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Perspective

Sustainable Energy Planning in a New Situation

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Abstract: Energy is one of the most important aspects of urban development and technological advancements. As its production and consumption are connected to several environmental, social, and economic issues covering all three sustainability pillars, strategic and targeted energy planning is vital to the smooth transition towards a more efficient and greener society. In accordance with the specific priorities of every state, sustainable energy planning should also satisfy the international trends, requirements, and targets, including the global commitments for sustainable development. As of this time, energy transition with further deployment of renewable energy and energy efficiency improvement are the priorities for a sustainable future. However, due to recent global events, a new situation has been established. The COVID-19 pandemic and the ongoing war in Ukraine have caused new circumstances challenging the recognized approaches for an effective sustainable energy strategy. While the global pandemic led to a temporary reduction of energy use and created habits for further savings, the war caused energy security issues, especially for Europe, and an increase in energy prices. Moreover, both questioned the implementation of green energy strategies and policies and initiated energy poverty. In this framework, the perspectives of the criteria, on which the energy planning and the relevant research could lean, are investigated and discussed.

Keywords: energy; energy planning; sustainability; strategic energy plan; COVID-19; Ukraine war

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1. Introduction

Energy is essential for human life as well as for every community, nation, or international organization. Moreover, it is essential for all contemporary economic sectors and supports all economic activities [1]. However, there are a number of environmental, social, and economic concerns associated with its production and consumption, including the global issue of climate change. Trends in the planet's vital signs alert scientists to the imminence of the phenomenon's emergence [2]. According to Statista (2022) [3], some nations' levels of energy consumption are disproportionately high in comparison to those of other nations around the world. China, the United States of America, and India were the three countries that used the most primary energy in 2021, with 157, 92, and 35 exajoules of consumption, respectively [4]. The transition of the energy sector is one of the priorities of sustainable development [5] which aims at the management of financial, technological, institutional, natural, and social resources to meet the needs of current and future generations [6], along with global warming mitigation, constituting the key areas of importance when it comes to energy planning optimization [7]. Simultaneously, policies and legislation are complementary to the incorporation of sustainable energy into energy planning [8]. In this context, modern policies and regulations for sustainable energy face a number of political, social, economic, environmental, and legal challenges [9]. Still, relevant targets and policies are necessary and have been adopted by governments worldwide [9–13].

In 2015, the United Nations (UN) introduced a set of goals for sustainability, known as the Sustainable Development Goals (SDGs) [9]. SDG 7 includes three key targets, i.e., to ensure affordable and reliable access to modern energy for all, to increase the share of renewable energy in the energy mix worldwide, and to improve the global rate of energy efficiency improvement [14]. At the same time, SDG 11 strives for sustainable cities and communities deeply linked with alternative sources of energy and adequate consumption patterns, which also correspond to responsible consumption and production (SDG 12) [9,15,16]. Acting as building blocks, the SDGs have been used for the creation of the European Green Deal (EGD) which aims at carbon neutrality by 2050. The generation and consumption of energy are responsible for more than 75% of the EU's total emissions of greenhouse gases. Decarbonizing the energy system of the EU is therefore essential in order to meet the climate goals of the EGD [17]. Concerning the energy sector, the EGD places a primary emphasis on the following three key principles for the transition to clean energy, all of which will contribute to the reduction of greenhouse gas emissions and the improvement of the quality of life for our citizens: (i) ensuring that the energy supply to the EU is both stable and affordable, (ii) establishing an EU energy market that is fully integrated, interconnected, and digitalized, with a focus on energy efficiency and the improvement of the energy performance of our buildings, and (iii) the establishment of a power sector that relies primarily on renewable sources of energy.

The replacement of fossil fuels with renewable energy by 2050 could be possible, with major lifestyle changes in developed countries, close cooperation among all countries, and the application of several measures such as the development of renewable energy, the improvement of energy efficiency, the increase in energy conservation, carbon taxes, the balance of human wellbeing with energy use per capita, cap and trade systems, the capture, utilization, and storage of carbon, and the development of nuclear power [18]. These actions concern and impact society, the economy, and the environment and are also according to the requirements of SGD 7 and SDG 13 (climate action).

