Assessment of Energy Security in Georgia, Czechia, and Slovakia and their policy objectives

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Abstract

Energy security is a national strategic interest of Georgia, Czechia, and Slovakia, affecting their economic, social, political and security environment. It is highly important for import-dependent and transit countries as they are, to secure their prospects of independent socio-economic development and to be reliable transit partners. This paper seeks to identify perceptions of energy security in Georgia, Czechia, and Slovakia, to assess the strengths, weaknesses, opportunities, and threats of their energy systems and to analyze the national energy security objectives and targets based on a comprehensive review of the strategic documents and consultations with key stakeholders. It is an attempt to create an energy security assessment framework incorporating political, management, legal and institutional, technological, economic, social, and environmental issues and display the big picture of energy security at a national level. While Georgia clearly defines energy security in its strategic documents as an overarching objective of the national energy policy, Slovakia and Czechia do not define it and provide narrow understanding of energy security. The paper has identified key principles of energy security, and variety of strengths, weaknesses, opportunities, and threats for each country. It has also identified commonalities in weaknesses and threats which can effectively be addressed with joint actions. Analyzing the big picture reflecting the strengths, weaknesses, opportunities, and threats of national energy security and setting right objectives are important but not sufficient. Political will and strong analytical and implementation capacities, with regular monitoring and improvement are vital factors to effectively achieve the high-level energy security in these countries.

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Introduction

Energy security is an integral component of national security, affecting the country's economic, social, political and security environment, and foreign relations. Its provision is in the national interest of countries including Georgia, Czechia, and Slovakia. Those countries come from the similar Soviet/socialist past, have an important strategic location, and perform an essential energy transit role in their regions. Despite these commons they differ with their energy systems, vulnerabilities and therefore policy objectives.

In the 21st century considering technological and economic development, rapid growth in energy demand, resource depletion, climate change, recent COVID-19 pandemic and increasing political tensions, ensuring energy security increasingly requires a comprehensive systemic study of economic, political, social, technological, and environmental factors.

Energy security is becoming even more important for import-dependent and transit countries to ensure their own socio-economic development and to be reliable transit partners. Considering only net-import energy dependence[1] of Georgia - 81%, Czech Republic – 60%, and Slovak Republic - 93% in 2019 indicates their vulnerability to external risks and underlines importance of the energy security.

For Georgia, given the high degree of external energy dependence, political, socio-economic, military, technological and environmental risk factors in the region, energy security is particularly relevant. In 2006 Russian energy blockade[2] and air raid on energy transit pipelines to Georgia and cyber-attack on BTC pipeline (on the territory of Turkey) during the 2008 War[3], necessitates inclusion of energy security in planning national security policy. The National Security Concept of Georgia (2011)[4], which is a primary document that outlines national values and interests, defines energy security as one of the key national interests.

Like Georgia, Slovak Republic in its recently published Security Strategy (2021)[5], which is very similar to the Security Strategy of the Czech Republic (2015) identifies energy security as one of the 20 strategic security interests. Energy security with reliable supply of raw materials has been recognized as primary preconditions for the development of the state economy. The increased political, environmental, and cyber risks of endangering critical energy infrastructure and security of energy supply have been underlined in the strategy. Climate change, and disruption or destruction of critical energy infrastructure, together with the interruption of the supply of energy

[1] IEA, Energy Balance 2019, including nuclear fuel import – Data tables – Data & Statistics - IEA
[2] CNN.com - Gas flowing to crisis-hit Georgia - Jan 23, 2006
[3] Mukhigulishvili, G. Margvelashvili, M. Energy Security and Energy Union Perspectives for Georgia, 2015, WEG. August 5, 2008 cyber-attack on BTC pipeline in Turkey disrupted oil transportation for 14 days and caused 1 billion dollars loss.
[4] National Security Concept of Georgia, NATIONAL SECURITY COUNCIL (nsc.gov.ge), 2011.
[5] Security Strategy of Slovak Republic, approved by the National Council on January 26, 2021

raw materials (especially for nuclear power production), are identified as threats to national security.

Czech Republic also included energy security as a strategic interest in its Security Strategy adopted in 2015[6]. Due to the growing dependence on energy imports, political pressures, increased kinetic (criminally motivated) and cyber threats to critical energy infrastructure, and the safety of nuclear power plants further increase the importance of energy security for the country.

During the energy crisis of 2009[7], Russia cut off the flow of natural gas to most European countries including Czechia (71% cut) and Slovakia (97% cut)[8]. By January 7 the flow to Slovakia was completely stopped and a state of emergency was declared in the country. About 500 million Euro was lost by economy of Slovak Republic in 13 days during the gas crisis.[9] Although Czech Republic managed to provide gas to its customers from Norway and Germany and increased domestic production by 15%, this crisis had significant negative impact to its economy. These examples demonstrated the importance of energy security and the need to diversify energy supply sources and routes along with other prevention, mitigation, and resilience measures.

The analysis is based on a comprehensive review of the strategic documents and consultations with key stakeholders. The paper tries to depict the big picture of energy security incorporating political, management, legal and institutional, technological, economic, social, and environmental issues. The following chapters provide analysis on how energy security is perceived in Georgia, Czechia, and Slovakia, what are the strengths, weaknesses, opportunities, and threats of energy security in these countries and what are their objectives for improving energy security. The main findings are summarized in the last chapter.

Definition of Energy Security

One of the main objectives of the energy sector is to achieve high level of energy security, which includes the supply of various energy carriers in a way that promotes the development of other sectors of the economy and preserves national interests and values. The development of the energy sector must lead the development of all other sectors so as not to hinder their progress, as energy is a critical factor in the economy.

Although there is no single definition of energy security and different countries have different perception of it, one of the classic explanations of energy security is provided by Daniel Yergin. According to the definition **objective of the energy security is to assure adequate, reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives[10].** International Energy Agency also provides similar definition of energy security - as **the**

[6] The Security Strategy of the Czech Republic, 2015
[7] The gas crisis paralyzed Europe as a result of a dispute between Russia and Ukraine, ostensibly over missed payments for gas imported by Ukraine.
[8] The Russo-Ukrainian gas dispute of January 2009: a comprehensive assessment Background (oxfordenergy.org)
[9] Economic Impact of Natural Gas Supply Disruptions - Case of Slovakia (researchgate.net), 2014
[10] Daniel Yergin, Energy Security in the 1990s, Foreign Affairs, Vol. 67, No. 1 (Fall 1988), pp.110-132 (111)

uninterrupted availability of energy sources at an affordable price, in the short and long-term perspective[11].

Energy security is a complex term comprising the following aspects: **availability of energy resources, physical accessibility to energy, reliability of energy infrastructure, financial affordability of quality energy, resilience and flexibility of energy system and sustainability**[12]**.**

Georgia, Czechia, and Slovakia consider energy security as one of the national security interests in their national security concept[13] and strategies[14]. To analyze a country's energy security, it is important to understand how it is defined by a particular country.

According to the draft National Energy and Climate Plan (NECP) of Georgia "**the objective of energy security is to ensure adequate and reliable supply of different types of high-quality energy to all consumers, at a fair price, while protecting the interests of national security and sustainable development, in the short and long term.**" This definition is very close to the classic definition of energy security. In addition, the law on Energy and Water Supply defines the security of supply as the ability of the electricity and natural gas system to supply energy to the final customer in compliance with the requirements established by this law[15].

Although in Slovak Republic policy documents do not provide official definition of energy security, it identifies **energy security as a strategic interest of the country, which is a precondition for economic development and functioning of the state**. In the Security Strategy[16] importance of **security and reliability of energy supply as well as cost-effectiveness and optimal energy mix including sustainable use of all low-carbon resources** are underlined. The Act 251/2012 Coll. on energy[17] defines security of electricity and gas supply as the ability of the system and the network to supply final customers electricity and gas, to ensure the **technical safety** of energy facilities and to balance electricity and gas supply and demand in the territory of the country. Improving **safety and reliability of nuclear power plants** is of paramount importance for the country, as underlined in the Integrated National Energy and Climate Plan 2021-2030 (NECP).

The NECP of Slovakia provides insights of the energy security, as an "efficient energy architecture which creates, for the benefit and protection of consumers, conditions for increasing energy security through the utilization of domestic energy sources, a favorable environment for the construction of low-carbon heat and electricity generation sources with the option of exporting electricity, and an optimal energy mix with low-carbon technologies in each sector." The NECP also provides key development areas in the energy security: diversification of energy sources and transit routes, increase nuclear safety and reliability, and energy supply security.

[11] Energy security - Areas of work - IEA
[12] Mukhigulishvili G, Shatirishvili N et al "Energy Security Assessment, Including the Legal and Institutional Framework" 2021.
[13] National Security Concept of Georgia, NATIONAL SECURITY COUNCIL (nsc.gov.ge), 2011.
[14] Security Strategy of Slovak Republic, 2021 and The Security Strategy of the Czech Republic, 2015
[15] Law on Energy and Water Supply, 2019
[16] Security Strategy of Slovak Republic, approved by the National Council on January 26, 2021
[17] **Act 251/2012 Coll. on energy** - https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/251/

Like Slovakia Czechia also does not provide official definition of energy security in its strategic documents. The Security Strategy of the Czech Republic (2015)[18] divides the security interests according to their importance into three categories: vital, strategic, and other important interests. Energy Security is one of the strategic interests identified in the Security Strategy. According to the strategy to ensure a **stable supply of electricity**, the priority is the **uninterrupted supply** of strategic raw materials (especially nuclear fuel) and the creation of strategic state reserves.

On the other hand, the State Energy Policy[19] of the Czech Republic (SEP 2015) defines the vision of energy sector as a reliable, affordable, and sustainable energy supplies for households and the economy. This vision is condensed into three top-level objectives of the Czech Republic's energy sector: security – competitiveness – sustainability. The SEP identifies the following strategic energy priorities: (i) a balanced energy mix / transformation of the energy industry; (ii) energy savings and energy efficiency improvements; (iii) infrastructure development; (iv) research in the field of energy and industry, human resources; (v) energy security. According to SEP to ensure the energy security and resilience of the Czech Republic (CR) it is essential to have access to a **robust transmission system** with ample regulatory powers and a reasonable distribution system.

