive position.

[77] See: Morena Skalamera, "The Russian Reality Check on Turkey's Gas Hub Hopes", Harvard Kennedy School, Belfer Center Policy Brief / January 2016

[78] http://www.mi.government.bg/en/themes/gas-interconnection-turkey-bulgaria-itb-913-347.html

[79] https://www.euractiv.com/section/energy/news/russia-can-use-trans-adriatic-pipeline-commission-confirms/

Both projects are sufficiently advanced and already at various stages of implementation. The governments of Albania, Montenegro, Bosnia and Croatia have already subscribed to the Adriatic–Ionian pipeline. SOCAR of Azerbaijan has acquired (or is attempting to acquire) a controlling stake in the Greek gas transmission company DESFA.

As Turkey is supplied with Russian gas (via Blue Stream and the Romania–Bulgaria corridor) and LNG (two receiving terminals) as well as pipeline gas from Iran, while storage options are limited, domestic consumers will choose and consume all gas that is offered at lower prices and decline more expensive gas.

4.4 East Mediterranean Gas

East Mediterranean (Levantine) gas production potential is likely to reach market beyond the time horizon of this paper (2025). Nevertheless, the existence and certainty of these gas resources already creates a strategic impact on infrastructure planning and investments in SEE. Various analyses from Greece indicate desires for long distance undersea pipeline infrastructure development to deliver gas from the Levant to Greece. Transit rent expectations have already developed and would be very welcome for Southern European countries in the context of the current economic crisis. However, more technical analyses indicate that future gas production from East Mediterranean offshore fields will most likely[80] flow toward the LNG market.

4.5 LNG options

LNG supply directly competes with pipeline gas at re-gas points and in sectors that are better served by LNG without immediate re-gasification such as transport or flexible power generation.

4.5.1 Black Sea and Danube

As CNG shipping options are overcome by small LNG technology development, small scale LNG emerges as an option for shipping gas across the Black Sea. That option is further enhanced by the recent advancements in small scale LNG technologies for liquefaction, shipping, and use. In addition to trade with Black Sea coastal markets, small scale LNG could use navigable rivers to access markets in Belgrade on the Danube or Kiev on the Dnieper[81].

Suitable shipping solutions are already available using self-propelled ships and articulated tug-and-barge arrangements. Such transport systems may deliver LNG (and other energy intensive products

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[80] See http://www.europeanenergyreview.eu/fcng-a-solution-to-unlock-the-full-potential-of-east-med-hydrocarbons/ . It is interesting to point out that Table 2 in this analysis overestimates FLNG costs to the level that makes that option uncompetitive with CNG and pipeline options. Author interviews with practitioners from the floating LNG industry confirm cost reductions that actually promote this option to the most competitive option. Taking into account similar distance to the market (1,100km) and similar volume estimates, as a Black Sea crossing from East to West coast, it seems that LNG emerges as the most competitive option for that purpose as well. The advantage increases with distance and standardization of vessels. It is to be considered that advances in LNG technologies (liquefaction, transport, storage) and shipping technologies (standardization, articulated tug-and-barge) favour LNG as the most competitive Black Sea crossing option providing similar structural benefits to those demonstrated by the map in Annex 3.

[81] This breakthrough in small scale LNG technologies strengthen the argument made in the previous analyses of SEE gas markets (https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG17-ThePotentialContributionofNaturalGasToSustainableDevelopmentinSoutheasternEurope-AleksanderKovacevic-2007.pdf) that the most effective gas transportation in the Black Sea area is actually shipping. As demand is getting more fragmented and more concentrated in urban centers with small density of demand across territory, shipping becomes more cost competitive versus pipelines that have to be built and maintained across vast territory with minimal demand along the route. This argument is further strengthened with experience of inflated pipeline cap-ex in Black Sea area in comparisons with international benchmarks. Investments into moveable assets (ships, floating terminals) inevitably remains within internationally comparable cap-ex range.

such as fertilizers) to (or from) ports such as Belgrade, Kiev, Rostov-on-Don, Baku, Batumi, Ruse, Bucharest, etc. With appropriate level of fleet standardization and reasonable volumes, transport costs may be comparable to open sea shipping. Available modern shipping standards are far more efficient than the traditional river-to-seagoing fleet proven during the1970s and 1980s in this region. The main sources of LNG in the Black Sea are ports on the Russian coast, Georgia (gas from Azerbaijan and eventually Turkmenistan) and Turkey (gas from Iran or Iraq) or Black Sea off shore sources.

Although the transit of loaded large scale LNG carriers through the Bosporus straits seems to be excluded due to safety reasons, the Government of Turkey is considering the construction of the Kanal Istanbul. If that channel is built to proposed dimensions it is likely to facilitate navigation by standard LNG carriers. However, that is to be considered as a long term goal.

Map 10: Proposed routes for the Istanbul Channel

Source: http://esasyatirim.com/kanal-istanbul-guzergahi-icin-5-alternatif-var/

For completeness, it is considered that a more feasible, small scale channel may be introduced following the same route (or one of the proposed routes) instead of, or before, or in parallel to the large scale scheme. “Small scale” in this context may be understood as the navigation standard of the Danube Iron Gates locks[82]. This would provide an opportunity to transport LNG by river-to-seagoing ships from the LNG terminal(s) in the Sea of Marmara to all destination in the Black Sea area including navigable routes of large rivers adjacent to the Black Sea (Danube, Dnieper, Volga-Don system and Caspian Sea).

New developments in small scale LNG technologies provide an opportunity for the introduction of a traded Black Sea LNG market that may be considered as a competitive gas-to-market option for most of the gas sources in the region. Eventual development of a suitable Istanbul channel may provide a link between such a Black Sea LNG market and the international LNG markets.

4.5.2 Mediterranean and Adriatic

The Mediterranean LNG market is an integral part of the international LNG market. There are a number of LNG sources in the Mediterranean itself and more LNG is available via Suez and Gibraltar.

[82] Navigable depth 4.5m, minimum width 33m, air height up to 11.5m. These dimensions allow navigation of river-to-sea ships that could navigate to the Danube, Dnieper, Volga–Don system and Caspian Sea.

Receiving terminals in Greece and the Adriatic could have slight transport cost advantages in accessing the LNG spot market.

However, such advantages are not sufficient to cover the pipeline transport costs of eventually moving gas from LNG terminals in the Balkans to consumers in Central Europe as pipeline infrastructure toward the coast is relatively limited in capacity. Atlantic and Baltic coast terminals will have better access to these markets.

In similar manner, Italian LNG terminals are better positioned to serve the Italian market as well as a considerable part of Central Europe via Slovenia.

Black Sea or Mediterranean LNG could be transported inland by railways (containers) or inland waterways (Danube) directly to large scale consumers or inland wholesale terminals to supply transport demand.

4.6 Use of existing infrastructure

Existing infrastructure in the region which could be used for gas transport in various forms comprises:

- conversion of underutilized oil pipelines to transport natural gas,
- use of (underutilized) railway lines to transport LNG in ISO containers,
- transport of natural gas in the form of LNG or fertilizers, along the Danube and Sava rivers,
- use of existing sea and inland ports and
- better utilization of existing gas pipelines.

Minimal upgrades may enhance use of existing infrastructure. For example, wider use of double height ISO containers[83]) on major railway lines may enhance the transport economics of LNG ISO containers[84] as LNG cargo has relatively low weight density. This is to be considered as a practical alternative since upgrades of railway infrastructure are now in progress across the Western Balkans with significant international donor assistance and credit arrangements.

This approach would facilitate the introduction of LNG to the Danube region on a large scale and from various directions with greater security and reliability of supply. At the same time, it would serve most urban areas in the region with direct LNG supply. This opportunity also facilitates LNG competition in the transport fuel market and in various stationary uses. This competition would be more intense in high density demand clusters (urban transport, Danube bunkering, etc.) increasing average distribution costs for liquid fuels and depriving local refineries of the most lucrative customers. The introduction of LNG as a transport fuel affects both the gas and petroleum product markets[85].

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[83] Double stacking (double stack rail cars, Econo Stack or Twin Stack well cars) is a well-established practice or is being considered in many countries (see for example: http://eex.gov.au/double-stacking-2/) . Chinese container operators are already experimenting with this along the Piraeus /Greece/Central Europe rail line.

[84] Author is aware of innovative aspects of this approach in the European market where there is no LNG terminal equipped with access to railway infrastructure or massive ISO LNG containers loading capacity. This approach may require openness of international financial institutions to desires and interest of private investors and traders that may not be entirely approved by host governments.

[85] It affects both aspects of the dual commodity Dixit – Stiglitz monopolistic framework and provides an opportunity to turn the entire market into a more competitive structure. At the same time, this approach decreases physical barriers to entry and creates a more competitive structure. See: Joseph E. Stiglitz: Competition and the Number of Firms in a Market: Are Duopolies More Competitive than Atomistic Markets?, Journal of Political Economy, 1987, vol. 95, no. 5, University of Chicago .

Map 11: Major inland road and railway freight corridors

Motorway (doubled by railway) | Railway for which no motorway alternative exists

Pan European corridors | Merchandise port of importance for the Balkan freight traffic

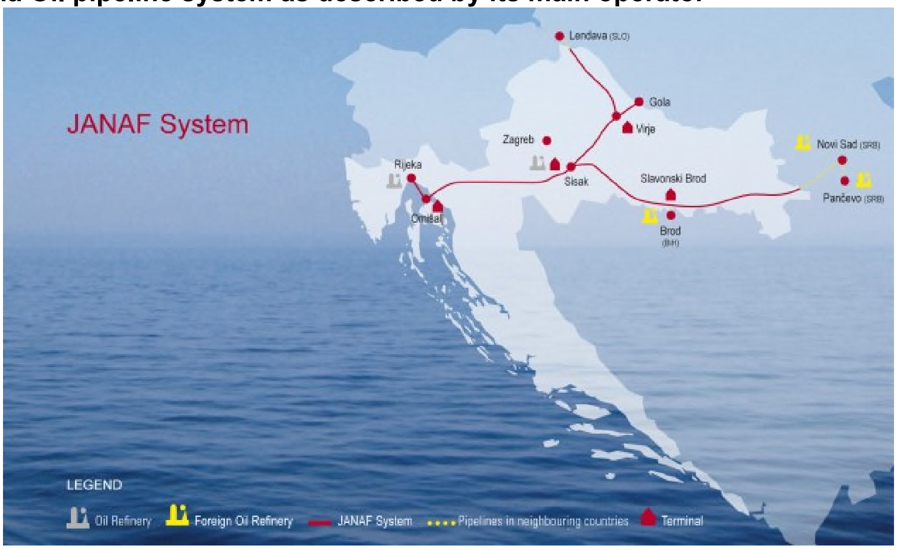
Source: http://www.zoinet.org/web/sites/default/files/publications/WB-Indicators-2012.pdf, page 31.
It is interesting to note that EU sponsored projects intended to foster LNG bunkering along the Aegean – Adriatic coast[86] and along the Danube River[87] may be used to promote commercial LNG transport along these natural transport corridors. LNG container transport may facilitate the development of intermodal transport across the SEE and provide further opportunities for other goods including petroleum products[88].

Use of crude oil pipelines (Adria pipeline and Macedonia pipeline[89]) to transport gas may be considered to provide immediate diversification.

4.6.1 Adria Oil pipeline and its future

The Adria pipeline (operated by Croatian state owned company JANAF and Transnafta of Serbia) supplies crude oil to outdated oil refineries at Sisak, Brod, Novi Sad and Pancevo. These refineries are losing competitive position due to small size and the depletion of local oil fields. Their local markets are protected by physical constraints to rail transport, Adriatic ports and Danube navigation, but these bottlenecks will be gradually eradicated following private investments and Chinese strategic institutional investments in transport infrastructure.

Map 12: Adria Oil pipeline system as described by its main operator



Source: JANAF[90]

If converted into gas pipelines, this system may link an eventual LNG terminal at Krk (Croatia) to North Croatia, North Serbia and Southern Hungary, which have the largest Underground Gas Storage potential (depleted oil and gas fields) in the region, as well as salt caverns in Tuzla (Bosnia and Herzegovina) that have potential for 60MCM of fast response gas storage. All in all, existing and new (potential) stores in this region exceed 3bcm in working gas volume potential.

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[86] http://www.poseidonmed.eu/; http://www.lngworldshipping.com/news/view,poseidon-med-ii-advances-lng-plans_41878.htm
[87] http://www.lngmasterplan.eu/masterplan/rationale-wbs
[88] http://www.ceep.be/liquefied-natural-gas-landlocked-countries/
[89] The existing oil pipeline from Thessaloniki to Skopje converted to transport gas could be able to deliver about 1bcm/year to Skopje and provide diversity of supply to Macedonian and Kosovo consumers. See: http://www.asprofos.gr/erga/project-details/pc-swlhnes/project-thessaloniki-skopje-16-inch-crude-oil-pipeline/
[90] JANAF is the Croatia state owned company that operates the oil terminal with storage at Krk island and the Adria Oil pipeline on Croatian territory. The Adria Oil pipeline section in Serbia is owned by the Government of Serbia and operated by Transnafta (company owned by the Government of Serbia).

Table 6: Diameters and lengths of Adria Oil pipeline sections and routes

Route	DIAMETER inches)	LENGTH (km)	Gas transport capacity (BCM/year)
Omišalj-Sisak	36	180	7
Omišalj-Urinj	20	7,2	-
Sisak-Virje-Gola (Croatian-Hungarian borderline)	28	109	3.7
Virje-Lendava	12	73	0.4
Sisak-Slavonski Brod	28	157	3.7
Slavonski Brod-Bosanski Brod[91] (BiH)	28	14	3.7
Slavonski Brod –Sotin (Croatian-Serbian borderline)[92]	26	85	3
Sotin – Novi Sad	26	64	3
Novi sad – Pancevo	18	91	1.5

Source: JANAF d.d., EIHP, Transnafta, author estimates

These areas are well integrated with existing gas infrastructure in Hungary and Slovenia while further integration to Romanian gas infrastructure is a relatively easy option. Connection to existing gas infrastructure is possible at a number of different points while linkage to South Stream seems a viable option. The Adria pipeline system ends in Pancevo (Serbia) across the bridge (over the Danube) from the Port of Smederevo – the most likely end terminal along the Danube for LNG supplies from the Black Sea.

This conversion provides an opportunity to integrate the Western Balkan system of new underground storages as potential storage resources are located along the route[93]. It also provides an opportunity to link with the Romanian gas system that is already well supplied with storage capacity. Taking into consideration specific SEE requirements for seasonality and flexibility, required UGS capacity is estimated to be up to 3bcm located in the Western Balkan area and well integrated with Hungarian and Romanian storage resources.

[91] Bosanski Brod is only 124km away from potential salt cavern underground gas storage near Tuzla in Bosnia and Herzegovina.

[92] Continues to TransNafta pipeline system toward Novi Sad and Pancevo in Serbia where it is linked to existing local gas and crude oil pipelines.

[93] Presentation by Alex Legakos ("Update on the course of Southeastern Europe towards becoming a regional gas market", UNECE April 2016) at page 7 indicates a shortage of gas storage capacity in SEE of 1.4bcm. The presentation assumes that over 3 bcm of Romanian UGS capacity is well integrated into SEE gas market that is not the case. Furthermore, the estimate targets minimal European storage capacity-to-total demand ratio of 25%.

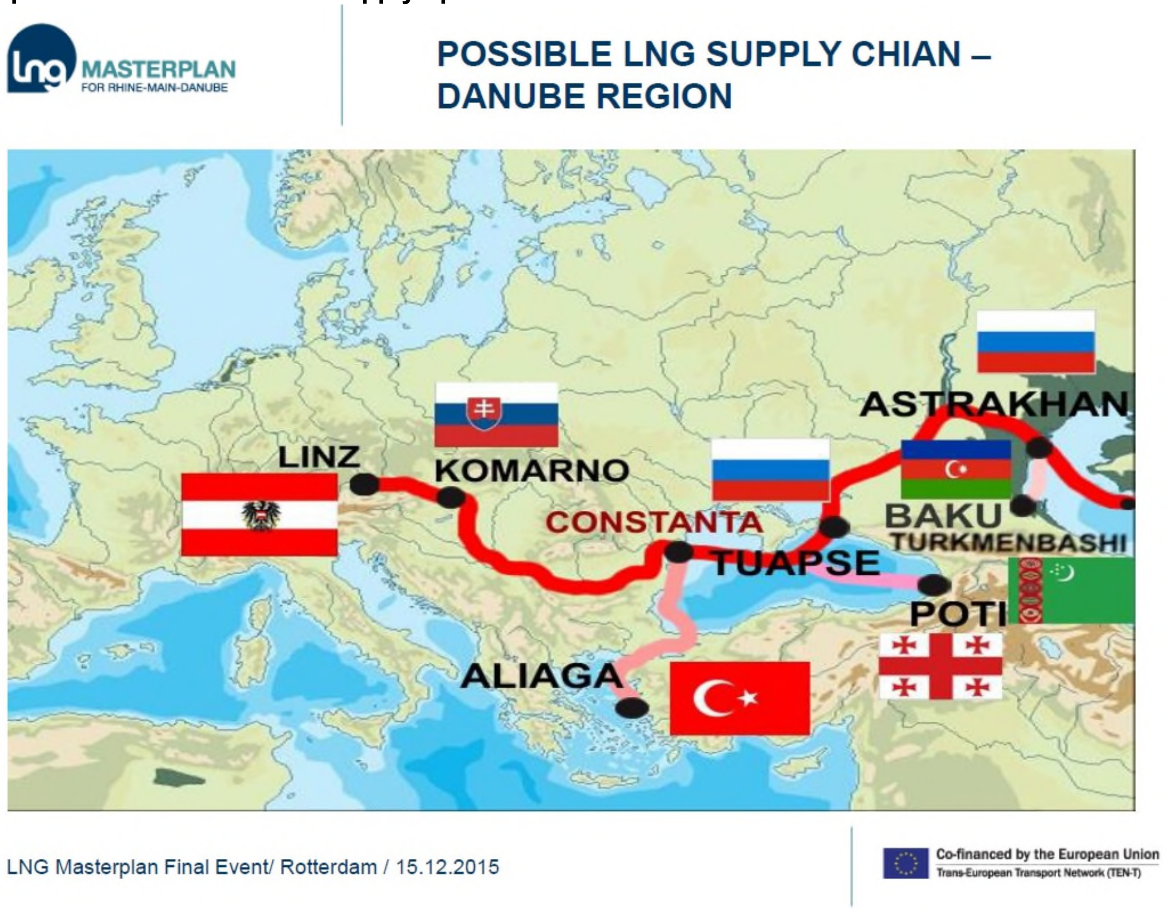
Map 13: New underground storage potential in the Western Balkan area

Source: Author estimate

4.6.2 Southern Gas Corridor and the River Danube

The river Danube provides two overlapping navigation/transportation systems: (1) river going vessels standardized for the Danube and Rhine and other Western Europe inland waterways and (2) river-to-seagoing vessels suitable for navigation between the Lower Danube, Black Sea, Dnieper, Volga-Don system and Caspian Sea. The recently completed Masterplan for Rhine-Main-Danube LNG bunkering identifies opportunities to supply LNG across the Black Sea and into the Danube. This transport scheme is very similar to one envisaged in 2007 and demonstrated in Annex 3.

Map 14: River Danube LNG supply options



Source: http://www.lngmasterplan.eu/images/2015-12-15_10-45_LNG_MP_FE_Masterclass_vessels_3_Danube_LNG_Robert.Kadnar.pdf , page 5

The Rhine-Main-Danube Masterplan envisages much smaller and less cost-effective river–to-seagoing ships than would be appropriate for the Lower Danube. It takes into consideration the current degraded, instead of designed characteristics of the Lower Danube navigation route. However, with appropriate river basin management in Serbia and use of available hydro power capacity, navigation may return to its designed capacity (demonstrated during 1972-1989) and facilitate the use of the river-to-sea fleet. This would indicate that the full transport potential is much larger than envisaged and sufficient to provide strategic LNG import to Central Europe from across the Black Sea with estimated volumes between 7 and 30 mtpa of LNG. In other words, Russian export of LNG across the Black Sea may approach the envisaged capacity of the South (Turkish) Stream. However, the Black Sea market inevitably remains open to internal and external competition that forces various Russian suppliers[94] to adopt competitive market behavior. Black Sea LNG market opening requires standardization of (river-to-sea) shipping technologies and cooperative arrangements. LNG supply from North Adriatic ports to the Danube river basin is also likely to contribute to this competitive landscape.

4.7 Pipeline gas via Ukraine

Gas supply via Ukraine to South Eastern Europe is an existing and proven option. This option is well supplied with UGS and significant pipeline capacity. UGS capacity at the Western border of Ukraine effectively separates European gas demand volatility from Ukraine (and Russia) gas demand volatility and provides seasonal gas supply to Europe and short term peaking supply required by Ukraine power and heat production facilities.

4.8 Interconnector(s) to Italy

Various gas interconnection projects between Italy and the Western Balkans have been considered, the most economical being the GEA Project, a shallow undersea pipeline connecting existing gas infrastructure on both sides of Adriatic and crossing an area with some off shore production and infrastructure.

