Building renovation delivers South-East Europe gas security

Dan Staniaszek
Buildings Performance Institute Europe (BPIE)
Rue de la Science 23
1040 Brussels
Belgium
dan.staniaszek@bpie.eu

Maarten De Groote
Buildings Performance Institute Europe (BPIE)
Rue de la Science 23
1040 Brussels
Belgium
maarten.degroote@bpie.eu

Filippos Anagnostopoulos
Buildings Performance Institute Europe (BPIE)
Rue de la Science 23
1040 Brussels
Belgium
filippos.anagnostopoulos@bpie.eu

Oliver Rapf
Buildings Performance Institute Europe (BPIE)
Rue de la Science 23
1040 Brussels
Belgium
oliver.rapf@bpie.eu

Keywords

building refurbishment, building retrofitting, deep renovations, demand side management (DSM), gas, infrastructure, modelling, energy security

Abstract

Security of gas supply is a political issue of considerable importance in South-East Europe, identified as the only region in Europe with a significant gas security issue in the event of an interruption of supply through Ukraine. While the Security of Gas Supply Regulation aims to ensure deliveries of gas to protected customers (i.e. households), its operation in a real crisis is unknown. Consumers, including business and public sector buildings not covered by the regulation, would not be able to rely on it to meet their heating needs in case of a serious supply disruption, as has been witnessed in recent years when supplies from Russia to Ukraine were cut. In order to better understand the risks faced by gas consumers, this study explores the vulnerability of the building sector to gas supply interruptions in specific countries of the region, through the prism of the Building stock Vulnerability Indicator (BVI), developed by BPIE. The BVI takes into account the importance of the use of gas in the building sector, along with the dependence on imported gas and its import routes. The results show that most countries of the region are at least moderately vulnerable, with Hungary and Slovakia found to be severely vulnerable. Rather than adding gas supply infrastructure, which ultimately INCREASES dependence on imported gas, this study shows how energy security can be considerably improved by drastically reducing demand for gas through a dedicated and targeted building renovation programme throughout the region, covering the following countries: Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Macedonia, Greece, Hungary, Kosovo, Montenegro, Romania, Serbia, Slovakia and Slovenia. In addition to improving energy security, such as approach yields a good return on investments and in addition provides considerable employment opportunities, while helping to tackle the serious health, air quality and fuel poverty issues suffered by many citizens in the region.

Introduction

The security of supply of gas in South-East Europe (SEE) is of both political and economic importance, and a key component of ensuring the welfare of citizens. It is, however, at risk. Modelling by the European Network of Transmission System Operators for Gas (ENTSO-G) and Energy Union Choices highlighted SEE as the only region in Europe with a significant gas security issue in the event of an interruption of supply. While Europe's Security of Gas Supply Regulation aims to protect customers and ensure them the constant delivery of gas, its practical implementation in a crisis is still unknown. Furthermore, business and public sector consumers are not protected by the regulation.

Options to mitigate the gas supply risk through demand management need to be seriously explored. Among these are the deep renovation of buildings currently heated by gas, and fuel switching to other energy sources for such buildings.

Current energy situation in South-East Europe

The recent formation of the Energy Union supports the EU's objective of ensuring the security of energy supply in Europe. Since the Ukraine-Russia disputes, concerns linked to security

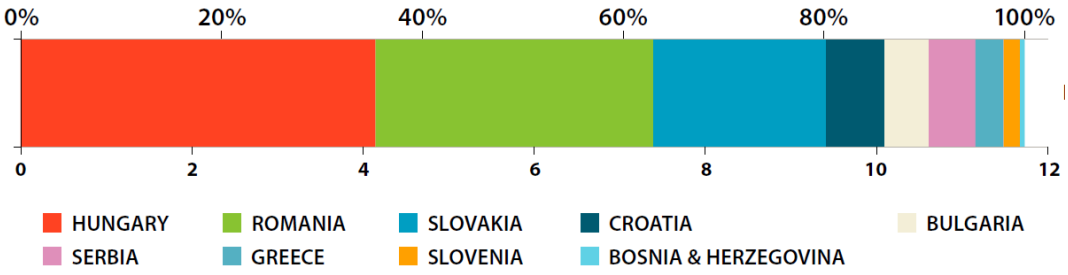

Figure 1. Share of direct and indirect gas use by buildings in (bcm/a) and as a share of the regional total (Source: Eurostat, 2014).

of supply have been heightened, affecting both EU and non-EU countries. Recent studies by Energy Union Choices (EUC) have highlighted the SEE region as being the most vulnerable to supply interruptions from the East (primarily Russia), whereas most other areas in Europe are resilient as they have a range of gas supply disruption types. The European Network of Transmission System Operators for Gas (ENTSO-G) has also recognised that some countries in SEE would face significant economy-wide gas shortages following a prolonged gas supply disruption from Russia. These security concerns led to the formation of the Central and South-Eastern Europe Gas Connectivity High-Level Working Group (CESEC) in 2015 to coordinate efforts to facilitate projects that diversify gas supplies to the region, including the countries covered in the present paper: Albania, Bosnia & Herzegovina, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia (FYROM), Greece, Hungary, Kosovo, Montenegro, Romania, Serbia, Slovakia and Slovenia.