The National Energy and Climate Plan (NECP)[20] of the CR underlines the importance of the energy sector as an intermediary for the functioning of the state. The safety and reliability of nuclear power plants is important for the CR as it intends to increase NPP's share in the power generation.

Perceptions of energy security in Georgia, Slovakia and Czechia can be visualized in the graphs below.

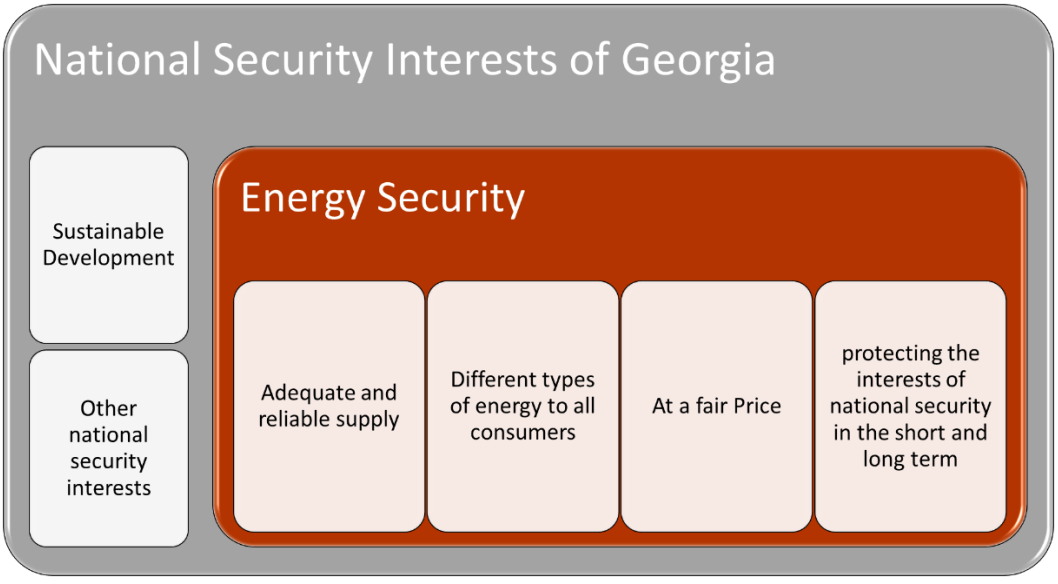

Figure 1 - Energy Security Perception of Georgia

[18] The Security Strategy of the Czech Republic, 2015
[19] The State Energy Policy of the Czech Republic (2015) - State Energy Policy | MPO
[20] National energy and climate plans (NECP) of CR (2019) - National energy and climate plans (NECPs) | Energy (europa.eu)

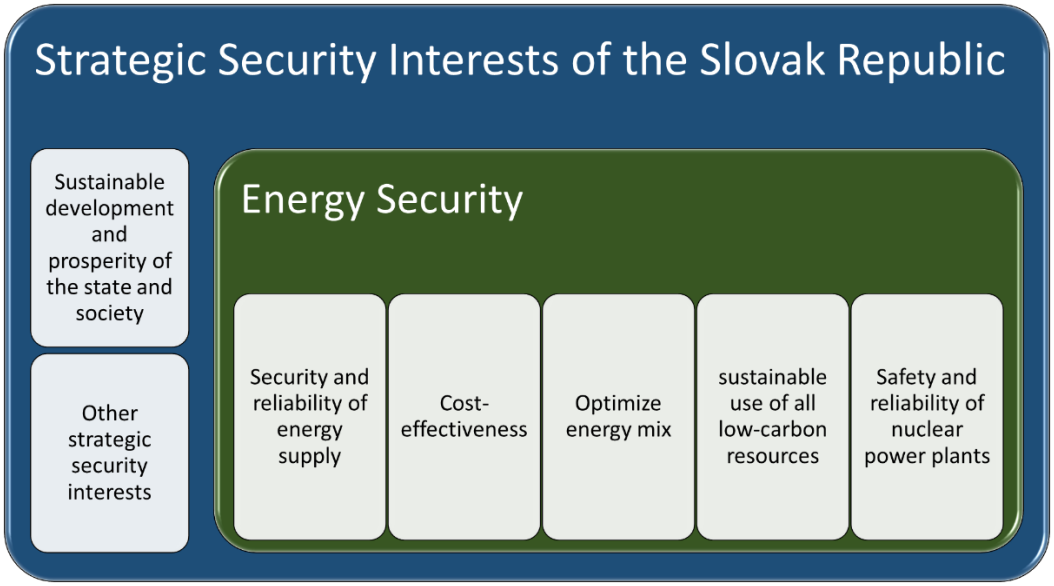

Figure 2 - Energy Security Perception of Slovak Republic

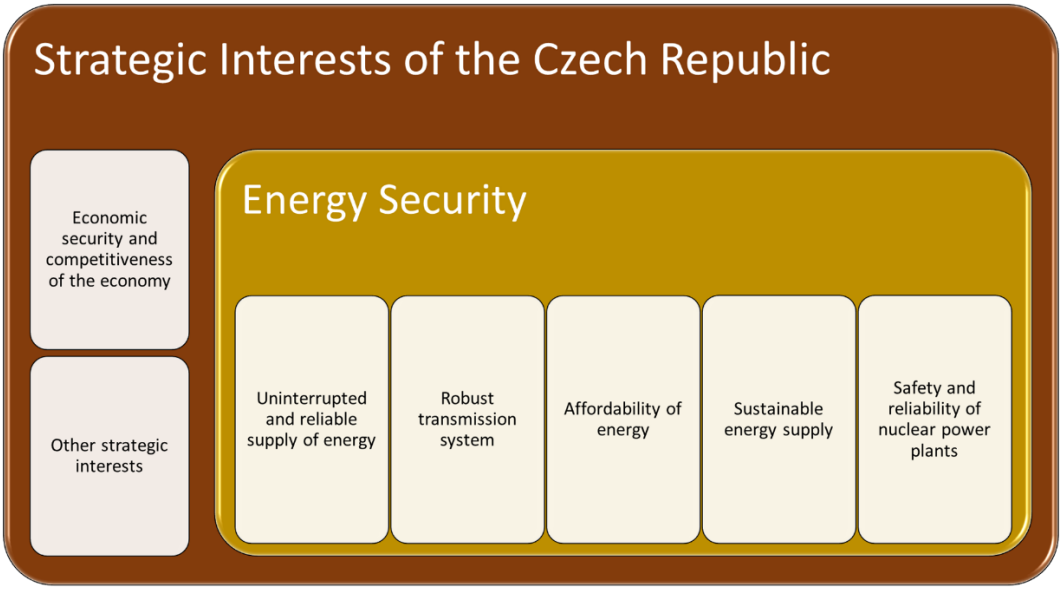

Figure 3 - Energy Security Perception of Czech Republic

Strengths, Weaknesses, Opportunities and Treats in Energy Security

The purpose of this chapter is to assess energy security of Georgia, Slovakia and Czechia using SWOT[21] analysis. SWOT is a useful tool for better representation of countries' energy security in a multidimensional big picture that reflects internal and external factors, as well as current and future potential. The analysis of the energy security has been conducted in terms of its objectives, which are the following:

- Assure availability of energy resources
- Ensure physical accessibility to energy for all consumers
- Guarantee adequate and reliable supply of energy
- Provide quality energy at an affordable price
- Ensure resilience and flexibility of energy system
- Consider sustainability principles.

The analysis covered policy and management, legal and institutional, technical, and technological, economic, social, and environmental issues. Qualitative and quantitative assessment were conducted using different indicators developed in the study – "Energy Security Assessment, Including the Legal and Institutional Framework"[22], including Energy Union indicators as well[23].

The assessment of the strengths, weaknesses, opportunities, and threats of the energy security in Georgia, Slovakia and Czechia is based on a comprehensive review of the strategic documents and consultations with key stakeholders. Wide range of strategic documents of these countries were reviewed during the period September-November 2021, including: the National Security Concept and Strategies; the Energy Security Strategy and the Energy Policy of SR; the National Energy and Climate Plans (NECPs); the Ten-Year Development Plans in Electricity and Gas; the National Reports of Security of Supply in electricity, gas and oil; the reports of the National Regulatory Bodies; the Preventive and Emergency Action Plans in electricity and gas; the Adaptation Plans and the National Communications on Climate Change to UNFCCC; the Cyber Security Strategies and other relevant strategies and plans (for more details see references below).
Consultations were conducted in the same period with the following key stakeholders: the representatives of the responsible ministries on energy sector in Georgia, Slovakia and Czechia, oil and gas corporations and associations in Georgia and Slovakia, Slovak Innovation and Energy Agency, the Energy Regulators of Georgia and Slovakia, the Ministries responsible for Environmental Protection, the Associations of Renewable Energy, Non-governmental Organizations, and independent energy Experts.

Participation in the annual Central European Energy Conference organized by the Slovak Foreign Policy Association was very useful. The High-level officials and energy experts from all Visegrad

[21] SWOT analysis is a technique for assessing the following four aspects: Strengths, Weaknesses, Opportunities and Threats of the issue. SWOT analysis assesses internal and external factors, as well as current and future potential.
[22] Mukhigulishvili G, Shatirishvili N, Oravcova V, Duleba A "Energy Security Assessment, Including the Legal and Institutional Framework" 2021.
[23] European Commission, Indicators for monitoring progress towards Energy Union objectives - | Energy (europa.eu)

countries were participated in the conference which gave me chance to ask questions on energy security issues.

Below are provided the results of the SWOT analysis for Georgia, Slovakia, and Czechia.