Other projects were mostly based on considerations of lower regulatory requirements for building LNG re-gas terminals in the Balkans to serve the Italian market. The installation of the Rovigo and Livorno terminals with further permits for import terminals in Italy has decreased investors' interests in investment in Balkan LNG facilities. Adriatic Sea crossing projects range from direct connections to LNG terminals with gas infrastructure at one or another side of the Sea to interconnections between existing gas transmission systems.

However, the potential to serve the Balkan market from Italy either by pipeline, short distance LNG shipping or under-sea power cable (gas-by-wire) creates interesting impacts on gas and power projects in the Balkans. The lack of gas (and electricity) supply flexibility on the Italian side of the Adriatic may create competitive off peak electricity (and gas) supplies that may affect utilization rates of power generation assets in the Balkans.

The large and diversified Italian gas market was able to facilitate the diversion of part of its[95] offshore gas production toward the Croatian market during the January 2009 crisis and for a period after it. Assuming gas supplies from Russia to Italy via Northern routes (Ukraine, Nord Stream), an LNG to gas (or electricity) swap allows SEE players to engage in international LNG trade. A Greece–Italy HVDC connection (500MWe capacity) is already available, Montenegro–Italy (1000MWe) is under development while Croatia–Italy (1000MWe) is envisaged.

4.9 Domestic production

Domestic production includes:

- Existing domestic production in Romania, Serbia and Croatia,
- Potential for new on shore production in Croatia, Romania and Bosnia and Herzegovina,

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[94] It seems from inconsistent and inconclusive information that various Russian gas producers including Gazprom, Rosneft and LukOil are considering LNG production, transport and export of LNG in the Black Sea region. The extent of these considerations is unknown. See for example: http://www.lngworldshipping.com/news/view,gazprom-and-fluxys-to-develop-smallscale-lng-in-europe_42393.htm

[95] Production from off shore fields in the Croatian economic zone is operated by JVs of Croatian and Italian companies (INA-ENI, INA-Edison) dedicated to deliver gas to the Italian market.

- Potential for new off shore production in Croatia, Romania, Greece and Montenegro as well as Turkey,
- Coal bed methane production in Serbia, Bosnia and Herzegovina, Kosovo, Romania, Bulgaria and possibly Greece,
- Unconventional gas production in Romania (and eventually Serbia).

Domestic production in Croatia and Serbia is declining while Romania may be able to offset declining with new production. Potential domestic production from unconventional sources is at the early stages of development and may take several years to come to the market. Governments are mostly excited with the prospect of natural resource rents and enthusiastic in publishing tenders and negotiating exploration rights. However, actual upstream investment has been disappointing and much exposed to political risks.

A notable exception is GazpromNeft's acquisition of the Serbian oil industry, including all domestic gas and oil upstream assets. The acquisition was packaged into a Government – to – Government agreement on South Stream[96] and accompanied by a JV agreement between the Serbian national gas company SerbiaGas and Gazprom on investment in an underground storage facility in Serbia. GazpromNeft thus expanded its upstream exploration activities from Serbia to Bosnia and Herzegovina[97], Hungary and Romania. MOL of Hungary is a partner with the Government of Croatia in the oil and gas company INA that is the largest domestic gas producer. There are two off-shore production JVs between INA and Italian counterparts.

It is interesting to note that the two largest prospective new EU domestic gas production options are located in the proximity of SEE: Romania and Cyprus. This is indicated in scenario 5.22/5.23 compared with the business-as-usual scenario 5.20/5.21in the following set of figures from the ENTSOG Ten Year Network Development Plan (TYNDP 2015).

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[96] http://www.isac-fund.org/download/Summary%20and%20Conclusions.pdf

[97] Serbian entity – Republic of Srpska. Muslim/Croatian entity – Federation of Bosnia and Herzegovina entered into exploration contract with Shell (http://af.reuters.com/article/energyOilNews/idAFL5N12036520150930; http://wire.seenews.com/news/bosnian-entity-to-continue-oil-gas-exploration-push-despite-shell-exit-495429) and looking to engage with alternative investor (http://newsbase.com/topstories/total-eyes-oil-exploration-bosnia).

Figure 8: Various scenarios of EU domestic gas production

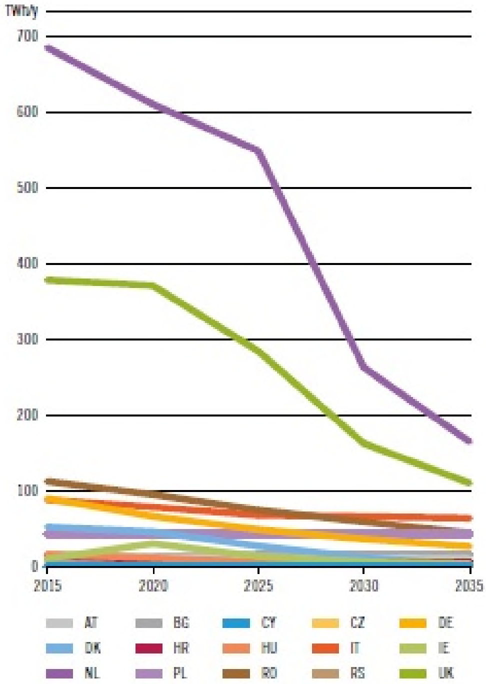


Figure 5.20: Potential of EU conventional production (excl. non-FID) 2015 – 2035

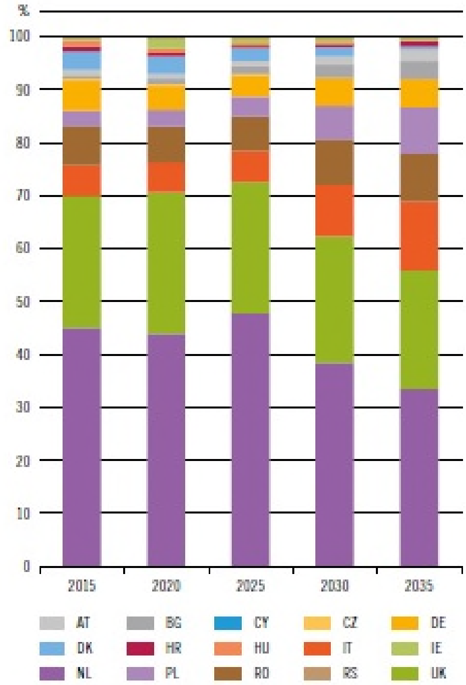


Figure 5.21: Shares of EU potential conventional production (excl. non-FID) 2015 – 2035

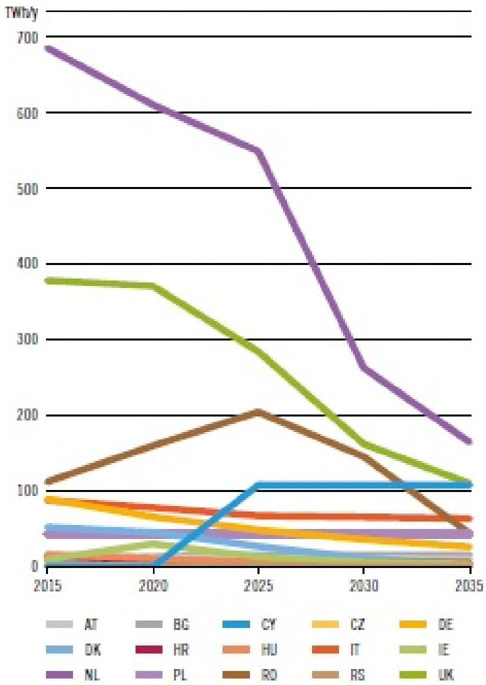


Figure 5.22: Potential of EU conventional production (incl. non-FID) 2015 – 2035

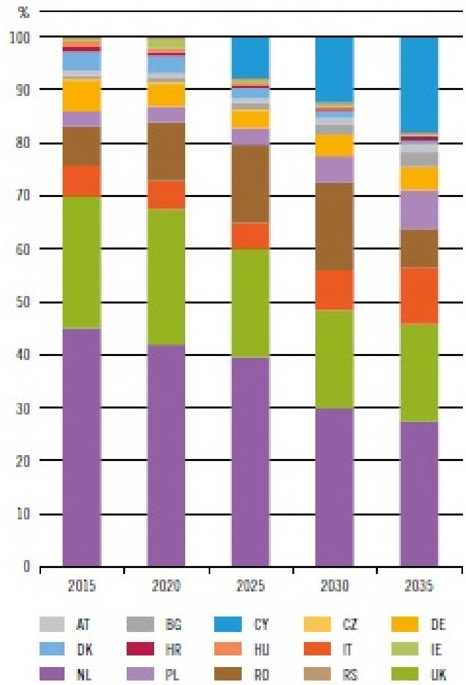


Figure 5.23: Shares of EU potential conventional production (incl. non-FID) 2015 – 2035

Source: TYNDP (2015)

4.9.1 Transit rent, resource rent and economic crisis

The interplay between transit rents, resource rents and the economic crisis and the strong presence of incumbent monopoly players creates multidimensional investments risks. Potential investors in alternative (possible, market opening) gas supply projects are exposed to technical, competitive, demand related, host country, regulatory and sunk cost risks. Table 7 is a 'score card' assessing these risks and considers the differences between various projects.

Table 7: Comparative investment risk assessment scorecard for various investment options intended to enhance security of supply in the South Eastern Europe (part 1)

	South Stream, Turkish Stream, Tesla pipelines	Turkey gas corridor	East Med gas pipeline	Ukraine corridor (upgrade)	Interconnectors to Italy	Croatia LNG on shore option
Technical						
Access to off-take infrastructure	5	5	5	1	3	3
Environmental impacts	4	3	4	1	4	5
Ubiquity to demand structure	5	5	5	1	3	1
Competition						
Availability of lower cost alternatives or spare capacity	5	5	5	3	3	5
Predatory pricing potential of incumbent monopoly	5	5	5	2	4	5
Renewable energy alternatives available	5	5	5	4	3	3
Priority demand on route	5	5	2	5	5	1
Demand						
Sustainability of existing demand	5	5	5	5	4	4
Demand data availability	5	5	5	5	5	5
Foreign trade deficit problem	5	4	4	4	3	5
Monopsony (oligopsony) market structure	1	3	3	1	2	5
Terms of trade risk	5	4	4	4	3	5
Credit worthiness of potential off-takers	1	4	5	2	4	5
Volatility of demand	4	5	5	1	2	1
Host country						
Political risks	3	4	4	5	3	2
Rent seeking	5	5	5	5	4	5
Transparency	5	5	5	4	5	5
Regulatory risks	5	5	5	3	2	5
Cross border disputes	5	5	5	5	4	5
Cont. next page						

Compliance						
Project compliance with EU regulation	5	3	3	2	2	4
Enforcement of EU regulation to competitors	1	5	5	5	5	5
Liquidity						
Transferability of the project assets	5	5	5	5	5	5
Effective exit strategy	5	5	5	4	4	5
Summary risk score	**99**	**105**	**104**	**77**	**82**	**94**

Source: Author estimates

Key: 1 = low risk; 5 = high risk

This first group of projects comprises well known, large scale, capital intensive projects that are promoted with the aim of gaining public support. The existence of these projects can be said to demonstrate a market failure which has discouraged commercial projects promoted by private developers relying on commercial funding. Risk mitigation strategies that reduce risks to private capital by exposing public capital to the same risks do not change the nature of risky markets. It is unlikely that projects exposed to such risks will mitigate security of supply risks.

Table 8: Comparative investment risk assessment scorecard for various investment options intended to enhance security of supply in the South Eastern Europe (part 2)

	Croatia Rijeka FSRU	JANAF conversion + UGS + Krk FSRU	Thessaloniki FSRU + Skoplje pipeline	Danube FSRU	Small LNG Fleet	Working capital deployment *
Technical						
Access to off-take infrastructure	3	2	2	2	2	2
Environmental impacts	3	2	2	2	1	1
Ubiquity to demand structure	1	1	1	1	1	1
Competition						
Availability of lower cost alternatives or spare capacity	1	1	1	1	1	1
Predatory pricing potential of incumbent monopoly	2	1	1	2	1	1
Renewable energy alternatives available	1	1	1	1	1	1
Priority demand on route	1	1	1	1	1	1
Demand						
Sustainability of new demand	1	1	1	1	1	1
Demand data availability	2	2	2	2	2	2
Foreign trade deficit problem	3	2	3	3	3	2
Monopsony (oligopsony) market structure	1	1	1	1	1	1
Terms of trade risk	2	2	2	2	2	1
Credit worthiness of potential off-	1	1	1	1	1	1

takers						
Volatility of demand	1	1	1	1	1	1
Host country						
Political risks	2	2	3	3	1	4
Rent seeking	3	3	2	2	1	4
Transparency	1	1	1	1	1	1
Regulatory risks	3	2	2	2	1	4
Cross border disputes	2	2	1	1	1	3
Compliance						
Project compliance with EU regulation	1	1	1	1	1	1
Enforcement of EU regulation to competitors	2	2	3	2	1	1
Liquidity						
Transferability of the project assets	2	3	2	2	2	2
Effective exit strategy	1	2	1	1	1	1
Summary risk score	**40**	**37**	**36**	**35**	**29**	**38**

Source: Author estimates

* Including mobile assets (containers, rail rolling stock, trucks) and commodities (LNG, CNG and pipeline gas feed)

As expected, in Table 8, smaller and less capital intensive projects are less exposed to risks and less desired by host governments due to their modest immediate contribution to domestic employment, GDP formation and currency appreciation. It is considered that giving preference to large scale projects plays in favour of an incumbent monopoly since the probability of implementing these projects remains low while uncertainty creates another barrier to entry.

Even this fairly primitive risk analysis demonstrates the advantage of LNG projects that are less capital intensive and able to attract as much revenue as possible.

5. Inter-fuel competition and complementarities

Prevailing long term contracts (LTC) for gas supply to this region, where gas price is pegged to oil (and oil product) prices with certain time lags, confuse price signals to seasonal gas demand and inter-fuel competition. Furthermore, collection of outstanding debts for delivered gas[98] and "soft" application of take-or-pay clauses[99] distort critical price signals in import country gas markets. Price signals change over time to reflect changes in the supply–demand situation. Even if a particular volume of oil (oil products) delivers the same volume of energy as an equivalent volume of gas [100]

[98] See Chapter 4 above.

[99] In "Pricing the "Invisible" Commodity", Discussion Paper, Gazprom Export, 11 January 2013) Sergey Komlev argues at page 52: "But there is a fundamental difference in the execution of take-or-pay obligations under the long-term contracts that Gazprom offers its clients and the short-term, one- or two-year contracts that the customers of our clients have. Long-term contracts offer a 'make-up' gas option (not to mention 'flexible take-or-pay' terms in some cases) that allows customers to take quantities not needed in the current year in later years, provided that prepayment is made." This is to be considered as demonstration of soft budget constraint practices in terms of volumes and take-or-pay obligations.

[100] Ibid, page 21: "To the consumer, a Btu or kilojoule of energy supplied by natural gas has, for all intents and purposes, the same value as a Btu of energy supplied by oil."

they serve different demand portfolios and may not have the same monetary value. This is even more the case for the same volumes of energy supplied at different times or after time lags.

SEE LTCs attach off season oil prices to peak season gas deliveries and peak season oil prices to off-season gas deliveries, and blend this pricing scheme with discretionary application of take-or-pay clauses and soft collection practices. This practice supports seasonal gas consumers such as low efficiency district heating services and may have fiscal impacts for import countries. Taking into account the scale of Gazprom interaction with the budget of the Russian Federation, it is to be considered that the fiscal impact for importers relates to the fiscal impact for the supplier. This fiscal interaction requires certain nominal predictability in order to provide "fair" fiscal optimization to both sides[101]. It is, however, a major distortion of price signals to market players. Furthermore, both (exporting and importing) state administrations have a vested interest in preserving low efficiency of gas consumption and the given technology mix.

The analysis of inter-fuel competition in the following sub-chapters is based on fundamentals rather than actual prices of pipeline gas. The opaque character of the pipeline gas pricing system (LTC) prolongs the business-as-usual situation while the accumulation of technology and competitiveness risks continues to grow. Governments, their international creditors, eventual private investors, the domestic public and the EU (institutions involved in the accession negotiations) are not fully aware of these risks and may acquire shadowed liabilities and become exposed to unpredicted default risks. Fundamental analysis of the inter-fuel competition demonstrates the need for gradual and parallel decomposition of this pricing system and its physical consequences: uncompetitive energy facilities.

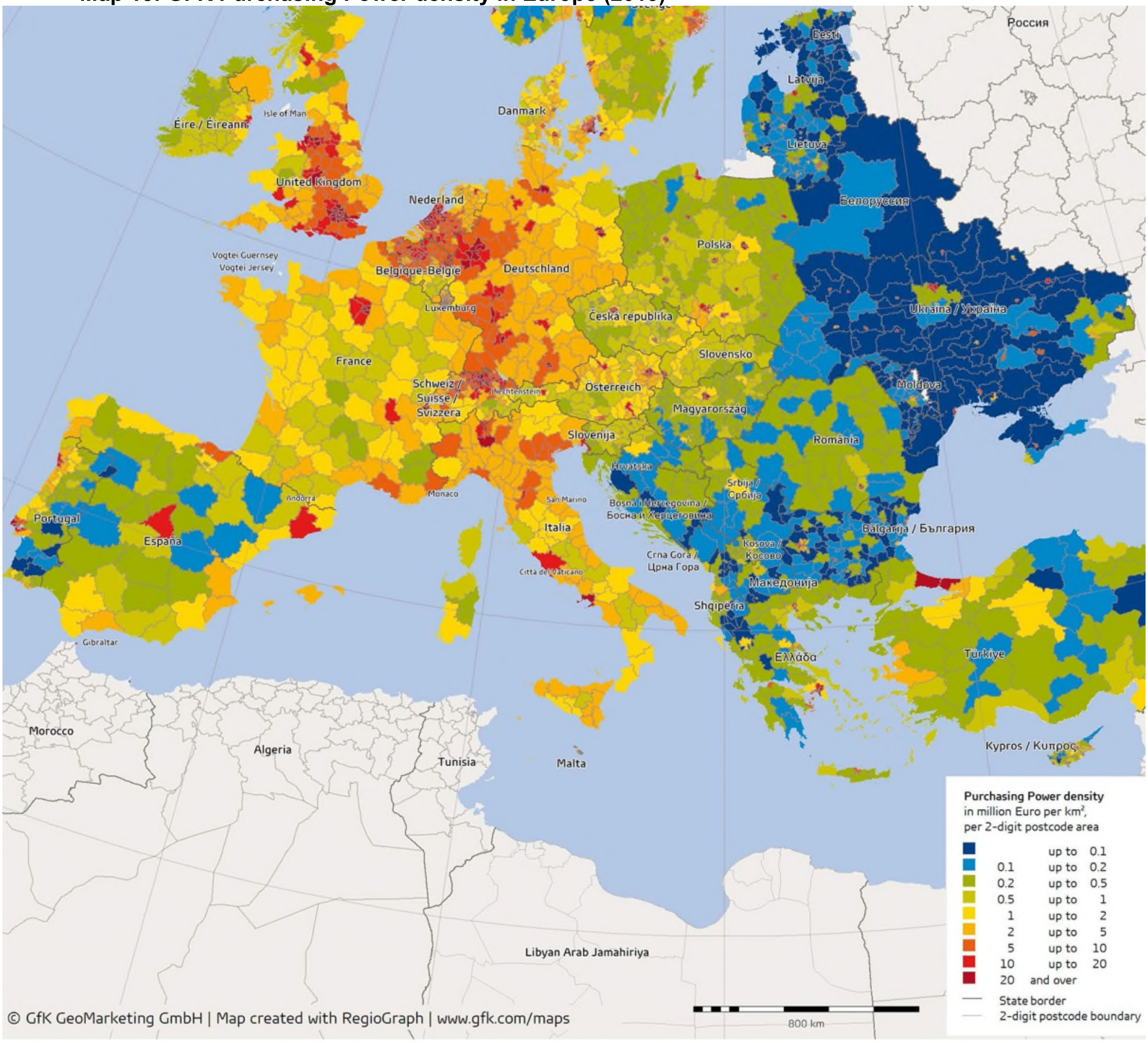
5.1 Gas – oil products

SEE is served by the most inefficient oil refining assets in Europe. The remaining operational refineries are forced to supply products to markets with a very low density of purchasing power and significant distribution costs. Refinery feedstock is dependent on URAL crude while hydrodesulphurization (HDS)[102] is supplied by overpriced natural gas.

[101] Mr. Komlev's concept of "fair" pricing may include this fiscal optimization component as LTCs are usually based on bilateral Government-to-Government agreements.

[102] Required technology add on in order to produce high quality fuels (EURO 5) in line with EU environmental regulations.