EU's Security of Gas Supply Regulation promotes a regional approach to strengthening cooperation and aims to ensure deliveries of gas to protected customers (i.e. households). However, its operation in a real crisis is unknown and, in the event of an energy crisis, significant challenges are likely to be faced.

Conventional solutions to improving energy supply security, including those currently pursued by countries in the region, would be to increase the diversity of supply routes and sources. Whilst doing so clearly has a role to play, this study explores an alternative approach focused on the roll-out of a major renovation programme that focuses on the gas-consuming building stock, improving its energy performance with a significantly reduced need for gas. Representing a progressive political vision for the region and adding to improved energy security, it also delivers cost-savings for building owners and occupants, improves the living conditions of millions of citizens and delivers substantial economic returns to governments by cutting expenditure on energy imports and supporting local industries and employment.

ENERGY USE IN BUILDINGS

Hungary and Slovakia are reliant on gas for over half of their buildings stock's energy requirements and are therefore in a vulnerable position with regards to gas supply. The Romanian building stock is also greatly dependent on gas, yet this is supplied largely from indigenous sources. These three countries account for over 80 % of gas consumption in the region's buildings (Figure 1[1]), and 28 % of total gas consumption.

District heating is to a great extent supplied by gas, and therefore countries like Bulgaria and Serbia are also at risk as they have extensive district heating networks. The other countries in the region rely to a substantial extent on electricity to heat their homes, followed by biomass and heating oil (especially the southern Balkans, such as Albania, Bosnia & Herzegovina, FYROM, Kosovo, Montenegro and Greece).

ENERGY POVERTY AND AIR POLLUTION AS A SIGNIFICANT REGIONAL ISSUE

Heating is the largest energy demand of households, putting a considerable strain on residents and the countries in question. Roughly 30 % of the overall population in SEE countries struggle to pay their energy bills (Table 1[2]), while 20 % of the population live in very low quality dwellings with serious defects, according to Eurostat's online statistics, 2014. This results in citizens experiencing higher incidences of poor health and damp-induced illnesses and diseases. These energy poverty indicators are among the highest in Europe, and provide a further dimension to the case for added focus on improving the energy performance and quality of the building stock in South-East Europe.

As well as the general poor quality of the building stock, poor air quality is a serious issue in many parts of the region, especially when considering particulate matter (PM). In total, 17 out of 50 European towns/cities with the highest atmospheric concentrations of PM10 are in the region, as well as 13 out of 50 for the smaller and more damaging to health PM2.5 particles.

Assessing the risk of gas supply disruption

For the present state of the economy, gas is needed to meet society's needs. Although there are many benefits, gas also comes with a number of adverse risks, including dependence of a large proportion of the building stock on a single energy carrier. As soon as buildings are dependent on gas to meet their heating needs, supply disruption can have devastating social and economic impacts. For this reason, the EU is taking steps to

1. Direct use of gas is gas which is delivered directly to buildings. Indirect use of gas is gas consumption caused by demand for electricity (taking into account the share of gas used to generate electricity and for district heating (again, taking into account the share of gas used for district heating).

2. Albania is missing from the datasets of Eurostat.

Table 1. Indicators of fuel poverty offered as a share of the total population (Source: Eurostat, 2014).

Country	Inability to keep home adequately warm	Arrears on utility bills	Living in a dwelling with a leaking roof and damp or rotten walls and floors
Bulgaria	40.5	32.9	13.2
Serbia	17.1	41.4	26.2
Greece	32.9	37.3	13.7
FYROM	26.1	38.8	15.2
Hungary	11.6	22.3	26.9
Slovenia	5.6	20.3	29.9
Croatia	9.7	29.1	11.7
Romania	12.3	21.1	12.7
Slovakia	6.1	6.1	7.0

Shading is related to percentage of population, as per scale below:

> 50 %	42–50 %	33 %–42 %	25–33 %	17–25 %	8–17 %	0–8 %

Table 2. Levels of building stock vulnerability to gas supply disruptions (developed by BPIE).