Energy Security of Georgia

Strength:	**Weakness:**
• Georgia with its strategic **geopolitical location** on a significant trading route between East and West as well as North and South plays a vital role in energy transit in the region and to world markets.[24] • Georgia has **independent energy regulatory body** - Georgian National Energy and Water Supply Regulatory Commission (GNERC) with qualified staff[25]. • Energy security is recognized as a **national interest** in the National Security Concept of Georgia (2011) and its updated draft (2021). • At the strategic level, to plan and coordinate national security policy, including energy security issues, a **National Security Council** was established in 2019 under the Prime Minister. In accordance with the rules of electricity supply security, an **Interagency Energy Security Group (IESG)** has been established, which acts as an inter-agency coordination body for energy security issues. • Georgia has been using comprehensive **planning tools** such as MARKAL and TIMES in energy sector planning, however analytical group has been outsourced under the donor support programs. • The high level of **environmental CSO** activity promotes sustainability of energy sector. • Georgia has high **Electricity Interconnection Capacity** with neighboring countries – 41.21% (2019)[26]. • Georgia has high level of **accessibility rate** on electricity – 100% and gas – 72% (2019). • **Affordability** of energy of household (share of energy expenditure in total expenditure of households in %) – 8.78% in 2019.	• Georgia needs to strengthen **strategic planning and policy making capacity in energy sector**. The MoESD responsible for energy policy have no permanent analytical staff working on energy planning. Georgia has not developed a comprehensive **energy security strategy yet**. Ownership of the energy policy documents developed mostly with donor support by external experts sometimes is very low. There is a **weak strategic communication** among public institutions and key stakeholders on developing strategic energy projects, including HPPs. **Low in-country capacity** makes transposition of EU energy acquis difficult and time-consuming. • There is no **research institutions** on energy issues. Insufficient attention is being paid to education, research and development thus hampering introduction of modern technologies. • **Dearth of own fossil fuel reserves** makes Georgia strongly dependent on energy imports and thus vulnerable to associated economic and political risks. Georgia is 81% (2019) **net energy import dependent** and this dependence is increasing. Net-import dependence in gas – 100% (2 sources), electricity – 11% (4 sources), oil – 100% (>10 source) • Georgian energy sector is characterized by **seasonal imbalance of electricity and gas supply and demand**. In winter, there is a shortage of electricity while in summer there is excess of power generation. The country consumes 3.5-4 times[27] more natural gas in winter compared to summer and has no own means of balancing the demand and hedging the supply risks increased due to the high strain on exporting countries and their systems. • The Georgian natural **gas market has a critically high concentration**, mainly due to the dominance of

[24] Important transit pipelines run through the country: the Baku-Supsa and Baku-Tbilisi-Ceyhan oil pipelines (approximately 30 million tons of oil annually), the Baku-Tbilisi-Erzurum gas pipeline (South Caucasus pipeline, 25 billion m3), and the North-South Russian gas pipeline (2 billion m3 per year). 4 million tons of Kazakh oil are transported annually by the Georgian Railway.

[25] georgia_report-assessment_of_energy_regulator_2017-eng_final.pdf (weg.ge)

[26] The Energy Union indicator measuring electricity interconnection capacity as a percentage of installed capacity. NGSE – TYNDP 2021-2031 https://gse.com.ge/sw/static/file/TYNDP_GE-2021-2031_GEO_NEW.pdf

[27] Statistics | Eurostat, 2019 - https://ec.europa.eu/eurostat/databrowser/view/NRG_CB_GASM__custom_1564374/default/table?lang=en

	the state-owned Azerbaijani company SOCAR in the import, wholesale, and retail trade. • **Need of the higher level of power system reserves** and **innovative demand management means**. Uncertainties in demand and supply is increasing in the face of an anticipated expansion of intermittent renewable electricity as well as variable demand from prosumers, electric vehicles, crypto-mining and other emerging new technologies. These uncertainties complicate the planning of a reliable power system and requires system reserves and innovative techniques in planning power supply and demand. • **Non-existence of own gas storage** - makes Georgia dependent on Azerbaijan for handling the seasonal imbalance of supply and demand. The storage would play a key role in normal market operations, helping lessen impact of high seasonality of current energy mix. • **Obsolete energy infrastructure** in the electricity and gas sectors with poor technical reliability which does not correspond to the requirements of modern planning, construction, and operation. (SAIFI and SAIDI are very high in the regions of Georgia)[28]. • Georgia has not yet created **strategic/emergency oil and oil products stocks** to meet its own demand in an emergency or extreme situation[29]. Georgia does not use its **oil refinery** capacity. • Georgia has not developed a comprehensive **cybersecurity law** or compliant rules **for the energy sector**[30]. The country lacks cyber security prevention and emergency plans. Georgia has not included yet **critical energy infrastructure** in the list of critical information systems[31]. The GoG plans to upgrade the list from January 2022 and include critical energy infrastructure as well. • Georgia has not yet adopted **security of gas supply rules**. It is in the process of development. • Georgia has not developed **adaptation plan/strategy** and has not studied in depth the impact of expected extreme weather conditions, increased temperatures, natural disasters, hydrology, and wind pattern changes on energy sector.

[28] Annual report, Georgian National Energy and Water Supply Regulatory Commission, 2020 - https://gnerc.org/en/commission/commission-reports/tsliuri-angarishebi
[29] Implementation Report of Georgia, 2021 - https://energy-community.org/implementation/Georgia.html
[30] CERT-GOV-GE is responsible for cyber protection in the energy sector. Identification of critical information infrastructure is not specific to critical energy assets. Implementation Report of Georgia, 2021 - https://energy-community.org/implementation/Georgia.html
[31] Decree of the President of Georgia on the approval of the list of subjects of the critical information system - https://matsne.gov.ge/ka/document/view/1867646?publication=0

	• Georgia has not yet adopted robust and **long-term economic strategy** to create a bases for energy sector planning. • Georgian government and energy companies cannot **guarantee the gas supply to the temporarily occupied territories of the country**. As a result, the heating demand causes inefficient use of electricity, overload of the power system, and a drop in the quality of supply. • **Unsustainable use of fuel wood** leads to deforestation, fuel deficiency and energy poverty in some regions of Georgia. • **A large share of energy inefficient buildings** in the residential and public sectors increases demand for energy for heating and cooling. Most of the buildings in Georgia were built in the period 1950-1990 when heating requirements were not considered. • **Reliability of gas and electricity infrastructure**: N-1 rule for gas infrastructure is about 87% (2020). N-1 rule for electricity was less than 100% by 2019. N-1 should be more than 100% to achieve reliability of infrastructure. • **Non-transparent and cost-inefficient transit fee** set on the North-South gas transit pipeline. • High **share of fossil fuel energy** – 77% in total energy supply.[32] This will make transition to low-carbon energy system difficult.
Opportunities: • **Southern energy transit corridor**, originally meant to weaken Europe's dependence on Russian gas, can become a part of a bigger strategy for the region to push economic reforms, encourage spill-over effects in other sectors, and hopefully promote pro-Euro-Atlantic policies. (EAOTC, AGRI, White Stream, Anaklia Deep Sea Port) • Georgia has an advantageous position to initiate **regional cooperation in energy trade** and develop regional energy market which will increase energy security of South Caucasus countries. • **Enacting EU energy acquis** under the Energy Community membership and Association Agreement will enhance energy security of Georgia. **Solidarity and mutual responsibility** are the main values of those agreements. • **Increasing availability of funds** by international funds and financial institutions (GCF, GEF, EU, EBRD, WB etc.) for developing low-carbon energy technologies. • By improving stability and investment climate (competitive market, transparency, and support schemes) and bringing in strategic and qualified investors Georgia can create opportunities for the	**Threats:** • **Russian hybrid warfare** and occupational policy creates significant threats for energy security of Georgia. Russian army occupied more than 20% of Georgia's territory. Kinetic/physical risks related to the critical energy infrastructure (gas, oil pipelines and power transmission lines etc.) in the vicinity of the occupied territories by Russia is realistic. Strategic Enguri and Vardnili HPPs are partially located in the occupied territory. Russia can use this as a political instrument against Georgia's Euro-Atlantic accession. (In 2006 Russian energy blockade and air raid on energy transit pipelines in Georgia, and cyber-attack on BTC pipeline during the 2008 War). • **Penetration of Russian capital to Georgian energy sector** (oil, electricity, HPPs) is very high. This makes energy security of Georgia vulnerable to external threats[35]. • Introduction of smart technologies and automation of critical energy infrastructure without relevant prevention, mitigation and resilience measures increases its vulnerability to **cyber-attacks**. • **Global Climate Change,** increased frequency and severity of extreme events causes the risks of

[32] IEA, Energy Balance 2019, including nuclear fuel import - Data tables – Data & Statistics - IEA
[35] https://idfi.ge/en/russian-capital-in-georgian-business-full-report

development of **domestic renewable and fossil energy resources**. Georgia has vast available renewable energy resources, especially hydro that can be economically developed in synergy with other renewable energy sources. • Development of renewable energy potential can be accelerated by **emissions trading schemes** that will help developed countries comply with their emission reduction targets. • To support **intermittent RES integration** in the power system Georgia can effectively develop aggregators, energy storage facilities (mainly pumped storage), and ancillary services. • **Diversification of gas supply.** The possibility of receiving gas from Turkey or any EU countries through the SCP. The swap of regasified LNG landing at a terminal in Turkey, Greece or Italy with piped gas delivered to Georgia through its offtake from SCP could provide Georgia with indirect access to LNG[33]. The option does not require development of new infrastructures. Receiving natural gas from Turkmenistan and/or Iran based on swap deals, with the participation of Azerbaijan or Armenia is also realistic[34]. • Development of **high-voltage transmission line on the Black Sea seabed** to connect Georgia and European power systems. It will play a significant role in the country's energy security through direct links with the Energy Community and EU member states. • **Energy efficiency programs.** Development of energy efficiency measures (in building, energy generation and transportation, industry, and transport sectors) planned under NECP can significantly contribute to the Georgia's energy security. • **Investment in research and innovation** will significantly enhance resilience of energy sector in Georgia.	increased and irregular demand on energy while also having a negative impact on energy infrastructure. Due to the average temperature increase in the future power consumption for cooling will increase. This will shift peak load from winter to summer and this kind of dramatic shift in a state's demand can have severe impacts on its overall energy security outlook. • **Volatility in cryptocurrency prices** causes drastic fluctuations in power consumption, complicating short- and long-term balancing of the power system. • **Devaluation of Georgian currency (GEL)** against USD increases the price of electricity and natural gas, as payments for imported energy are mainly carried out in hard currency. This may affect the affordability of energy by residential consumers and businesses. • **Corruption and involvement of unqualified developers** in the development of local energy infrastructure, and the **lack of strategic communication** by the government with the local population further increase the public protest against the energy projects. There may be also groups of people or CSOs who are supported by Russia to protest the construction of important energy infrastructure in Georgia. • **Supply gap of natural gas -** due to an expiration of the "additional" gas contract with Azerbaijan, rising domestic demand, and limited commercial Azeri export capacity, Georgia will have a supply gap after 2026. **Expiration of "additional" gas contract** (500 mcm/year) from Shahdeniz Consortium in 2026 necessitates additional sources of natural gas during the winter to meet the "social" sector demand. • **Black Swan Events[36] - the COVID-19 pandemic** and the impending epidemic situation in Georgia may pose a threat to critical personnel in the energy sector, create financial losses to energy producers and suppliers, cause uncertainty of supply and demand on energy markets, suspend development of strategic energy infrastructure (gas storage) and make energy less affordable for customers (increase subsidies).

