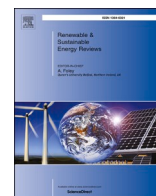




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Covid-19 shock: Development of strategic management framework for global energy

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ABSTRACT

Energy resources are vital for the economic development of any nation, and they are currently recognised as an essential commodity for human beings. Many countries are facing various levels up to severe energy crisis due to limited natural resources, coupled with the Covid-19 pandemic. This crisis can lead to the shutdown or restriction of many industrial units, limited energy access, exacerbating unemployment, simultaneous impacts on people's lives. The main reason for these problems is the increasing gap between energy supply and demand, logistics, financial issues, as well as ineffective strategic planning issues. Different countries have different visions, missions, and strategies for energy management. Integrated strategic management is requisite for managing global energy. This study aims to develop a strategic management framework that can be used as a methodology for policymakers to analyse, plan, implement, and evaluate the energy strategy globally. A conceptual research method that relies on examining the related literature is applied to develop the framework. The present study yielded two main observations: 1) The identification of key concepts to consider in designing the strategic management framework for global energy, and 2) A strategic management framework that integrates the scope, process, important components, and steps to manage global energy strategies. This framework would contribute to providing a standard procedure to manage energy strategies for policymakers at the global, regional, national, state, city, district, and sector levels.

1. Introduction

Energy has a vital role in human life. It supports the development of various sectors, including industry, agriculture, telecommunication, and transportation [1]. Bilgen [1] stated that energy is defined as the strength and capability required for doing activities. The type of energy is diverse such as electrical, thermal, gravitational, sound, chemical, radiant, nuclear, and elastic. Energy sources are classified as non-renewable and renewable energy. Non-renewable sources of energy consist of fossil fuels (coal, natural gas, petroleum) and uranium. Renewable sources of energy refer to solar energy, wind turbines, geothermal, biomass, and hydropower [2].

Energy use in most countries increases over the time due to social and lifestyle changes [3], architectural and urban designs that are not

environmentally friendly [4], and the growth in population in a country [5]. Butler et al. [6] found that consumer activities directly impact on energy consumption. Lifestyle in big cities is energy-intensive, and people are conspicuous and excessively consumptive [7]. Improved living standards have increased consumer demand, thereby increasing energy demand quickly, which is causing growth in carbon emissions [8].

European Union [9] observed that energy consumption of the world in 2018 reached 9938 Mt of oil equivalent (Mtoe). This growth was primarily driven by China, the United States, and India, which together account for about two-thirds of the growth. The highest amount of energy consumed by China, which reached 2067 Mtoe. Depending on the most recent historical average, the most remarkable growth is in the United States. The report showed that energy consumption in the United

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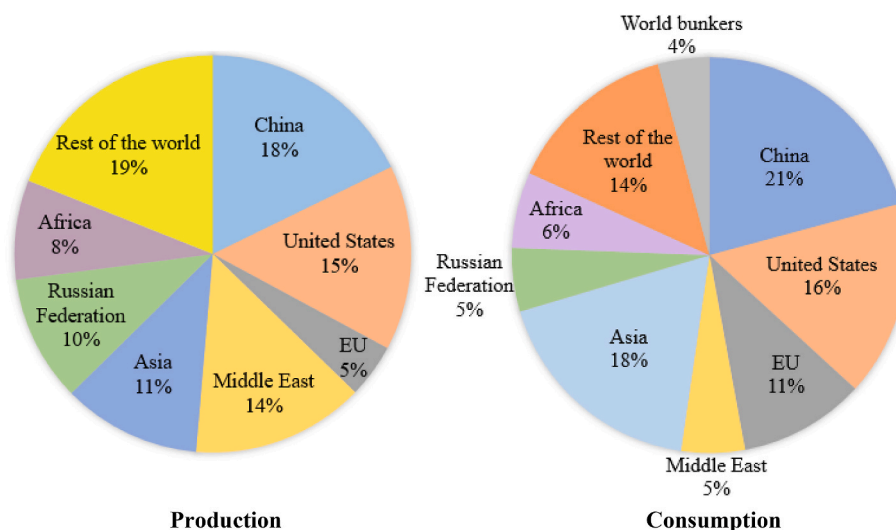


Fig. 1. Global energy production and consumption by region [9].

States reached 1594 Mtoe. In Europe, it reached 1023 Mtoe in 2018. In Asia (non-OECD and OECD Asia, excluding China), final energy consumption reached 1795 Mtoe. Energy use in the Middle East reached 519 Mtoe. The amount of energy consumption obtained by Russia reached 514 Mtoe.

Given the challenges of the new millennium for faster modern socio-economic development and the adoption of new lifestyles, industrial development imposes very high energy production [1]. The forecasts indicate that energy production will keep increasing [10]. EU report [9] observed that China is ranked as the most top energy-producing country in the world, reaching 2562 Mtoe in 2018. The second rank is occupied by the United States, which produced 2173 Mtoe of energy. In the Middle East, ultimate energy production reached 2040 Mtoe. Energy production in Europe reached 628 Mtoe. In Asia, it reached 1631 Mtoe in 2018. Fig. 1 shows the statistics of global energy production and consumption.

The strength in energy consumption is practically reflected throughout all fuels, and the majority of them grow more robust than historically average. BP report [10] argued that global primary energy increases by 2.9% in 2018, which is the fastest growth since 2010. This phenomenon happened amidst the background of modest Gross Domestic Product (GDP) growth and rising energy prices. At the same time, carbon emissions from energy use grow by 2%. This amount shows the fastest expansion in years, with emissions increasing by around 0.6×10^9 t.

Global energy production and consumption can be influenced by many aspects, such as economic, political, technological, environmental, and social. One case that occurred was the COVID-19 coronavirus pandemic which affected the global energy sector, such as a drastic decline in oil prices and demand, increased global CO₂ emissions, energy supply shock, and unemployment. These issues lead to the global energy crisis problem.

A fluctuation in energy demand that is not in balance with its production, followed by a significant increase in energy prices and emissions, shows an unclear energy vision. Global energy resources should be managed using strategic management to attain the identified goals and objectives. In the process, the policymakers need to formulate strategies that allow them to attain better performance and competitive advantage.

Global energy intensity is an indicator used to track progress on global energy efficiency. International Energy Agency [11] mentioned that the initial target is to reduce annual energy by 2.6% until 2030. However, the rate of increase in global energy intensity is only 1.7% in 2017, and an increase to 2.7%/y is needed until 2030. In 2018, an

increase in global energy intensity was only 1.2%. This means that from 2019 to 2030, global energy intensity has to increase again by 2.9% every year to reach the sustainable development goals and targets. A substantial step is required in planning and implementing energy efficiency strategies and policies to achieve this goal.

The strategic management process for global energy determines where the global energy transition has to go, why this transition has to go there when the humans have to go there, and how to get there [12]. In doing so, the policymakers should have a long-term plan that involves decision-making processes in all levels, including global, regional, national, state, city, district, and sector [13]. This long-term plan requires a method that demonstrates the process of designing strategic management for global energy. Current efforts focus solely on strategic management for a country [14]. Different states have different visions, missions, and strategies for energy management according to their benefits [15]. In supporting the development of sustainability, nations should consider the sustainability aspect in their strategic management [16]. In reality, sustainability embedment in strategic management for global energy is still relatively low [17]. There is a need for global-level strategic management that integrates the vision, mission, and strategies of all countries so that the production and consumption of all energy sources can be sustainable and meet all the needs of the community.

From an academic point of view, research on strategic management for global energy is still limited in number. Prasad et al. [13] argued that there is no strategic energy planning available at the global level due to a lack of international governments. Existing studies only emphasise on one source of energy, such as renewable energy [18], crude oil [19], and fossil [20]. Some other existing studies focused on one sector, such as the power sector [21] and manufacturing [22], and one aspect of strategic management, such as politics [23] and resources [24].

Based on this argument, this study aims to develop a strategic management framework that can be used as a methodology for policymakers to analyse, plan, implement, and evaluate the energy strategy globally. This framework embroils strategy analysis for all types of energy (renewable and non-renewable energies) and various aspects of strategic management, including scope, process, models, and methods. The scope of the methodology should cover all levels of stakeholders in global energy management including global, regional, national, state, city, district, and sector to align all strategies for energy as a whole. This idea is intended to avoid managing an energy strategy that only focuses on the interests of a country or region, unfair competition for resources, unequal increases in certain energy prices, and exploitation of energy production in certain countries or regions.

This study applies a conceptual research approach to develop the

proposed framework through an in-depth examination of related literature. This study yielded two main observations: i) The identification of key concepts to consider in designing the strategic management framework for global energy, and ii) Development of a strategic management framework that integrates the scope, process, model, and method to manage global energy strategies. The proposed framework considering general features of strategic management methodology that can be useful for energy producers, suppliers, and customers (international institutions, national government, equipment manufacturers and retailers, energy supply companies, facilities management companies, energy services companies, and energy producers) to grasp the essential aspects in developing energy strategies in the international and national scope. Specifically, the proposed methodology can be adopted by policymakers at the global, regional, national, state, cities, districts, and sectors, such as intergovernmental organisations and government agencies, as a guide for analysing, formulating, implementing, and evaluating energy strategies globally.