Building stock vulnerability level		Appropriate response	
Critical	Gas users are extremely vulnerable	**EXCEPTIONAL**	Maximum energy security measures to minimise vulnerability and risk.
Severe	Gas users are highly vulnerable		
Substantial	Gas users have significant exposure to supply disruption	**HEIGHTENED**	Additional energy security measures reflecting specific consumer vulnerabilities and judgements on acceptable risk.
Moderate	Gas users have some exposure to supply disruption		
Low	Gas users are broadly secure	**NORMAL**	Routine energy security measures.
N/A	Gas users are not exposed		

safeguard energy supply with the Security of Gas Supply Regulation, through which the EU is calling on Member States to guarantee gas deliveries to a number of 'protected customers' in severe conditions, comprising of at least all domestic customers (e.g. customers that use gas for heating).

BUILDING STOCK VULNERABILITY INDICATOR – BVI

The risk of gas not being supplied to countries needs to be assessed to know the impact on residents and businesses in the region. For this purpose, BPIE developed a Building stock Vulnerability Indicator (BVI) that enables a risk assessment of the building stock to be undertaken. This also ranks countries according to defined vulnerability levels. Table 2 presents the classification of building stock vulnerability levels.

BVI ranks countries according to the vulnerability of their buildings to a disruption in gas supply. In broad terms, the vulnerability (and BVI score) increases according to the importance of gas as a source of heating fuel in buildings and the level of gas import dependency. Conversely, the BVI decreases with increasing levels of gas supply diversification, also taking into account the original source of the gas (see Box 1).

A low BVI score indicates buildings are resilient to gas-supply shortages/shocks. For example, the country is covered by domestic production to a significant extent, or because the sector does not rely on a lot of gas, or because a country is not dependent on just one supply route. A high BVI score indicates

Box 1. The building stock vulnerability indicator.

$$BVI = \frac{Bg}{Bt} * EDg * IRF * 100$$

Where:

Bg is the absolute amount of gas use in buildings;

Bt is the total absolute amount of energy consumption of buildings;

EDg is the Energy Dependence for gas defined as the net imports of gas divided by the sum of gross inland energy consumption;

IRF is the Interconnection Risk Factor, defined by the formula:

IRF = CountryA*IRFa + CountryB*IRFb + . . . + CountryN*IRFn

Where, each country "N" has its corresponding Interconnection Risk Factor "n", taking values from 0 to 1 according to the following logic:

- IRF = 0.8 for imports from Ukraine, 0.6 from Turkey, 0.5 from Austria, Czech R. and Italy
- IRF = 0.4 for LNG,
- IRF = 0 for no interconnection

the building stock is of high vulnerability – for example, a country that heats a large proportion of the building stock with imported gas from just one source.

Based on a detailed appraisal of the factors affecting gas supply vulnerability, BPIE has derived BVIs for the countries in the region. Although potential provisions under the Security of Gas Supply Regulation have not been reflected in the BVI, one can assume that non-EU countries in the region will face increased risks compared to their neighbouring EU countries that should act in solidarity. Table 3 discusses the position of each country regarding its vulnerability score.

It can be seen that most countries in the region have some degree of building stock vulnerability to gas supply interruptions. The vulnerability may not be felt immediately after a gas supply disruption as many countries have built gas storage facilities in place. These storage systems are between 60 % and 75 % full and able to cover 10 % to 45 % of inland gas consumption for a limited period of time, until their supplies become scarce.

Two countries are particularly reliant on gas and together account for over half of the region's building gas usage: **Hungary** and **Slovakia**, both rated as being severe on the BVI index. These countries should maximise their efforts to reduce their risk. However, in order for utmost security, all countries would benefit from co-ordinated action. A concerted programme of building renovation to a high-energy performance level provides a long term sustainable solution to energy security while also improving the countries' balance of payments, reducing fuel poverty, improving air quality and generating local jobs.

Mitigation of gas dependency through building renovation

The traditional approach of addressing energy security calls for additional supply infrastructure and expansion of sources. While doing so provides some short-medium term increase in gas security, the long-term impact is actually increased dependence on imported gas. This approach also carries financial risk in the form of stranded assets, should gas consumption fall short of predicted levels, as has been the case historically. While some additional gas infrastructure is warranted (such as reverse-flow pipelines), the need for it can be greatly reduced by cutting gas usage, reducing investment requirements and avoiding the risk of stranded assets.

THE BENEFITS OF ENERGY EFFICIENCY INFRASTRUCTURE FOR ENERGY SECURITY

The implementation of a publicly supported system of building renovation has the potential to cut gas demand significantly, thus reducing the vulnerability for the building stock and the SEE region as a whole.

Table 3. Building stock vulnerability level by country (Source: BPIE own analysis).