[33] The Ministerial Council of The Energy Community has recommended to include the project "SCP Georgian Offtake Expansion for EU LNG Swap" which involves the idea of LNG swap landed at a terminal of a European country(ies) in the list of Projects of Mutual Interest (PMI).
[34] A "swap" in this context is a contractual arrangement to purchase a commodity (LNG) from a provider in a separate location for the same commodity at an agreed upon price.
[36] A Black Swan is an unpredictable event or disruption that exceeds normal expectations and has the potential to inflict severe consequences.

	• **Regional conflict between Azerbaijan and Armenia –** may pose security threats to transit infrastructure passing through Georgia. • **Terrorism** is an emerging threat for the critical energy infrastructure and therefore the security of energy supply in the Caucasus region. • According to the IEA WEO[37] - higher or more **volatile prices for critical minerals** such as lithium, cobalt, nickel, copper, and rare earth elements could slow global progress towards a clean energy future or make it more costly.

[37] World Energy Outlook 2021 - https://iea.blob.core.windows.net/assets/88dec0c7-3a11-4d3b-99dc-8323ebfb388b/WorldEnergyOutlook2021.pdf

Energy Security of Slovak Republic

Strength:	Weakness:
• **Solidarity mechanism** - SR is a member of EU and NATO, and the Visegrad Group. In addition, SR is one of the founding members of the CESEC (Central and Southeastern Europe Energy Connectivity) group, where energy security, infrastructure development and market integration are discussed. • The Slovak Republic is an important **transit country** for natural gas moving from east to west and west to east. It has reliable TSO – Eustream. • SR has **independent energy regulatory body** - the Regulatory Office for Network Industries (URSO) with qualified staff[38]. • Energy security is recognized as a **national strategic interest** in the Security Strategy of Slovak Republic (2021) • SR established **Committee for Energy Security** as a permanent working body of the Security Council[39]. The advisory body of the government participates in the creation and implementation of the security system of the country, evaluates the security situation and prepares for the government proposals for measures to maintain the security of the SR (prevent and resolve crisis situations). • SR has a **long experience in energy security and energy policy development**[40]. In 2008 SR developed Energy Security Strategy[41] and later in 2014 the Ministry of Economy published Energy Policy[42] document defining the energy sector's primary objectives and priorities until 2035 with a view to 2050. In 2019 the Energy Policy (2014) upgraded by adoption of Integrated National Energy and Climate Plan (NECP) of SR for 2021 to 2030[43]. In 2014 Strategy for the Peaceful Utilization of Nuclear Energy in SR was published.[44] In 2015 the	• The SR is 93% (2019) **net energy import dependent**. Net-import dependence in nuclear fuel - 100% (1 source), gas – 97% (1 source), electricity – 6% (4 sources, no connection with Austria), oil – 97% (1 source), coal – 92% (2-3 Source)[59]. High-level dependence on Russia in gas, oil, and nuclear fuel supply. Furthermore, NPP in SR are based on Russian technologies, but with major modification influenced after Fukushima. • **Seasonality in Gas consumption** – SR consumes 2.5-3 times[60] more natural gas in winter then in summer, however, it has own balancing reserves (gas storages). • **SR needs flexible power reserves** to balance supply and demand considering the high share of hard base load power (nuclear), intermittent RES (wind, solar), development of EVs. • Despite long experience in energy security and energy policy development SR **needs to strengthen strategic coordination among public institutions and its planning capacity** in developing national energy policy. Ministry of Economy lacks permanent analytical team using comprehensive planning tools (ex. TIMES, MESSAGE, MAED etc). Integrated planning is still challenging. Although, the Ministry of Environmental Protection of SR with the support of World Bank used modeling tools - Compact Primes Model (CPS) and ENVISAGE Slovakia (Slovak CGE) to set climate and renewable targets.[61] • Due to the **demanding EIA and public protest** SR refuses to develop HPP (NECP pp194). • Although SR stressed in its NECP that diversification and reducing energy dependence are the country's

[38] URSO | Úrad pre reguláciu sieťových odvetví (gov.sk) - https://www.urso.gov.sk/about-urso/
[39] Act 110/2004 on functioning of the Security Council of the Slovak Republic in a peacetime (last amendment of January 1, 2016), https://www.zakonypreludi.sk/zz/2004-110
[40] Ministry of Economy of the Slovak Republic (MoE) is responsible for developing the Energy Policy for a minimum period of 20 years and updating it on a five-year cycle at a minimum pursuant to Section 88 of Act 251/2012 Coll. on energy
[41] Návrh stratégie energetickej bezpečnosti SR, 2008, https://rokovania.gov.sk/RVL/Material/4819/1
[42] Energy Policy of SR (Ministry of Economy of SR, October 2014 – approved by the Government of SR on October 30, 2014), English version: https://www.mhsr.sk/uploads/files/47NgRIPQ.pdf
[43] Integrated National Energy and Climate Plan of SR for 2021 to 2030 (Ministry of Economy of SR and Ministry of Environment of SR, 2019 – NECP), English version: https://ec.europa.eu/energy/sites/ener/files/sk_final_necp_main_en.pdf
[44] Approved by the Government of SR on January 15, 2014, https://www.mhsr.sk/uploads/files/ITgnG37d.pdf
[59] IEA Energy Balance, 2019 - Data tables – Data & Statistics - IEA
[60] Statistics | Eurostat, 2019 - https://ec.europa.eu/eurostat/databrowser/view/NRG_CB_GASM__custom_1564374/default/table?lang=en
[61] https://www.minzp.sk/files/oblasti/politika-zmeny-klimy/ets/lts-sk-eng.pdf

Ministry of Interior affairs adopted the National Strategy of Security Risks Management of the SR[45]. • SR has a **regulation about critical infrastructure** including energy sector (mining, power system, gas, oil, and oil products).[46] • SR has already transposed into national legislation all **EU energy security acquis**. • SR has developed specific plans dealing with prevention of disruption of natural gas supply: **Preventive Action Plan** (Ministry of Economy of SR, 2017), and **Emergency Plan** (Ministry of Economy of SR, 2017).[47] • SR has **Economic Policy Strategy to 2030**,[48] which creates bases for energy sector planning. • **High public acceptance of nuclear and renewable energy in SR.** The program Green Households and SFRB (State Fund for Housing Development) support awareness raising in SR. • To achieve higher effectiveness of general government expenditures (including the energy sector), financial unit **Value for Money** under Ministry of Finance of SR was established in June 2016[49]. The value for money principle is one of the key criteria in decision making of SR, which guarantees transparency and efficient public spending of money. This can be used to avoid **inefficient energy subsidies** and therefore tariff increases. However, SR has not provided sufficient information on the **amount of energy subsidies** in the NECP[50]. • **Diversification of supplier of nuclear fuel**. Slovenské elektrárne, a.s., TVEL and Euratom Supply Agency signed a contract for the supply of nuclear fuel for nuclear power plants in Slovakia in 2019. The contract is valid for the 2022-2026 period, with the option extension to 2030, and allows programs for the introduction of nuclear fuel from alternative suppliers. However, there is **no details in the NECP.**	main goals, it did **not set specific targets** for improving energy security.[62] • The government of SR approved **the National Cybersecurity Strategy 2021-2025** in May 2021[63]; It is the country's third strategy with the others published in 2009 and 2015 respectively. however, it does not include specific threats or measures in energy sector. • SR has developed the Strategy for **Adaptation to Climate Change** (Ministry of Environment of SR, 2018). It underlines threats that energy sector is exposed to climate change[64]. However, there is no specific measures planned in short, mid, or long-term periods. No comprehensive analysis is provided in the NECP and in the 7th National Communication of SR. • **Affordability of energy** - energy expenditure share in final consumption expenditure for the poorest 20% of the population is very high – 22.06% in 2018[65]. • SR has high rate of energy **Supplier Concentration Index (SCI)** – 68.17 (2018, optimal is <50). SCI shows the concentration of main energy carriers (coal, oil and petroleum products, gas) imports from suppliers outside of the European Economic Area (EEA). The SCI is an Herfindahl-Hirschman Index (HHI) scaled in the range of 0-100[66]. • SR has a high **potential in energy saving and energy efficiency**. Final energy intensity in industry – 150.89 toe/mln EUR in 2019 (EU average - 90.41 toe/mln. EUR); Final energy intensity in services sector – 24.06 toe/mln. EUR in 2019 (EU average - 14.88 toe/mln. EUR)[67]. • High **share of fossil fuel energy** – 62% in total energy supply.[68]This will make transition to low-carbon energy system difficult.