The structure of this paper is classified as follows. Section 2 analyses the pertinent literature on strategic management for global energy and reveals the knowledge gaps. Section 3 describes the methodology used to attain the research objective. Section 4 presents the development process of the strategic management framework. Section 5 discusses the main results obtained and their imperative for managing global energy. Section 6 concludes the study by delivering research contributions and future research opportunities.

2. Literature review

This section discusses some concepts associated with strategic management for global energy and reviews existing studies in the field of strategic management for energy. This process is useful to identify related concepts used for strategic management for energy at the global scale and reveal the knowledge gaps and contradictions in the existing study. The literature analysis is categorised into two parts: concept explanation related to strategic management for global energy and research review on strategic management for energy. The concept related to strategic management for global energy includes scope, strategic management process, and model. The analysis of the existing study on strategic management for energy includes contents and methodology review. Fig. 2 presents the categorisation of literature in this study.

2.1. Concepts related to strategic management for energy

This study identified several related concepts about strategic management for global energy. The first concept is the scope, which refers to the range or area of the policymaker plans to offer the strategy. The second concept is the strategic management process, which shows a coherent approach used by policymakers to attain strategic competitiveness and to get above-average returns. The third concept is the strategic management model, which shows the important elements to consider in strategic management for global energy. Each of these concepts is discussed in the following sub-sections.

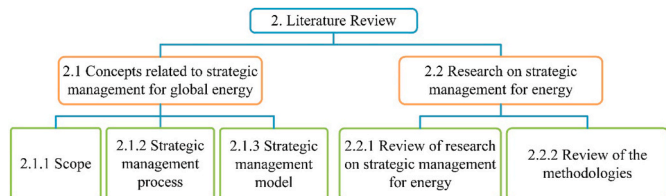


Fig. 2. The structure of the literature review.

2.1.1. Scope

In achieving sustainable improvements in global energy management for the long-term, policymakers need a strategic management methodology to design, implement, and evaluate energy strategies globally [25]. This methodology should have a broader scope of strategy covering global, regional, national, state, city, district, and sector [13] to avoid some strategic issues including designing and implementing energy strategies that only focuses on the interests of a country or region, unfair competition for resources, unequal increases in certain energy prices, and exploitation of energy production in certain countries or regions. Having a long-term view on energy conservation and energy management globally, which includes the use of environmentally responsible and cost-effective energy throughout the world, makes it possible to continue to improve energy management in operations [26]. This process involves all key stakeholders in managing global energy [27]. Practitioners should ensure to meet customer requirements regarding energy utilisation, analyse, and communicate progress and success in energy innovation to internal and external stakeholders [28].

In global energy planning, classification of energy sources are based on suppliers and customers, and the data obtained and analysed has to be complete and reliable, which will later be integrated into a global energy system [29]. European Environment Agency [30] mentioned that policymakers need to understand the implications of selected energy, environmental and economic programs, policies and plans, and their impact on the formation of development and on the feasibility of making this development sustainable. This energy indicator is more than just energy statistics because it provides a deeper understanding and association about energy, the environment, and economic relations.

Prasad et al. [13] stated the importance of a nation to comprehensively see its needs for energy sources from internal and external sources. A nation needs to examine the supply chain of energy sources to predict risks and opportunities. A nation also needs to know and control energy costs and analyse energy suppliers because this affects the daily lives of people and businesses. The nations that have energy sources as the backbone of their economy need a comprehensive strategic management method to predict and control their competitors and the prices of energy sales. For this reason, energy planning needs to consider the geographical level consisting of global, national, regional, city, and district.

Krog and Sperling [25] argued that a strategic energy plan should embrace all levels in the energy system. They believed that long-term energy planning has to encourage sustainable development that is adequate and available at a reasonable cost to meet people’s energy needs without having negative social and environmental impacts. This study summarises the scope, process, and output of global strategic energy planning, as given in Fig. 3.

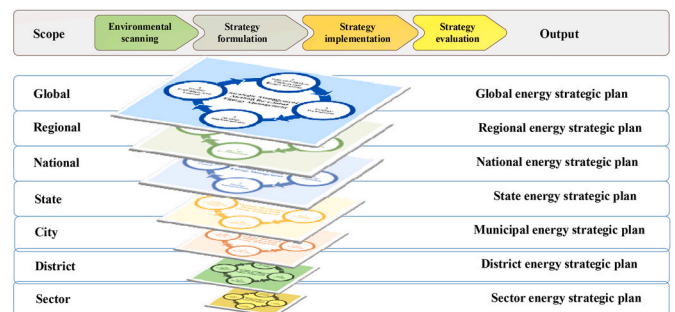


Fig. 3. Schematic representation of a global strategic energy management.

2.1.2. Strategic management process

Strategic management has a vital role in managing global energy [31]. This concept helps policymakers achieve sustainable improvements in energy performance over a long-term period [32] to reduce energy consumption through increased energy efficiency and energy conservation [31]. The long-term strategy also improves the highest demand management and reduces demand costs, reduces overall energy costs, increases reliability through the integration of distributed energy resources, and reduces greenhouse gas (GHG) emissions [33]. The application of strategic management concepts and tools in global energy management enables the practitioners to set long-term energy planning and predict the future trends of global energy production and consumption.

Krog and Sperling [25] mentioned that strategic energy planning has to secure future energy systems that are energy-efficient and flexible.

Strategic energy planning includes all possible elements of the global energy plan, stakeholder coordination, and security of supply strategies. International governments has to carry out strategic energy planning to create optimal interactions between energy demand and energy supply in such a way that energy resources are used optimally.

The strategic management process provides a logical procedure for defining strategies [34]. This process enables decision-makers to analyse the current situation and assess future directions to get better performance [35]. The strategic management process is an iterative procedure that includes several steps, including scanning the current situation, formulating strategies, implementing strategies, and evaluating strategies [36]. Each stage contains several key components that need to be considered in the strategic management process. Fig. 4 provides the steps of the strategic management process.

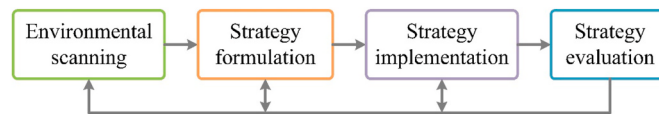


Fig. 4. Strategic management process (adapted from Hitt et al. [36]).

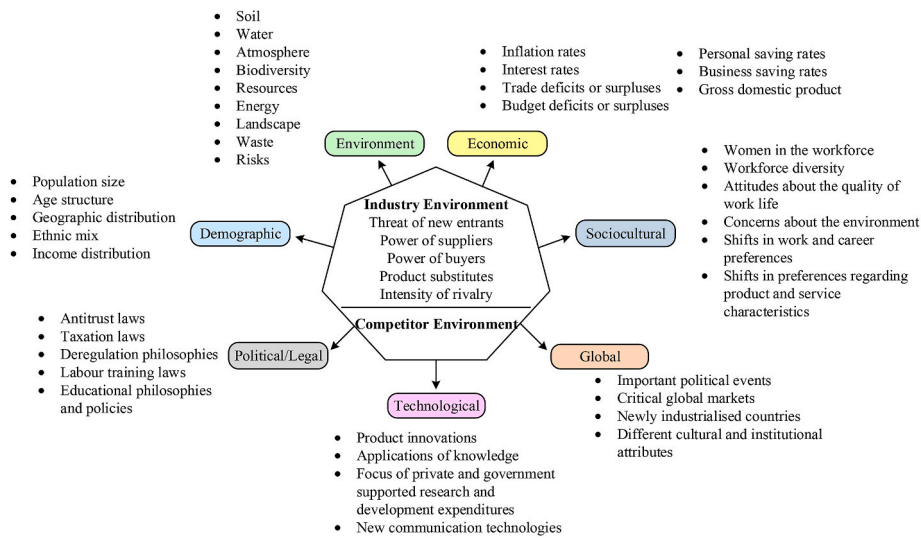


Fig. 5. The I/O model (adapted from Hitt et al. [36] and Global Reporting Initiative [47]).

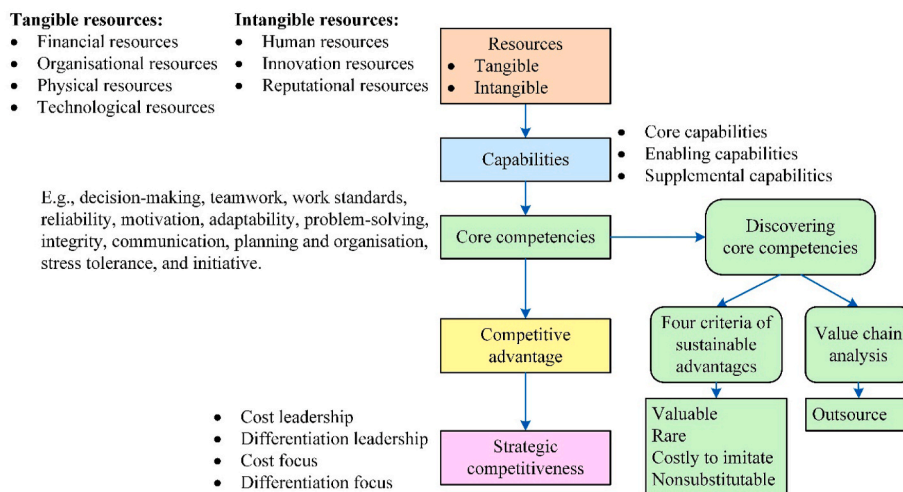


Fig. 6. The resource-based model (adapted from Hitt et al. [36], Plank and Dobliger [49], Porter [50], and Achinas [51]).