Building stock vulnerability level	Description
N/A *(countries either do not use or do not import gas)*	**Kosovo and Montenegro** do not use gas to heat their buildings and are thus not vulnerable to gas supply shocks. **Albania** does not import gas, so it is not vulnerable to external supply interruptions.
Low	**Romania** has little import dependency as it largely covers its significant gas demand from indigenous production. However, due to its limited interconnectivity, it could face some problems in the future, where production from national resources could be compromised. **Croatia** uses a significant amount of gas in buildings, but has a large indigenous share of gas, so it lowers its risk level. **Greece** has a low BVI due to its diversity of supply routes, in particular its import capacity from LNG infrastructure.
Moderate	**Bosnia & Herzegovina** and **FYROM** have a relatively low reliance on gas as a heating fuel for their building stocks but their complete import dependency brings moderate risk. Also, as non-EU members, they may be exposed to a relatively higher additional risk as they are not covered by the provisions of the EU Security of Gas Supply Regulation. **Slovenia** is characterised as moderately vulnerable considering its combination of moderate gas demand in buildings, and 100 % import dependency. **Serbia**, while having a comparatively lower import dependency (71 %), imports gas from just one country. It also faces an additional risk as it does not currently benefit from the provisions on protected customers of the EU Security of Gas Supply Regulation.
Substantial	**Bulgaria** is substantially vulnerable due to a relatively higher share of gas use in buildings and its 100 % import dependency. Its vulnerability became obvious in 2009 when there was a disruption in gas imports.
Severe	Buildings and their inhabitants in **Hungary** and **Slovakia** are severely vulnerable in case of a gas-supply disruption. In both countries, gas demand in buildings is half of the total demand for gas. They are also connected to **Ukraine**, which is at the epicentre of geopolitical issues at present and whose gas supply, as a transit country from **Russia**, has been interrupted in recent years. Pipelines from **Ukraine** make up 70 % of **Slovakia's** import capacity and 82 % of **Hungary's**.
Critical	No countries have been assessed as having a critical BVI.

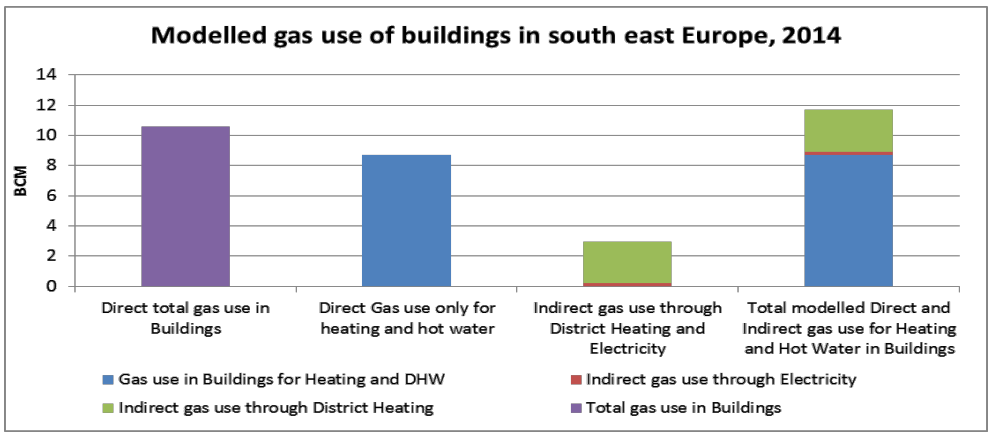

Figure 2. Direct and indirect gas use of buildings in South-East Europe in 2014 (annual demand in bcm) (Source: BPIE own analysis).

Table 4. Energy savings compared to initial state of the building and associated renovation costs (source: BPIE).

Renovation type	Energy saving	Cost (€/m²)
Minor renovation depth	15 %	75
Moderate renovation depth	45 %	120
Deep renovation depth	75 %	225
nZEB renovation depth	95 %	400

BPIE modelled the impact of energy demand infrastructure upgrades to the building stock in the region[3]. In order to better understand the risks faced by gas consumers, this study explores the vulnerability of the building sector (both residential and non-residential) to gas supply interruptions in specific countries of the region, through the prism of the Building stock Vulnerability Indicator (BVI). Modelling estimates the macro-economic benefits arising from the upgrade of buildings via energy performance improvement measures. To put this in context, the goal of this analysis was to improve energy security by reducing use of gas, by improving the building stock heat retention properties and by increasing the resilience to gas supply interruptions. The demand-led approach provides numerous co-benefits and delivers across a range of national and regional strategic priorities.

The analysis shows that addressing supply-side problems with demand-side measures is an effective solution that offers many co-benefits, addresses long-term energy demand concerns and overall and climate issues when compared with a "supply infrastructure only" driven approach.