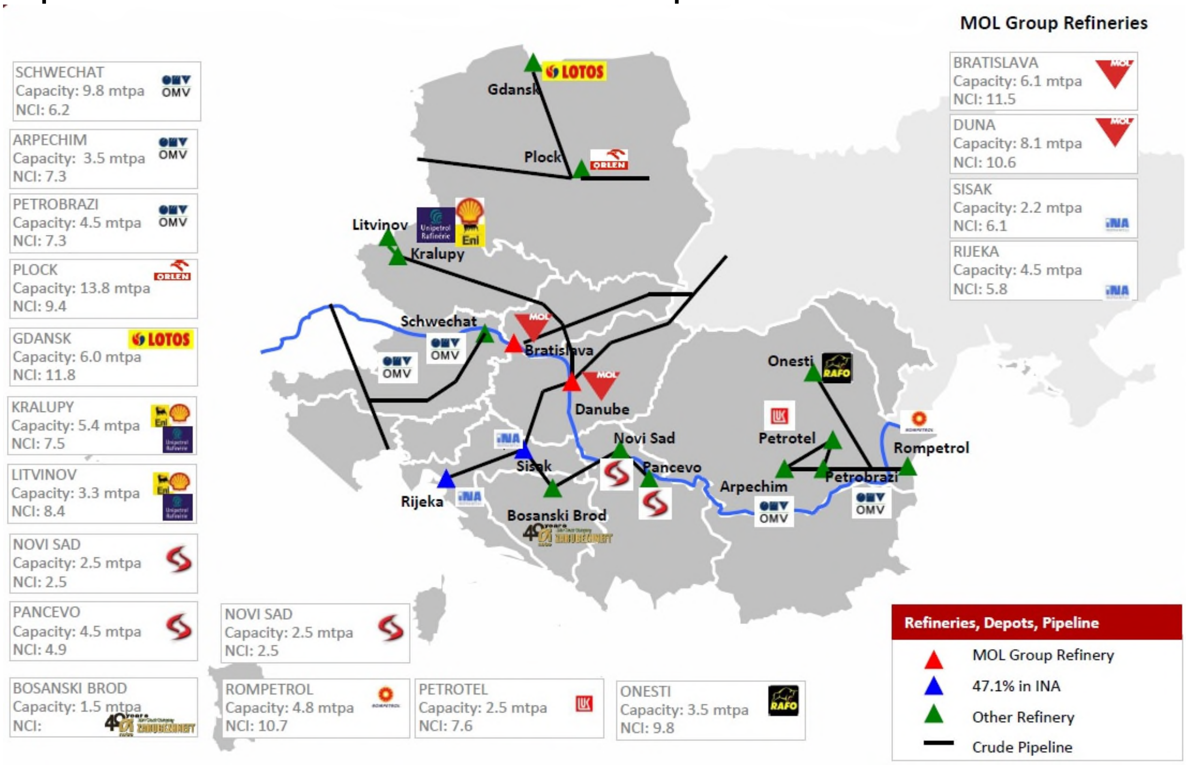
Map 15: GFK Purchasing Power density in Europe (2013)



Source: GFK, 2014

Lower complexity, lower utilization rates and more expensive feedstock contribute to the refinery closure risk that is exacerbated by strong competition from Russia, the Caspian Sea and the Middle East (as well as Western Europe and the Baltics) where refineries are located in proximity to crude oil (and gas) production, with much larger economies of scale and access to waterborne transport as well as higher density of demand.

Map 16: Oil refineries in Central and South East Europe



Source: MOL, 4th EU Refining Forum Brussels, 11 December 2014

Gas competes with oil products in transport and stationary use. In stationary use gas mostly competes with heavy fuel oil (HFO) and that competition seems to be mostly won by natural gas due to environmental impacts and the price of HFO. Traditional HFO consumers (industry, waterborne transport, district heating)[103] are all switching to natural gas or renewable energy[104]. As a consequence, refineries in the region are under pressure to decrease the volume of oil residuals in production and improve specification[105]. That is possible by conventional means: increased complexity of refineries, increased depth of refining and the use of HFO for self-steam and power generation. These options are costly. Low electricity prices throughout the region do not justify investments in this kind of power generation. All operational refineries emerged during recent years as natural gas consumers.

All oil refineries in the region (with the possible exception of Burgas in Bulgaria that is owned and operated by LUKOIL) are much too small to afford complex solutions to gasification of HFO, hydrodesulphurization and competitive power and steam generation. The LUKOil-operated refinery in

[103] Lignite-fired power plants in the region are also HFO consumers. HFO is used to support starts and combustion when lignite is below boiler fuel quality requirement. Closure of lignite-fired plants is soon likely to eliminate remaining HFO demand. There are comparative studies that demonstrate that even in this low efficiency use, natural gas is superior to HFO. However, shortening the remaining service life of lignite-fired plants (and intermittent use of capacity) prevents investment in gas infrastructure. In this context, closure of lignite mines is likely to remove significant (poor quality) diesel demand.
[104] The assumption is made that indigenous renewable energy (biomass, geothermal) is going to displace natural gas from most low grade heat applications including district heating.
[105] Limitation of sulphur in liquid fuels, including HFO is prescribed by the Energy Community Treaty. Some Western Balkan countries are still struggling to implement this obligation and this effectively supports local refineries staying in business for a while.

Romania is experimenting with combustion of residuals in a modern fluidized bed boiler but steam and power efficiencies are well below international market standards.

Refineries in Romania, Serbia and Croatia are supported by low royalties for domestic oil and gas production that is effectively a cross subsidy to refining and marketing of liquid fuels. There is a declining trend in domestic hydrocarbon production[106].

It seems most likely that the combined impacts of natural gas competition, renewable energy and competition of imported oil products are going to push all refineries in the region) out of business (with the possible exception of Burgas and one refinery in Romania.

The competitiveness of various transport fuels at the current stage of technology and local specifics for the Balkans are described as follows:

- Taking into account the configuration and electrification of railways, it is to be expected that most of the railway system will use electricity as the main transport fuel. However, greater use of LNG in power generation is going to facilitate greater flexibility of power generation that may enhance electricity recovery on (mountainous) railways and improve efficiency.
- Urban buses may use CNG (LNG) as a main fuel (instead of diesel, due to its supply costs following the collapse of regional refining industries) but CNG may be sourced either from pipeline gas or from LNG.
- Car manufacturing in the region (Serbia and Romania) already includes models that use CNG as a main fuel while market penetration of CNG vehicles into public transport is very significant in Bulgaria and is growing in Serbia.

It seems that the competitiveness of CNG and LNG against diesel in most high utilization rate[107] transport applications in this region is not disputable even at current pricing. The critical limiting factor remains availability of LNG and its distribution infrastructure.

The likely collapse of oil refining in the region will enhance the shift of oil pipelines to transport natural gas. The revenue opportunity may motivate this change of use[108] in which case some refineries may be deprived of pipeline transport. These two processes are likely to enhance each other.

The lower cost of road transport and bunkering due to the conversion to LNG (CNG) would enhance competitiveness of distributed LNG and biomass compared with conventional liquid fuels (HFO) in stationary applications. Furthermore, lower transport costs and more efficient LNG heavy vehicles are likely to improve competitiveness of biomass against lignite in power generation in this region with high forestation rates. That, in turn, limits demand for HFO for lignite power generators.

5.1.1 LNG bunkering on the Danube and Adriatic Sea

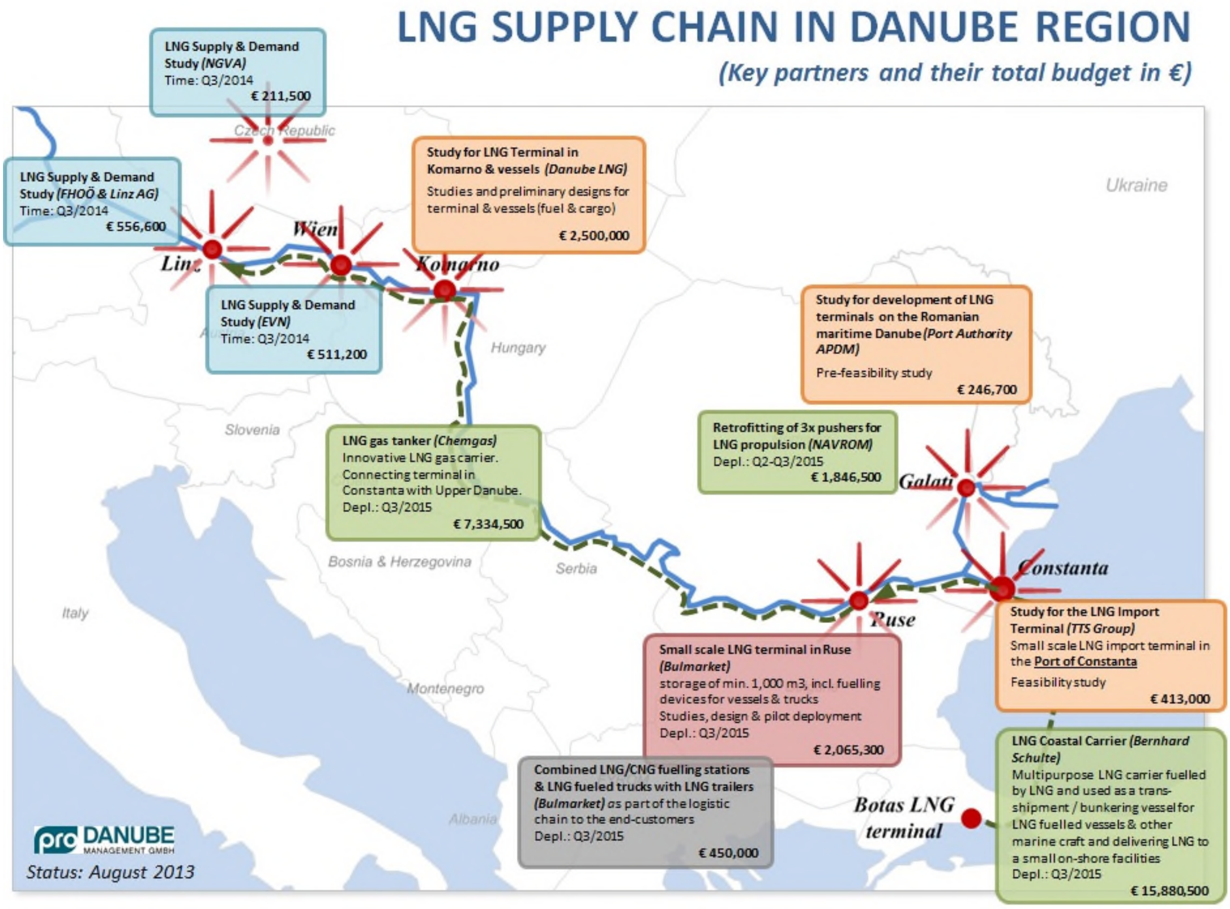
Oil products are already under threat as bunkering fuels on the Danube inland waterways following decisions of the Danube Commission to introduce LNG as a main bunkering fuel. In similar manner, there are intentions to introduce LNG as a fuel in the Aegean and Adriatic Seas.

[106] Even though Romania may increase unconventional gas production.

[107] And high vehicle turnover rate

[108] An obvious example is the fairly modern Thessaloniki – Skopje oil pipeline that is mostly out of use. It may convert into a gas pipeline and offer immediate diversification to the Macedonian market (in particular the Skopje DH system and power plants) as well as supply options to Kosovo. That would justify counter flow on the existing Bulgaria – Macedonia pipeline and add supply alternatives for Bulgaria and Serbia.

Map 17: Possible LNG supply to bunkering along the Danube river[109]



Source: Seitz, Manfred: LNG Masterplan for Rhine-Main-Danube 2012-EU-18067-S, presentation, Workshop Danube Commission, Pro Danube, Budapest, 17 September, 2013

Conversion to LNG (or CNG) will have a twofold impact on the market: (1) It will remove demand for (low quality) diesel and HFO and (2) it will decrease transport costs along the Danube (and along the Adriatic coast) facilitating competitiveness of imported bulk cargoes: fertilizers, steel and steel products, agriculture products, petroleum and petrochemicals and LNG itself. A shift to LNG as a main fuel will be an opportunity for fleet modernization that is likely to decrease transport costs even further.

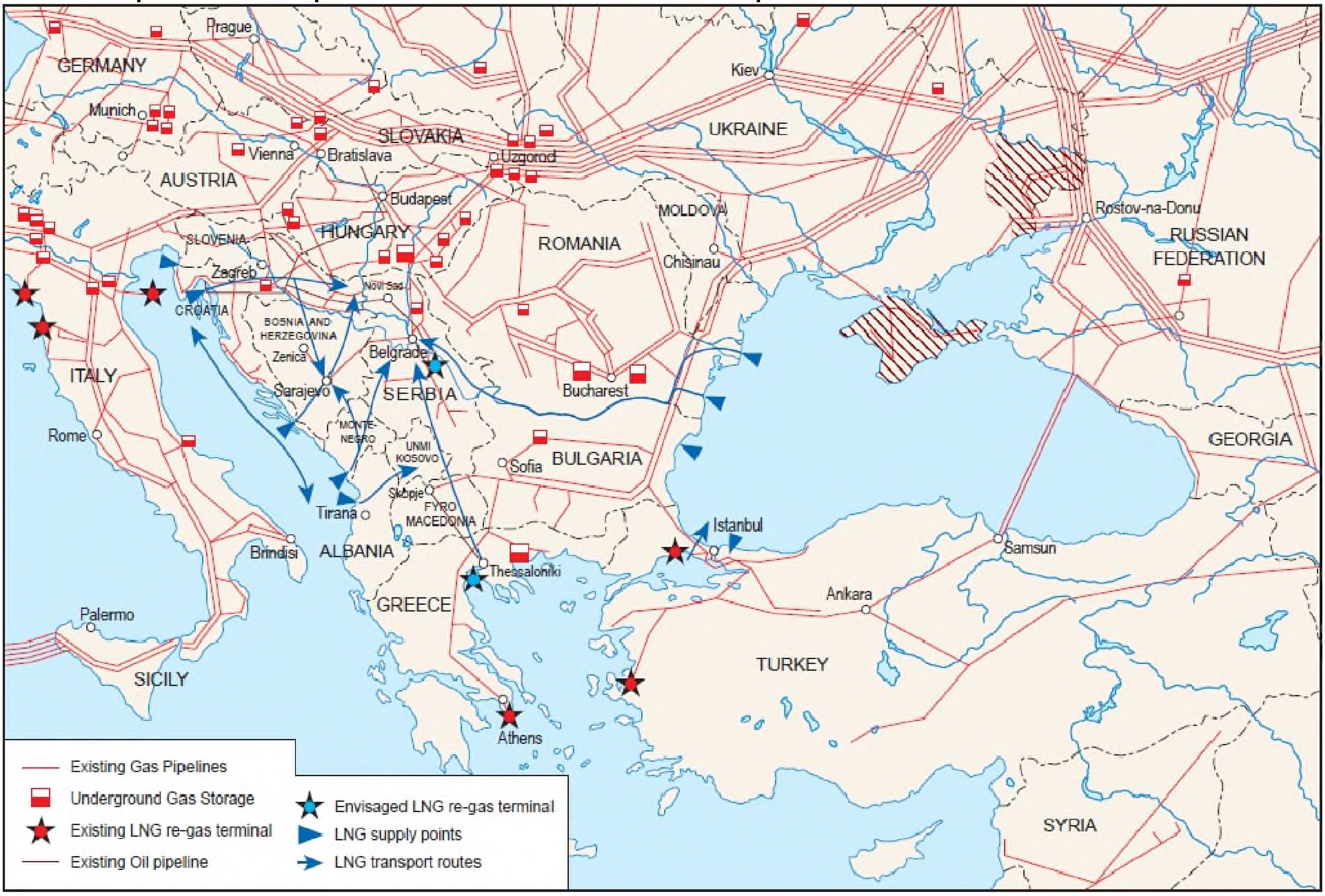
Bunkering demand on the Danube has a growth potential related to the increase in inland waterway transport on the Danube that is already persistently growing, following a depression during the wars in former Yugoslavia during the 1990s. Growth is likely to continue to be fueled by growth in trade between Europe and Turkey/the Black Sea/and Central Asia. Trade in fertilizers, cereals and LNG are likely to enhance this even further and create further demand for LNG bunkering. Transport potential on the Lower Danube is far from saturated at its proven technical capacity.

In similar manner there is a significant growth in shipping and ship visits to Adriatic and Aegean ports. The number and size of passenger ships as well as the number and size of container ships visiting ports in Greece and along the Adriatic are all increasing. There is a need to provide LNG also to

[109] It is worth noting that the critical section of the Danube river in Serbia and Croatia where river-to-seagoing navigation overlaps with inland waterway navigation is not covered by envisaged LNG supply options.

inland transport by rail or trucks. Potential and on-going projects are considering LNG transport[110] for bunkering along the coast and toward main ports. The ambition of these transport options is limited to small volume and slow growth rates and based on experience with slow new technology adoption in the maritime transport industry. However, the obvious competitiveness of LNG as a transport fuel in road transport may require much stronger growth in small scale (high turnover) supply options.

Map 18: LNG transportation routes in South Eastern Europe



Source: Author estimate

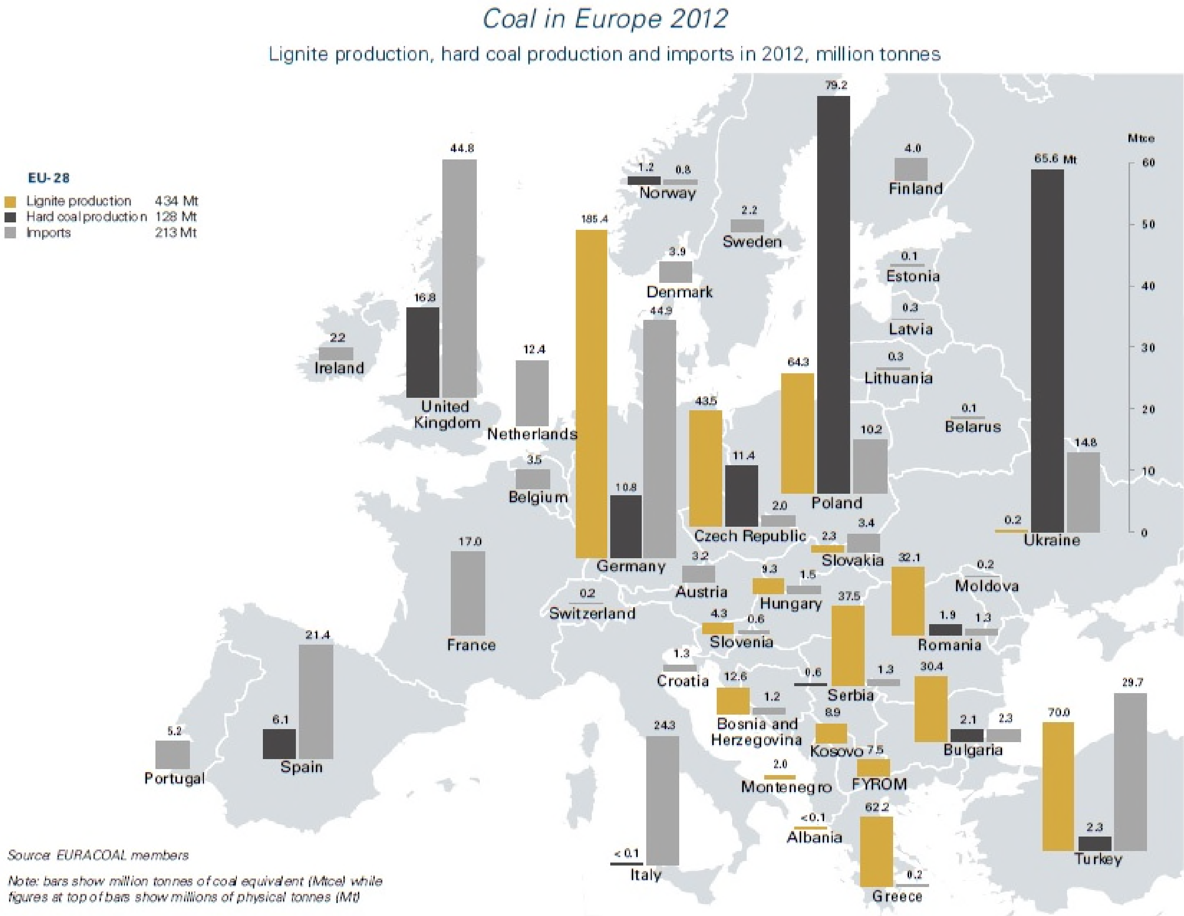
5.2 Gas versus lignite in power generation

While SEE is the largest consumer of lignite in Europe, the size of the lignite industry in Bulgaria, Romania, Greece, Kosovo, Serbia, FYR Macedonia, Bosnia and Herzegovina and Montenegro[111] is far beyond sustainable in comparison with the size of GDP. Greece is the largest lignite consumer per

[110] http://www.widermos.eu/cvdata/ppt/I_Bakas%20-%20Poseidon%20Med%20and%20the%20Corridor%20approach%20in%20LNG.compressed.pdf
[111] During 2012 these countries with Slovenia (comprising about 55 million residents) produced and consumed 195.7 million tonnes of lignite that is more than Germany (185.7 million tonnes, 80 million residents).

capita in the World. Lignite looks like a secure option for countries with security of supply problems but these countries are paying a dire price for using it: productivity of lignite extraction lags behind productivity[112] of coal, oil or gas extraction by a factor of 4 to 15 times while its environmental impacts are beyond any other fossil fuel. When the lignite industry is fairly large in the context of GDP, this productivity deficit affects competitiveness of the entire economy

Map 19: Lignite production, hard coal production and imports in Mt in 2004



Source: EuraCoal, 2013, page 77.