Table 1
Summary of research on strategic management for energy in the scope of global, regional, and national.

Reference	Research focus	Methodology
Bilgen [1]	Investigate global energy consumption, energy security, and energy policy.	Review
British Petroleum [10]	Report global statistics on energy demand and carbon emissions.	Statistical review
Energy Information Administration [50]	Collect, investigate, and publish global energy information.	Statistical review
European Commission [9]	Report global and European statistics of energy supply and use.	Statistical review
Jonsson et al. [52]	Identify a complete set of energy security features for measuring low-carbon energy scenarios.	Review
Krog and Sperling [25]	Propose a framework for analysing strategic energy planning in Denmark.	Conceptual research
Terrados et al. [54]	Analyse current energy planning and propose a new methodology to plan renewable energy strategies.	SWOT analysis, multi-criteria decision analysis, and Delphi method
Ervural et al. [55]	Propose a hybrid methodology to analyse energy planning and management in Turkey.	Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis.
Tagliapietra [53]	Investigate the effect of the global energy transition on economics and politics in the Middle East and North Africa.	Review
Tofigh and Abedian [56]	Analyse energy production, consumption, export, and import in Iran and identify their strengths and weaknesses.	Review
Alizadeh et al. [14]	Introduce an integrated scenario planning method for energy management in Iran.	Scenario thinking process
Chen and Wu [57]	Study global energy consumption to provide strategic allegations for sustainable energy policymaking.	Statistical review
Wu and Chen [58]	Examine the global consumption of crude oil.	Statistical review
Abbaszadeh et al. [59]	Analyse energy status in Iran and develop scenario planning based on production and consumption.	Scenario thinking process
Mollahosseini et al. [60]	Provide a general idea of the current status and demands of renewable energy management in Iran.	Statistical review
Achinas et al. [51]	Analyse the biofuels energy industry and discuss the interrelation between the technological aspect and sustainability.	PESTLE analysis

1. Environmental scanning

The external and internal environment should be scanned to determine the development and forecasts of factors that will influence the success of the organisation [37]. Olamade et al. [38] mentioned that environmental scanning refers to the ownership and utilisation of information about events, patterns, trends, and relationships in the organisation’s internal and external environment. It helps the policymakers

to decide on the upcoming path of the organisation. In the scanning process, they need to identify the strengths, weaknesses, opportunities, and threats factors that impact on the new system implementation [39]. The techniques for scanning the environment that is generally used by experts consist of the Strengths Weaknesses Opportunity and Threats (SWOT) analysis and Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) analysis [40].

2. Strategy formulation

Strategy formulation refers to the process of planning a strategy and choosing the right actions to implement the strategy and realise the goals and objectives of the organisation in accordance with the vision [41].

3. Strategy implementation

Strategy implementation is the implementation of the chosen strategy into organisational action to achieve strategic objectives [42]. Strategy implementation is also defined as the process by which practitioners develop, utilise, and combine organisational structures, control systems, and culture to follow strategies that lead to better performance and competitive advantage [43].

4. Strategy evaluation

Strategy evaluation is the final stage of the strategy management process. In this process, practitioners need to evaluate and control the implementation of the strategy [44]. Some important things to do in evaluating the strategy include the suitability of the strategy with the objectives that have been identified [45]. The practitioner also needs to evaluate whether the strategy meets the expectations of the stakeholders [46].

2.1.3. Strategic management model

The strategic management model used to generate the strategy consists of an industrial organisation (I/O) model of above-average returns and a resource-based model [36]. The I/O model encompasses

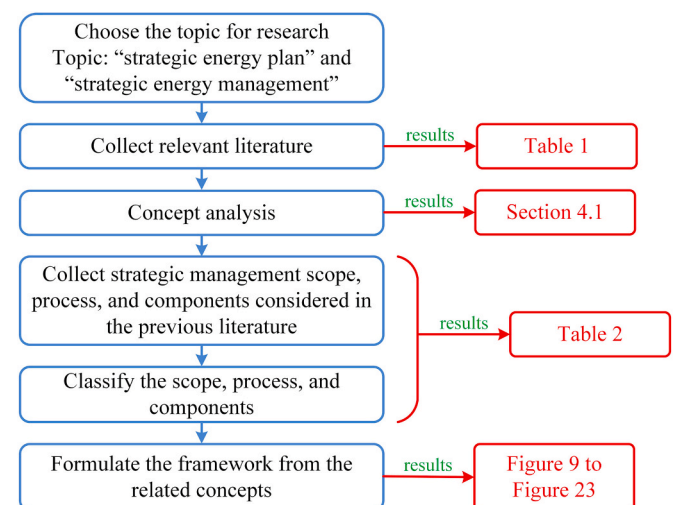


Fig. 7. Stages in conceptual research method (adapted from Chofreh et al. [64]).

an analysis of the external environment (economic, sociocultural, global, technological, political/legal, demographic, and environmental factors) and industry environment (suppliers, customers, and competitors) [43]. The resource-based model consists of the identification and analysis of the internal environment, including resources (liquid fuels, natural gas, coal, nuclear, and renewables), capabilities, core competencies, and competitive advantage [43]. The categorisation of the strategic management model is consecutively given in Figs. 5 and 6.

The I/O model is considered as a primary component in strategic management that should be analysed to achieve an effective strategy [36]. White [48] stated that this model influences decisive action as it helps policymakers to determine threats and opportunities from all aspects of the external environment. It challenges management to compete because most organisations are supposed to have valuable resources, and their performance can be increased if they can use the resources optimally to implement the strategy.

The resource-based model assists the policymakers to analyse the internal environment of an organisation [43]. Hitt et al. [36] explained that the main components of this model include resources, capabilities, and core competencies. Resources are related to tangible and intangible inputs for the production process, such as capital, skills, and raw materials. A capability refers to a set of resources to perform an integrated activity. Core competencies are resources and capabilities that serve as a basis of competitive advantage for an organisation over its competitors. In the resource-based model, the performance of an organisation depends on its resources and capabilities.

2.2. Research on strategic management for energy

This section provides the literature analysis to understand better the focus of the current study on strategic management for energy and to identify the inconsistencies in the literature. This step is conducted by analysing the existing research based on two paradigms: content and methodology. The process and its results are explained in the following sub-sections.

2.2.1. Review of research on strategic management for energy

Research on strategic management for energy has emerged as a subject of significant scholarly attention. Even though the topic under this research is various, the majority of them focused on energy strategies for specific regions or countries. For example, Jonsson et al. [52] investigated the strategy aspects of energy security in the EU countries. They found that security of demand security and geopolitics are essential for transforming low-carbon energy. Other important aspects are related to future global climate agreements and international relations, which have a significant influence on security energy transfer in the EU. Another study conducted by Krog and Sperling [25] analysed numerous vital aspects to improve strategic energy planning for renewable energy systems in Denmark, which culminated in a conceptual framework. They considered several issues, including levels and elements in strategic energy planning, and various tools and methods to analyse them. Tagliapietra [53] discussed an energy transition in the Middle East and North Africa. They observed that the global energy transition might be a positive input for hydrocarbon producers based on economic and political aspects.

Since energy studies on a global scope are still sparse, the present study broadens the scope of studies by focusing on strategic management for energy on a global, regional, and national. This literature analysis helps identify key components in strategic management concept that needs to be considered for managing global energy, including process, model, and methodology. Table 1 provides an overview of the study on strategic management for energy with the identification of

critical components and sub-components in the strategic management concept.

Table 1 shows the components and sub-components of strategic management adopted in the existing studies. The analysis reveals that studies focusing on global energy are still relatively small. The majority of the study in this topic emphasises on strategic planning at regional and national levels. Other components considered in the study are strategic management processes and models; however, their sub-components are not completely considered. This idea can be seen in the work of Bilgen [1] that studied some factors instigating the growth of energy consumption based on resources. The author conducted a statistical analysis to investigate the relationship between energy consumption and economic growth. A similar study conducted by Jonsson et al. [52] that scanned and scoped out energy security in Europe from several aspects, including political, sociocultural, economic, technological, and environmental. This gap motivates the present study to consider a more comprehensive suite of components and sub-components of strategic management to get an effective global energy strategy. The method should cover the following features:

- i. It should integrate relevant aspects of strategic management into a unified form,
- ii. It should provide sequential stages of how to develop global energy strategic management,
- iii. Each aspect should have a breakdown structure.