[45] https://rokovania.gov.sk/RVL/Material/12589/1
[46] Act 45/20021 Coll. on critical infrastructure (last amended on March 1, 2021), https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2011/45/20210301.html
[47] https://www.mhsr.sk/uploads/files/PS41ZTp9.pdf / https://www.mhsr.sk/uploads/files/CFF8Tt6y.pdf
[48] Government Resolution No 300/2018
[49] https://www.mfsr.sk/en/finance/value-money/about-value-money/
[50] EC comments on NECP - staff_working_document_assessment_necp_slovakia_en.pdf (europa.eu)
[62] EC comments on NECP - staff_working_document_assessment_necp_slovakia_en.pdf (europa.eu)
[63] https://www.nbu.gov.sk/wp-content/uploads/kyberneticka-bezpecnost/Strategia_kybernetickej_bezpecnosti_2021.pdf
[64] Strategy for Adaptation of SR to Climate Change (Ministry of Environment of SR, 2018), https://www.minzp.sk/files/odbor-politiky-zmeny-klimy/strategia-adaptacie-sr-zmenu-klimy-aktualizacia.pdf
[65] European Commission, Indicators for monitoring progress towards Energy Union objectives - Energy (europa.eu)
[66] Metadata_for_energy_union_indicators.pdf (europa.eu)
[67] Indicators for monitoring progress towards Energy Union objectives. Although efficiency of industry has significantly improved in recent years, SR is on the 4th place in EU with energy intensity in industry (after Bulgaria, Finland and Latvia).
[68] IEA, Energy Balance 2019, including nuclear fuel import - Data tables – Data & Statistics - IEA

• **Gas storages.** Two companies operate underground storage facilities in Slovakia - NAFTA a.s., Bratislava and POZAGAS a.s., Malacky. The total storage capacity - 4.01 bcm. (as of 1 August 2019); the maximum daily fixed withdrawal capacity – 44 mcm; maximum daily fixed injection Capacity - 38 mcm. The Dolní Bojanovice underground storage facility (in the Czech Republic) operated by the company SPP Storage s.r.o., Prague, with a capacity of 0.65 bcm and a maximum daily withdrawal capacity of 8.8 mcm is also used to supply Slovakia. It has a high degree of flexibility and can switch from injection to withdrawal and back relatively quickly[51]. • SR established **Emergency Oil Stocks Agency** that maintains emergency stocks on behalf of industry participants[52]. Emergency stock of crude oil and oil products are maintained at 100.8 days of average daily net-imports[53]. • SR uses **oil refinery** – Slovnaft (owned by Hungarian – MOL) with a processing capacity of 5.5 - 6 million tons of crude oil/annually (since 2004)[54] • A total of 64.7% of apartment **buildings** and 48.9% of family houses had been renovated in Slovakia, by the end of 2018[55]. SR has in place ESCO and Guaranteed energy service (GES). • Decision makers in energy sector (URSO, MoE) have **strategic communication** with customers, explaining causes of the tariff increase, drivers of the reforms. **Economic development** and decreasing share of energy expenditure in total HH expenditure is also a critical factor. • SR has high **Electricity Interconnection Capacity** with neighboring countries – 41.39% (2020)[56]. Interconnection capacity has been increased in April 2021 with two new lines connecting to Hungary. • **Reliability of gas infrastructure in SR**: N-1 rule for gas infrastructure is about 526.4% (2020)[57]. • SR has high level of **accessibility rate** on electricity – 100% and gas – 90% (2019) [58].	
Opportunities: • EU provides **multi-fund support** (recovery fund, ESIF[69], modernization and innovation funds, structural and cohesion fund, Connecting Europe Facility, ERDF, ESF+, etc) for member states to	**Threats:** • After **2023 when coal production supported by the governmental subsidies will stop**[78], there will be a need for low-cost energy not to increase electricity prices. For that reason, the **Mochovce Nuclear**

[51] NECP of SR, pp 63.
[52] Act No 218/2013 Coll. on emergency stocks of petroleum and petroleum products (last amendment of January 1, 2021), https://www.zakonypreludi.sk/zz/2013-218
[53] NECP of SR, pp 190.
[54] https://slovnaft.sk/en/
[55] NECP of SR, pp 111.
[56] European Commission, Indicators for monitoring progress towards Energy Union objectives, Scoreboard.
[57] Report on the results of security of supply monitoring, Gas 2020| MHSR / V z o r (mhsr.sk)
[58] NECP, 2021 pp9
[69] European Structural and Investment Funds
[78] NECP of SR, pp 188.

develop EE and RES projects to achieve set targets by 2030 and 2050. There is also additional funding for projects of common interest (PCI).

- **Diversification of gas supply sources. Eastring project** bi-directional gas pipeline system potentially supplied from Caspian region and Turkish gas hub. The pipeline connection between Slovakia and Hungary will connect high-pressure transmission systems. It will provide Slovakia with access to the planned southern gas corridors or to the LNG terminal in Croatia. There is also a need to complete connections in the north-south direction **- the Slovak-Polish interconnection project,** providing access to LNG terminals in Poland. SR to increase its energy transit role initiates projects that make the country reliable partner. One of them is the **the Veľké Kapušany Underground Gas Storage** Facility, the project envisages the possibility of energy storage in the form of a mixture of natural gas and hydrogen.[70]
- To support **intermittent RES integration** in the power system SR can effectively develop aggregators, energy storage facilities (mainly pumped storage), and ancillary services. Shortening of the currently used trading intervals on daily, intraday, and balancing markets can be alternative solution, which will contribute to better management of the interconnected electricity system as well as integration of a higher share of intermittent sources[71].
- In the **heating sector** SR plans to support development of cost-efficient district heating systems (on RES, waste heat from industrial processes), multi-fuel heating systems as well as heat pumps. These will significantly improve resilience/flexibility of heating sector.[72]
- **Energy efficiency programs.** With massive energy efficiency programs in building sector[73] SR can significantly contribute to its energy security. SR also plans to decrease transportation losses in power sector by substituting 220 kV system with 400 kV until 2029[74].
- Development of **oil pipeline** (12.814 km with a connection point at a Slovnaft a.s. refinery and ending on the Slovak-Austrian border near Kittsee) will reduce oil supply from Russia[75].
- SR has **research institutes specializing in energy technologies**. Involvement of scientists and experts

Power Plant units 3 (470 MW) and 4 (470 MW) will be commissioned in the near future. However, if there is a low demand for surplus electricity in the export market, it will create a balancing problem and negatively affect the tariff. However, it can also create opportunity for hydrogen production.

- **Possible exclusion of Nuclear Power Plants from EU Taxonomy for sustainable activities,** reducing support to NPPs.
- Given the development of **gas prices** in the previous period, the economic efficiency of gas-fired power plants can be under question in the future. A high market gas price and low electricity price would not allow them to operate profitably, and so their future is dependent on the trend in fuel prices and emission permit prices.
- Development of **new transit pipelines** (NORD stream 2, TAP) bypassing Slovakia will diminish its transit role; expiration of Russian-Ukrainian long-term gas contract in 2019 creates supply uncertainty and market liquidity problems; however, they have no significant impact on security of supply in SR.
- Introduction of smart technologies and automation of critical energy infrastructure without relevant prevention, mitigation and resilience measures increases its vulnerability to **cyber-attacks**.
- **Climate change** will increase uncertainty of energy supply and demand, which will result price volatility on real time market. Extreme weather events will damage the critical energy infrastructure. Water shortages will negatively affect operation of NPP and TPPs.
- **The COVID-19 pandemic** and the impending epidemic situation in SR may pose a threat to critical personnel in the energy sector. Pandemic has already introduced high uncertainty in electricity and gas markets; due to the unpredictable supply and demand long-term agreements failed, caused price volatility and overall increase of the costs.
- **Increasing shares of foreign capital** (especially those which might have political interests in SR) in critical energy infrastructure of SR.
- Risks related to the **safety and security of the Nuclear Power Plants**.

[70] NECP of SR, pp 63-64.
[71] NECP of SR, pp 65.
[72] NECP of SR, pp 65.
[73] Long-term strategy for renovation of buildings, https://www.slov-lex.sk/legislativne-procesy/-/SK/dokumenty/LP-2020-575
[74] NECP of SR, pp 126.
[75] NECP of SR, pp 61.

in the energy policy planning process will significantly contribute to its development. • **Hydrogen development** is an emerging opportunity for the world in a transition to low-carbon pathway. The Ministry of Economy prepared the National Hydrogen Strategy "Prepared for the future" which has been adopted by the Slovak Government in June 2021[76]. • By investing in research and innovation and close cooperation with Czechia, Slovakia can efficiently **reuse nuclear waste**[77] for energy generation and create small scale, easy to construct new-design NPPs, combining hydrogen production.	• According to the IEA WEO[79] - higher or more **volatile prices for critical minerals** such as lithium, cobalt, nickel, copper, and rare earth elements could slow global progress towards a clean energy future or make it more costly.