It is, of course, possible to cross subsidize the low productivity of lignite extraction by minimizing investment in the prevention of environmental pollution but that is possible only for a limited period as environmental and health[113] impacts (such as soil acidification and heavy metal deposition) are cumulative. Compared to their size, SEE economies are among the largest sources of SO^2 and acid rain in Europe.

[112] For example, the lignite industry in Serbia employed 12,300 full time workers to produce 37.5 million tonnes of lignite and about 100 million m^3 of overburden in 2012 while the German industry was able to produce 185.7 million tonnes of lignite and about one billion m^3 of overburden with 16,600 workers.

[113] An indication of lignite combustion health impacts in Serbia are available in: http://www.env-health.org/IMG/pdf/heal_report_the_unpaid_health_bill_how_coal_power_plants_make_us_sick_final.pdf (see table at page 49) The cost of these health impacts is way beyond value of electricity generated from lignite in Serbia. These findings are confirmed in the Energy Community study: http://www.energy-community.org/pls/portal/docs/2652179.PDF

Acidification (and illegal logging linked with energy poverty and security of supply problems) causes a major loss of forest cover that in areas with significant precipitation levels creates a major risks of floods, sliding and erosion. Given their location in the bottoms of karst fields[114], lignite open pit mines are disproportionally exposed to flood and landslide risks.

Taking into account the environmental impacts, depletion of better-than-average quality resources and flood risks as well as the introduction of stricter EU environmental regulation, the lignite industry in SEE is unlikely to remain viable. Survival of this industry requires costs too high for these small economies to bear and would continue to damage their economies.

Consequently, natural gas could compete with lignite provided that lignite-fired power plants paid the full cost of their environmental impacts in line with EU legislation, and when the cross subsidy of lignite power with (depreciated) hydro power is ended. Taking into account the inevitable small scale of lignite-fired power plants in the Balkans[115], the implementation of most modern lignite combustion technologies is not an option. Consequently, the lignite industry will shrink within the next six to eight years leaving the region with a massive need for new power generation capacity.

Lignite extraction is burdened with significant fixed costs (land acquisition, machinery, labour, overburden removal and disposal, ash disposal) that may or may not be competitive with international energy prices. Competitiveness will also depend on the calorific value of lignite and overburden-to-lignite ratio as well as the size of deposit, which determines economies of scale. In South Eastern Europe the density of the high voltage grid and the size of lignite deposits are not favourable to the deployment of very large supercritical lignite combustion plants with high efficiency. The most advanced lignite combustion power plants deployable in this region may have an efficiency of 57% (50% for existing plants) of that of the most efficient gas-fired CCGT plants and are likely to have more than 2.5 times higher capex and opex.

SEE lignite resources and industrial productivity produce fuel that is more expensive than coal imported into Europe[116] and Western European coal industries that aim to remain competitive with imports. A recent study produced in the context of the Energy Community[117] (EnCT) demonstrates competitiveness of lignite power generation (brown spread) versus gas (spark spread) power generation:

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[114] Dinaric Alps are one of largest karst areas in the World where mountains made of porous rock (karst) combine with valleys (known as karst fields), massive surface and underground water flows and biodiversity. More details on this environmentally sensitive context available at: http://unesdoc.unesco.org/images/0018/001885/188582e.pdf

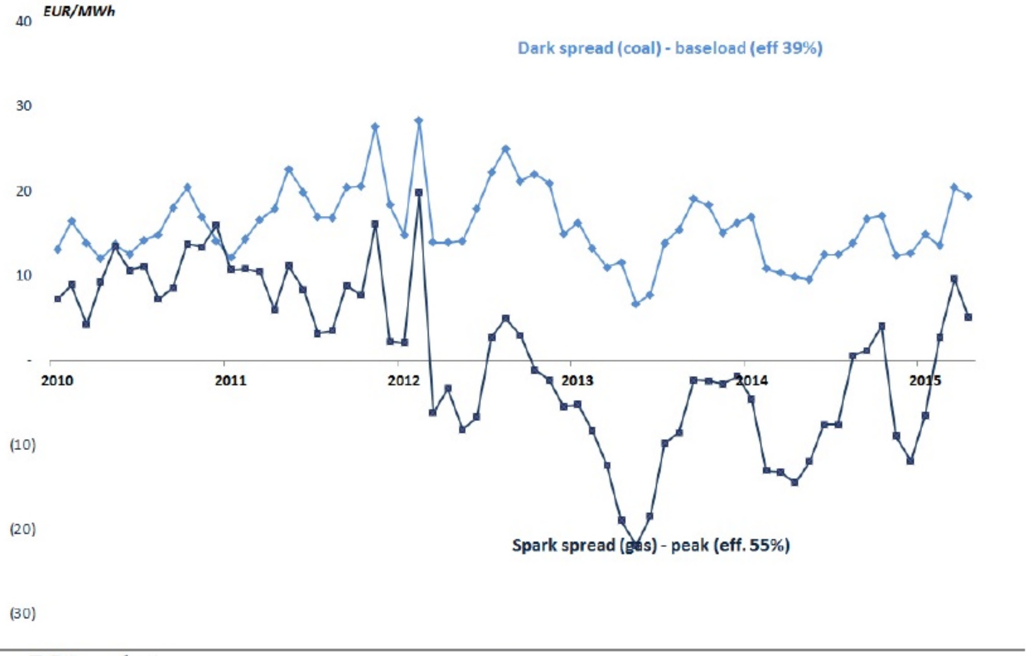
[115] Most lignite deposits are too small to support modern large plant sufficiently long to recover investments. Kosovo lignite resources are often considered as an investment option for large scale lignite-fired power plant. However, Kosovo lacks water resources and size of air-shed as well as size of power grid and back up capacity to support a large scale power plant.

[116] The well known ARA (Amsterdam-Rotterdam-Antwerp) coal price index is estimated to be about 50$/t or roughly 2$/GJ (compare to: http://bruegel.org/2015/12/when-will-the-eu-switch-away-from-coal/ and https://knoema.com/xfakeuc/coal-prices-long-term-forecast-to-2020-data-and-charts). The cost covering cost of lignite in Balkans is estimated at about 3.7 $/GJ or between 3.3-3.4€/GJ. One of the very rare reports on lignite mining indicates that cost range: http://www.parlamentfbih.gov.ba/dom_naroda/bos/parlament/propisi/El_materijali_2016/INFORMACIJA%20za%20parlament%20el.sektora_bos.pdf

Taking into account the relative efficiency of modern gas CCGT power plant compared with existing lignite-fired power plants available in SEE, as well as twice higher O&M costs of lignite combustion plants, it is to be considered that imported gas-to-electricity is competitive with lignite-to-electricity even without the introduction of CO^2 related costs This effect may increase further if or when existing power plants are equipped with flue gas desulphurization (FGD) plants that decrease actual efficiency of conventional pulverized lignite plants. Eventual price competition between LNG and Russian pipeline gas in this region may further affect the competitiveness of domestic lignite and economies that are dependent on electricity supply.

[117] https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3758164/192E17AC7BED4BDEE053C92FA8C0D198.PDF

Figure 9: Commercial spark and dark spreads



Source: ECA analysis

Source: https://www.energy community.org/portal/page/portal/ENC_HOME/DOCS/3758164/192E17AC7BED4BDEE053C92FA8C0D198.PDF , page 59.

Unfortunately, lignite-fired power plants available in the SEE are not demonstrating a baseload efficiency of 39% as indicated in Figure 9. Efficiencies that are attainable are between 28-34%[118] while most of plants from the 1970s and 1980s may achieve about 30% only[119].

There are very few published analyses on the impacts of power plant efficiency on power generation costs. Agios Dimitrios Power plant in Greece was analyzed from this perspective.

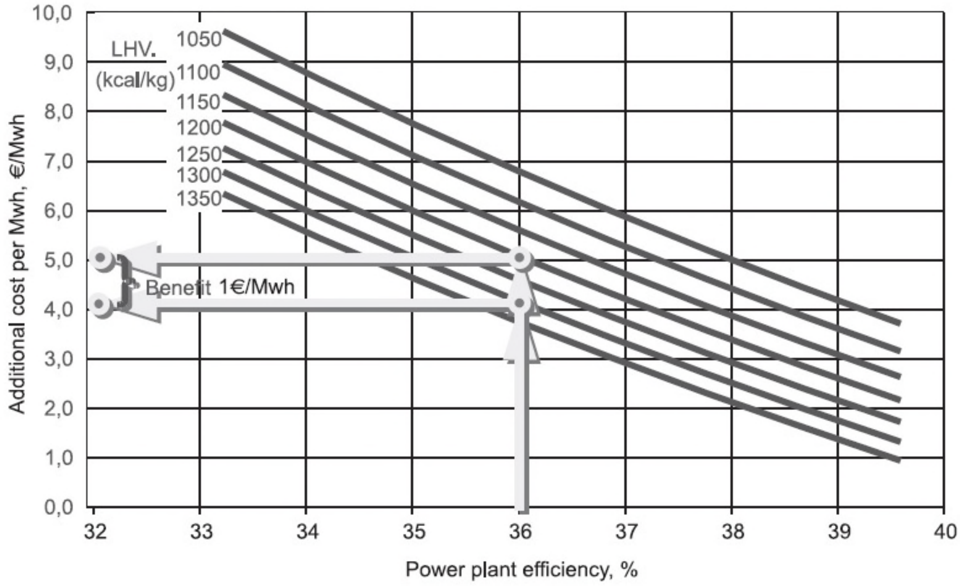
Figure 10: The effect of power plant efficiency and lower Heating Value (LHV) on the generation cost of Agios Dimitrios power plant.[120]

[118] When flue gas desulphurization and NOx control are added to existing plants, efficiency is likely to decrease to 26-32%, utilization rate and availability are likely to decrease due to increased complexity of plant and fixed O&M costs are likely to increase.

[119] One recent presentation (Mourtzikou, September 2106, page 7) indicates LNG import price to Greece at 15.6Euro/MWh, which is about 4.33Euro/GJ. Assuming that gas-to-electricity conversion is twice as efficient as lignite-to-electricity conversion and taking into account the larger operation and maintenance cost of lignite-fired plant in comparison to gas-fired plant, the competitive price of lignite should be well below 2 Euros/GJ. That price is, most likely, not achievable for almost all lignite mines in the region in the longer term. It may be achieved for a limited period of time with delay in overburden removal and significant risk to sustainability of operation. Alignment of existing lignite plants in the region with the EU environmental standards by simple flue gas desulphurization retrofit renders these plants uncompetitive.

[120] Agios Dimitrios power plant is a lignite-fired power plant comprising 5 units (2x300MW, 2x310MW, 1x350MW) built from 1984 to 1997 and recently upgraded to appropriate environmental standards. This plant represents the better portion of lignite power plants in the region in terms of efficiency and economy of scale. Therefore, efficiency penalties to other lignite fired plants in the region are likely to be more significant than demonstrated in this example. Following obligations from the EnCT, other plants are obliged to install flue gas desulphurization and NOx control (that increases operation and maintenance costs, complexity of the plant and CO_2 emissions per unit of energy) while CO_2 costs are inevitably going to be introduced.

Figure 10: The effect of power plant efficiency and Lower Heating value (*LHV)* on the generation cost of Agios Dimitrios power plant



Source: http://journals.bg.agh.edu.pl/GORNICTWO/2007-02/GG_2007_2_29.pdf

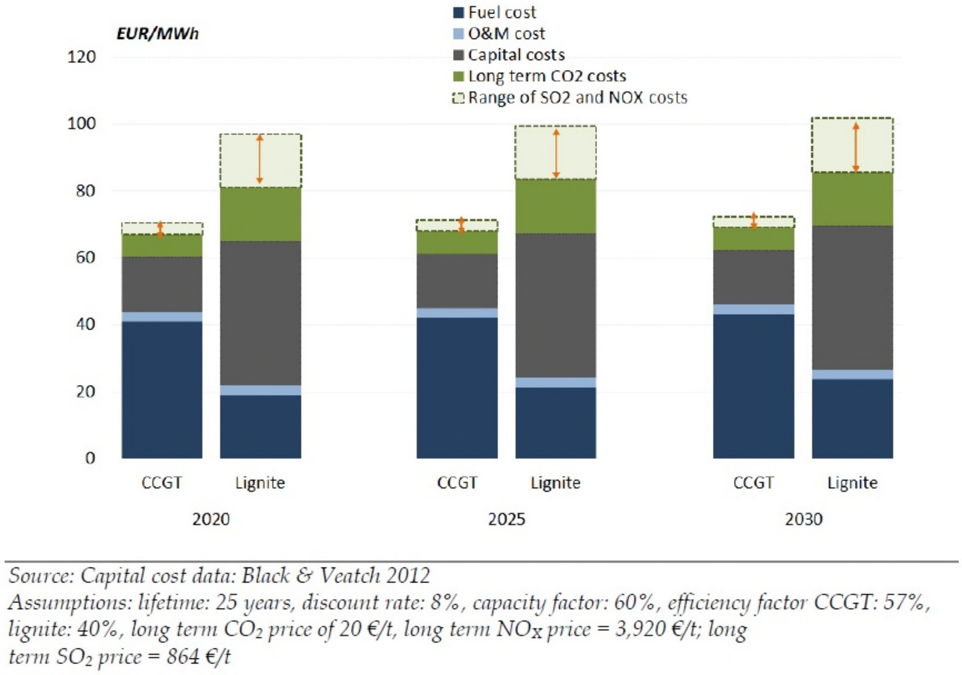
It is estimated that a decrease of 1% in base load efficiency increases cost by 1€/MWh. A drop in efficiency of 10% from 39% to 29% (estimated for existing plant fleet and with installation of flue gas desulphurization and NOx control) increases the cost by 10 €/MWh. At identical market prices (resulting from market liberalization envisaged by the EnCT), the brown spread diminishes to very close to the spark spread even if only marginal costs are considered.

Furthermore, decrease in quality of lignite and even volatility in lignite quality at the given average calorific value further decreases power generation efficiency. As lignite mines mature, lignite resources diminish in quality and demonstrate greater volatility in physical properties[121].

Comparison of new-build power plants provides as follows:

[121] The EnCT Secretariat recently opened the first case on the State Aid to lignite mines in the region: https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Dispute_Settlement/2014/11_14. The case indicates the inability of mines to cover growing costs of blending lignite (to cope with volatile quality) and land acquisition from actual revenues.

Figure 11: Electricity generation costs



Source: https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3758164/192E17AC7BED4BDEE053C92FA8C0D198.PDF , page 66[122]

Modern CCGT gas-fired power plants are more flexible and a lower capex proposition than modern lignite-fired power plants. A power market supplied by lignite-fired power plants is likely to require flexibility support from hydro power accumulation plants that are available in the SEE. However, flexible power capacity may be on demand in more liquid markets in Europe that may create high opportunity costs.

It is very difficult to envisage funding for new lignite-fired power plants (or even reconstruction of existing lignite-fired power plants) following the decisions of most international financial institutions active in the region to limit their exposure to coal and lignite investments as well as recent OECD export credit arrangements[123].

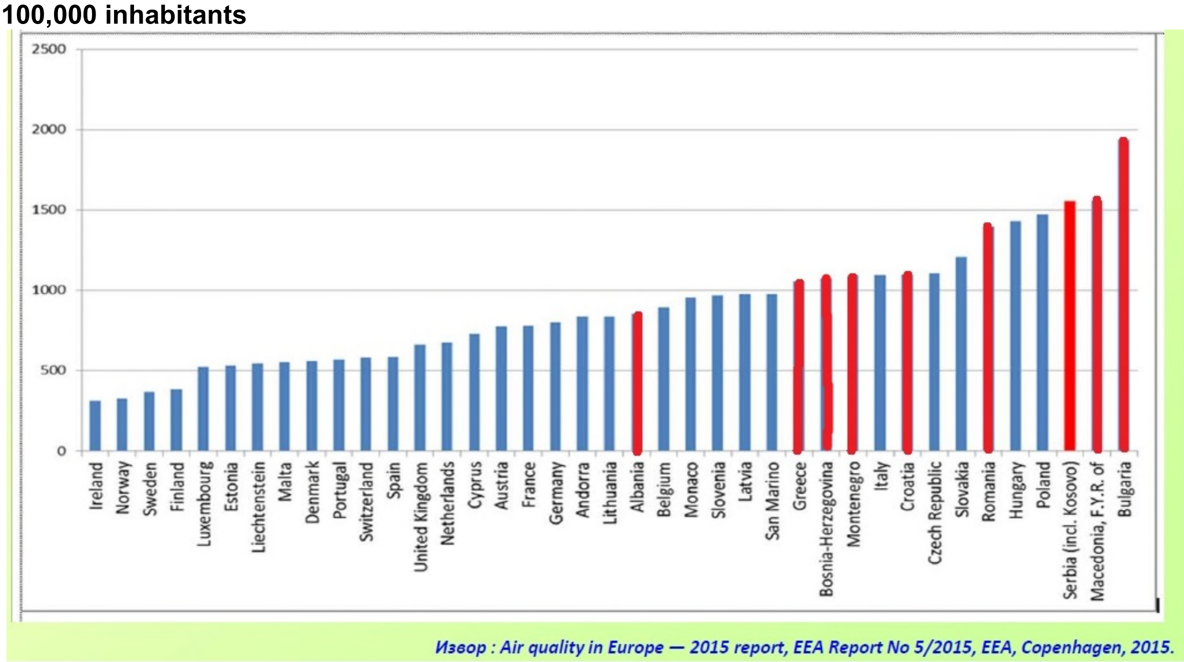
It is interesting to consider the structural relationship between gas market development and lignite extraction. Open cast mining of lignite requires continuous acquisition of vast areas of land. Shallow and thin layers of lignite in the Balkans could be accessed by mechanical disposal of overburden into old, exploited lignite fields or (if that is not practical) to green fields. Combustion of lignite results in large volumes of ash that need to be disposed of. Lignite deposits are typically located under arable land that historically attracted human settlements and infrastructure. Expropriation of private property is a critical prerequisite for lignite extraction. Government assisted expropriation is considered as state

[122] It is interesting to note that the report indicates CO_2 costs (that are not yet imposed to EnCT area) as more likely than SO_2 and NOx abatement costs (that are already envisaged by EnCT). This indication contributes to uncertainty on actual and timely enforcement of the EnCT rules to EnCT Contracting Parties. A long-term CO_2 price of 20€/MWh is to be considered as modest. 40% base load efficiency for new lignite-fired power plant, burning low quality lignite available in SEE and at the size below 500MWe, equipped with flue gas desulphurization and NOx control is a challenge within commercially available technologies. Larger units are hardly attainable in given market/grid/density of demand/size of lignite deposit/air shed circumstances.

[123] http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/PG(2015)9/FINAL&docLanguage=En

aid in EU legislation. German courts[124] recently indicated that interference with private property rights (where protection of property rights is a public good) is only possible on behalf of other public goods such as security of energy supply. In a similar way, lignite extraction in Serbia, Kosovo, Greece and Bulgaria is considered as critical for national energy security. Gas supply is usually considered as critical from a security of supply point of view. Consequently, if gas supply is arranged in a secure fashion, by traded markets and durable international arrangements (TTIP[125], intra OECD trade, or similar) it will be difficult to argue security of supply risk as the public interest sufficient to justify expropriation of private property rights and lignite combustion environmental impacts.