2.2.2. Review of the methodologies

This section discusses the methods used in the existing strategic management for energy studies. Table 1 shows various methods adopted in the study, consisting of review, statistical review, conceptual research, SWOT analysis, scenario development, and PESTLE analysis. The application of the methodology determined by the research question that the study attempts to respond [61]. Each method has its logical basis and limitations so that none of these methods is considered superior to the other. For instance, review methods are used to encapsulate the current state of understanding of a research area [62]. This method is more likely to be used to investigate and summarise existing studies than to analyse and reveal new concepts. A review study shows things such as academics who are experts in their fields, the latest discoveries and innovations, knowledge gaps that are important to analyse, issues being debated, and ideas for future studies [63].

A statistical review is a type of review paper that includes rigorous statistical and data analysis related to a topic [57]. It allows scholars to collect and analyse the data and produce the information systematically [58]. Chofreh et al. [64] discussed that conceptual research method emphasises the concept or theory that describes the phenomenon being studied. This method is appropriate for answering “what” and “how” research questions. This method is generally used to develop a new concept by observing existing related studies.

Another approach used in the field of strategic management for energy is a SWOT analysis. Ervural et al. [55] stated that this technique is typically used to identify and assess the strengths, weaknesses, opportunities, and threats factors involved in making a business decision. This process is performed before committing to any business actions, explore new initiatives, improve internal policies, and consider existing opportunities. The primary purpose of SWOT analysis is to formulate new strategies that extricate the business from competitors and successfully compete in the marketplace.

Scenario thinking, also known as scenario planning, is a systematic process to anticipate and forecast future business decisions due to the increased technological and social change, and an unpredictable future [14]. The objectives of scenario thinking are fostering useful strategic

conversations among stakeholders, enhance responsiveness to emerging challenges and opportunities, align strategic planning activities across the organisation, generate and assess innovative strategies and options, and build a deep understanding of business environment drivers [57].

3. Methodology

This study aims to answer the question of “What are the steps for managing global energy strategy?”. Conceptual research is considered as a suitable methodology to answer this question. This method is generally used to develop a novel concept or interpret existing ideas from a different viewpoint. It is a fundamental technique in the grounded theory research providing thorough literature analysis [64]. Fig. 7 portrays the general stages in the conceptual research method.

The first stage in the conceptual research method is to choose the research topic based on its significance and knowledge gaps [64]. Strategic management for global energy is selected as a research topic that needs to be observed; however, the study in this area is still narrow. The topics discussed are mostly related to strategic energy planning in a

specific region and energy resource. This research would be useful for academics to broaden the scope of research related to energy management.

The second stage is a collection of relevant literature in the area of “strategic energy plan” and “strategic energy management” [64]. This literature search is conducted in several scientific databases, including Science Direct, Google Scholar, and Scopus. The results show numerous published articles in those two research areas in various journals. The present study limits the search time by selecting papers from high impact journals consisting of Renewable and Sustainable Energy Reviews, Journal of Cleaner Production, Energy Strategy Reviews, Technological Forecasting and Social Change, Energy Policy, and official reports.

The third stage is analysing the relevant concept that needs to be envisaged for developing the strategic management framework for global energy. The concept is derived from the literature analysis that exposes an idea to formulate the framework.

The fourth stage is collecting the strategic management components considered in the previous literature to get a general idea in developing

Table 2
Concepts adopted in the existing studies.

Reference	Scope	Process	Model	
			I/O Model (external environment)	Resource-based model (internal environment)
Bilgen [1]	Global	Environmental scanning	Economic Political/legal	Resource
British Petroleum [10]	Global	Environmental scanning	–	Resource
Energy Information Administration [26]	Global and regional	Environmental scanning	–	Resource
European Commission [9]	Global and regional	Environmental scanning	–	Resource
Jonsson et al. [52]	Regional	Environmental scanning	Political/legal Sociocultural Economic Technological Environmental	Resource
Krog and Sperling [25]	National	Environmental scanning Strategy formulation	Political/legal	Resource
Terrados et al. [54]	Regional	Environmental scanning Strategy formulation	Technological Environment Sociocultural Economic	Resource
Ervural et al. [55]	National	Environmental scanning Strategy formulation	Economic Sociocultural Technological Political/legal Demographic	Resource
Tagliapietra [53]	Regional	Environmental scanning	Economic Political/legal	Resource
Tofigh and Abedian [56]	National	Environmental scanning	Sociocultural Technological Economic Environmental Political/legal	Resource
Alizadeh et al. [14]	National	Environmental scanning	Technological Political/legal Sociocultural Economic	Resource
Chen and Wu [56]	Global Regional National	Environmental scanning	Economic	Resource
Wu and Chen [57]	Regional	Environmental scanning	Political/legal Economic	Resource
Abbaszadeh et al. [58]	National	Environmental scanning	Political/legal Economic Sociocultural	Resource
Mollahosseini et al. [59]	National	Environmental scanning	Environment	Resource
Achinas et al. [51]	Regional	Environmental scanning	Sociocultural Technological Economic Environmental Political/legal	

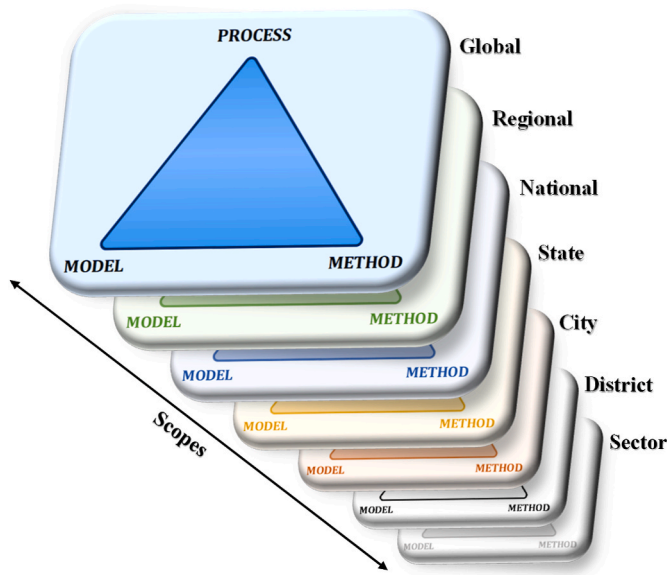


Fig. 8. An overview of the adopted concept.

the strategic management framework and to find more concrete methodology. The fifth stage is analysing and classifying the collected components. This activity provides a literature analysis by mapping the components to the specific aspects that need to be considered in strategic management methodology including scope, process, and model, as given in Table 2. Further explanation of this activity is given in Section 4.1.

The sixth stage is the identification of specific components that are related to the present study from the related concepts that are used in the existing study. This process assists the study in finding the knowledge gaps and identifying a new variable or scope in the study. The identified components are then integrated into a unified framework that can be seen in Figs. 9–23.

4. Development of the framework

This section presents the development process of the strategic management for global energy framework. It involves several stages of literature analysis consisting of a review of the related studies to analyse the adopted concepts and formulate the structure of the framework. The detailed procedure of this stage is described in the following subsections.

4.1. Concept analysis

The present study analyses the previous studies in the field of strategic management for energy to find an idea for formulating the framework. The literature analysis revealed four strategic management main aspects that need to be considered in the framework, including scope, process, model, and methodology.

The scope includes global, regional, national, state, city, district, and sector. It shows the level of stakeholders' involvement in all processes of strategic management. The process consists of analysis, strategy formulation, implementation, and evaluation and control. It shows how the stakeholders at a different level should act through all the process. In the global energy management, the analysis should be conducted within the boundary of global, region, country, state, city, district, and sector to determine vision and mission and set of objectives of each sector.

The model includes the I/O model and the resource-based model. The strategic management model shows the approach that needs to be envisaged throughout all strategic management processes. The I/O

model embraces the external perspective that has a dominant influence on the strategic decisions for global energy management. The resource-based model adopts an internal perspective to enlighten distinctive internal resources, capabilities, and core competencies that serve as a source for getting above-average returns. According to this model, the resources, capabilities, and core competencies found in the internal environment are essential to determine the suitability of strategic actions. The methodology aspect shows a systematic procedure for investigating the strategic management process. These main aspects (scope, process, model, and methodology) are then integrated into a unified form, as shown in Fig. 8.

The next step in the development process is the collection of the strategic management scope, process, model, and methodology from the previous literature. Based on the literature analysis, the majority of study considered all main aspects. However, they do not consider all segments and elements of the aspects. For example, Jonsson et al. [52] focused their environmental scans related to regional energy security. They analysed the current energy security scenario based on political/legal, sociocultural, economic, technological, and environmental aspects. Terrados et al. [54] studied the development of renewable energy in the Spanish region and introduced a methodology for formulating strategies. They also investigated the planning of renewable energy based on several aspects, including technological, environment, socio-culture, and economy. The collected scope, process, model, and methodology from the previous studies are then classified, as given in Table 2.

4.2. Framework design

The strategic management framework for global energy is generally developed based on four main aspects, namely, scope, process, model, and method. These aspects are integrated and interconnected into a cohesive framework to provide a practical methodology for practitioners to design strategies for global energy. The framework consists of two parts: the main framework and the detailed framework. The main framework, as given in Fig. 9, provides an overall view of a methodology to design strategies for global energy. It includes the two main aspects, including scope and process. The remain aspects, model and method, are included in the detailed framework.