However, during the last three years, two events that can be characterized as "black swans", as defined by Taleb [19–21], have occurred. Initially, the COVID-19 pandemic and then the Ukraine war. Both are improbable events, but with high impact and consequences significantly influenced the energy sector as well as energy options and priorities. Moreover, the economic crisis occurred because of them, and created the need to modify the strategic goals of individual energy policies [22]. In 2021, the global primary energy consumption surpassed 595 exajoules. This represented an increase of approximately 5.5% compared to the year 2020, when the coronavirus pandemic and its impact on transportation fuel demand and overall economic performance led to a decline in primary energy consumption to 2016 levels [23]. During the pandemic, several effecting factors were differentiated, since environmental performance was improved. The electricity consumption decreased [24], as well as energy demand [18], while the carbon emissions declined [25], the waste in coastal areas was reduced [26], and the air quality was improved [27]. However, the energy economics were also affected [27] and recovery funds as a response to the pandemic were introduced [28].

Regarding the escalation of the war in Ukraine which followed, environmental aspects were burdened, causing further effects. Russia, which invaded, is a major energy supplier for the European countries, especially of natural gas (NG) which was transported via Ukraine [29]. The consequential efforts of the EU to reduce the dependency on the Russian natural gas, the spike of the energy prices [30], and the relevant energy security issues [31] therefore create a new reality.

Specifically, in 2021, the EU and the United Kingdom (UK) imported approximately USD 147.8 billion of crude oil, petroleum products, and natural gas from Russia. The EU is highly reliant on Russia for its energy needs, particularly when it comes to pipeline-supplied natural gas. As a result of the Russia–Ukraine conflict, imports of petroleum products and gas have been subjected to stringent scrutiny, and the EU is attempting to reduce its reliance on Russian oil and gas [32]. At the same time, with the announcement of additional sanctions against Russia, the Russian ruble lost 20% of its offshore value against the dollar. Furthermore, up to 12% of Germany's GDP is estimated to be lost due to sustained high energy prices, while inflation in the UK is projected to peak at 13% following announced price increases in household electricity and gas, of which gas, electricity, and fuel would account for 6.5% [33].

Under these conditions, the usual approaches for sustainable energy planning and the evaluation of energy choices, strategies, and policies have to be investigated, discussed, and altered accordingly. The reasons for sustainability and the SDGs, and relevant strategic and political approaches, still exist in the circumstances and climate change continues to be a global problem that shall be urgently confronted. Taleb [19] proposed to tame or even befriend the "black swans". Consequently, the criteria for sustainability energy planning options must, from now on, take into consideration the new realities, as well as possibilities. This work highlights the recent approaches to form and select energy planning, the new situation is described, and the relevant perspectives for research in terms of selections of evaluation factors are shaped in order to create a clearer pathway which integrates existing strategies, directives, and action plans centered around sustainability but altered according to recent events which change the mapping of combating climate change globally.

2. Trends in Energy Sustainability Planning Assessment

Within the last few years, the trends in sustainable energy planning as well as relevant research shifted towards the direction of the fulfillment of the requirements of SGD 7 and SDG 13. Energy strategies and sustainable energy criteria and indicators take into consideration, among others, society, the economy, and, in particular, the environment, with the main concern being the global warming potential. In pursuit of the monitoring of goals set by the EU such as those of the EGD, the Circular Economy Strategy, SDGs, and, particularly, sustainability pillars (environment, society, economy), the use of performance indicators to quantify sustainability aspects has increased [26,34,35]. According to Zorpas (2020) [36] and Loizia et al. (2021) [26], "measuring something that is not there" is a complex process that governments and, by extension, citizens do not fully comprehend. Cities and municipalities, policymakers, and stakeholders have begun using indicators in the creation of sustainable, green cities as a result of heightened concern and urgency regarding climate change [35,37]. The energy sustainability indicators such as absolute greenhouse gas emissions, absolute energy costs, and absolute energy demand have been recently proposed by Klemm and Wiese to be used in optimization models of urban energy systems [38]. The Kenyan power technology options were evaluated against 17 combined energy indicators covering the dimensions of sustainability and technology and using a hybrid analytical hierarchy process–technique for order preference by similarity to ideal solution (AHP–TOPSIS) technique. These included capital and operation and maintenance costs, reliability, maturity of technology, resource availability, ability to respond, requirements for land, emissions, water consumption, creation of jobs, safety risks, and social acceptability [39]. Sustainability performance scores were used to evaluate the alternative for the electricity mix of Pakistan. These also cover environmental, social, economic, and technical issues but also operational ones including, among others, reserves, expected life, fuel cost, construction time, radioactive emissions, and noise [40].