Figure 12: Health impacts attributable to $PM_{2.5}$[126] in 2012 in total years of life lost (YoLL) per 100,000 inhabitants



Source: Cited from Serbia Environmental Protection Agency and checked at original source table at EU EEA (Red highlights to indicate SEE countries by author)

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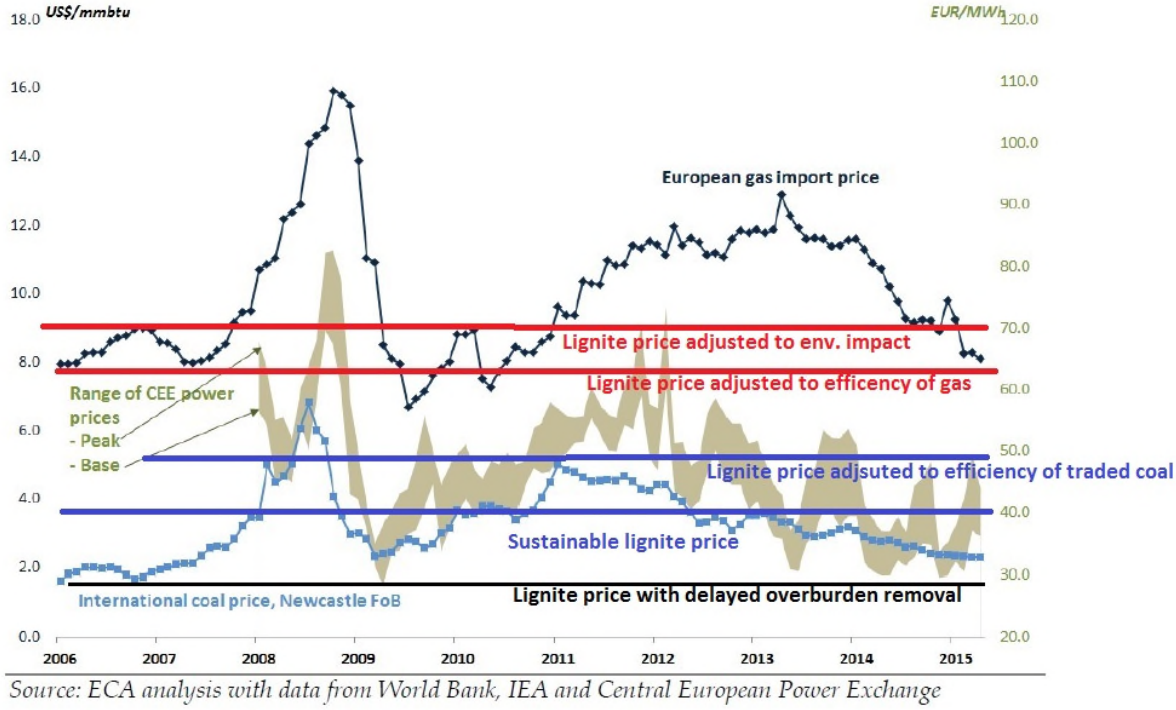
[124] http://www.spiegel.de/international/germany/german-court-to-rule-on-property-rights-in-brown-coal-mining-dispute-a-903642.html ; https://www.bundesverfassungsgericht.de/SharedDocs/Pressemitteilungen/EN/2013/bvg13-076.html ; http://www.dw.com/en/constitutional-court-clears-residents-complaint-on-garzweiler-ii-coal-plant/a-17304292

[125] Transatlantic Trade and Investment Partnership,

[126] Particulate matter less than 2.5 µm (PM_{25}). For detailed reference see: http://glossary.eea.europa.eu/terminology/concept_html?term=particulate%20matter

Figure 13: Lignite prices compared to traded coal, electricity and gas prices



Source: https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3758164/192E17AC7BED4BDEE053C92FA8C0D198.PDF, page 58. Lignite price estimates are provisionally estimated by Author

In the SEE governance landscape, expropriation of private property for lignite extraction and external costs of lignite combustion create various opportunities for resource rents that contribute to prolonged inadequate quality of governance. Therefore, a secure and commercial gas supply is perceived as an important aspect for the commercialization of the lignite industry and the phase out of public subsidies. It is considered that the competitiveness of lignite use for power generation will deteriorate when additional environmental costs, absence of government support for land expropriation and constraints of public funding are institutionalized. In other words, a 'level playing field' competitiveness of SEE lignite versus natural gas is not likely[127].

Lignite mines are significant electricity consumers in Serbia, Kosovo, Greece, Bulgaria and Romania. Closing these mines effectively decreases electricity demand and makes power markets more transparent. Conventional lignite extraction excludes coal-bed-methane (lignite-seam-methane) production. In many cases, methane from lignite seams escapes into the atmosphere contributing to the carbon footprint of SEE countries.

The integration into EU electricity markets envisaged by the EnCT, requires the application of the EU Emission Trading System (ETS) or any other similar climate change-related taxation system. Taking into account the relatively high carbon intensity of the predominantly lignite-based power generation

[127] Lignite may not be competitive versus gas imported from Russia if Gazprom becomes exposed to competition and is forced to adjust prices. However, in the case of Gazprom-dominated markets, investments in gas-fired power plants are going to be possible only for investors related to Gazprom. Insecurity of supply is therefore going to spread to another vital sector: power generation. That situation may result in diminishment of the capacity of the lignite industry to support a soft budget constraint system and decisive increase in dependence of monopolistic supplier.

industry, its low efficiency and high energy intensity of economy, the impact of CO^2 costs on the economy will increase as ETS unit CO^2 prices rise.

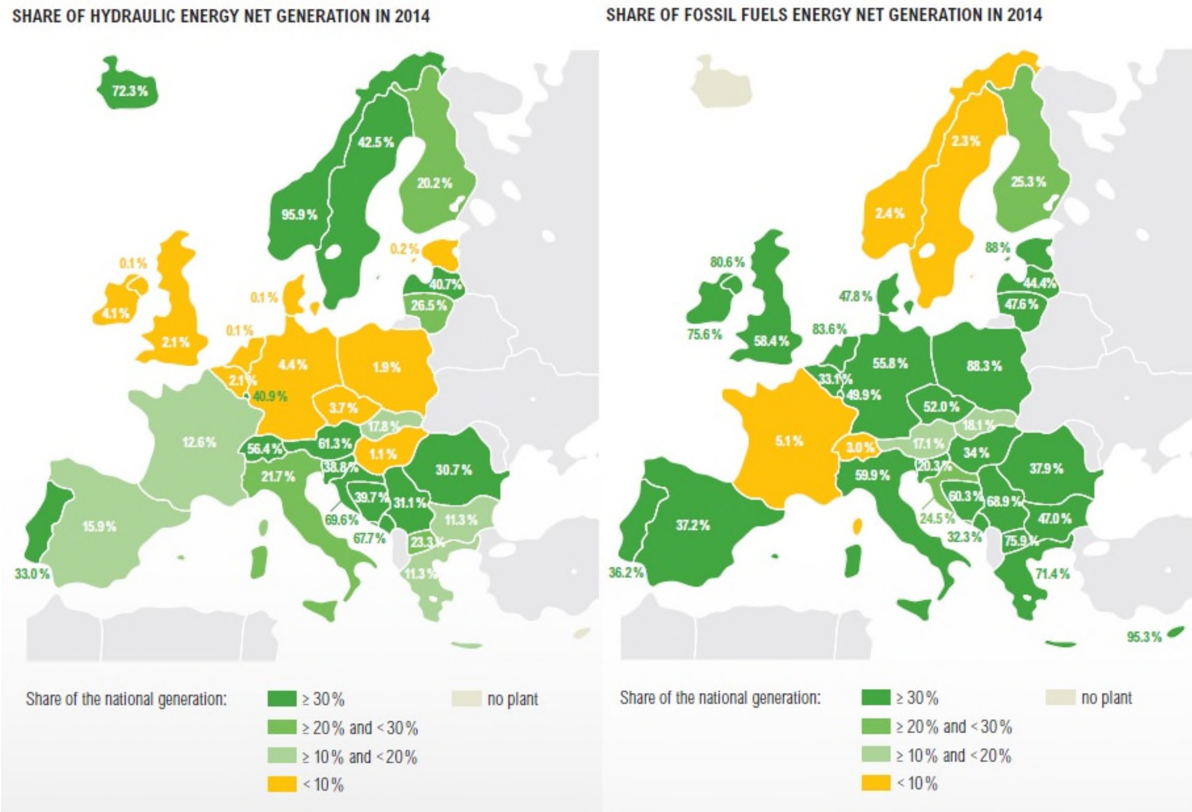
Table 9: CO_2 emission rights price estimate under EU ETS system

€/t	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Real ('14 euros)	7.8	11	13	14	14	15	17	19	20	22	24	25	26	28	29	30
Nominal	8.0	11	13	15	16	17	19	22	24	27	29	32	34	37	39	41

Source: Thomson Reuters, CARBON MARKET ANALYST, 2030 EU Carbon Price Forecast: What's next for the EU ETS, 2015

Minimal diversification of the power generation structures (even that of Romania and Bulgaria which are also served with nuclear power) indicates the relative size of risks if competitiveness of lignite power is lost.

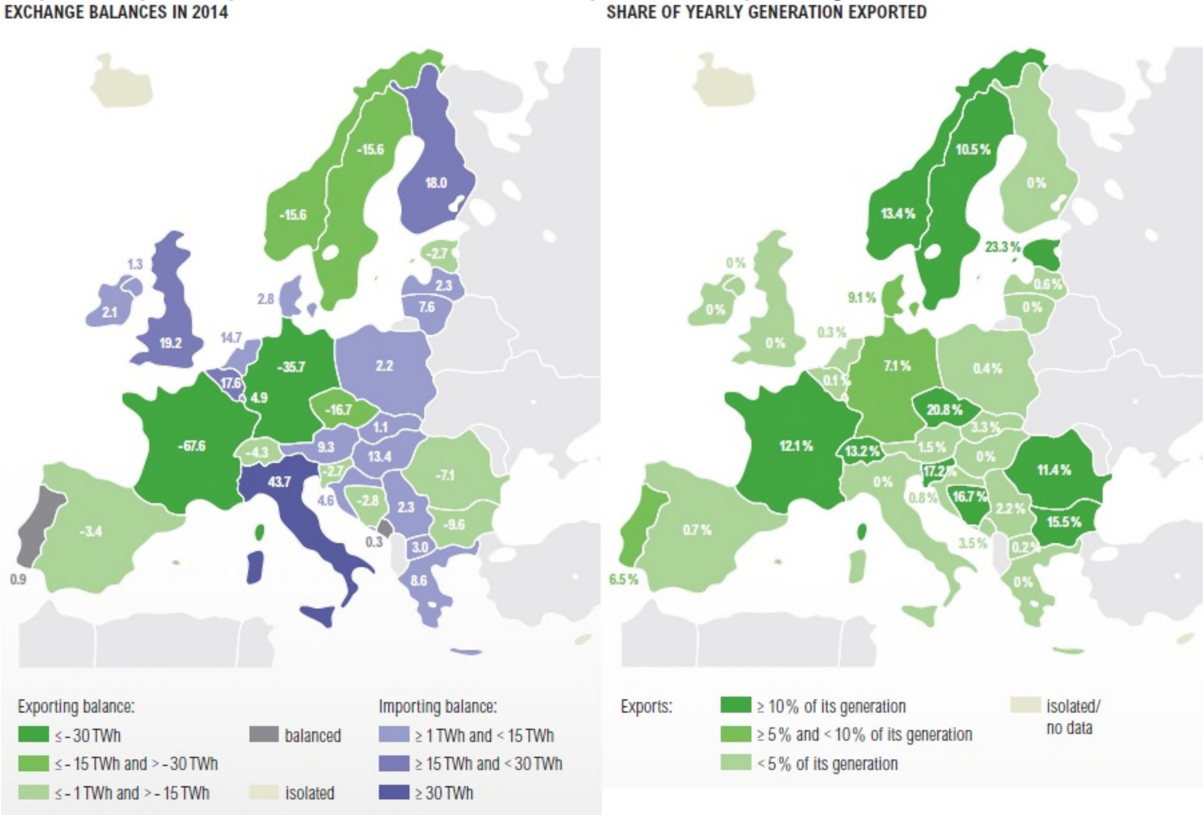
Map 20: Indication of net power generation structure in Europe



Source: TYNDP, 2015

Until the curtailment of nuclear energy and the deep de-carbonization of German power generation, there is an opportunity to import electricity from the oversupplied German (or French) market. Alternatively, the market may open to new private investments.

Map 21: Import/export balance and share of export in total power generation



Source: TYNDP, 2015

New power generation investments in the region may be based on local lignite, imported natural gas, biomass or other renewable energy. However, use of new hydro power resources is constrained by environmental concerns, cross border issues and change in water regimes following massive deforestation[128]. Combustion of lignite with its acid emissions contributes to deforestation, change in water regime and risk of flooding.

Despite optimistic projections of lignite production costs expressed in various national energy strategy documents[129], it is considered that the actual sustainable cost of extraction is between 3.3 and 3.4€/GJ, that is in line with actual achievements. Mines are mostly in a dilapidated condition, with significant delay in overburden removal accumulated over time, and require investment[130] to sustain them in operation for a longer period of time.

5.2.1 Chinese infrastructure investments

Following a high level political summit in Warsaw (2012) between China and 16 Central and South East European countries, China established a credit line of 10 billion USD to support Chinese business operations. It was followed by the establishment of the China–CEE Investment Fund (1.5

[128] The most recent demonstration of change in water regimes was major floods during May-June 2014.

[129] Author is aware of cost estimates between 1.3 and 2.5€/GJ. However, these costs never actually materialize within a comparable mining framework that includes commercial land procurement, land re-cultivation, flood risks, environmental protection and absence of state aid – all in line with the EU/EnCT regulation. No one country in the region applies UNECE guidelines to estimate low rank coal reserves that include economics of extraction.

[130] It is the last moment to fully apply "mining for closure" principles demonstrated in the UNEP study "Mining and Environment in the Western Balkans" in the www.envsec.org framework.

billion USD) to support private investments and a further 2 billion USD support for financial institutions from Central and South East Europe to access China bond markets[131]. China published a comprehensive investment and cooperation agenda for these investments[132]. It is considered that this agenda is harmonized with the U.S.-China Joint Presidential Statement on Climate Change[133] that aligns China investment activities in the energy and transport sector with the OECD export credit arrangements. This undertaking obviously serves a broad range of Chinese commercial and strategic interests including: efficient China–Europe transport, support for energy efficiency, renewable energy and forestry in order to decrease import dependence and moderate demand for internationally traded fuels. Chinese competition in industrial and energy intensive goods effectively decreases industrial energy demand in Europe. It is interesting to indicate that Chinese financial institutions invested in lignite-fired power plants in Serbia, Bosnia and Romania while investments in lignite-to-power projects[134] are not listed after November 2015 even while some large projects[135] are still in progress[136]. Alignment of Chinese investments[137] with EU regulations on competition, procurement and state aid remains a matter of concern.

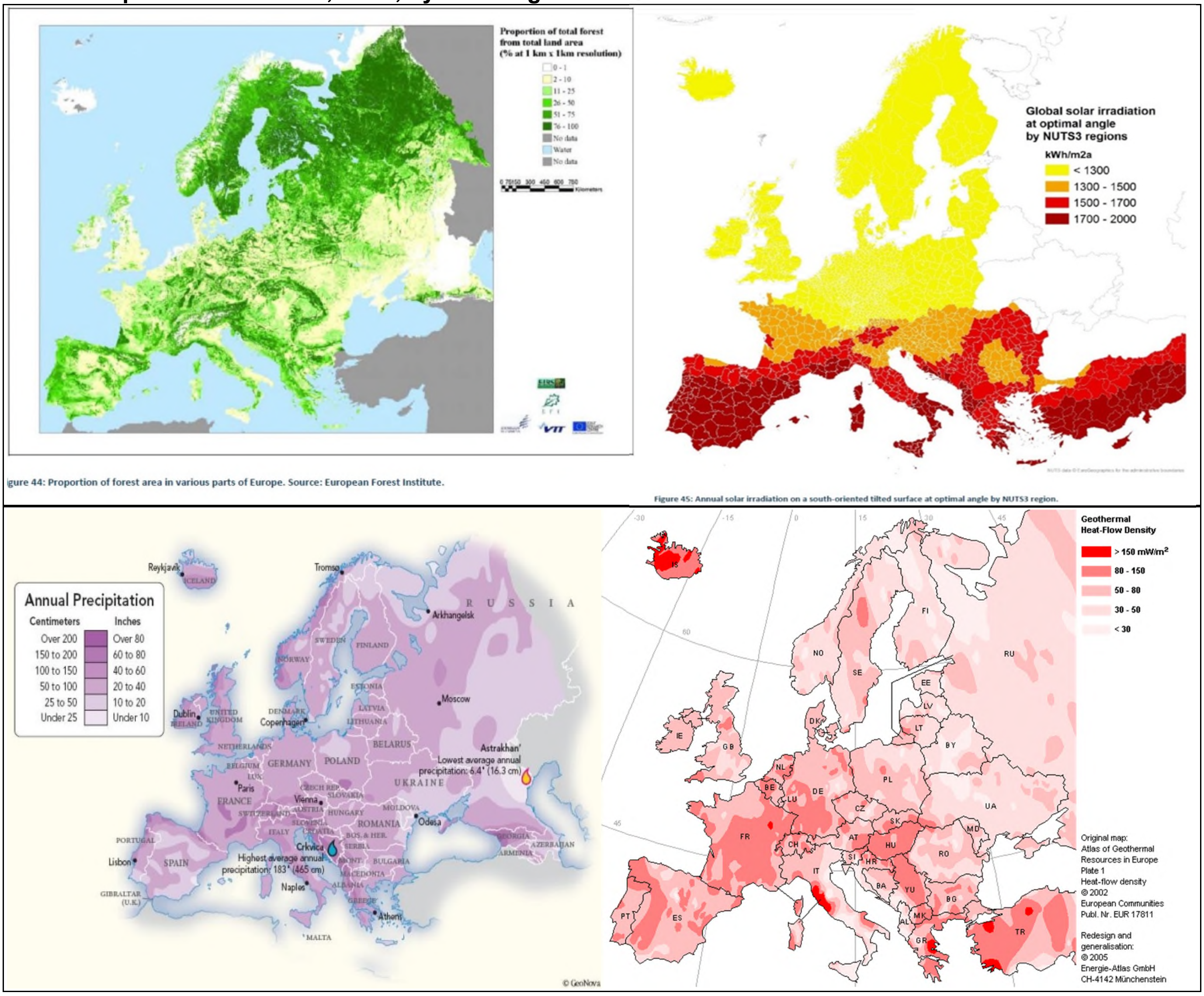
5.3 Gas – renewables

In contrast with fossil fuel resources, SEE is well supplied with renewable energy: hydro, geothermal, biomass, solar and, to some extent, wind. Its small density of population and minimal density of economic activity provides an encouraging environment for harvesting renewable energy.

It is not likely that natural gas is going to preserve its market share in heating (district heating, residential heating) services. This region is well supplied by geothermal resources, fuel wood and a climate that is suitable for air source heat pumps that are all more efficient heating options than natural gas boilers. For example, the use of gas for power generation in CHP and electricity to power air source heat pumps provides 2.7 times better COP[138] than using gas in residential gas boilers and almost 5 times better COP than burning gas in a heat-only-boiler (HoB) district heating system with variable load and devastated distribution infrastructure[139].

[131] More details at: http://online.wirtschaftsblatt.at/chinesischeinvestitionen/?page_id=547
[132] http://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1318038.shtml
[133] https://www.whitehouse.gov/the-press-office/2015/09/25/us-china-joint-presidential-statement-climate-change
[134] https://www.chinadialogue.net/blog/6794-Dirty-Bosnian-coal-plant-shows-holes-in-China-s-green-investment-drive/en
[135] Credit arrangements for new lignite-fired power plant Kostolac B3 (350MWe, over 700 million USD) in Serbia were ratified by Serbia's Parliament at the beginning of 2015, followed by a Serbian down payment.
[136] Conflict between China Ex-Im Bank's requirement for sovereign guarantee issued by host government on behalf of State Owned Company (SoE) and EU (and EnCT) regulation that limits state aid.
[137] http://www.cbrc.gov.cn/EngdocView.do?docID=3CE646AB629B46B9B533B1D8D9FF8C4A
[138] Coefficient of Performance (COP) is a common measurement of energy efficiency. It indicates the multiplier between fuel energy and useful heat produced. For example, an efficient gas boiler with 92% conversion efficiency is going to have a COP of 0.92.
[139] See Annex 2 for comparisons

Maps 22-25: Biomass, solar, hydro and geothermal resources



Source: EEA, European Commission

Conversion of heating services to renewable heat sources is the sort of demand destruction that is to be expected in the region if it is going to develop away from poverty. The use of imported fuel at low efficiency for purposes that do not result in export of goods and services indicates that the country is going to encounter a deficit in foreign trade. Seasonal differences in import volumes are likely to add disproportionally large imports costs due to poor utilization rate of import infrastructure. Relatively low energy efficiency in using expensive fuel is likely to hold back the export competitiveness of the economy and contributes to an increase in the trade deficit. The country will be forced to use other export revenue to cover both the deficit in efficiency and the deficit in trade volume causing poor terms of trade. If negative terms of trade occur in much of the economy, poverty is almost inevitable. On the contrary, shifting the use of imported fuel to sectors that result in competitive exports and an increase in its efficiency beyond the competitive threshold, causes a positive balance in terms of trade and poverty eradication. That is the effect of the switch in natural gas use from inefficient district heating to competitive transit transport services in the SEE.

In the longer term, SEE may emerge as an interesting market for bio-methane production. That would require gas infrastructure and a favourable investment climate as well as a ramp up in the intensity of land use that all depend on the availability and use of the natural gas in the near future.

Natural gas is considered as the marginal fuel determining the price of electricity in the region. In this context it is not going to be competitive with biomass[140] and hydro power[141]. However, natural gas is an enabling fuel to enhance the use of biomass and hydro power in the Balkans.

Natural gas for transport is likely to decrease the cost of harvesting and transporting biomass to large scale biomass-fired power plants. Natural gas power generation may provide load following features that could, in turn, release massive hydro accumulation resources to export markets.

Biomass resources in the Balkans stem from a need for systematic forest management. This resource is so sizeable that it could support biomass power generation for decades. However, biomass power generation capacity is limited and is to be considered as price-taking versus gas-to-power.

Due to its specific intermittency, solar and wind power are complements to natural gas.