[76] https://www.visegradgroup.eu/news/slovak-national-hydrogen

[77] Slovakia is located in a seismic active zone, and it is difficult to store the nuclear waste, which also damages underground waters. (Minister of Environment of SR, CEEC conference, Bratislava, 22 Nov 2021)

[79] World Energy Outlook 2021 - https://iea.blob.core.windows.net/assets/88dec0c7-3a11-4d3b-99dc-8323ebfb388b/WorldEnergyOutlook2021.pdf

Energy Security of Czech Republic

Strength:	**Weakness:**
• **Solidarity mechanism** - CR is a member of EU and NATO, and the Visegrad Group. Regulation (EU) 2017/1938 has introduced solidarity mechanism in gas sector[80]. • The Czech Republic is an important **transit country** for natural gas moving from east to west and north to south. It uses a very good connection to the gas infrastructure of neighboring countries, especially Germany and Slovakia. • CR has **independent energy regulatory body** – the Energy Regulatory Office (ERO) with qualified staff[81]. • Energy security is recognized as a **national strategic interest** in the Security Strategy of the Czech Republic (2015). • CR has an intensive **experience in national policy development related to energy security**[82]. It has developed the following key documents: Security Strategy of the Czech Republic (2015); the State Energy Policy of the Czech Republic (2015); National energy and climate plans (NECP) of CR (2019); Transport Policy of the Czech Republic for 2014–2020 with the Prospect of 2050; Innovation Strategy of the Czech Republic 2019–2030; National Action Plan for Smart Grids (NAP SG, 2019). • CR has been using **comprehensive analytical tools** in energy sector planning - PLEXOS, MESSAGE modeling tools.[83] • CR has a **regulation about critical infrastructure** (Government Decree No 432/2010) including energy sector (electricity, natural gas, oil and petroleum products and central heat supply).[84] • CR has already transposed into national legislation all **EU energy security acquis**. • CR has developed specific plans dealing with prevention of disruption of natural gas supply:	• The CR is 59.6% (2019) **net energy import dependent**. Net-import dependence in nuclear fuel - 100% (1 source, Russian company TVEL), gas – 98% (Russia and >1/3 from EU gas exchange), crude oil – 98% (3 sources, Russia, Azerbaijan, and Kazakhstan)[97]. High-level dependence on Russia in gas, oil, and nuclear fuel supply. Unlike Slovakia, the Czech Republic is in a better position because part of its NPPs is upgraded with western technologies[98]. • **Seasonality in Gas consumption** – CR consumes 3-3.5 times[99] more natural gas in winter then in summer, however, it has own balancing reserves (gas storages). • **Obsolete energy infrastructure** in the electricity and gas sectors. (SEP 2015, pp 27) • **CR needs flexible power reserves** to balance supply and demand considering the high share of hard base load power (nuclear), intermittent RES (wind, solar), development of EVs. • **Affordability of energy** - energy expenditure share in final consumption expenditure for the poorest 20% of the population is high – 20.43% in 2018[100]. • SR has moderate rate of energy **Supplier Concentration Index (SCI)** – 31.63 (2018, optimal is <30). SCI shows the concentration of main energy carriers (coal, oil and petroleum products, gas) imports from suppliers outside of the European Economic Area (EEA).[101] • CR has a high **potential in energy saving and energy efficiency**. Final energy intensity in industry – 115.75 toe/mln EUR in 2019 (EU average - 90.41 toe/mln. EUR); final residential energy consumption per m2 – 21.53 kgoe/m2 in 2018 (EU average - 14.42 kgoe/m2); Final energy intensity in services sector – 30.16

[80] NECP of CR, pp 130
[81] The Energy Regulatory Office (ERO) - https://www.eru.cz/en/o-uradu
[82] The **Ministry of Industry and Trade (MIT)** is responsible for developing the Energy Policy for a minimum period of 25 years and updating it on a five-year cycle.
[83] NECP of CR, PLEXOS - Integrated energy model for energy market modelling, MESSAGE - Model for Energy Supply Strategy Alternatives and their General Environmental Impacts.
[84] Government Decree No 432/2010, on the criteria for determining the critical infrastructure. Act No 240/2000, on crisis management and amending certain acts.
[97] IEA Energy Balance, 2019 - Data tables – Data & Statistics - IEA
[98] From Economic to Energy Transition, Three Decades of Transitions in Central and Eastern Europe, Book, 2021
[99] Statistics | Eurostat, 2019 - https://ec.europa.eu/eurostat/databrowser/view/NRG_CB_GASM__custom_1564374/default/table?lang=en
[100] European Commission, Indicators for monitoring progress towards Energy Union objectives - Energy (europa.eu)
[101] The SCI is an Herfindahl-Hirschman Index (HHI) scaled in the range of 0-100, Metadata_for_energy_union_indicators.pdf (europa.eu)

Preventive Action Plan (TSO), and **Emergency Plan,** which is revised and refined every year.[85] • CR has developed - **the Strategic Framework Czech Republic 2030** in 2017,[86] which creates bases for energy sector planning. • **Cyber Security** of the Critical Information Infrastructure which consists of electricity, natural gas, oil and petroleum products and central heat supply is under the National Cyber and Information Security Agency (NCISA) responsibility. In line with the Directive (EU) 2016/1148 CR created another institute "basic service operator" in energy sector to monitor and handle cyber security issues[87]. CR has developed **National Cyber Security Strategy (2015-2020)** and **Cyber Defense Strategy** of the Czech Republic (2018-2022)[88]. however, only first one includes brief information for energy sector. • CR has developed the **Strategy and Action Plan on Adaptation to Climate Change in the Czech Republic** (Ministry of Environment of CR, 2015)[89]. The strategy provides information on impacts and adaptation measures in subsectors of energy. It is in line with the EU Adaptation Strategy. • **Public acceptance of nuclear energy[90].** A total of 86% of the population within 20 km of the Dukovany NPP supports modernization and long-term operation of the Dukovany NPP. • **Diversification of supplier of nuclear fuel and storage**. Although CR has not mined uranium since 2017[91] and has been dependent on import, it has sufficient stocks of the fuel to produce electricity over the next few years. A total of 6 nuclear power units in the Temelín (2x1,055 MW) power plant and the Dukovany (4x510 MW) power plant are currently in operation in the Czech Republic. • **Gas storages.** The capacity of the storage facilities located in the Czech Republic totals 3.753 bcm, and their maximum deliverability is almost 79 mcm per day.[92] • CR according to the Decree No 165/2013 created **Emergency Oil Stocks** in an amount equivalent to at least 90 days of average daily net imports of the reference year[93].	toe/mln. EUR in 2019 (EU average - 14.88 toe/mln. EUR). • High **share of fossil fuel energy** – 77% in total energy supply.[102]

[85] NECP of CR, pp 130
[86] The Strategic Framework Czech Republic 2030 (2017) - Czech Republic 2030 - Strategic framework | European Website on Integration (europa.eu)
[87] NECP of CR, pp 133-134
[88] Osnova strategie kybernetické bezpečnosti České republiky (europa.eu) / 69-Cyber-Defence-Strategy-2018.pdf (vzcr.cz)
[89] Czech Republic: Strategy on adaptation to climate change | PreventionWeb
[90] Czech Republic 2018 (iaea.org)
[91] Czech Republic still has deposits of uranium ore but mining is not planned in the near future due to low price of Uranium.
[92] NECP of CR, pp 256.
[93] NECP of CR, pp 131
[102] IEA, Energy Balance 2019, including nuclear fuel import - Data tables – Data & Statistics - IEA

• The Czech Republic has **two oil refineries** in Litvínov and Kralupy. The aggregate processing capacity of the refineries is approximately 8.7 million tons of oil per year. The domestic refinery output covers approximately 80% of national gasoline and diesel consumption.[94] • CR has high **Electricity Interconnection Capacity** with neighboring countries – 27.45% (2020)[95]. • **Reliability of gas infrastructure in CR:** N-1 rule for gas infrastructure is 372.6% (2020)[96]. • CR has high level of **accessibility rate** on electricity – 100% (2019)	
Opportunities: • EU provides **multi-fund support** (recovery fund, ESIF[103], modernization and innovation funds, structural and cohesion fund, Connecting Europe Facility, ERDF, ESF+, etc) for member states to develop EE and RES projects to achieve set targets by 2030 and 2050. There is also additional funding for projects of common interest (PCI). • **Diversification of gas supply sources and routs.** Gas TSO plans two projects - the Bidirectional Austria-Czech Interconnection (BACI), which will create the first direct interconnection between the Czech Republic and Austria, and the Czech-Polish interconnection (the STORK II project). Both projects are part of the 'north-south interconnection' and the Czech Republic could potentially gain access to the LNG terminal in Swinoujscie (Norwegian gas transported by the Baltic Pipe to Poland), to the LNG terminal Krk in Croatia or sources from the Caspian region (especially the Southern Gas Corridor)[104]. With implementation of the Capacity4Gas project, new opportunities for the domestic market arise not only from the interconnection to the Nord Stream 2 pipeline, but also to the new LNG terminals in Germany. The development of new types of gas (biomethane, synthetic gas, hydrogen) from domestic sources will bring greater security in the future, thus reducing the import dependence of the Czech Republic in this area. All these projects can strengthen also **transit potential** of the CR. • To support **intermittent RES integration** in the power system CR plans to use **energy storage** facilities (mainly pumped storage) and develop	**Threats:** • Expected **shortage of power capacity** and risk of failure to meet generation adequacy after decommissioning the coal power plants until 2030 and Dukovany NPP (2040 MW)[109] by 2035. There will be a need for low-cost energy, otherwise, it will increase **affordability issue** in CR. • Deterioration of the operational **reliability of the electricity system** due to massive development of **intermittent RES** without the introduction of additional measures. (SEP 2015). • **Possible exclusion of Nuclear Power Plants from EU Taxonomy for sustainable activities,** reducing support to NPPs. • Given the increasing **gas prices** and reduction in **emission permits**, the economic efficiency of gas-fired power plants can be under question in the future. • Development of **new transit pipelines** (NORD stream 2, TAP) will diminish transit role of CR; expiration of Russian-Ukrainian long-term gas contract in 2019 creates supply uncertainty and market liquidity problems; however, they have no significant impact on security of supply in CR. • Introduction of smart technologies and automation of critical energy infrastructure without relevant prevention, mitigation and resilience measures increases its vulnerability to **cyber-attacks**. • **Climate change** will increase uncertainty of energy supply and demand, which will result price volatility on real time market. Extreme weather events will damage the critical energy infrastructure. Water shortages will negatively affect operation of NPP and TPPs. • **The COVID-19 pandemic** and the impending epidemic situation in CR may pose a threat to