For the scope, the present study uses geographical levels of energy planning introduced by Prasad et al. [13]. This scope includes global, regional, national, state, city, district, and sector. This means that the

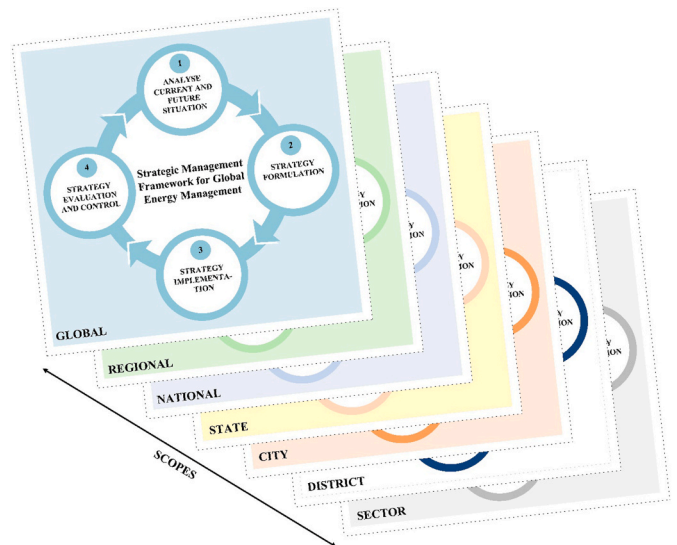


Fig. 9. The main strategic management framework for global energy.

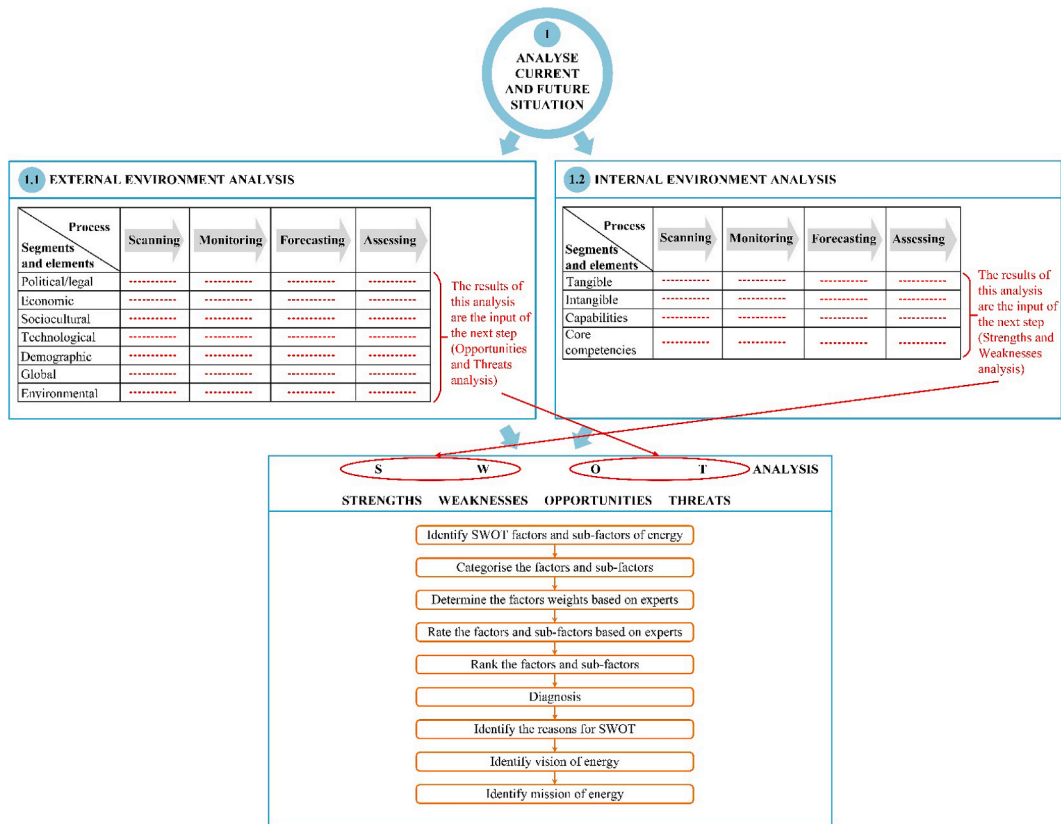


Fig. 10. The detailed framework – Analyse current and future situation.

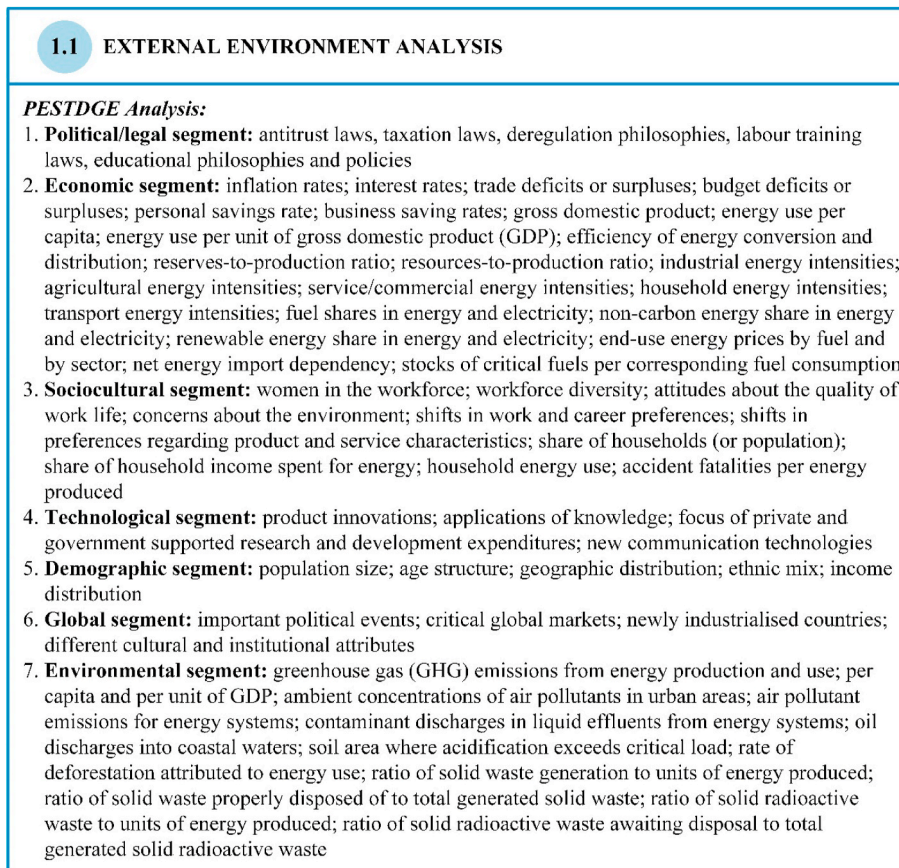


Fig. 11. Segments and elements of external environment analysis.

strategy for managing energy should be designed in every scope (top to down) so that all strategies are aligned and integrated. For the strategic management process, this study adopts the strategic management process from the work of Hitt et al. [36]. The process includes analyse current and future situation, strategy formulation, strategy implementation, and strategy evaluation and control. It is an iterative process as strategies should be constantly reviewed and updated every few years to continuously track energy performance. This process is useful to respond and react to rapidly changing global business environment and global issues.

As seen in Fig. 9, the strategic management process is similar in each scope. However, the strategies designed as an output of the process will be different as each scope has its own competencies and capabilities in managing energy strategies. It should be noted that the strategies designed in all areas should be perfectly aligned with the vision, mission, and goals of the global management to ensure that daily actions and decisions in regional, national, state, city, district, and sector in line with the strategic direction in the global scope.

The structure of the main framework is then broken down into a more detailed framework based on the strategic management process to facilitate the practitioners in following each process and step to design a strategy. The detailed framework consists of 1) Analyse current and future situation, 2) Strategy formulation, 3) Strategy implementation and 4) Strategy evaluation and control, which are presented in Figs. 10, 13, 15 and 22.

The analysis process begins with external and internal environments. The primary purpose of analysing the external environment is to determine opportunities and threats in global energy management. The external environmental analysis process should be in various segments, including political/legal, economic, sociocultural, technological, demographic, and global which is adapted from the work of Hitt et al. [36], the environmental segment which is taken from Achinas et al. [51]. The main purpose of the analysing the internal environment is to identify the strengths to develop and weaknesses to control global energy management. This analysis should be carried out in several segments, including tangible analysis, intangible analysis, capabilities, and core competencies, which are adapted from Hitt et al. [36].