Hydro power in the Western Balkans deserves special attention. It is the largest and yet to be fully utilized hydro resource in Europe. High levels of precipitation (moist Mediterranean air mass interacting with cold, forested mountains) condense at high altitudes, creating water flow to either the Danube or Adriatic – Ionian catchment area.

Table 10: Hydro power capacity and hydro power production estimates in Bosnia and Herzegovina, Croatia, Montenegro and Serbia

Capacity and energy	Year	HPP (Pi>10MW)	Small HPP	Pump Storage HPP	Total
Installed capacity of hydro power plants (MW)	2010	5997	112	1326	7135
	2020	7451	367	1326	9144
	2050	9780	665	5028	15473
Hydro power production estimate according to multiannual water flow (GWh)	2010	22130	381	1043	23554
	2020	26039	1190	1220	28449
	2050	33034	2006	6393	41433

Source: Author estimates assisted by Eduard Kotri[142]

[140] Biomass is the product of land and relatively limited labour and (depreciable) capital. Its variable cost of production is small and competitive with any imported fuel. Low cost of gas implies low cost of harvesting biomass assuming that gas is fuel for harvesting machinery and transport. Peacetime price of biomass co-integrates in the longer term with the price of substitute fuel (oil, coal or gas). (See for example: http://pub.epsilon.slu.se/8859/1/olsson_o_120509.pdf) In this paper the assumption is made that local (not tradeable) biomass energy (wood chips, agriculture biomass) could be used efficiently in large scale CHP plants with capex lower than lignite-fired plant and higher than gas CCGT. Such CHP will have a higher heat utilization rate but lower power generation efficiency than CCGT. Local biomass provides local employment and enhances the local economy. Its use does not need a balancing of international trade position. Its price will be derived from the price of electricity (set by marginal power generation) and efficiency of conversion. Efficiency of biomass-to-power conversion is considered more efficient than lignite-to-power conversion in existing plants and comparable with most modern large scale lignite-to-power plants. Price distortions caused by public subsidies for small scale biomass-to-power are not considered in this context. Assumptions are based on open market pricing. In the longer term, biomass energy carbon capture and storage (BECCS) is considered to be more effective than CCGT with CCS due to higher CO^2 concentration in the flue gas. Biomass-to-power-to-heat provides a COP (coefficient of performance) of 2.3 and gas-to-power-to-heat provides COP of 2.7 using modern heat pumps in both options. Therefore, gas is going to have higher efficiency for the same heating duty but local fuel has an advantage in providing a local (non-exportable) service. With a relative abundance of land in comparison with density of economic activity in the Balkans, it is to be considered that the price of biomass for power generation will be adjusted to allow power and heat generation competitive with imported natural gas.

[141] Only existing hydro power plants and extensions of existing hydro power plants are considered here.

Water flow is, however, volatile and flooding has increased. During periods of maximum water inflow, hydro power plants are forced to maximize production regardless of market demand and price levels. The efficiency of water flow-to-electricity conversion is optimal at a flow range that is normally designed according to historical flow data. At minimal and maximal flow, efficiency is diminished. If water flow is beyond the designed maximum, hydro energy is lost by overflow. The contrast between floods and droughts increases with deforestation[143]. Such changes resulted in the massive Iron Gates dam and lake[144] being insufficient to maintain the most favorable navigation conditions on the lower Danube.

During high water inflow periods, hydro power[145] production displaces thermal power capacity from the market, decreasing the utilization rate of transmission assets while increasing unit electricity costs from these assets. Massive reforestation and the displacement of surplus electricity production during peak water inflow are critical prerequisites to enable investments in new (biomass and natural gas) thermal power capacity in SEE. As already indicated, LNG fuel may support a ramp up in forestry operations and increase the competitiveness of large scale biomass-to-power investments.

An interesting option to make use of surplus hydro power during Spring/Autumn is to power the compressors of underground gas stores. Assuming that gas discharge from storage is equipped with turbo-expanders some of this electricity may be recovered during peak demand periods by discharging gas. In the future, where gas is proportionally more used for power generation, it is to be assumed that peak demand for gas corresponds with peak demand for electricity. For this purpose, the Pannonian area in Croatia and Serbia provide ample underground storage development potential along with the salt cavern in Bosnia. It is assumed that 3bcm of underground gas storage capacity with appropriate electrical compressor/turbo-expander capacity will be sufficient to convert 16TWh of low cost flood and off peak hydro power into over 12TWh of valuable peak electricity. Combined with over 18TWh of peak hydroelectricity that may result from the development of existing hydro potential and 3bcm of gas available as peak supply, this volume of energy becomes the (renewable and sustainable) equivalent of about 8bcm of peak gas capacity currently available from the Groningen field in the Netherlands that is depleting over time. This volume of energy is to be considered as an interesting and strategically important addition to European flexible power capacity that may facilitate massive deployment of intermittent renewable energy across Central Europe.

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[142] Estimates are based on a background document produced for forthcoming publication: “Prosperity by other means” drafted by the Author. Eduard Kotri was a leading hydro power expert in former Yugoslavia and long term Chairman of the Energy Industry Cluster at the Chamber of Commerce in Former Yugoslavia. New hydro power capacity is estimated without further impacts on natural water flows.

[143] It is estimated that one grown beech tree conserves about nine times more water than shrubbery or grassland. Although the Western Balkans remains among the most forested areas in Europe, loss of forest quality (height and percentage of grown trees) during 1992-2015 is enormous and accounts for millions of hectares.

[144] http://www.britannica.com/place/Iron-Gate#ref868881

[145] Hydro power peaking capacity was used during 1972-1992 to deliver peak electricity and ancillary services to the European market and for arbitration opportunities in trading electricity between Central, Eastern and Western Europe. Displacing this energy allowed for market leading performance of thermal power within Western Europe interconnection. Former Yugoslavia exercised an advanced capacity and commodity electricity market. Following disintegration of Yugoslavia, hydro power resources turned into a cross border and almost entirely disputed resource. It was displaced from the international market and underutilized to date. International assistance to the Western Balkans missed providing an effective solution for this loss of resources. An immediate consequence was shortage of variable capacity in Ukraine that prompted use of gas transmission assets to facilitate flexibility and caused structural problem in security of gas transit via Ukraine. For further details on proliferation of this problem see: “The Concept of Interconnector in the Context of the Energy Community Treaty”, Branislava Lepotić Kovačević and Aleksandar Kovačević in “The Energy Community. A New Energy Governance System” Dirk Buschle and Kim Talus (eds.), Intersentia, 2015.

5.4 Gas-to-gas competition

Although a lot of time and effort is spent in implementing EU market liberalization in the region, countries in the SEE remain served by national gas companies and their spin-off transmission system operators. Somewhat more diversification is available to the Romania market where private investors are involved in trade and distribution. Domestic transmission system operators remain state owned and served by national regulatory institutions.

Transmission system operators prefer to serve high priority demand (district heating, residential heating, fertilizers) with strong seasonality, strong weather sensitivity and low efficiency. This form of demand provides the best cost–benefit for the state owned TSO: minimal annual gas demand and maximal peak demand as well as maximum security of supply concern. This situation prompts public investments in additional transmission capacity at minimal overall capacity utilization that allows regular operation at reduced pressure and minimal maintenance costs. The only way to serve this kind of demand is if supply is accompanied with some sort of subsidy and soft budget constraint. Therefore, state owned TSOs in the region have an obvious preference for the incumbent monopoly supplier. If that supplier has a vested interest in facilitating (excessive) soft budget constraint toward the least efficient consumers it forms the perfect match with the state owned TSO. Such a TSO has very little interest in gas-to-gas competition: potential supply competitors are likely to target the most efficient customers they can; these customers are likely to require a high standard of service that entails higher maintenance costs while these customers are looking to minimize transmission fees.

Construction of new large gas transit infrastructure targeting customers in other countries (with promise of margins on construction works and transit rents) is another desired scenario: it does not disrupt the domestic status quo, it increases scope for budget constraint to domestic customers and it provides opportunity for transit rents.

The potential effective engagement of the domestic state owned TSO in the facilitation of gas-to-gas competition is going to be fairly awkward: that is going to be a bid with negative return.

For that reason efforts to liberalize markets are very much focused on Governments that own TSOs and that may – in theory – have a preference to build up a liberalized market as a common public good[146].

However, the assumption is made that growing effective gas–to–gas competition in this region requires genuine private commercial engagement. Geographical location and availability of different gas suppliers and rudimentary but growing commercial gas demand provide an opportunity for attractive market formation.

Different pipeline gas supply options to the region have different price signals (see map 9 above. Large parts of these supply options are bound into long term contracts and not directly available to the market. SEE could be supplied through Turkey, Hungary or Italy. Any of these transit countries are likely to retain and use the most economical gas supplies that may prompt some sellers to dedicate some gas supplies to SEE but only in the case that SEE provides a liquid demand opportunity.

In other words, the formation of pipeline gas to pipeline gas competition in SEE depends on the liquidity of the market established in the region.

The most interesting competition points could be identified as follows:

[146] See for example: http://www.reuters.com/article/serbia-gas-idUSL5N16T4C2

- Russian gas versus Caspian gas from the Turkey corridor in Bulgaria: Bulgaria is likely to obtain sufficient pipeline capacity from the direction of Turkey to cover its gas demand versus Russian supplies through Ukraine or South Stream.
- TAP versus Russian gas (through Ukraine or South Stream) in Greece. DESFA that is owned by Azeri interests is, at the same time, partner with Gazprom in delivering Russian gas to Greece.
- TAP (via Adriatic Ionian link) versus Russian gas (through Ukraine and Hungary or South Stream) in Croatia
- Latent competition between the Turkish Corridor and Russian gas in Serbia, Macedonia, Kosovo or Bosnia and Herzegovina
- Latent competition between Italian pipeline gas (produced off shore between Croatia and Italy) and Russian Supplies to Croatia.

A special aspect of gas-to–gas competition is competition between fertilizers and chemicals produced from imported gas versus imported fertilizers and chemicals produced near the source of gas. It is obvious, in the case of SEE, that fertilizers and chemicals produced near the source of gas will have favorable economies of scale.

Transport costs of fertilizers and chemicals from production plants to the consumption area in SEE (mostly likely the Pannonia plain) are relatively modest as ports, railways and Danube inland shipping are all readily available. Use of LNG as a transport fuel is likely to reduce transport costs even further and make local production mostly uncompetitive. That is likely to decrease regional demand for gas to industry and increase transport fuel demand. This shift plays in favor of LNG versus pipeline gas.

Buyers are able to procure LNG on the international LNG market where LNG-to-LNG competition is well established. The small SEE market is likely to be a price taker in this context. The LNG import price is likely to determine regional pricing of LNG from CBM and LNG for transport and create a price cap on pipeline gas as soon as sufficient LNG import capacity is available. In a similar manner Mediterranean (international) LNG is going to create a price cap over indigenous Black Sea LNG supply.

Direct competition between LNG and pipeline gas is possible at places where:

a) **LNG is re-gasified into pipeline gas**: That includes all LNG re-gas terminals (including especially Floating Storage and Re-gas Units – FSRU) that are connected to gas pipeline grids and feed gas into the grid. The assumption is that gas is inserted into the grid at appropriate pressure and therefore FSRU adds functionality to the grid.

b) **LNG is directly used instead of pipeline gas**: Two main uses include power generation and prime movers (including stationary motors). LNG adds efficiency of effective cooling to power generation facilities (CCGT, GT open cycle, fuel cells) or engines. It also facilitates great flexibility of power generation, separating power plants from limitations of gas grids.

c) **Pipeline gas is liquefied into LNG**: Any larger scale liquefaction of pipeline gas near demand centres is likely to cause environmental concerns. Therefore this option is not considered. Gas liquefaction is an option to bring coal bed methane (CBM) directly to the market that is similar to b). Some CBM schemes might have a choice between feed into pipeline and liquefaction. That situation is going to be determined by LNG or pipeline gas market margins, i.e. linked to competition between pipeline gas and LNG.

d) **LNG is gasified into CNG and pipeline gas is compressed into CNG**: Both LNG and pipeline gas may produce CNG at the point of consumption. This situation is equivalent to case b).

6. Black Sea & Balkans (BS&B) gas hub in a Carbon Constrained World

> "European history has shown that unification has never been achieved by primarily administrative procedures. It has required a unifier – Prussia in Germany, Piedmont in Italy – without whose leadership (and willingness to create *faits accomplis*) unification would have remained stillborn"
>
> Henry Kissinger "World Order", Penguin, 2014

In many aspects, a trading gas hub in the SEE may be formed by *faits accomplis,* but not in the way that the North West European hubs developed. While all the countries in the region have made political expressions that they would like to host a "hub", the concept is that a "hub"[147] is a form of mechanism to extract transit rents. This would be an extension of the large transit infrastructure projects and would follow from a desire to cluster more than two large projects in the territory of someone's polity.

In this environment, commercial trade at minimal transaction costs may emerge only below the political radar: surprising everybody and making the entire undertaking effectively a *fait accompli*. That would require a bold and powerful group of commercial investors. Assuming that something like that is possible, the following specification of the trading hub may be considered:

It would be possible to imagine a new gas hub in SE Europe that would build upon trading opportunities facilitated by the:

- Southern Gas Corridor,
- North – South Corridor
- Enlargement of the Suez Canal
- Emergence of renewable energy sources in South Eastern Europe and elsewhere in Europe.
- LNG import terminals
- LNG supply across the Black Sea and along the Danube River
- Existing gas supply options via Ukraine to Croatia, Serbia, and Romania
- Domestic gas production in the SEE
- Underground storage potential in the SEE

There are seven distinct sources of natural gas that may be delivered to SEE including:

1) Russian pipeline gas via Ukraine that is likely to be under the control of Gazprom,
2) Russian LNG delivered across the Black Sea to ports on the Western side of the Black Sea and into the River Danube that may comprise gas owned by various Russian producers and traders,
3) Atlantic LNG delivered to LNG terminals at Thessaloniki, Athens, along the Adriatic coast and in the Kvarner Bay in Croatia,
4) Qatari and other Middle East or East Africa LNG as well as East Mediterranean LNG delivered to the same LNG import terminals as in 3.
5) Central Asia and Caspian pipeline gas delivered to SEE (Bulgaria and Greece) via Turkey,

[147] https://www.stratfor.com/the-hub/elusiveness-south-east-european-natural-gas-hubs
http://www.europeanenergyreview.eu/emerging-gas-hubs-in-southeast-europe-and-the-east-med-a-reality-check/
http://www.eiranews.com/index.php/en/past-issues/52-volume-3-issue-4/1075-greece-as-key-gas-hub-in-southern-europe-but-then-russia-is-unavoidable

6) Caspian LNG delivered as pipeline gas to a Georgian port and transported across the Black Sea as LNG to ports on the Western side of the Black Sea and in the River Danube,
7) Gas production within SEE

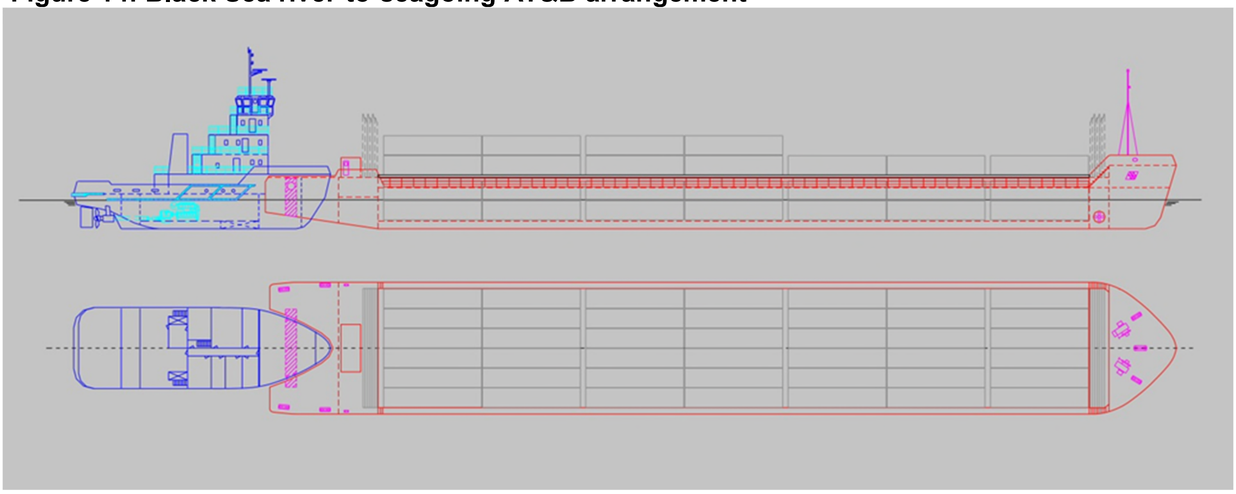
All these enable trade with other European gas markets.

These distinct gas sources can be grouped according to their netback cost characteristics and form seven different clusters of gas supply options. Each option is led by a large supplier that sets up the cost structure and pricing framework. Interaction between these different supply options may derive from the interplay between physical deliveries assuming that a trading facility is available.

The eventual construction of a small scale navigable Istanbul channel would provide an opportunity to trade LNG between the Black Sea and Mediterranean as well as trading LNG versus pipeline gas. This is likely to emerge as a very interesting trading location and its importance for the Turkish market may grow. However, that is beyond the scope of this paper.

The sizing of the Istanbul Channel requires adequate standardization of the Black Sea river-to-seagoing fleet, to provide the widest possible catchment area for the fleet. Modern Articulated Tug & Barge (AT&B) standard provides a very appropriate option.

Figure 14: Black Sea river-to-seagoing AT&B arrangement[148]



Source: Author estimate assisted by the Belgrade Shipyard Naval Architecture bureau

With three distinct sources of LNG and a number of delivery/demand points, the Black Sea may grow into a market in its own right. Deliveries to coastal demand points in Romania and Bulgaria may provide interesting diversification options to these national markets. LNG shipping across Black Sea would provide an effective price cap over excessive transit rents for pipeline gas. However, Black Sea LNG has to be connected with LNG from open seas and in somewhat larger scale in order to play its role in an effective way.

The Russian mercantile exchange[149] and recent Gazprom gas auctions potentially indicate a certain openness for commercial trade and transparency. If that policy is eventually extended to the Black

[148] The figure demonstrates a standard US (coast, Great Lakes, Mississippi, Tennessee) AT&B (Articulated Tug & Barge) solution adjusted to the Lower Danube – Dniepr – Volga- Don – Caspian Sea locks and navigation conditions and using a standard tug delivered from the Belgrade shipyard to the Port of Novorossiysk, the largest oil export terminal on the Black Sea. The container barge is dimensioned to the Volga – Don - Danube standard. Its estimated capacity will be over 8,000m^3 of LNG. Standardization is intended to decrease unit costs and align transport costs to the open sea LNG trade.

Sea the Black Sea area may acquire a tool to optimize between pipeline gas sales and LNG sales. Similar logic applies to the Caspian gas. Gas liquefaction on the Eastern side of the Black Sea would provide an opportunity for carbon capture and storage and enhanced oil and gas recovery arrangements[150].

There is available underground gas storage development potential accompanied with low cost and renewable (hydro) energy to operate gas stores. The availability of (hydro) energy indicates that storage injection will be more probable during Spring/Autumn periods that are off-season in comparison with other markets in Central Europe (predominant Winter season) and Southern markets (Italy, Greece, Turkey) where Summer demand is enhanced by the tourism season and air conditioning. Furthermore, the use of storage and supply from low cost floating LNG infrastructure as well as plenty of interconnector capacity would allow very flexible peak supply.

Therefore, the BS&B Gas Hub is to be envisaged as a physical hub that is distinguished from existing gas infrastructure and local gas markets with regulated prices as well as existing long term supply contracts. It would serve an entirely liberalized transport fuel market that was physically constrained to allow access of international market players. It would be established by private commercial players that are granted the rights needed to acquire, build and operate appropriate physical infrastructure by more than two governments, observed by the European Commission and supported by international financial institutions. Its operation would be in compliance with the EU Third Energy Package. It would facilitate trade in gas and various related commodities and securities.