Alongside indicators, displacement of people and soil pollution are included in a multi-criteria decision analysis (MCDA) to evaluate the future trends for energy sustainability for Nigeria, a country with one of the largest populations and economies in sub-Saharan Africa [41]. Bilal et al. [42] implement a more extensive list of environmental, economic, technological, and socio-political criteria for a multi-criteria decision making (MCDM) evaluation of four alternative policy approaches for the China Pakistan Economic Corridor (CPEC) which depends on circumstantial political concerns. The list includes, apart from some criteria already mentioned, waste disposal, political acceptance, compatibility with the government's energy plans, and financial resources. Sustainable energy characterization with 21 indicators has also been performed with four MCDA methods for the central and eastern EU countries. A group of energy indicators are used additionally to the economic, social, and environmental ones. These include and admeasure supplementary topics such as the share of renewable energy, dependence on energy imports, GDP per capita, energy productivity, electricity prices for households, and the percentage of population that is not able to keep their home adequately warm because of poverty status [43].

Saraswat and Digalwar [44] evaluate the alternative energy sources for sustainable development of the Indian energy sector by using six different fuzzy MCDM techniques. The research presented a group of flexibility criteria, further to the groups of criteria already included in other work. These are integrated with other sources to fulfill the peak load demand. Moreover, impact on ecosystems, social benefits, technology maturity, payback period, and levelized cost of energy are some criteria added by this work to the literature. The VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) analysis method using analytical hierarchy process (AHP) weights is implemented to select the most sustainable energy production methods in Chile. The used criteria are grouped as technical, environmental, and socio-economic criteria and additionally include stability and predictability of the technology and smooth running of the plants [45]. The technique for order preference by similarity to ideal solution (TOPSIS) method allowed the authors in [46] to rank the countries of the EU, according to how they adopt a sustainable energy economy. The criteria used are also grouped as four groups, including energy, for the dimension of sustainability and are similar to those of other previously mentioned works, apart from the final energy consumption and energy taxes which are specially implemented in this research.

The Baltic states were ranked according to their progress towards the main energy security goals of the European Energy Union Strategy. MCDM and specifically the COmplex Proportional ASsessment (COPRAS) method were implemented The criteria were calculated as energy security indicators including dependency on imports, supplier concentration, electricity interconnection capacity, market concentration, switching rates of electricity, and energy affordability [47]. In another work, energy planning of the electricity supply sector in Iran was overviewed by using the AHP–TOPSIS method. The criteria were divided into techno-economic, social, and environmental criteria. The criteria were additionally measured in the final comparison of the evaluated pathways regarding the sensitivity to fuel price changes, acidification potential, human toxicity, and nuclear waste [48]. The Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE) was also used to evaluate the alternative transformation pathways for a sustainable energy system in the EU. The evaluation criteria were the regulatory framework, the compatibility with the market, the compliance with a specific plan, and the awareness of the stakeholders [49].

Apart from the MCDM approaches, the calculations of several sustainability indicators are also shown in the literature. A string of technical, environmental, economic, and social factors formulates indicators that characterize affordability, self-reliance, and sustainability and compose a key evaluation index, that is used to evaluate the southeast Europe power market [50] while an energy transition and sustainable development index is calculated for Normandy. This is composed of several metrics including, among others, the living standard, energy sobriety, natural heritage, sustainable mobility, and territorial governance [51]. The Sustainable Energy Development Aggregated Index was measured to rank the EU Member States on their way to sustainable energy. Several categories of metrics were admeasured covering the social, economic, and environmental dimensions and including equity, health, competitive energy market, energy security, energy consumption patterns, environmental pressure, resource pressure, and energy taxes [52].

Nine different indicators (i.e., share of RES, greenhouse gases (GHGs) per GDP, energy intensity, primary efficiency, industry efficiency, energy consumption in households, space heating efficiency, pollutant emissions from transport, and specific energy consumption of transport sector) were calculated by Pakere (2021) [53] in order to analyze the energy and environmental performance of EU countries. Dergachova et al. [54] used the OECD Monitoring Framework for the ESU 2035 [55] to analyze Ukraine's energy strategy. The framework calculates the level of performance for several objectives including energy efficiency, energy independence, reliability and sustainable development, market development, modern management system, network integration, and the level of performance by subsectors. Moreover, seven sustainability metrics including nuclear aversion were calculated for a case study for New England as well [56].