SCOPE OF THE RENOVATION MODELLING METHODOLOGY

Energy performance improvements are focused on the "regulated" end-uses covered by the Energy Performance of Buildings Directive, namely heating, cooling, ventilation & air conditioning (collectively, "HVAC"), domestic hot water, fixed lighting (mainly in non-residential buildings), passive solar systems and solar protection. Cooking[4] and appliances such as televisions and refrigerators are not covered by the EPBD requirements. Therefore, for modelling purposes, we focus on the share of energy carriers for heating and hot water (i.e. electric or gas boilers for hot water, electric space heaters, wood stoves, district heating supply, etc.).

The indirect use of gas by buildings through their use of electricity generated by gas, as well as the use of gas in district heating systems, is also taken into account. Gas is part of the fuel mix generating electricity and heat and thus a significant reduction in the energy demand of buildings would decrease the demand for gas in power plants. An overview of the modelled gas use in buildings is visualised in Figure 2. Direct gas demand by buildings for heating and hot water is 8,7 bcm/a, compared to 2,9 bcm/a for indirect gas use (through use in generation of electricity and district heating).

The four scenarios described below represent progressively more ambitious views of the future development of the building renovation market, focused around two key drivers:

- Renovation rates that reflect the expansion of the renovation market, following support from enabling policies, such as national renovation strategies. They are defined as the percentage of useful floor area of annually renovated buildings divided by the total useful floor area of the entire building stock.
- Renovation depths, i.e. the level of energy savings achieved by a given renovation.

Both the renovation rate and the renovation depth are dynamic[5]. Figure 3 shows how modelled renovation rates grow

3. Albania and FYROM were not covered in the analysis because data on their building stock is lacking and because their gas use in buildings is non-existent according to Eurostat.

4. Additional gas savings could be achieved from switching away from gas fired appliances, though this has not been included within the scope of the analysis.

5. The "frozen" scenario is an exception. In it, renovation rates and depths stay constant at today's levels.

over time, eventually reaching a plateau. For renovation depths, three renovation paths were modelled, based on assumptions on the market share of each renovation depth and its evolution over time. Progressively deeper renovations take on a larger share of the market. This is because building codes and other policy drivers will result in higher energy performance requirements, and because economies of scale decrease the renovation costs, thus bringing deeper renovations within reach. The pathways are presented in the following graphs.

For each of the scenarios, analysis was done on two bases:

- *Unfocused renovation of the building stock* – An untargeted renovation plan, open to all buildings, would lead to moderate gas savings and would only have a limited impact on reducing gas supply vulnerability.
- *Renovation focused on buildings using gas* – A renovation programme focusing exclusively on gas-using buildings would ensure that the potential to mitigate gas supply risks are maximised. The remainder of this paper presents the results based on this approach.

The four scenarios are created by the relevant combination of renovation rate and renovation pathway, as summarised in Table 5, while Table 6 shows the gas saving potential under each scenario.

The "energy security" scenario allows gas demand to be reduced by 70 % and therefore substantially reduces the threat posed by gas-supply disruptions to society and economy. The residual low demand for gas in the region, of 3.5 bcm/a, could readily be covered through reverse-flow pipelines and imports