The external and internal analysis activity can be carried out

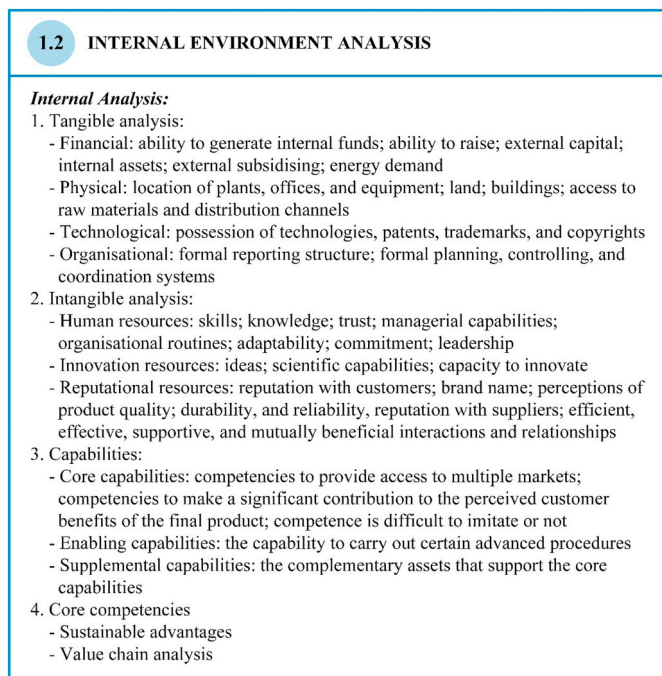


Fig. 12. Segments and elements of the internal environment analysis.

simultaneously. The segments of external and internal analysis are then detailed into several elements to show the specific criteria that need to be analysed. These elements are adopted from Hitt et al. [36] and IAEA [65] and they are consecutively presented in Figs. 11 and 12.

The next step of the analysis process is SWOT analysis by identifying the SWOT factors and sub-factors. SWOT is a technique to analyse the strengths, weaknesses, opportunities, and threats, then determine the strategies for global energy. As shown in Fig. 10, the output of internal environment analysis will be the input of strengths and weaknesses analysis; meanwhile, the output of external analysis will be the input of opportunities and threats analysis. The steps in SWOT analysis are altered from the work of Ervural et al. [55].

Strategy formulation, also known as strategic planning, is a process of developing the global energy strategy. In this process, the

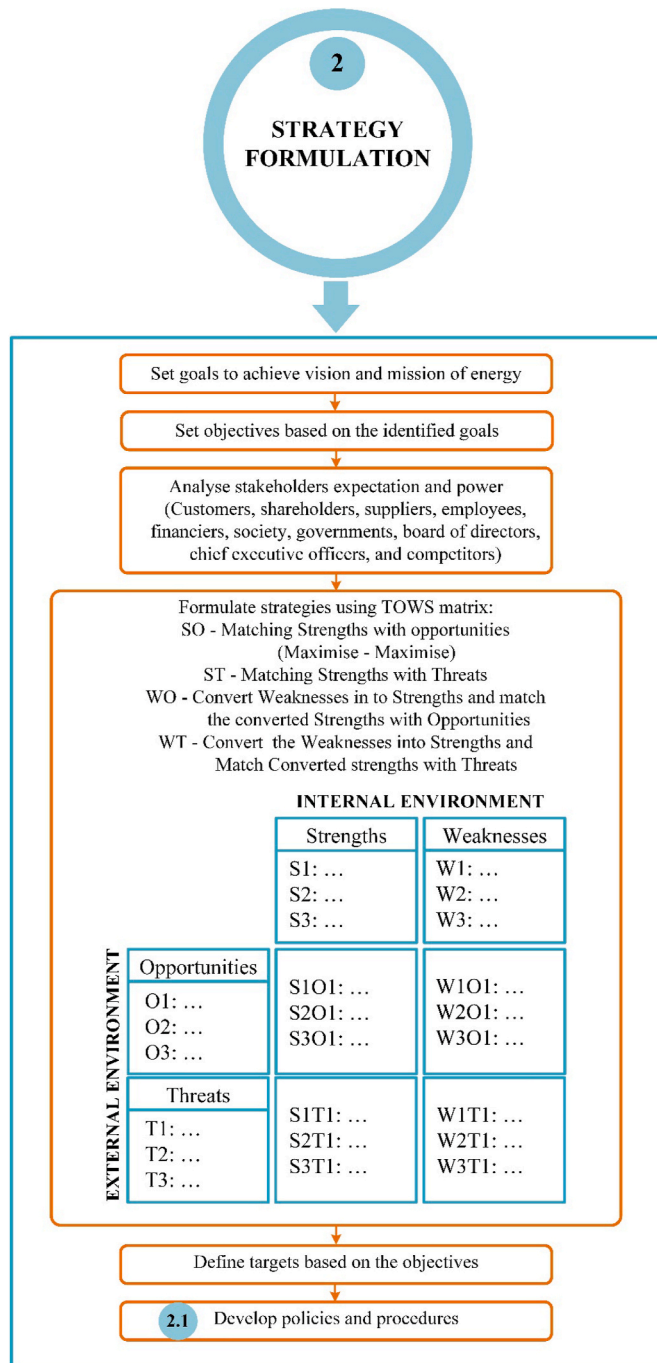


Fig. 13. Strategic management framework – Strategy formulation.

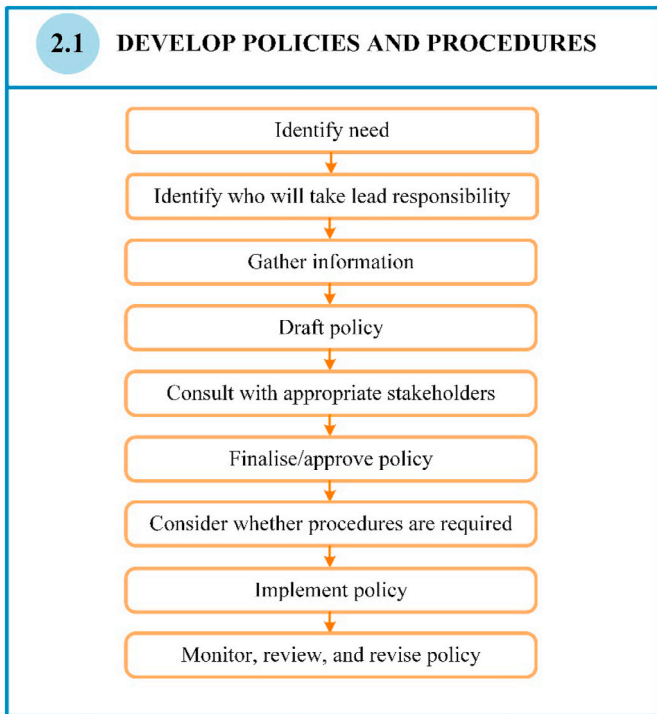


Fig. 14. Steps to develop policies and procedures.

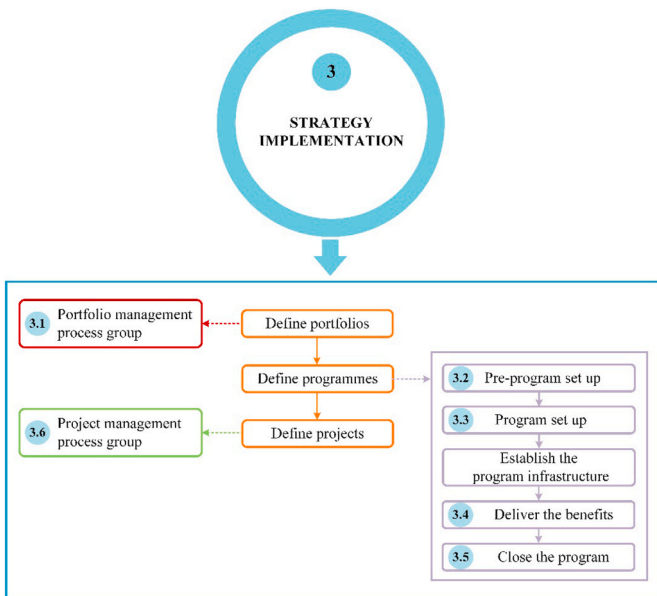


Fig. 15. Strategic management framework – Strategy implementation.

practitioners should identify and decide the most appropriate courses of action to achieve the goals of global energy implementation. It is the primary process in strategic management as it provides an action plan that leads to the expected outcomes.

Strategy formulation requires the policymakers to define the strategic goals and objectives to achieve the identified vision and mission [41]. Then, stakeholder expectations and power, production, market share, and advanced technology should be analysed to discover and align their expectations and individual impact on the product [46]. This

study adopts stakeholders expectation analysis step from Li et al. [66], who investigated energy performance from various stakeholders. The formulation of strategy generally uses the TOWS matrix as a tool for analysing, generating, comparing and selecting the most appropriate strategy to achieve the goals of global energy implementation. The proposed strategic management framework used a TOWS matrix from Gottfried et al. [67]. The next step is defining the performance targets and policies. Fig. 13 presents the detailed process in strategy formulation.