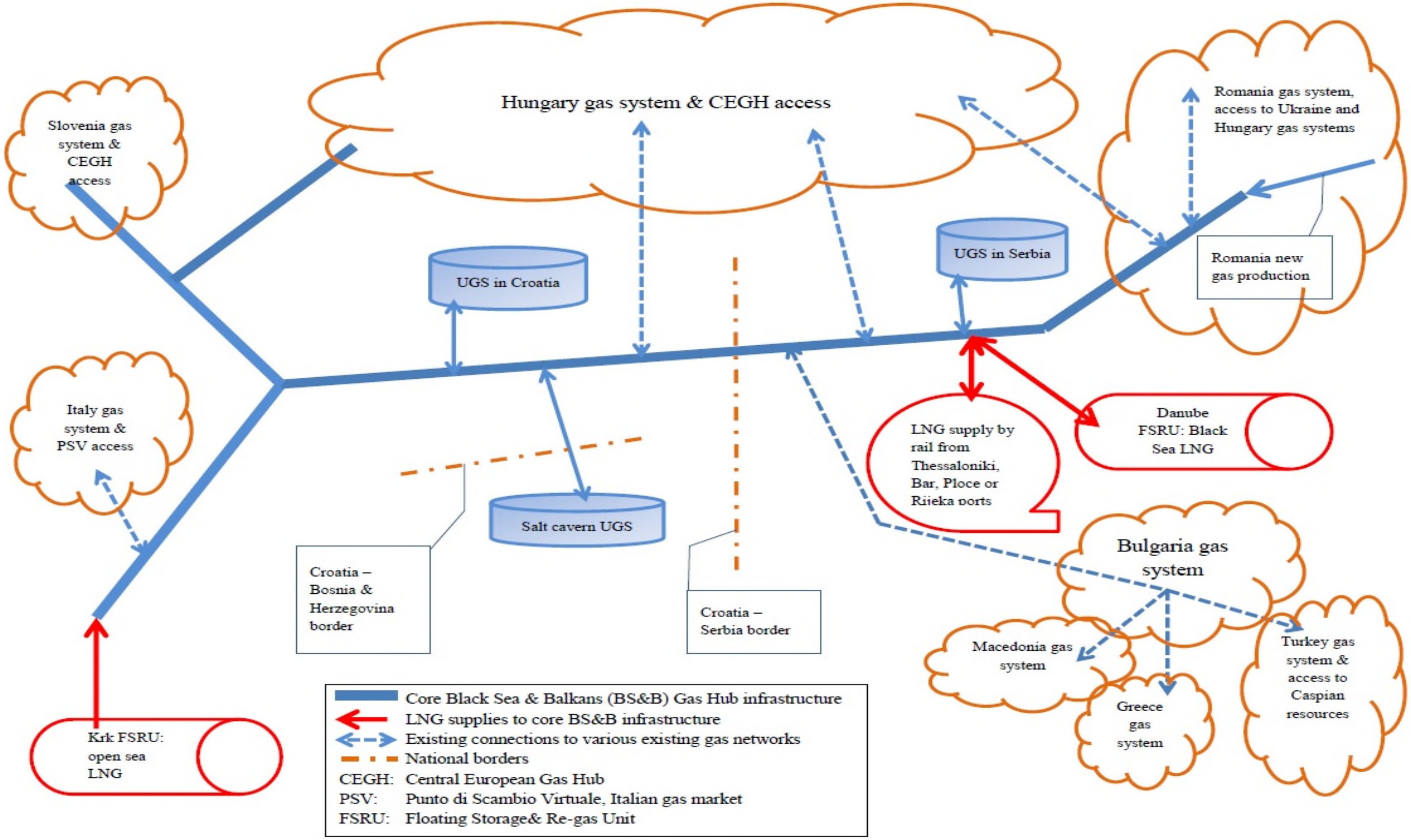
The BS&B Gas Hub would be established by the acquisition of the Adria oil pipeline infrastructure (apart from oil and oil product storage capacity) from Government owned companies in Croatia and Serbia and conversion of that pipeline into a gas pipeline and its extension toward and connection to the Romanian gas system. It would be accompanied by UGS and salt cavern storage capacity in Bosnia and Herzegovina, Croatia and Serbia as well as linkages to existing gas infrastructure in the region. It would also be supplied by two or more Floating Storage and Re-gas Units (FSRU) located in the Rijeka Port Area and JANAF Oil terminal at Island Krk as well as an FSRU located on the Danube River downstream from Belgrade. These FSRUs would be equipped with large scale ISO container loading facilities, railway and highway access. The total (multiple) pipeline delivery capacity toward Central Europe would exceed 24bcm/year equivalent capacity while its capacity to deliver LNG in containers would be in millions of tonnes/year.

A Schematic presentation of the BS&B Gas Hub infrastructure is shown in Figure 15:

[149] http://spimex.com/en/

[150] The liquefaction process effectively decreases carbon content of LNG in comparison with its gas feedstock and provides opportunity for carbon capture. Potential to use captured CO^2 in enhanced oil and gas recovery is far larger in the Former Soviet Union than in Europe. See for example: http://www.ieaghg.org/docs/General_Docs/Reports/2009-12.pdf, page 45. As a consequence, energy delivered in form of LNG is going to be less carbon intensive than the same volume of energy delivered in the form of pipeline gas.

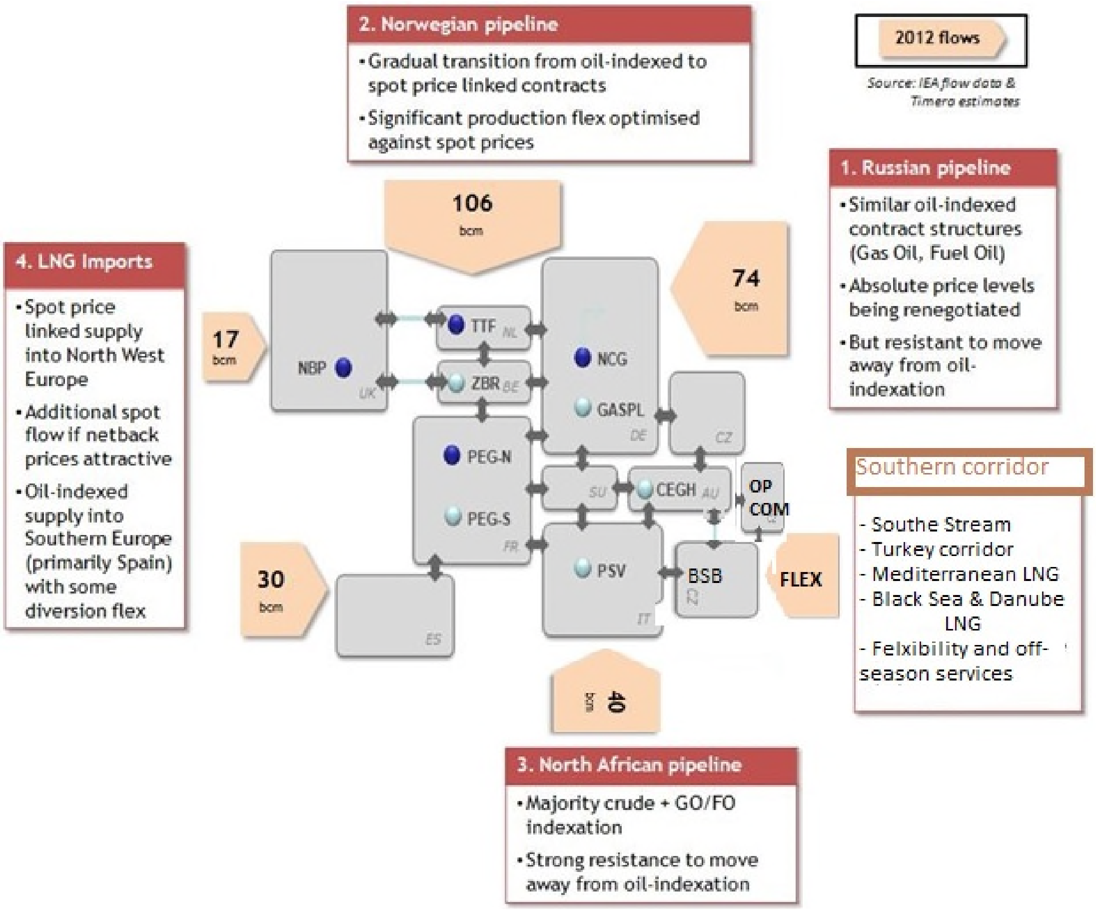
Figure 15: Black Sea & Balkans (BS&B) Gas Hub



Source: Author estimate

The Black Sea & Balkans (BSB) gas hub would integrate with existing European gas hubs as demonstrated in Figure 16:

Figure 16: Black Sea & Balkans (BSB) gas hub could be introduced as follows:



Source: Author estimate based on Timera

The specification of Black Sea & Balkans (BSB) Gas Hub trade practice would be supported by a comprehensive trading platform and allow OTC ("over the counter") trade.

Table 11: Black Sea & Balkans (BSB) Gas Hub summary

Demand		Supply
Commodities		**Commodities**
LNG container		LNG container
Natural gas		Natural gas
Ammonia		Ammonia
Fertilizers		Fertilizers
Electricity		Electricity
Gas & Power bundle		Gas & Power bundle
Capacity		**Capacity**
LNG Storage		LNG Storage
LNG re-gas capacity	**TRADE**	LNG re-gas capacity
Underground gas storage (UGS)		Underground gas storage (UGS)
Gas-to-power capacity		Gas-to-power capacity
Gas pipeline interconnector capacity		Gas pipeline interconnector capacity
Securities		**Securities**
Hydro Power Bonds		Hydro Power Bonds
Futures & Options		Futures & Options
Gas & Power trade bonds		Gas & Power trade bonds
LNG Trade Bonds		LNG Trade Bonds
BSB Gas Price Index: Weighted average price of all natural gas and LNG sales during given period of time		
BSB Gas-to-Market Index: Average cost to bring MWh (MMBTU) of LNG to the BSB market		
BSB Fertilizer Price Indexes		

It is interesting to contemplate the pricing dynamics that may affect the BS&B gas hub price level and formation. US LNG would likely be diverted to this hub as soon as it offers sales prices above NBP or TTF. This opportunity is likely to create an effective price cap over excessive pricing from any other source of gas available to the hub, and would contribute to the alignment of pricing between BS&B and NBP/TTF. Trading gas at peak demand may provide a premium to investors in that trade, but the premium would be limited by competition at CEGH, PSV and OPCOM and the ability of that competition to respond to demand. Hub-to-hub competition is a form of market coupling that would produce alignment of prices.

Another interesting question is the impact on incumbent monopolies and market practices. LNG is a competitive fuel in the transport fuel AND stationary use gas market[151]. It affects the competitiveness of crude oil imported into Central Europe. Assuming that the BS&B gas hub commercial structure is strong enough to sustain political risks within the first years, it would break most existing barriers to entry. Incumbent players would be forced to abandon soft budget constraint practices as local consumers are likely to use interest free loans to buy gas from the hub as soon as there is an opportunity. Effectively, incumbents would be exposed to hub pricing without using hub services and opportunities which would be suboptimal. The use of hub services would allow the optimization of sales in the context of a new and emerging European gas market increasingly served by renewable energy.

[151] Therefore, LNG trade affects oil products and pipeline gas simultaneously as is required to impact the Dixit-Stiglitz monopoly arrangements discussed earlier.

The prospect of hardening budget constraints would force inefficient customers to switch away from natural gas and/or to improve energy efficiency. That is key for the improvement in security of supply and allows diversification of supply sources through hub trade. The BS&B Gas Hub development also justifies investments in underground gas storage that increase storage capacity to minimal European levels and the integration of fragmented gas systems across the region.

6.1.1 In search of "anchor load"

It is interesting that promoters of various large scale gas transit projects are all looking to new or modified demand to justify new investments. Projects promoted by Gazprom are justified by existing demand while an assumption is made that gas supply will be diverted from existing supply routes (Ukraine) and supplied via these new alternative routes. There is little change assumed in the structure of demand while the proposed investment raises expectations among transit host governments of immediate gains in terms of employment, GDP formation and currency appreciation. These short term gains may cause some increase in gas demand.

Projects promoted within the EnCT framework[152] are for gas-to-power and retail gas distribution. While it is obvious that in the context of the current international energy market, gas-to-power is to be considered as the least cost option compared with the lignite-to-power option, it is very difficult to understand how SEE countries are going to build up the export competitiveness required in order to earn hard currency to become able to import the increased volumes of natural gas[153] required to offset the decline in lignite power generation. It is not easy to imagine a gas supply arrangement that is going facilitate the emergence of export-competitive industry without developing a portfolio of domestic energy sources. The most this region may expect is the convergence of gas prices to other European gas prices. If that is the case, the region would need to build industrial capacity to compete with other European countries in industrial technology and productivity. That does not seem realistic in the foreseeable future.

While the gas infrastructure investments considered in Chapter 6 are modest in comparison with other publicly known investment options, there is still a need for sustainable gas demand to justify investments and ensure an appropriate rate of return on investments. Gas-to-transport offsets the import of crude oil and liquid fuels and decreases both the cost of transport and import bills. The massive build-up of forest resources is included in transport fuel demand estimates in order to facilitate amelioration of coppice forests, re-forestation of deforested or devastated land and develop forest plantations to improve the water regime across Western Balkans territory, optimize outcomes from existing hydro assets and produce fuel for new biomass-to-power CHP investments. Gas-to-power arrangements provide an opportunity to swap secure gas-to-power supply for the use[154] of existing hydro resources and enhance hydro power export opportunities toward the rest of Europe, creating export revenues to cover the costs of importing natural gas. The Black Sea & Balkans (BSB) gas hub provides valuable peak supply to Central Europe that enhances value of imported gas creating an additional layer of sustainable load. These "anchor load" arrangements are reflected in Table 12 in Chapter 7. All gas-to-power investments are considered as Combined Heat & Power (CHP) arrangements to make use of waste heat.

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[152] https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3758164/192E17AC7BED4BDEE053C92FA8C0D198.PDF

[153] Offsetting production from well over 10GW of lignite-fired power plants that operate at fairly high utilization rates, is going to require over 12 bcm/year of natural gas – 50% of current gas demand and entirely supplied from imports. In case of such a massive increase in gas imports within the current soft budget constraint framework, preference is likely to be given to gas suppliers that are able and willing to provide soft budget constraints over payments for gas. This may further complicate the security of supply problem.

[154] Introduction of a commercial operator of hydro assets allows optimal use of existing assets, investments in new assets, provides Governments with secure electricity supply and mitigates weather sensitivity.

7. Conclusions

The status quo and business-as-usual in the SEE energy markets are likely to become subject to external disruption:

- There is an emerging depletion of lignite resources for most of the available thermal power plants in the region: lignite becomes more expensive, more difficult to finance, more difficult to access and of lower quality while more exposed to environmental regulation;
- Prospects for large transit energy flows of any kind (accompanied by high transit rents) are mostly exhausted and there is little chance that any new infrastructure investment project will be progressed by Government officials any time soon;
- Financial crisis is increasingly accompanied by tectonic changes in the competitiveness of key domestic commodity export industries with the likely disintegration of entire industrial clusters;
- Soft budget constraint is increasingly difficult to maintain due to lack of resources and critical service providers are prone to periodical illiquidity;
- There is pressure to decrease emissions from fossil fuels that are likely to cause closures of the least efficient energy conversion plants (lignite-fired power plants, oil refineries) that are exposed to strong competition as a consequence of liberalization and further integration of energy markets.

The rapid deterioration of security of supply seems inevitable in the context of the conventional energy framework. There is a false perception that the political choice is between:

- Loss of security of supply accompanied by unemployment and social unrest and
- Circumvention of international commitments including the Energy Community Treaty, the EU accession process and combating climate change.

The weak commercial and professional structures prevailing in this region are incapable of acquiring and employing modern energy technologies, advanced commodity trading or risk mitigation techniques that are increasingly available in international markets. During disruptive periods, when critical knowledge is in the private domain, state owned enterprises (SoE) are not the most appropriate agents of change. SoEs are likely to compromise commercial interests with fiscal priorities of their sovereign owners while price signals remain distorted. If energy policy is further compromised with vested interests and not transparent, societies are left with very little means to pursue adequate choices.

This paper presents and discusses a collection of choices that are technically feasible and could be implemented when the need arises. The need for and probability of implementing such changes is increasing. Although a descent into deeper poverty and disorder may seem the most likely option, there is still a possibility for modernization. Table 12 demonstrates that modernization possibly yields a reasonable energy balance. Table 3 demonstrated actual gas demand. Comparison between these two tables demonstrate significant drop of gas consumption for district heating services, inefficient industrial transformations and residential use. These uses are both uncompetitive and unaffordable. Curtailment of this demand may result in deeper poverty (no energy consumption, collapse of comfort and deep poverty) or switch to more efficient solutions. In the case of significant disruption, pockets of demand may be supplied by LNG containers that are now increasingly available, supplied by a (small, but) competitive market. Gas emerges as competitive fuel for transport, agriculture and forestry as well as new CHP plants displacing options (petroleum products, lignite) that particularly inefficient in this region and facilitating new pattern of economic growth. The emergence of gas-to-gas competition is inevitable in this region: at very small scale following collapse of demand or in growing scale serving new demand. These two processes could overlap that may result in relatively stable volumes but hugely different sectoral and seasonal demand profile.

Over optimistic demand projections and proposed gas supply/infrastructure project proposals are unlikely to materialize in the reality of South Eastern Europe without radical change in the structure of gas use. A trade balance constraint, sustainability of demand, experience to date and anecdotal evidence presented in this paper (and many more of the same sort) do not support projections of gas demand growth and do not provide justification for any large infrastructure investment. Probability of structural change is way too small to justify investments while investment risks are way too high to provide ground for new investments.

However, better use of existing infrastructure with minimal investment requirement is feasible. Increased utilization of existing infrastructure may provide far more durable contribution to economic growth than investments into new infrastructure. There are six major shifts that may be envisaged as follows:

Shift from lignite to biomass in power generation that provides improvement in resource productivity, decrease in environmental impact and increase in power generation efficiency,

- Shift from heat-only-boiler technologies to modern combined heat and power solutions that offers four-fold improvement in energy efficiency of heating,
- Shift from petroleum products to gas in transport, agriculture and forestry that eliminates wasteful and uncompetitive oil refining process, reduces environmental impact and provides better value for money,
- Redirection of fuel wood use from low efficiency stoves to modern biomass power plants that offers multiple productivity and health gains,
- These changes require doubling utilization rate of oil pipelines, Danube transport corridor and railway infrastructure provides uplift for local economies at minimal investment cost which, in turn,
- Decreases barriers to entry and curtails dual monopoly power with its facilitation of soft budget constraint and bad governance.

Comprehensive commercial undertaking supported by financial means that already earmarked for this region by various donors, international financial institutions and investors may or may not be pursued and status quo, with all risks, may or may not prevail. Intention of this paper is to inform decisions and make available options and outcomes more transparent.

The organized development of a regional gas trading hub – a Black Sea and Balkans (BS&B) gas hub – would be a positive outcome for the rest of Europe as it would facilitate flexibility, efficiency and renewable energy. It may emerge during about the next 10 years as a component in the turnaround[155] of the entire energy sector in the South Eastern Europe.

Gas hub development is an on-going practice in Europe. New gas hub enterprises need to be established in innovative ways to gain a competitive position in the market. There is little LNG-to-rail unloading at existing European LNG receiving terminals. New SEE hubs are all envisaged with access to railway and ISO container loading on a large scale. The capacity to load LNG to trucks in Europe is very limited, accounting for only 0.1-0.2% of total gas demand. Nearly one third of gas to SEE may be delivered to customers by containers and intermodal transport. The European marketplace is intended for large integrated players. The SEE emerging gas market provides opportunities for small and mid-scale innovative players. Flexibility in Europe is to a large extent based on conventional upstream solutions while SEE provides an opportunity for renewable energy

[155] Massive use of lignite emerged in former Yugoslavia during only 10 years, between 1976 and 1986, entailing unprecedented material intensity, adoption of new technologies, recruitment of tens of thousands of workers and acquisition of land areas larger than most urban areas built to that time and development of the largest industrial organization ever seen. It was accompanied by the largest reforestation effort to date: average forestation in Serbia during the 1970s and 1980s has been over 15 times more intensive than during the last 20 years. For comparisons: Benjamin K. Sovacool, "How long will it take? Conceptualizing the temporal dynamics of energy transitions", Energy Research & Social Science Journal, http://www.sciencedirect.com/science/article/pii/S2214629615300827.

combined with gas and power flexibility mechanisms. Flexibility requires low cost infrastructure options capable of sustaining variable utilization rates: floating gas supply options are likely to have a competitive advantage.