All the above literature evaluates or compares different projected or existent energy planning approaches, taking into consideration the use of several energy resources, not only renewable, but also non-renewable (i.e., coal, natural gas, and oil), according to the availabilities and the policies. Table 1 presents a summary of the types of energy or resources comprising parts of the evaluated energy mix, as options or as alternatives for energy planning in the reviewed papers, where these are mentioned. According to the findings, nuclear energy is considered a primary aspect of clean energy transition and independence from both conventional energy usage of fossil fuels and unexpected events such as the war in Ukraine. Furthermore, hydropower seems to have an increasing potential according to the scientific community alongside renewable energy sources. Carbon capture and storage (CCS) is also considered as an option for energy sustainability in the examined scenarios [49].

Table 1. Energy types or resources in the literature.

Energy Type or Resource	Reference
Hydro	[39–42,44,45,48,50,56]
Nuclear	[40,44,45,48–50,56]
Renewable energy sources	[41,42,49,50,54]
Combined cycle	[48]
Steam power	[48]
Solar energy	[38–40,44,45,48,56]
Wind energy	[39,40,44,45,48,56]
Thermal power plants	[41,42,44,48,50]
Coal	[39–41,45,48,54]
Natural gas	[38,40,41,44,45,48,54,56]
Oil or diesel	[45,54]
Geothermal	[39,45,48]
Biomass	[39–41,44,45,48]
Ocean/tidal and wave	[45]

Oil is the most widely used primary energy source in the world. Approximately 184.2 exajoules of oil were consumed in 2021 (Figure 1). This represented a nearly 6% increase compared to the previous year. Hydroelectricity was the only primary energy source that experienced a decrease in consumption that year. As the demand for primary energy continues to rise, the demand for fossil fuels—such as natural gas, oil, and coal—has remained high. Excluding the effects of the coronavirus pandemic, the annual increase in oil consumption has been consistent.

At the same time, natural gas and coal usage exhibit a steady to rising usage around the world from 140 exajoules in 2019 to 145 exajoules by 2021. However, other alternative energy sources such as nuclear energy, hydroelectricity, and renewables do not represent the desired percentages of increase throughout the years [57].