[94] NECP of CR, pp 240
[95] European Commission, Indicators for monitoring progress towards Energy Union objectives, Scoreboard.
[96]European Commission, Indicators for monitoring progress towards Energy Union objectives, Scoreboard; according to the NECP of CR (pp 127) 395.2% was in 2020.
[103] European Structural and Investment Funds
[104] NECP of Czech Republic, 2019, pp 126
[109] NPP Dukovany | CEZ Group

smart grids. National Action Plan for Smart Grids (NAP SG, 2019)[105]. • In the **heating sector** higher degree of diversification of heat sources is expected in the future due to the gradual replacement of coal (waste, biomass, natural gas, CHP, Cogeneration, heat pumps)[106]. These will significantly improve resilience/flexibility of heating sector. • **Energy efficiency programs.** By implementing energy efficiency measures in building, industry and energy transformation sectors CR can significantly reduce primary energy consumption. The aim of the Czech Republic to reach primary energy supply at the level of 1735 PJ in 2030, final consumption at the level of 990 PJ still shows high potential of energy saving. • Development of **oil pipeline.** Increasing the capacity of the TAL oil pipeline and construction of an oil pipeline connection between the Litvínov and Leuna (Spergau) refineries [107]. • **Hydrogen development** is an emerging opportunity for the world in a transition to low-carbon pathway**.** The Government of the Czech Republic approved the Hydrogen Strategy[108], which was prepared by the Ministry of Industry and Trade of the Czech Republic (2021). • CR can efficiently **use abundant waste** for energy purposes. • By investing in research and innovation and close cooperation with Slovakia, Czechia can efficiently **reuse nuclear waste** for energy generation and create small scale, easy to construct new-design NPPs, combining hydrogen production.	critical personnel in the energy sector. Pandemic has already introduced high uncertainty in electricity and gas markets; due to the unpredictable supply and demand long-term agreements failed, caused price volatility and overall increase of the costs. • Emerging threats to **critical energy infrastructure** due to **attacks by state and non-state actors**. High share of foreign capital of potentially high-risk origin and purpose into the Czech Republic's critical infrastructure. • Risks related to the **safety and security of the Nuclear Power Plants**. • According to the IEA WEO[110] - higher or more **volatile prices for critical minerals** such as lithium, cobalt, nickel, copper, and rare earth elements could slow global progress towards a clean energy future or make it more costly.

An analysis of the strengths, weaknesses, opportunities, and threats of energy security in Georgia, Slovakia, and Czechia has shown that with some differences they have much in common.

In terms of **strengths** – attractive geopolitical location and important role in energy transit, independent energy regulators, recognition of energy security as a national security interest, public bodies responsible for energy security issues, high electricity interconnection capacity with neighbors, and high level of accessibility rate on electricity are main assets Georgia, Czechia and Slovakia have in common.

These countries are facing the following common **weaknesses** from energy security point of view: shortage of own fossil fuels, high import-dependence and undiversified supply sources, seasonal imbalance of electricity and gas supply and demand, lack of flexible power reserves for the

[105] National Action Plan for Smart Grids (NAP SG) | MPO
[106] NECP of CR, pp 132.
[107] NECP of SR, pp 61.
[108] Hydrogen-Strategy_CZ_2021-09-09.pdf (mpo.cz)
[110] World Energy Outlook 2021 - https://iea.blob.core.windows.net/assets/88dec0c7-3a11-4d3b-99dc-8323ebfb388b/WorldEnergyOutlook2021.pdf

integration of renewables, weak strategic planning capacity and coordination among public institutions, obsolete energy infrastructure (less observed in Slovakia), absence of cyber-security strategies/plans in energy sector (less common for Czechia), lack of comprehensive adaptation strategies in energy sector, high potential of energy savings and efficiency, and high share of fossil fuel in energy mix.

The risks related to reliability of the electricity system due to massive development of intermittent renewable and high-capacity demand technologies, increasing prices on energy products and reducing affordability of energy, risks of cyber-attacks and kinetic threats to critical energy infrastructure from state and non-state actors, negative impact of climate change and COVID-19 pandemic on energy infrastructure development, penetration of foreign capital in critical energy infrastructure, volatile prices for critical minerals are the main **threats** Georgia, Slovakia and Czechia are facing.

Although there are common **opportunities** as new routes and ways to diversify gas supply sources (LNG, swaps), multi-fund support for developing projects of common interest, renewable, energy efficient and alternative technologies, including hydrogen, new means supporting intermittent renewable energy integration in the power system, investment in research and innovation to enhance resilience of energy sector, these three countries have more opportunities while considering their national circumstances. As the market for LNG grows and prices drop, the opportunities for "swaps" will grow. This is an opportunity for these countries to cooperate and enhance their energy security.

Since 2006 **Georgia** has improved its energy security despite its massive dependence on Azeri gas by transitioning away from overreliance on a less secure supplier, Russia. There are additional positive developments in energy security of Georgia, such as establishment of interagency energy security group (IESG) in 2020 and increasing deployment of comprehensive sector planning tools (MARKAL, TIMES) under the donor support programs. Affordability of energy - share of energy expenditure in total household expenditure on average is lower than in Slovakia and Czechia, because of cheap gas from transit service and budget subsidies. On the other hand, Georgia has more weaknesses compared to Slovakia and Czechia, including absence of own gas storage and emergency oil and oil products stocks; lack of robust and long-term economic strategy; underdeveloped energy research institutions; inability to supply high quality energy to the temporarily occupied territories of the country; unsustainable use of fuel wood for energy purposes; large share of energy inefficient buildings; low reliability of gas and electricity infrastructure; absence of security of gas supply rules and non-transparent and cost-inefficient transit fee set on the North-South gas transit pipeline. In line with these weaknesses Georgian energy security faces significant threats such as Russian hybrid warfare and non-stop occupation of Georgian territories, where critical energy infrastructure is located; high penetration of Russian capital to Georgian energy sector; volatility in cryptocurrency prices; devaluation of Georgian currency (GEL) against USD; corruption in the development of energy infrastructure; terrorism and regional conflict between Azerbaijan and Armenia. To address its weaknesses and prevent threats Georgia has significant opportunities, as developing new transit projects under the Southern energy corridor and via Black Sea, strengthen regional cooperation in energy trade, enacting EU

energy acquis and attracting strategic investors in energy, and those opportunities already mentioned above.

Slovakia and Czechia have many similarities in strength, weaknesses, threats, and opportunities. Solidarity mechanism under the membership of EU, NATO and Visegrad group; already enacted EU energy security acquis; having in place preventive and emergency plans in gas sector; well-developed gas storage facilities, sufficient emergency oil stocks and nuclear fuel reserves; adequate oil refinery capacities; regulations about critical energy infrastructure; developed long-term economic strategies; public acceptance of nuclear energy and high reliability of gas infrastructure are part of their **strengths** from energy security perspective.

High share of energy costs in total household expenditure and the high rate of energy Supplier Concentration Index (SCI) are **additional weaknesses** that Slovakia and Czechia face.

As for the **additional threats** to the energy security of Slovakia and Czechia, these are the following: possible exclusion of Nuclear Power Plants from EU Taxonomy for sustainable activities; increasing gas prices; development of new transit pipelines diminishing their transit role; risks related to the safety and security of the Nuclear Power Plants.

In addition to the **opportunities** mentioned above, in heating sector Czechia and Slovakia plan to support development of cost-efficient and multi-fuel heating systems as well as heat pumps, both countries have adopted hydrogen strategy which creates significant opportunities in transition to low-carbon pathway. By investing in research and innovation they can efficiently recycle nuclear waste for energy generation and create small scale, easy to construct new-design NPPs, combining hydrogen production.

Energy Security Policy Objectives

Usually, states develop strategies and national energy policies, including set of objectives to address energy security weaknesses and threats. They use their strengths and opportunities to enhance energy security at national level and if possible, at higher-regional level as well. Hence, to understand how states intend to transform their weaknesses into strengths and prevent, mitigate, or adapt to threats and therefor improve national energy security, it is better to identify their energy security objectives. Despite many differences in weaknesses and threats in energy security of Georgia, Czechia, and Slovakia there are significant commonalities in their national objectives.

The draft NECP (2021) of Georgia provides the following objectives under energy security dimension until 2030 with an outlook to 2050:

- Minimize the supply risks through diversification of energy sources and supply routes.
- Reduce energy import dependency by developing domestic energy sources.
- Become net-zero import of electricity by 2030.
- Increase the flexibility and resilience of energy systems.

- Protect critical infrastructure and mitigate risks related to cyber security and climate change.
- Develop demand side measures and establish sustainable power distribution over the whole territory of Georgia.
- Stabilize and curb the energy security risks stemming from occupation of Georgia's territories.

In line with these objectives the draft NECP also provides key principles and long-term directions for energy policy of Georgia. Optimization of external supply sources, putting them into transparent competitive environment and development of new supply alternatives are considered as important objectives of foreign and domestic energy policies. Development of renewable energy and energy efficient technologies are at the core of energy security improvements. Expansion of renewable energy sources (hydro, wind, solar, biomass) will be optimized with respect to seasonality and diurnal variations.

Georgia also intends to keep up with the current trends in studying and deploying new clean and alternative technologies, including green hydrogen, distributed generation, smart grids, energy storage technologies, LNG, and local small renewable facilities. By using clean and advanced energy technologies Georgia can ensure sustainable low-emission development of the sector.

Development and optimal use of own hydrocarbon reserves remains one of the key directions of Georgian energy policy. Georgia plans to construct the gas storage facility (500 million m3) and establish strategic reserves of oil and oil products in compliance with Directive 2009/119/EC. This will ensure the security of supply, and balance seasonal variations of supply and demand.

Improving energy security requires not only the development of renewable energy technologies and infrastructure, but energy efficiency as well to eliminate the gap between energy demand and supply.

Georgia will significantly address its weaknesses and prevent threats if it achieves these objectives in the mid and even long-term perspective. However, Georgia does not have sufficient human and own financial resources to achieve them. Strong political will to strengthen strategic planning capacity and coordinate with international financial institutions and donor organizations to effectively realize these objectives and increase investment in education, research, and development are critical. The driver of reform should be the political will and not just commitments under international treaties.