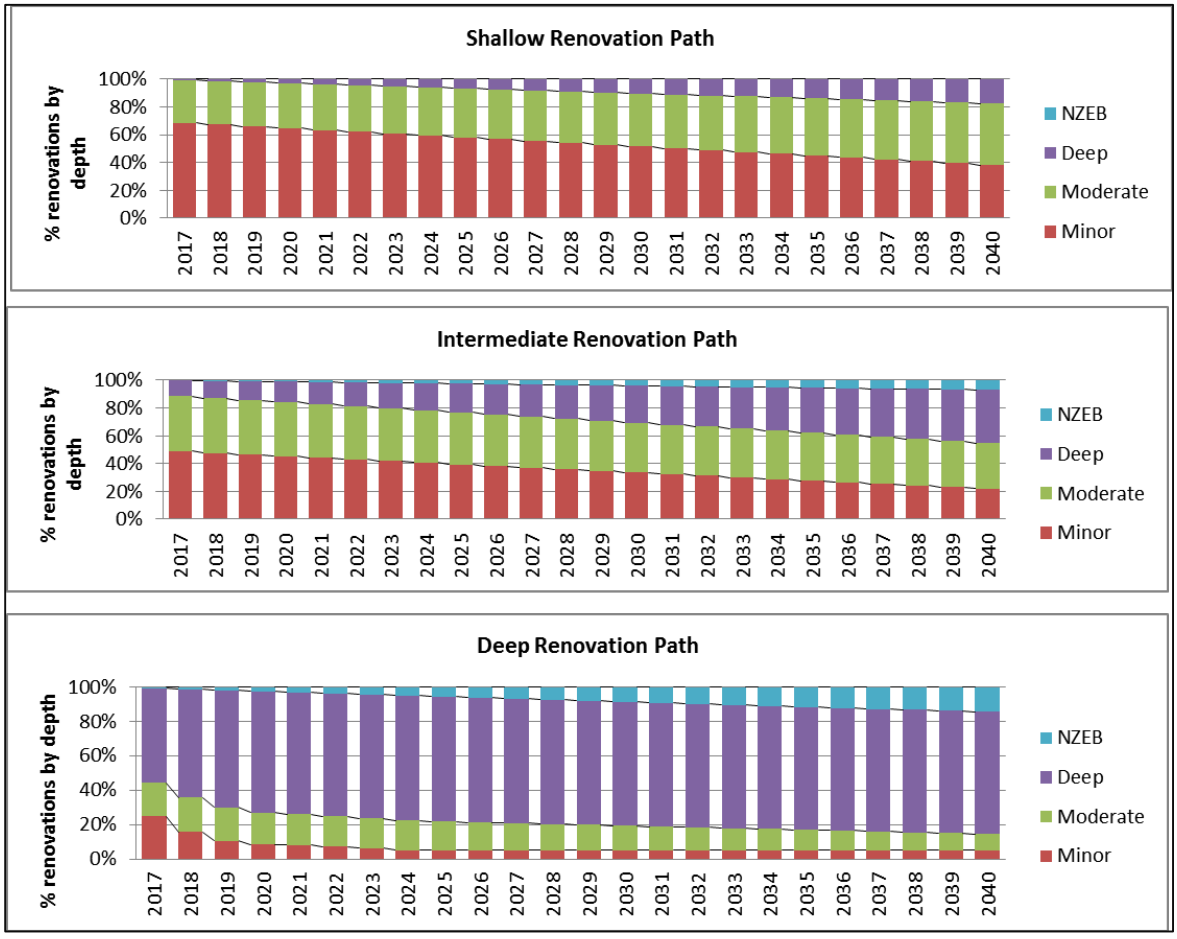

Figure 3. Renovation pathway assumptions on the share of renovation depths (Source: BPIE own analysis).

Table 5. Renovation scenarios linked to the rate and depth (source: BPIE).

Scenarios	Frozen	Limited protection	Risk mitigation	Energy security
Renovation rate	**Baseline rate**	**Slow rate**	**Medium rate**	**Fast rate**
Renovation pathway	**Baseline renovation (frozen at starting year)**	**Shallow renovation path**	**Intermediate renovation path**	**Deep renovation path**

Table 6. Achievable levels of gas demand reduction at the end of the 20-year period under the four scenarios (source: BPIE own analysis).

Resilience benefits of a 20-year targeted renovation programme	Frozen	Limited protection	Risk mitigation	Energy security
Demand reduction through renovation (bcm/a)	1.7	2.8	4.7	8,2
Residual gas use (bcm/a)	10.1	8.9	7.0	3.5
Gas demand reduction (%)	14 %	24 %	40 %	70 %

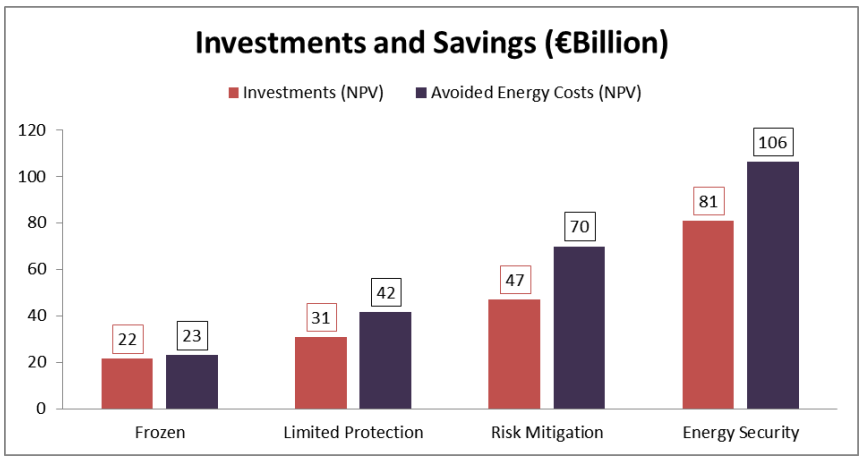

Figure 4. Investment costs for deployment of energy efficiency and the corresponding avoided energy costs (source: BPIE own analysis).

through LNG terminals in neighbouring countries, including Greece.

The "risk mitigation" scenario, having renovated 88 % of the gas-using building stock by 2037, can make a significant contribution to reducing supply vulnerability. With 40 % less demand compared to current levels, affected countries would be able to withstand a supply disruption for a considerable period of time.

Under the "limited protection" and "frozen" scenarios, however, the reduction of gas demand by 24 % and 14 % respectively will do little to guard countries in the region against a supply disruption. In case the interruption exceeds the monthly limit currently proposed as the minimum coverage of protected customers, the economic and social implications could be worse than Bulgaria's in 2009. It should be remembered that Bulgaria only suffered a 14-day gas-supply interruption.