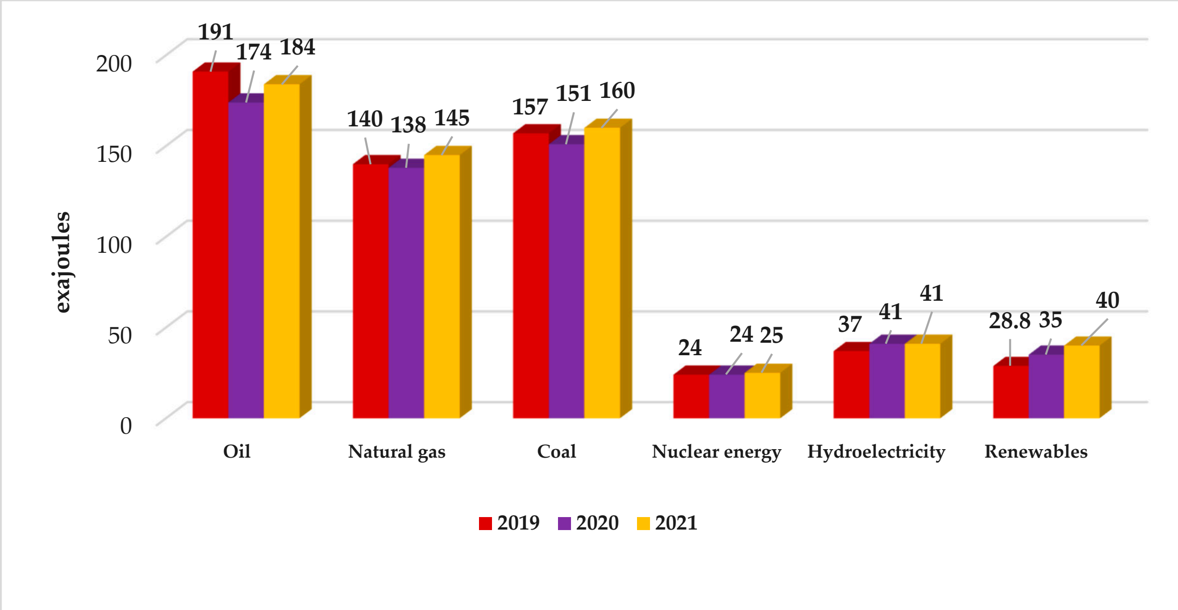

Figure 1. Consumption of energy worldwide by energy fuel type [57].

3. The New Situation

During the last few years, a new situation has been established regarding energy. Two consecutively significant events with global effects which can be characterized as "black swans" [19] changed several issues affecting human life and therefore the factors that were usually taken into consideration for sustainable energy planning. Chronologically, the COVID-19 pandemic and the war in Ukraine triggered fluctuations in the previous conditions concerning energy and its economic, environmental, and social aspects. Both events impacted the global economy and the energy sector [58].

3.1. COVID-19 Pandemic

The COVID-19 pandemic was declared in March 2020, three months after the first detection of the novel coronavirus causing the disease in Wuhan, China. Since the start of the pandemic, the impact on the global economy, the consequences on the national health and welfare systems, and the most suitable mitigation measures have been raised as issues [59,60]. Due to the rapid spread of the infection, a lot of countries around the world implemented strict measures to control it, such as lockdown, social distancing, wearing a mask, etc. [61] as well as remote work practices [27]. Consequently, drastic fluctuations in energy demand, shocks for oil price, energy supply chain disruptions, and difficulties for energy investments were observed [58] and the global economy, society, and environment were affected [27]. The damage of COVID-19 to the global economy was deemed to be even worse than that of World War II [62].

However, some of the impacts were positive. Several researchers investigated the variations in electricity demand during and because of the pandemic, and for future trends as well. The usage of electricity in residential buildings, for example, occupied apartments in New York, increased [63]. However, Kparti and Aldubyan [64] concluded that for various countries, including China, India, Italy, and Germany, and US states, although the overall electricity demand was lower because of lockdowns which impacted commercial buildings and the manufacturing sectors, the housing sector energy consumption was increased. A comparison of electricity consumption in a simulated pandemic-free scenario showed that the actual consumption from January to August 2020 in China was 29% lower [65]. Due to the decline in electricity demand, research concerning the UK concluded that low-carbon-emission renewable energy sources such as solar, wind, and biomass can be expected to keep rising in demand in the future [66].

During the initial pandemic period in 2020, the carbon dioxide emissions were also reduced. However, although this was proven by various studies, there is a certain probability that the reduction will be impermanent as the economies start to stabilize [62]. Consequently, because of the lower greenhouse gases emissions, green energy goals were achieved in several countries [27]. The COVID-19 effects, in combination with the higher efficiency of decentralized energy systems, led to positive trends in the development of renewable energy [27]. Moreover, because of the lockdowns, air pollution reduction and wildlife shifts were noticed [67], while reduced usage and therefore waste were also observed [26]. However, although the pandemic has impacted the climate positively and contributed to the energy policy goals, it has been costly [27]. Poverty was increased, especially in non-developed countries, and SDG 1 has been adversely affected [61]. Energy poverty has also increased and the relevant impact will be very slowly restrained, not before 2025 [68]. Moreover, the economic recovery will require investments to restart economic activity, to modernize technically existing infrastructure, and to increase energy efficiency [27]. However, policymakers seem to support the incumbent energy industry in the post-pandemic era to save the economy [58]

3.2. Russia–Ukraine War

In February 2022, Russia initiated its invasion of Ukraine and the two countries are still at war. Due to the attack, the Russian government is subject to strict economic sanctions [69]. Nevertheless, Russia is a main energy supplier for the EU countries and, by a preliminary assessment, there is a large potential impact on the crude oil trade and a large direct loss for the natural gas trade, while coal trade has the least impact [70]. Other markets such as agricultural and metals were also affected by the intensification of the Russia–Ukraine conflict [71]. The war influenced the worldwide food and energy security [72] and caused an increase in energy prices and energy security challenges. Simultaneously, energy security aspects of the EU were heavily impacted as Russia is one of the major energy suppliers of the EU and Ukraine is a main passage for the Russian NG [29]. Moreover, new terms and conditions for the payment of gas supplies were imposed by Russia, threatening to disrupt this supply to any country that would not accept the new requirements [29]. However, the initial indication shows that worldwide policymaking is looking for short-term, apparently faster solutions, and looking for new supply routes of fossil fuel in order to face the problem [58]. The USA and Qatar may be important providers of liquefied natural gas for the EU [29].