In Energy Policy (2014) of Slovak Republic the following priorities were defined for increasing energy security until 2035: diversify energy sources and transport routes; utilize nuclear power plants and increase their safety and reliability; optimal use of domestic renewable energy sources for generating heat in a cost-effective way; develop natural gas and oil storage capacities; lower dependence on imported fossil fuels; increase energy efficiency and decrease final energy consumption; maximum utilization of transport and transmission routes passing through Slovakia.

The Energy Policy objectives have been updated in the NECP (2019), which provides wide spectrum of energy policy priorities supporting to energy security as well. The following 17 energy policy objectives are set until 2030 with an outlook to 2050: an optimal energy mix; increase energy supply

security; develop the energy infrastructure; diversify energy sources and distribution routes; maximum use of transmission networks and transit systems passing through the SR; application of the primacy of energy efficiency principle; reduce energy intensity; a functioning energy market in a competitive environment; high-quality energy supply at affordable prices; protect vulnerable customers; address energy poverty; a reasonable pro-export balance in the electricity system; promote high-efficiency cogeneration; promote the use of efficient district heating systems (DHS); promote the use of RES to produce electricity, hydrogen, heat and cooling; use nuclear energy as a low-carbon electricity source; improve the safety and reliability of nuclear power plants.

In defining the priorities of the Slovak Republic and ensuring synergies among them the following criteria were used: cost efficiency, enforcement of the principles of sovereignty in the energy mix, preservation of competitiveness and energy security. The NECP of SR also provides specific measures to achieve these objectives. Unlike Georgia Slovakia has developed economy and sufficient resources to address its weaknesses and prevent threats. However, Slovakia still needs to develop sustainable integrated planning capacity and coordination among public institutions to effectively realize these objectives.

According to the NECP (2019) of the Czech Republic main objectives of energy security are: the diversification of energy mix, maintaining self-sufficiency in electricity supply, ensuring sufficient development of energy infrastructure, and no significant increase in import dependency. Czechia set energy import dependence target maximum 65% by 2030 and 70% by 2040, including nuclear fuel. CR has also defined the sector-specific objectives and targets. In electricity sector it intends to maintain the high quality of energy supply and achieve adequacy of production capacity; ensure self-sufficiency in electricity generation using high efficiency of conversion and increasing share of renewables; maintain a positive power balance and ensure the adequacy of the power reserves of -5% to +15% of the maximum load of the electricity system; ensure diversification of primary energy sources; maintain nuclear fuel stocks; and ensure energy supply in local (island) subsystems during the large-scale failures caused by natural disasters, terrorist, or cyber-attacks to guarantee the minimum supply to the population and maintain the functioning of critical infrastructure.

In the gas sector main objectives of Czech Republic are: ensure diversification of gas sources and transport routes through the implementation of planned infrastructure projects as well as the effective functioning of domestic gas storage facilities; guarantee access to transit capacities for domestic use of natural gas; permanently ensure the ability of reverse flow and the upgrade of the gas transmission system; ensure sufficient capacity of natural gas supply; maintain and strengthen the transit role; ensuring the capacity of gas storage facilities in the Czech Republic at 35–40 % of annual gas consumption and at least 70 % of the peak daily consumption in the winter; create conditions for the reverse flow of the transmission system and the capacity to deliver gas from the North to the West of at least 40 mcm per day; supporting biomethane, synthetic gas and hydrogen production; ensure connection of the gas transmission and distribution systems with the coal based large heat plants, for switching and system flexibility purposes; prepare the gas transmission and distribution system for a higher share of new gas types and sector coupling.

In the oil sector diversification of oil and petroleum product supplies, through increasing the capacity of the TAL oil pipeline and construction of an oil pipeline connection between the Litvínov

and Leuna/Spergau refineries; maintain sufficient oil transportation capacity for the needs of oil refineries and ensure that oil processing capacities are permanently operational at least at 50% of domestic consumption; ensure emergency stocks of oil and petroleum products in accordance with Council Directive 2009/119/EC of at least 90 days of net imports are the main objectives of the Czech Republic.

Heating is an important sub-sector where Czechia intends to ensure economically efficient and energy-efficient heat supply systems; cover at least 60% of heat supply from high-efficiency cogeneration; upgrade the heat supply systems and promote the transition to multi-fuel, medium and small heat supply systems; develop renewable energy-based heat supply systems at regional and local levels; ensure coal reserves for the heat supply in case of emergencies; achieve high recovery rate of the heat from waste incineration; develop larger heat plants for regulatory services; ensure operations of heat plants in an island mode during emergency situations.

Security Strategy of the Czech Republic (2015) further identifies the following objectives to improve energy security: avoid diminishing the state's influence and control in strategic energy companies and avoid strengthening the influence, anywhere in the energy sector, of those entities, countries, or regions on whom the Czech Republic is significantly energy dependent; cooperate effectively on energy security issues with energy and mining companies; support investment into science, research and human resources development in the energy sector.

Unlike Georgia and Slovakia Czechia defines specific objectives and targets in energy security and actively develops sub-sectoral strategies and plans. It is important that these strategies do not remain on the shelf and that the objectives are effectively implemented.

Conclusion

Energy is vital to national security and functioning of states. Energy security which is a complex term comprising availability of energy resources, physical accessibility to energy, reliability of energy infrastructure, financial affordability of quality energy, resilience and flexibility of energy system and sustainability is commonly considered an integral component of national security. For import-dependent and transit countries such as Georgia, Czechia and Slovakia, energy security is even more important, to ensure their own socio-economic development and to be reliable transit partners. Those countries come from the same socialist past, have an important strategic location, and perform an essential energy transit role in the Caucasus, and Central and Eastern Europe regions.

This paper has analyzed perceptions of energy security in Georgia, Czechia, and Slovakia, and assessed the strengths, weaknesses, opportunities, and threats of their energy systems and it has also identified the national energy security objectives and targets based on a comprehensive review of the strategic documents and consultations with key stakeholders. The main objective of this paper is to create an energy security assessment framework, incorporating political, management, legal and institutional, technological, economic, social, and environmental issues and display the big picture of energy security at a national level. Big picture helps to identify synergies among countries to transform their weaknesses into strength and increase energy system resilience against the threats.

Clear definition of energy security with its principles and indicators is important for regular monitoring and improvement of the energy sector at a national level. Georgia, Czechia, and Slovakia have defined energy security as one of the national security interests in their national security concept and strategies. All three countries have own understanding of energy security. While Georgian definition of energy security is mostly in line with the classic definition, Slovakia and Czechia do not clearly define energy security and provides wide range of objectives/measures of it in the strategic documents. The objective of energy security of Georgia is to ensure adequate and reliable supply of different types of high-quality energy to all consumers, at a fair price, while protecting the interests of national security and sustainable development, in the short and long term. For Slovakia to achieve energy security, reliability of energy supply as well as cost-effectiveness and optimal energy mix including sustainable use of all low-carbon resources are key objectives. On the other hand, the State Energy Policy of the Czech Republic defines the vision of energy sector as a reliable, affordable, and sustainable energy supplies for households and the economy, and set top-level objectives – security, competitiveness, and sustainability. The safety and reliability of nuclear power plants is critical not only for energy security purposes but for national security of Czechia and Slovakia.

In the paper wide range of strengths, weaknesses, opportunities, and threats in energy security of Georgia, Slovakia and Czechia have been identified. Despite some commonalities they differ with their energy systems, vulnerabilities and therefore policy objectives. For Georgia, given its high degree of external energy dependence, Russian hybrid warfare and occupation of Georgian territories where critical energy infrastructure is located, regional conflicts, seasonality of energy

supply and demand, lack of strategic gas and oil reserves, obsolete energy infrastructure and low reliability of gas and electricity systems, cyber and climate threats, unsustainable use of fuel wood, inefficient consumption of energy, volatility in cryptocurrency prices and devaluation of Georgia currency against USD, energy security are particularly relevant. On the other hand, the growing dependence on energy imports and high rate of energy supplier concentration, need of flexible power reserves, increasing energy prices, high potential in energy saving, increased kinetic (criminally motivated) and cyber threats to critical energy infrastructure, the safety of nuclear power plants, significant share of fossil fuels in total energy mix, new transit pipelines, climate change and COVID-19 pandemic are main energy security concerns of Slovakia and Czechia.

To improve national energy security Georgia, Slovakia and Czechia intend to reduce energy import-dependence, diversify of energy supply sources and routs, increase the flexibility and resilience of critical energy systems, develop renewable, energy efficient and alternative technologies, including green hydrogen by 2030. Despite these grand objectives Georgia does not have sufficient human and own financial resources to achieve them. Strong political will to strengthen strategic planning capacity and coordination with international partners, increasing investment in education, research, and development and sharing world best practices to effectively realize these objectives are crucial for Georgia. The driver of reforms should be the political will and not just commitments under international treaties.

Unlike Georgia Slovakia has developed economy and sufficient resources to address its weaknesses and prevent threats. However, Slovakia still needs to develop sustainable integrated planning capacity and coordination among public institutions to effectively accomplish these objectives. On the other hand, Czechia defines specific objectives and targets in energy security and actively develops sub-sectoral strategies and plans. Though, new Czech government needs strong coordinated action to keep up with the EU clean energy transition and effectively achieve its energy security objectives.

In 21st century achieving a high level of energy security without international cooperation is very difficult, even unrealistic. There are commonalities in weaknesses and threats which can effectively addressed with joint actions. Diversification of gas supply sources and routs via swaps (southern energy corridor), sharing own practices in increasing power system flexibility, energy efficiency and integrated planning of energy system and coordination among key institutions, experience in improving cyber-security and adaptation to climate change of energy systems, good practices used in energy security during COVID-19 pandemic, these are a short list of issues where Georgia, Slovakia and Czechia can effectively cooperate.

To conclude, energy has become critical factor in functioning of the states, analyzing the big picture reflecting the strengths, weaknesses, opportunities, and threats of national energy security and setting right objectives are important but not sufficient. Political will and strong analytical and implementation capacities, with regular monitoring and improvement are vital factors to effectively achieve the high-level energy security.

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