Table12: Projected natural gas supply and demand in 2025 per country

Energy (000 m3)**	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Greece	Kosovo*	FYR of Macedonia	Montenegro	Romania	Serbia	Total (000 m3)
Production	17842	0	274263	1107142	7105	0	0	0	8422653	310674	10139679
Minimal LNG imports	905717	396106	1369350	1056785	1183113	148470	189527	311044	623606	967851	7151569
Imports	0	903268	1751346	90110	3865897	348479	478343	0	26501	1989367	9453311
Exports	0	0	0	0	0	0	0	0	0	0	0
Stock changes	0	0	0	0	0	0	0	0	0	0	0
Domestic supply	**923559**	**1299374**	**3394960**	**2254037**	**5056116**	**496949**	**667869**	**311044**	**9072760**	**3267891**	**26744559**
statistical differences	0	0	0	0	0	0	0	0	0	0	0
Transformation	**399818**	**685402**	**882411**	**235873**	**2755926**	**289091**	**311368**	**190364**	**822459**	**1525333**	**8098045**
Electricity plants*****	0	13947	2474	2684	2159263	0	0	0	0	0	2178368
CHP plants****	399818	671455	879938	233189	596663	289091	311368	190364	822459	1525333	5919677
Heat plants	0	0	0	0	0	0	0	0	0	0	0
Oil refineries	0	0	0	0	0	0	0	0	0	0	0
Other transformation	0	0	0	0	0	0	0	0	0	0	0
Energy Industry own use	0	0	0	0	0	0	0	0	0	0	0
Losses	0	1000	13053	40447	0	0	737	0	158053	15921	229211
Final consumption	**523741**	**612972**	**2499495**	**1977717**	**2300190**	**207858**	**355764**	**120681**	**8092248**	**1726638**	**18417303**
Industry	13565	129392	965078	567325	853539	28013	78961	32495	3222790	511950	6403109
Transport*	374816	375937	1076268	654041	1141429	133903	178322	75075	1920642	682113	6612545
Residential	0	58579	55026	138383	0	6723	17928	1121	1346755	108194	1732710
Commercial and public services	0	0	110041	215224	263537	24652	69348	5603	978455	138643	1805502
Agriculture & Forestry***	103088	20169	291738	363749	6723	14567	11205	5042	608054	285738	1710074
Fishing	32271	0	1345	38994	34960	0	0	1345	15553	0	124468

Other non-specified	0	28895	0	0	0	0	0	0	0	0	28895
Non- energy use	0	0	0	0	0	0	0	0	0		0
of which chemical /petrochemical	0	0	0	0	0	0	0	0	0	0	0
Total consumption	**923559**	**1299374**	**3394960**	**2254037**	**5056116**	**496949**	**667869**	**311044**	**9072760**	**3267891**	**26744559**

Source: Author projections based on IEA natural gas, electricity and transport fuels statistics for 2013 and taking into account infrastructure development envisaged in the analyses.

* Use of natural gas for transport results in higher proportion of the transport fuel market than direct replacement of diesel fuel following overall improvement in energy efficiency of gas fuelled motors in comparison with conventional diesel motors. Historical vehicle replacement rate is taken into consideration in these estimates.

** Energy equivalent of natural gas is calculated at 38GJ (or 10.5556MWh) per 1000m^3 of natural gas. LNG based supply mix may have higher energy content and, therefore, lesser volumes than demonstrated hereby.

***Takes into consideration significant growth in wood biomass production for energy purposes as well as use of gas as a main forestry – harvest – transport fuel in this context.

**** New gas-fired CHP plants and gas consumption within biomass CHP plants.

***** Use of existing gas-fired power plants and replacement / upgrade to more efficient generation technologies.

8. Recommendations

It is possible to indicate a few very basic recommendations from the above analyses and extensive literature review. This paper is not a blueprint for action. It describes options and ideas that are not suitable for further development by Government institutions or consultants contracted by these institutions. It is, however, intended to stimulate private commercial innovation that seems to be needed in the European energy market. Therefore, the following recommendations are intended to provide support for market innovation. :

- International creditors and the EU to refrain from any lending to the Governments in SEE for the construction of new energy infrastructure beyond projects that are already committed until the utilization rate of existing infrastructure increases.
- International financial institutions may support private investors with equity and comprehensive political risk coverage to form private commercial project development companies that will deliver innovative project proposals for the consideration of strategic investors.
- Physical openness of South Eastern Europe for trade in commodities and industrial goods should be considered in the context of free trade agreements between the EU and USA, South Korea, China, India and other countries.
- A dedicated regional program of the Extraction Industries Transparency Initiative (EITI) to be established for the SEE region and all countries from the region to subscribe to the EITI transparency platform.
- Provide a support platform for cities from SEE that would like to pursue energy investments with private investors in various forms of Public Private Partnerships,
- Assist countries in the region to use National Emission Reduction Plans (NERP) and Low Emission Development Strategies (LEDS) to phase out lignite in a more comprehensive manner in order to minimize stress and cost.
- Request governments in the region to consider restructuring and corporatization of energy companies in their portfolio (SoE) in order to face competition, and
- Facilitate twinning assistance programs between non-government professional associations in the region and counterparts from OECD countries in order to prepare them to take some public responsibilities.

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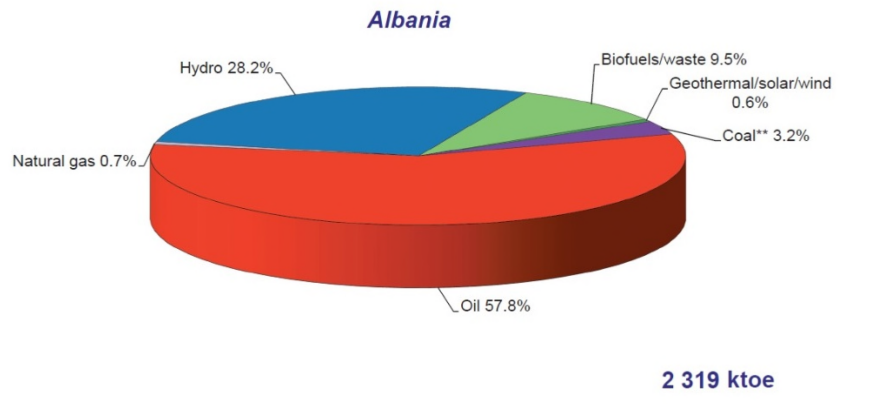
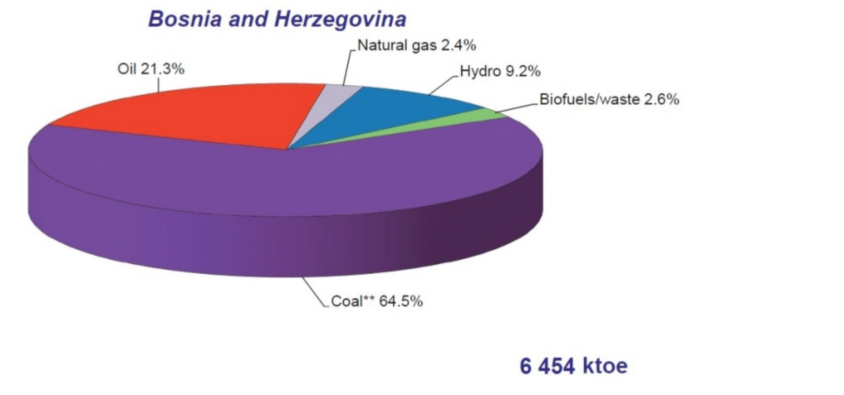
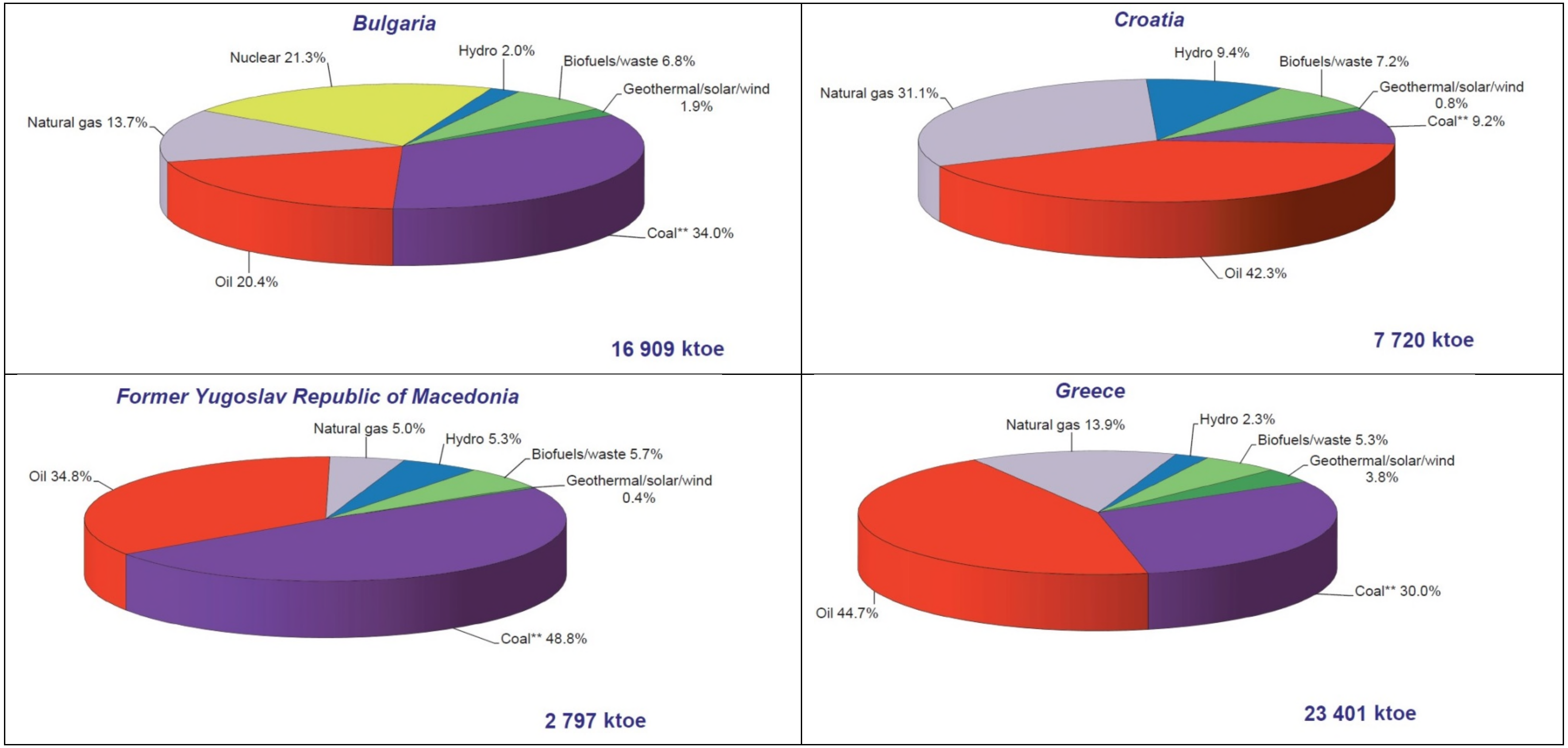
Annex 1: Gas share in Total Primary Energy Supply (TPES) in the SEE

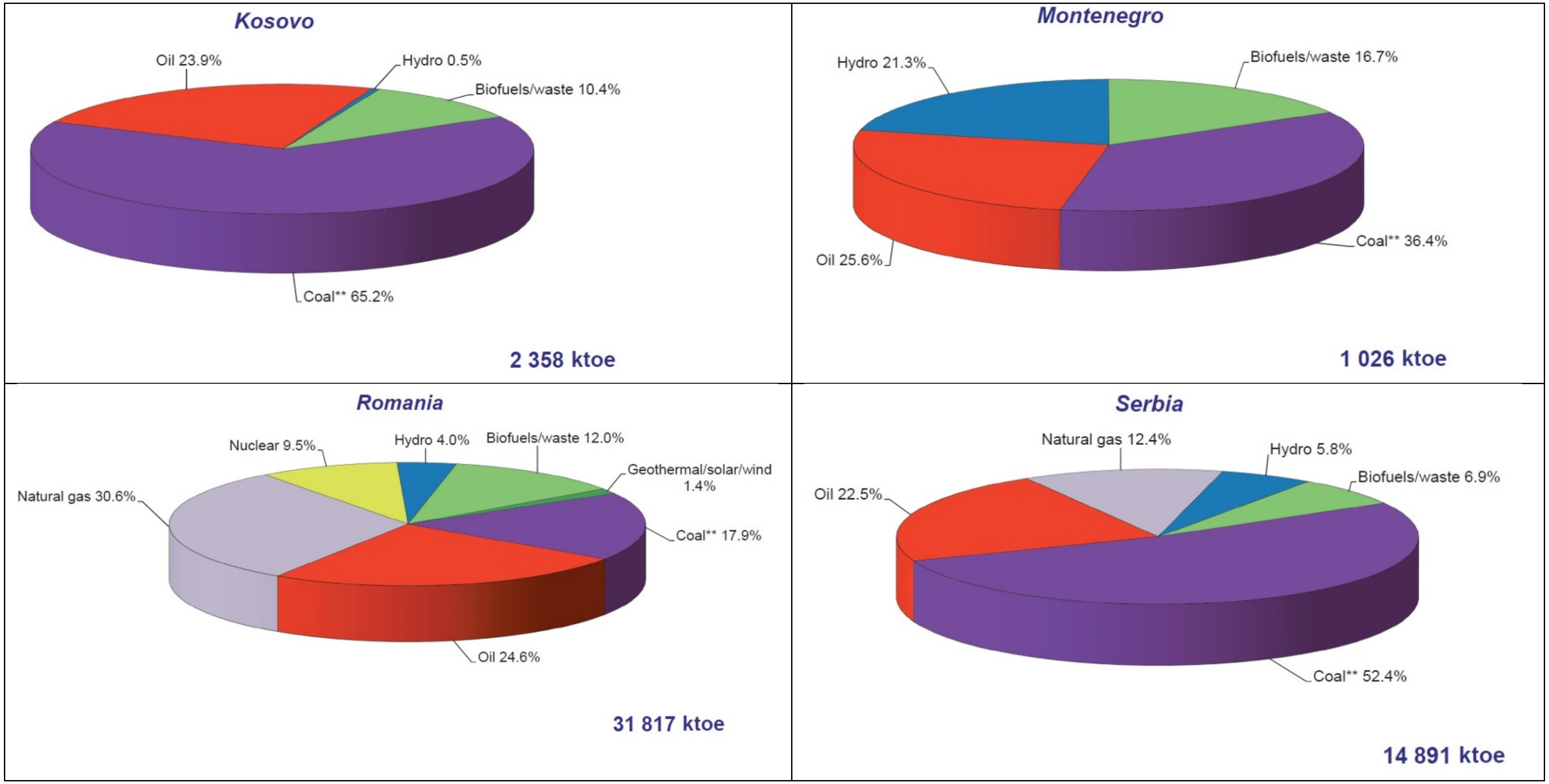
Table: Total Primary Energy Supply (TPES) structure for SEE countries (IEA 2013 data)

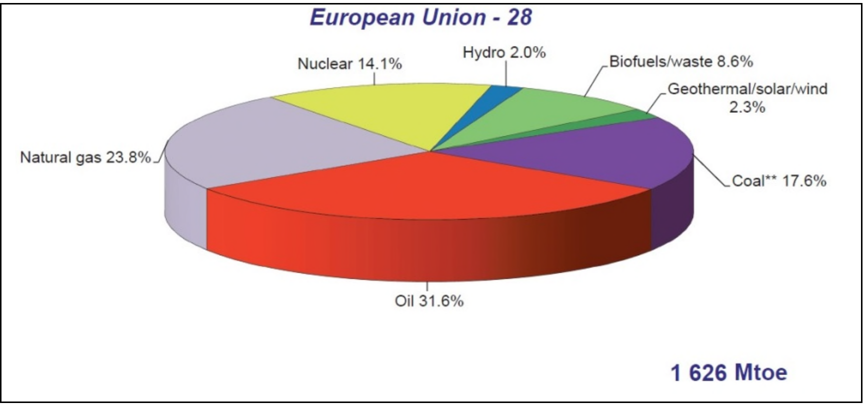






Bulgaria
Nuclear 21.3%
Hydro 2.0%
Biofuels/waste 6.8%
Geothermal/solar/wind 1.9%
Natural gas 13.7%
Coal** 34.0%
Oil 20.4%
16 909 ktoe
Croatia
Hydro 9.4%
Biofuels/waste 7.2%
Natural gas 31.1%
Geothermal/solar/wind 0.8%
Coal** 9.2%
Oil 42.3%
7 720 ktoe
Former Yugoslav Republic of Macedonia
Natural gas 5.0%
Hydro 5.3%
Biofuels/waste 5.7%
Oil 34.8%
Geothermal/solar/wind 0.4%
Coal** 48.8%
2 797 ktoe
Greece
Natural gas 13.9%
Hydro 2.3%
Biofuels/waste 5.3%
Geothermal/solar/wind 3.8%
Coal** 30.0%
Oil 44.7%
23 401 ktoe

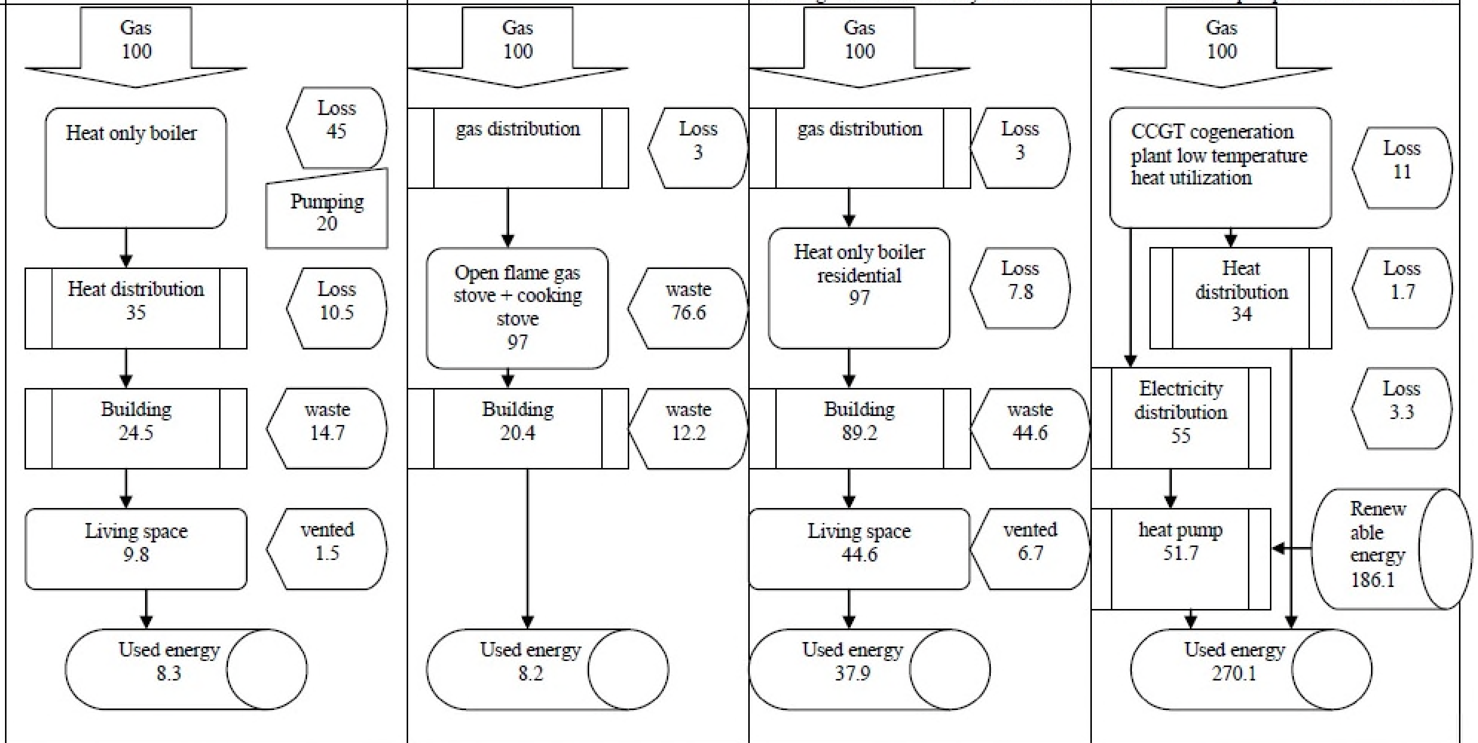

Kosovo
Oil 23.9%
Hydro 0.5%
Biofuels/waste 10.4%
Coal** 65.2%
2 358 ktoe
Montenegro
Hydro 21.3%
Biofuels/waste 16.7%
Coal** 36.4%
Oil 25.6%
1 026 ktoe
Romania
Nuclear 9.5%
Hydro 4.0%
Biofuels/waste 12.0%
Geothermal/solar/wind 1.4%
Natural gas 30.6%
Coal** 17.9%
Oil 24.6%
31 817 ktoe
Serbia
Natural gas 12.4%
Hydro 5.8%
Biofuels/waste 6.9%
Oil 22.5%
Coal** 52.4%
14 891 ktoe

Notes:	
• Share of TPES excludes electricity trade. • In this graph, peat and oil shale are aggregated with coal, when relevant. • In all countries lignite is dominant coal supply • For presentational purposes, shares of under 0.1% are not included and consequently the total may not add up to 100%. • Use of fuel wood (biofuels / waste) is underestimated in official energy statistics in SEE countries	

Source: IEA / OECD 2015 online data services

Annex 2: Comparative efficiency to use 100 units of natural gas for heating

	District Heating plus gas cooking	Direct gas heating and cooking	Gas boiler heating and hot water plus cooking with heat recovery ventilation	Best available CCGT cogeneration plus ambient air heat pumps and waste heat use



Volume of gas required for equivalent comfort	**32.5**	**32.9**	**7.1**	**1**
Geographical coverage	Eastern Europe, Ukraine, Russia, Belarus, downtowns and dense suburbs	Eastern Europe retail gas distribution areas, low density suburbs, villages	Western Europe, UK, Italy, gas distribution areas	Scandinavia, modern energy efficient homes

Source: Author estimates

Annex 3: Gas infrastructure development options and Black Sea gas shipping

Source: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG17-ThePotentialContributionofNaturalGasToSustainableDevelopmentinSoutheasternEurope-AleksanderKovacevic-2007.pdf