Financial implications

Renovating a large share of the building stock, over a 20-year period, demands substantial investment - as much as €81 bn (present value) under the most ambitious "energy security" scenario. However, overall these investments would result in €106 bn (present value) in energy cost-savings over the lifetime of the measures, and therefore more than offsets the total investment (see Figure 4).

While governmental and EU sources of financing (such as the European Fund for Strategic Investment and the European Structural and Investment Funds) can and should be used to boost the renovation market, building owners are expected to be the principal funders. That said, citizens, public authorities and businesses often lack the fiscal reserves to provide the upfront investment. For this, well-designed financing schemes will need to be established to overcome the initial capital investment barrier. Similarly, governments must develop additional non-financial forms of support to support these investments and endeavours. This might include, for example, one-stop-shops, help with training, awareness raising, and regulatory measures that provide the right indications and support to consumers when undertaking renovation on their properties.

Based on this, governments will need to develop truly strategic national renovation roadmaps that actually overcome the barriers to and provide an effective financing framework, together with giving market confidence in a long-term transition of the existing building stock towards a highly efficient energy performance level.

Policy recommendations

PREVENTIVE MEASURES

European institutions and countries in the region are encouraged to develop an energy infrastructure that includes end users and which prioritises demand reduction through energy efficiency and increased deployment of renewables. Developing a strategic roadmap would support the region to make a shift from traditional heating and cooling methods based on fossil fuels and local biomass, towards modern approaches based on best available low-carbon technologies.

NATIONAL AND MULTI-COUNTRY APPROACHES

Structural changes are required to facilitate the transformation of the gas-consuming energy system into a highly efficient, electrified and renewable-based system. Subsidies that are offered to fossil fuel investments must be redirected towards

clean energy developments supporting renewable energy technologies and energy efficiency improvements in the building sector.

A strategic multi-country approach should ensure that local employment opportunities are maximised and that economic benefits are retained within the region. Not only would a dedicated renovation programme deliver energy savings and security, it would also include additional benefits.

Countries in the region are encouraged to take the Building stock Vulnerability Indicator (BVI) into account when preparing their risk assessments and Preventive Action Plans under the Security of Gas Supply Regulation. Participating countries need to look into demand-side measures on an equal footing with supply-side measures. "Efficiency First" should be a fundamental principle of the energy market design proposals, as identified by the European Commission in its Energy Union Strategy[6] .

Energy efficiency of the wider energy system also needs to be addressed. District heating, for example, meets the heating needs of a significant share of customers, especially in Bulgaria, Serbia and Romania. It would be beneficial to replace gas or coal-fired district heating with those based on heat pump technology or utilising waste heat and/or local renewable sources.

EU LEVEL POLICIES AND NATIONAL POLICY ADOPTION STRATEGIES

Renovations are faced with the significant barrier of high upfront costs and the fact that they are not usually considered as infrastructure. The European institutions and the target countries of this analysis are strongly encouraged to set energy efficiency as an infrastructure priority. State Aid rules will need to accommodate the new definitions of energy efficiency.

European funding sources (such as Connecting Europe Facility, the Multiannual Financial Framework, the European Fund for Strategic Investments and the Structural and Investment Funds) should be channelled towards investments in deep renovation of the building stock.

The Projects of Common Interest list for 2018 will include combined modelling between ENTSO-G and ENTSO-E. It is proposed that energy efficiency and demand-side response developments are taken into account when modelling future energy demand.

Conclusions

This report identifies the SEE region as vulnerable to gas-supply disruptions, with its building stock consuming 38 % of gas imports. BPIE's Building stock Vulnerability Indicator (BVI) takes three factors into account: the importance of gas as a fuel in buildings, the degree of gas-import dependency, and the diversity of supply routes. Based on these, the BVI analysis in the SEE region concludes that:

- Most countries in the region are exposed to some vulnerability;
- Bulgaria has a substantial vulnerability;
- Hungary and Slovakia are severely vulnerable.

Gas dependency cannot be solved with more gas-supply options, which would only lead to increased dependency, but it can be significantly mitigated with demand-side measures in the form of comprehensive and deep renovation of buildings. The scenario-modelling analysis shows that, within 20 years, a dedicated renovation programme could:

- Address all gas-consuming buildings in SEE and
- Reduce the building stock's gas consumption by as much as 8.2 bcm/a, or by 70 % of the current consumption.