Since the prices of energy and other commodities increased significantly, renewable energy firms benefitted as investors realized the need for alternative sources [69]. The access to energy became a severe problem for EU countries, and the highest possible independence became quite important concerning the degree of implementation for SDG 7 [73]. The EGD, which was approved by the EU in December 2019, outlined the conversion of the Member States to a climate-neutral economy. Following the war, a new policy framework of the EU for natural gas trade was formed [29]. However, the denial of the EU for energy collaboration with the Russian Federation, because of the military operation against Ukraine and the sanctions, may delay the achievement of the climate targets in Europe [74]. Moreover, although the high energy cost had a grave impact on the European economy and created conditions for aggravating energy poverty, the high prices of natural gas can be an opportunity to accelerate the transition process towards decarbonized energy systems [75]. The war also pointed out the there is need for EU countries to abandon fossil energy sources and reduce their dependency on Russia for their energy security, instead using renewable energy sources, while hydrogen became the accelerating factor for the European energy transition [76]. However, although the Ukraine war mostly affects Europe, its impacts are not restricted and are global, or form a probable situation for other parts of the world as well.

4. The Future of Energy Planning Criteria

The criteria and indicators usually used to evaluate the energy strategies, policies, or sustainable selection of energy sources are multiple and include, further to the environmental issues, social aspects as well economic, political, and technical priorities. Sustainable energy strategies, until today, were considered to ensure the mitigation of the triggers of climate change and a transition to a clean energy future with a balance between environment, society, and the economy, including fossil fuel use elimination, further deployment of renewable energy, and energy efficiency improvement. Moreover, common social effort and international cooperation are believed to have the capacity to lead to a clean energy system [27]. However the recent two, highly improbable [19], events create circumstances and an occasion to appraise this approach once again.

While reviewing the criteria used to assess the energy planning sustainability during recent years, some of them seem to be suitable and close to the new needs which have been formed. Construction time and radioactive emissions used by Mehmood (2020) [40] are important in the present situation. Firstly, because a timely reaction to the interruption of supplies from Russia is crucial and, secondly, due to the fact that nuclear energy may be deemed as a solution to the associated energy supply and energy security complications. The Ukraine war pointed out once again the magnitude of importance for a country or union of countries to be energy self-sufficient, therefore criteria for dependency on energy imports or energy independence, which were admeasured in the past [43,47,56], are also critical. Furthermore, energy security issues highlight the significance of criteria for the integration of other sources alongside conventional energy sources and the ability to fulfill the peak of energy demand [44,47]. Moreover, due to the current high energy prices, factors such as electricity prices for households and the percentage of the population that is not able to keep their home adequately warm because of poverty status [43], sensitivity to fuel price changes [48], energy affordability [47], and energy cost [38] are also indicators that have to be taken into consideration. Nevertheless, climate change still exists and is an urgent issue [2] and the actions, plans, and targets against it must not be suspended [77]. The achievement of green energy goals [27] also seems to be temporal. Therefore, the compliance with a specific evaluation plan criterion [49] is also suitable to be used in order to ensure that unexpected conditions do not influence the global priorities and policies for sustainable development. Additionally, greenhouse gas emissions [53] shall also continue to be considered.