The study details the development of policies and procedures, as provided in Fig. 14. The development of policies aims to confirm obedience with laws and regulations, provide direction for decision-making, and streamline internal processes. This activity begins with the identification of needs by assessing the activities, responsibilities, and external environment. Then, the management committee needs to identify who will be responsible for the policy based on the required expertise. Some information related to legal responsibility, the accuracy

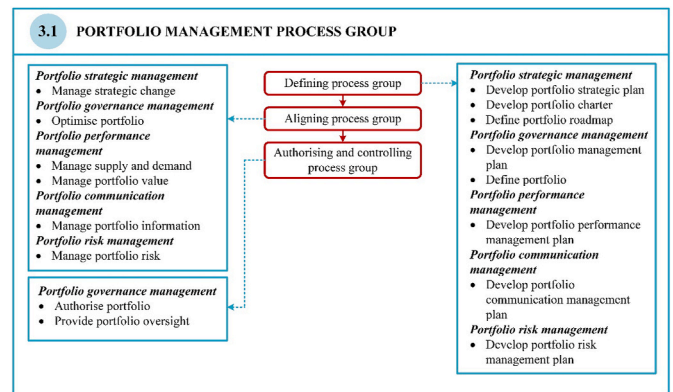


Fig. 16. Portfolio management process group.

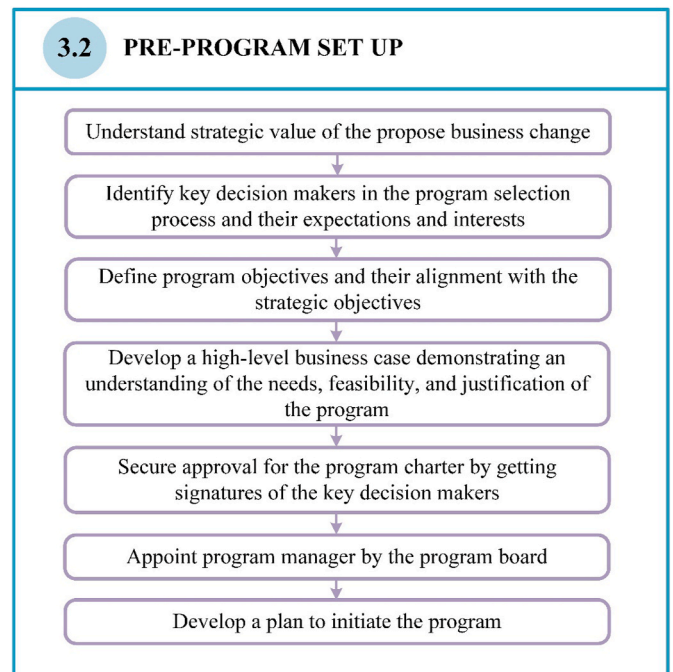


Fig. 17. Steps to pre-program set up.

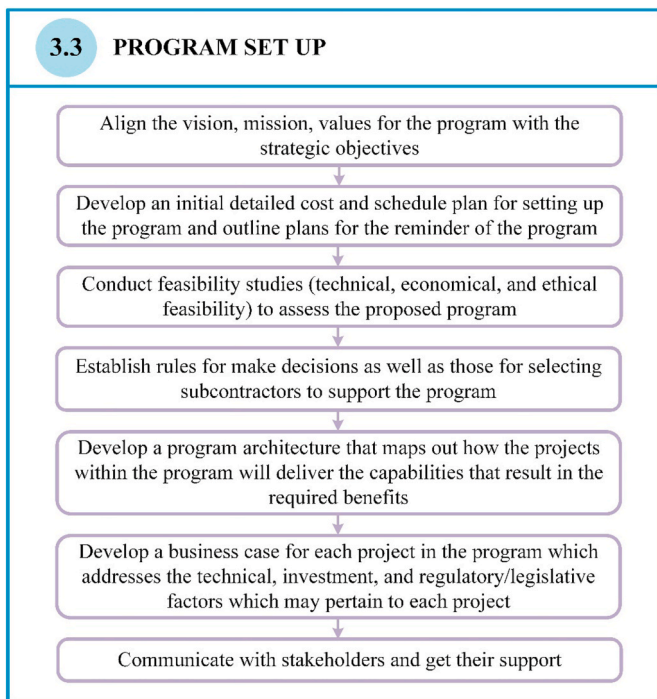


Fig. 18. Steps to the program set up.

of the data and information, competitors, and the availability of the existing guidelines needs to be gathered to support the planning. The next step is the draft policy and ensures that the designed policy are appropriate to the stakeholder's expectation as they need to approve it. After the approval, the developed policies and procedures are implemented, monitored, and reviewed. Policy revision is required to up-to-date the information related to regulations, technology, and best practices, and to make policies consistent and effective.

The next strategic management process is strategy implementation that requires the practitioners to execute and manage strategic activities associated with the delivery of the strategic plan. The strategy implementation process involves the policymakers to develop and integrate business structure, culture, resources, and control system of global energy following the identified strategies [43]. Fig. 15 illustrates the elements of strategy implementation.

Strategy implementation involves three main activities: defining portfolios, programmes and projects. A portfolio is a group of programs and projects to facilitate effective management to attain strategic business objectives. A program is a collection of several projects that are managed and delivered as a single package. A project is a series of activities that need to be accomplished to achieve a specific outcome. Defining portfolios, programmes, and projects are required in the strategy implementation process to have a concrete, detailed, and comprehensive implementation plan that supports the success of strategic management.

Portfolio management process group can be used to define the portfolios. This study adopts the detailed process from The Standard for Program Management [68], as it is a formal standard used for managing portfolios. The portfolio management process group entails three main steps, including defining, aligning, and authorising and controlling process group. The activities under each step are mapped to five portfolio knowledge areas: strategic management, governance management,

performance management, communication management, and risk management. Fig. 16 demonstrates the detailed steps of the portfolio management process group.

As mentioned in The Standard for Program Management [68], the process of defining programmes consists of several steps including pre-program setup, program set up, establish program management and technical infrastructure, deliver the benefits, and closing. The objective of the pre-program set-up is to establish program support and approval from the key decision-makers. The detailed steps in the pre-program set up are illustrated in Fig. 17. After the program has been approved, the program team needs to set up the program by developing a detailed roadmap that provides direction in managing the program and defining its key deliverables. Fig. 18 shows the detailed steps of the program set-up.

The next activity is to establish an infrastructure to support the

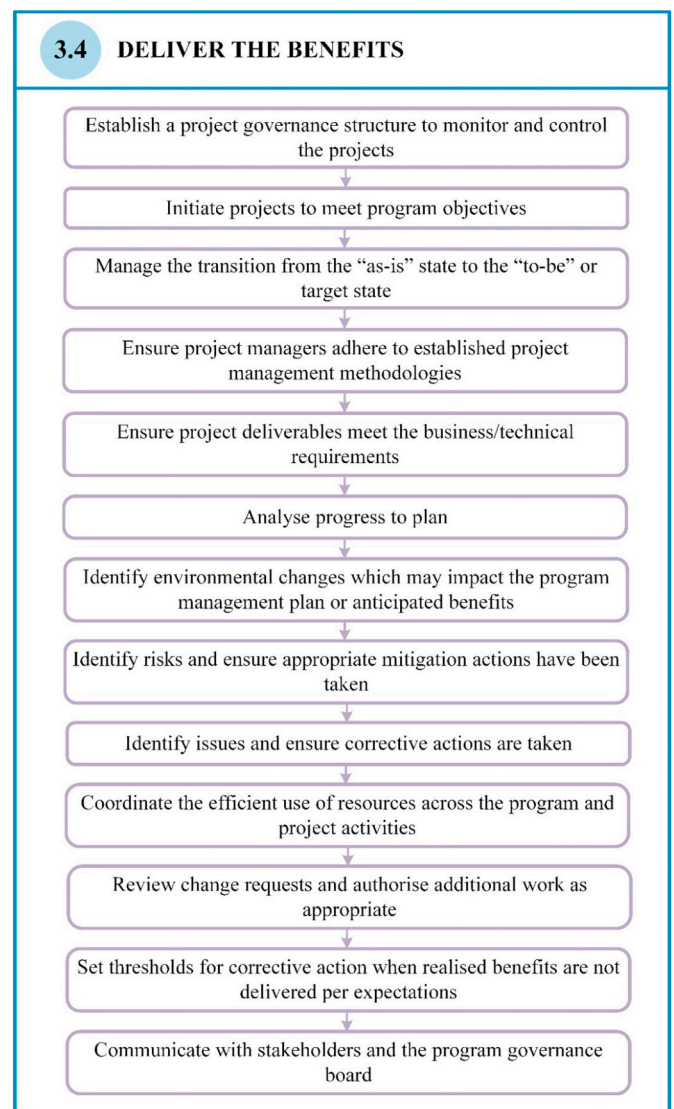


Fig. 19. Steps to deliver the benefits.