In order to ensure a successful implementation of the above demand-driven solutions, national governments in the region should adopt the strategic objective of tackling energy security, in particular in relation to gas, within the context of a drive towards low-carbon economies. Doing so will help improve the living conditions of millions of citizens, reduce air pollution and provide a significant economic stimulus. Relevant bodies, such as ACER, ENTSO-G and national regulatory authorities, should be required to work together in a co-ordinated fashion to achieve this strategic objective.

Following the presentation of the results of this study at the CESEC High Level Group in September 2016, the issue of demand reduction is now on the CESEC agenda through the establishment of a working group to examine what actions might be taken at the regional level to promote the cost-effective development of renewable energy and energy efficiency in the region, inter alia through sharing best practice, promoting investment, and promoting job creation[7].

References

BPIE, "Accelerating the renovation of the Bulgarian building stock", http://bpie.eu/publication/ accelerating-the-renovation-of-the-bulgarian-building-stock/, 2016.

BPIE, "Safeguarding energy security in South-East Europe with investment in demand-side infrastructure", 2016

Christie E. H., BAEV P. K., Golovko V., "Vulnerability and bargaining power in EU-Russia gas relations", 2011.

E3G, "More security, lower cost – A smarter approach to gas infrastructure in Europe", 2016.

Energy Union Choices, "A perspective on infrastructure and energy security in the transition", https://europeanclimate.org/energy-union-choices-a-perspective-on-infrastructure-and-energysecurity-in-the-transition/, 2016.

ENTSOG, Information on website [Accessed: 2016].

European Commission (2014). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL European Energy Security Strategy COM/2014/0330 final.

European Commission, Staff Working Document SWD (2016) 25/2: "Impact assessment accompanying the document proposal for a regulation of the European Parliament and of the Council concerning measures to

6. See more at the ECF report "Governance for Efficiency First: "Plan, Finance And Deliver" https://europeanclimate.org/wp-content uploads/2016/06/ECF_Report_Summary_v9-screen-spreads.pdf.

7. Minute no. 20 in the conclusions of the September 2016 CESEC meeting, Budapest. https://ec.europa.eu/energy/sites/ener/files/documents/CESEC%202016.09.09%20HLG%20conclusions%20-%20FINAL.PDF.

safeguard security of gas supply and repealing Council Regulation 994/2010", 2016.
European Commission, Inception Impact Assessment: "Review of the Energy Performance of Buildings Directive, including the 'Smart Financing for Smart Buildings' initiative", http://ec.europa.eu/ smart-regulation/roadmaps/ docs/2016_ener_001_epbd_smart_buildings_en.pdf, 2016.
European Commission, SWD (2014) 326 final – "Preparedness for a possible disruption of supplies from the East during the fall and winter of 2014/2015", https:// ec.europa.eu/energy/sites/ener/files/ documents/2014_ energystresstests_southeasteuropeanfocusgroup.pdf, 2014.
European Commission, "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, An EU Strategy on Heating and Cooling", COM (2016) 51 final, https://ec.europa.eu/transparency/regdoc/rep/1/2016/ EN/1-2016-51-EN-F1-1.PDF, 2016.
European Climate Foundation, "Governance for Efficiency First: Plan, Finance And Deliver", https://europeanclimate.org/wp-content/uploads/2016/06/ECF_Report_Summary_v9-screen-spreads.pdf, 2016.
European Climate Foundation, Energy Union Choices: A Perspective on Infrastructure and Energy Security in the Transition, 2016.
European Parliament, "Report on European Energy Security Strategy", http://www.europarl.europa.eu/ sides/ getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2015-0164+0+DOC+XML+V0//EN, 2015.
Eurostat online statistical database, ec.europa.eu/Eurostat.eu, accessed in April 2016.
Fraunhofer ISI, "Mapping and analyses of the current and future (2020–2030) heating/cooling fuel deployment (fossil/ renewables). Work package 1: Final energy consumption for the year 2012", 2016.
South-East Europe Sustainable Energy Policy, "South-East Europe: The EU road or the road to nowhere", 2016 Support for Low-Emission Development in South-Eastern Europe (SLED), "The typology of the residential building stock of Montenegro and modelling its low-carbon transformation", 2015.
World Health Organization (WHO), "Global urban ambient air pollution database", http://www.who.int/ phe/health_ topics/outdoorair/databases/cities/en/, update 2016.
WHO, "Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide", http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf, 2006.
World Health Organization (WHO) "Global Urban Ambient Air Pollution Database" (update 2016) http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/.

Acknowledgements

BPIE would like to thank the following individuals who provided constructive comments in the formulation of this paper: Frank Klinckenberg (The Policy Partners, Belgium); Visar Azemi (Balkan Green Foundation, Kosovo); Jozsef Feiler (European Climate Foundation, Hungary); Rod Janssen (Energy in Demand, France); Horia Petran (URBAN-INCERC, Romania); László Szabo (Regional Centre for Energy Policy Research, Hungary).