The perspectives of strategic energy planning and its evaluation as well as the relevant research are believed to continue in this framework. For energy sustainability to be ensured and a focus on it to be observed, it will be more beneficial to measure criteria that are already in use combined with quantifying concerns originating from recent significant events. In addition, as fuzzy thinking is more useful when dealing with "black swans" [19], it is suggested that fuzzy methods should be considered in future research. However, a gap in effective energy planning noticed as there is lack of criteria considering the "unexpected" concerning, but not limited to, energy planning evaluation as depicted in Figure 2. It is suggested that the issues calculated should include factors that can add the potential of emergency or even improbable events such as the two that consecutively occurred within the last few years. At the same time, due to the rapid technological development of the 21st century and Industry 4.0, digitalization is an integral part of any analysis or observation. Digitalization refers to the incorporation of technology into daily life. It is the process of converting data collected physically (via sensors) into digital languages. It encourages the development of IoT-connected intelligent systems, which in turn can address challenges and strategies and help decisionmakers make better decisions based on the data provided [78–83]. Such an approach can accelerate the energy sector's transition towards sustainability while at the same time, in combination with unexpected events monitoring, produce future trends and pinpoint threats regarding energy poverty and/or security. Alongside this, digitalization technologies (i.e., IoT, artificial intelligence, smart technologies, etc.) will aid policymakers and governments to achieve the existing legislations, policies, strategies, and action plans such as SDGs through adequate monitoring and direct data registration [81]. Moreover, although it is mostly Europe that seems to be affected by the Ukraine war, several of its impacts concern the international community, while COVID-19 pandemic effects are global. Therefore, this approach shall be implemented for every country, wherever it is.

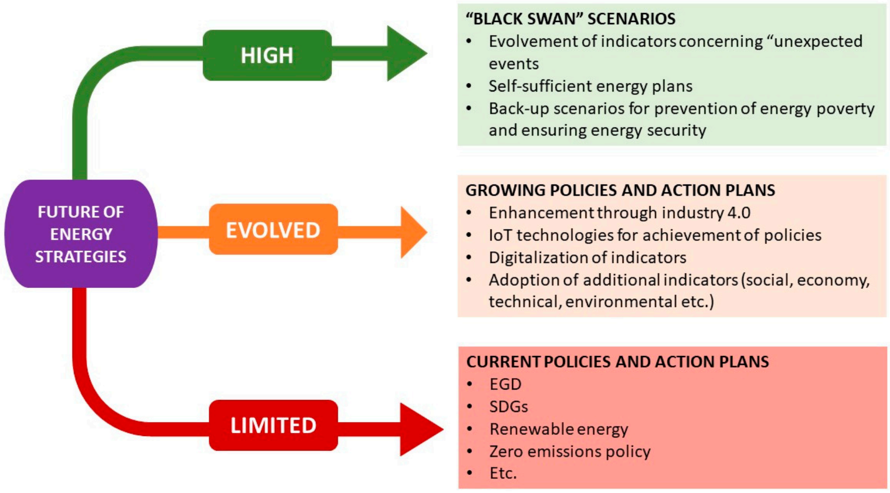

Figure 2. The gap of existing and evolving policies and action plans regarding energy in accordance with the "black swan" scenarios of unexpected events.

5. Conclusions

Threats to efficient energy planning and its assessment have emerged as a result of the effects of the COVID-19 pandemic as well as the effects of the war between Russia and Ukraine on the energy sector and the relevant sectors. These effects have an impact on the energy and other relevant sectors. Greenhouse gas emissions and pollution reduction, the decrease in energy demand, the increase in the share of renewable energy, the temporary achievement of the SDG targets, energy supply difficulties and energy security issues (particularly for Europe), economic recession, high energy prices, energy poverty, and the rush to replace Russia with other fossil fuel suppliers or enhance nuclear energy may direct decisions that are harmful for sustainability. The criteria and indicators used to evaluate the long-term viability of energy strategies, plans, policies, and the choice of energy resources can be found in the research published over the past few years. These can be applied to a wide variety of issues and factors. Integration with other sources, the ability for fulfilling the peak of energy demand, interconnection, electricity prices for households, the percentage of the population that is unable to keep their homes adequately warm, sensitivity to changes in fuel price, energy affordability, energy cost, compliance with a specific plan, and greenhouse gas emissions are some of the factors that appear to be important. Other factors include the amount of time it takes to build a facility, radioactive emissions, dependence on energy imports or energy independence, integration with other sources, and the ability to fulfill demand. It is expected that the upcoming research will concentrate on them both now and in the future. In addition, it is believed that the fuzzy approach is appropriate for the circumstances, and it is suggested that this approach be taken into consideration. Nevertheless, in accordance with sufficient planning for sustainability, the gap in consideration for emergency or improbable "unexpected" events must also be covered.

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