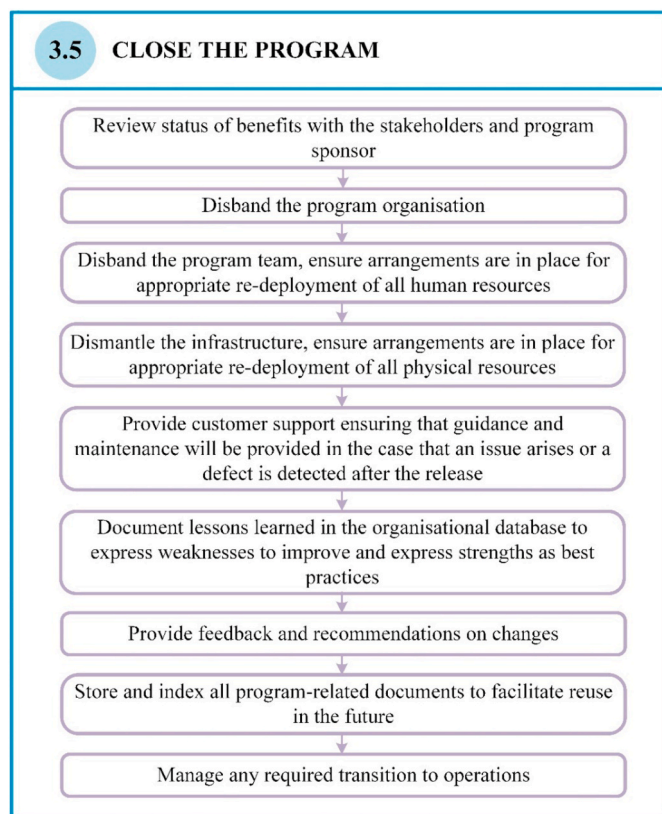


Fig. 20. Steps to close the program.

implementation of the program and its constituent projects. This infrastructure includes processes and procedures, specific tools (software and hardware), and facilities. Establishing the program infrastructure is a key success to support the success of program execution. Delivering the incremental benefits of a program is a process to review the program and its constituent projects, whether they have achieved the planned benefits or not. The results should be communicated to the stakeholders and key decision-makers for their feedbacks. The detailed steps of this process can be seen in Fig. 19.

The final step in defining programmes is closing that entails shutting down the process of the program organisation and infrastructure. The program management team needs to ensure that the closure is smooth and safe. As an outcome, the team needs to document lessons learned for future works, and recommendations on changes that may benefit the stakeholders. Fig. 20 is given to describe the specific steps in the program closure.

This study adopts the steps to define projects from the Project Management Body of Knowledge [69]. The steps consist of initiating, planning, executing, monitoring/controlling, and closing. The detailed activities under each step are categorised based on ten project management knowledge areas including integration, scope, schedule, cost, quality, resource, communications, risk, procurement, and stakeholder. All the steps and activities can be seen in Fig. 21.

The final strategic management process is an evaluation and control of strategies where policymakers need to ensure that the strategy formulated is adequately implemented and fulfil the objectives or not [70]. Implementing strategies requires effective control and information systems, which provide practitioners with accurate, complete, real-time

feedback so they can make decisions based on data [71]. Fig. 22 shows the detailed process of strategy evaluation and control. This study adopts the intricate process of strategy evaluation and control from the work of Wheelen and Hunger [72]. This process helps policymakers to monitor the progress of strategy implementation. Adequate and timely feedback is the basis for an effective strategy. In this process, the practitioners can ascertain what needs to be achieved by comparing the performance with the desired results and providing the feedback to evaluate the results and take corrective actions as required.

5. Results discussion

The strategic management framework for global energy is generally developed to guide policymakers in designing energy strategies to achieve a sustainable strategic competition in the worldwide market. It is an essential tool for policymakers such as intergovernmental organisations and government agencies to formulate and implement the goals and initiatives involved in the energy strategies. An energy strategy has to exist to support the business functions and operations in creating a wise decision-making process.

The strategic management framework entails an evaluation of the energy business vision, goals, objectives, and plans for the future. The framework also can be useful for energy producers, suppliers, and customers (international institutions, national government, equipment manufacturers and retailers, energy supply companies, facilities management companies, energy services companies, and energy producers) to grasp the essential aspects in developing energy strategies in the international and national scope. Fig. 23 provides an overview of the framework in the form of a sequential diagram. The policymakers can apply the framework by sequentially following the process and steps in the framework.

The economic crisis caused by the COVID-19 pandemic is prompting international and national governments around the world to enact emergency support measures. Economic activity and the wellbeing of households during the crisis has served to underline the urgency of achieving universal access to energy.

The COVID-19 also increased the demand for PPE (Personal Protection Equipment) very considerably [73]. During the outbreak of the pandemic the generation of medical waste increased sharply (+370%) in just Hubei Province, with a high proportion of plastics. In spring worldwide were needed 129 G masks/month, consuming 1.29 TWh/month = ~4.6 PJ/month [74]. The growth rate of medical-use ethanol in 2020 was so far 20.0% and has been still growing. For example, in March 2020, sales of multipurpose cleaners in the USA spiked by 166% and aerosol disinfectants 343% from a year ago, which disrupted the supply chains of disinfectants [75].

The energy sector has played a vital role in supporting the delivery of healthcare, remote working, and many other needs. Like many other sectors, however, the energy sector has been strongly affected by the COVID-19 crisis [76]. In these circumstances, policymakers need to review and rethink their energy strategy and long-term plans to address the problems posed by pandemics and survive during and after a pandemic. The proposed strategic management framework would help them to re-analyse the strategies and actions requiring changes to attain better performance and competitive advantage.

In providing long-term recovery plans, the policymakers need to reassess several energy sector measures, which generally consist of electricity, transport, industry, buildings, fuel supply, and strategic opportunities in technology innovation [77]. They have to look at the short-term and long-term implications of these measures for job creation, economic growth, energy security, resilience, and emissions. Some

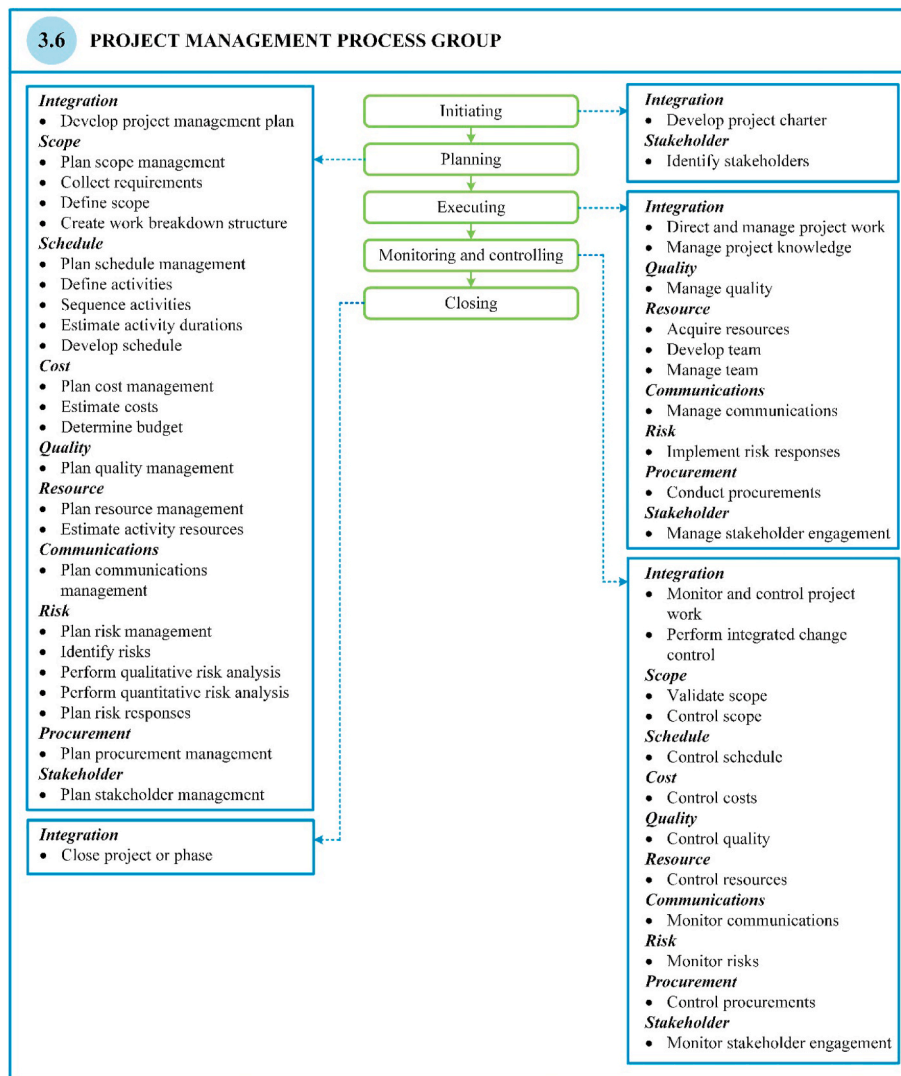


Fig. 21. Project management process group.

measures may be more appropriate for certain countries depending on national circumstances. Suppose governments around the world align their strategies and actions, there may be synergistic benefits from more integrated energy value chains and reduced costs related to cumulative adoption and policy coordination across markets. Such coordination can make for a more cost-effective and quicker recovery for all.

Three aspects of the strategic energy plan requiring revision in light of the COVID-19 crisis may include, but not limited to customers' energy needs, demands, and the competitive positioning, marketing strategies, and supply and operations. The policymakers need to re-analyse and update current and future situation, which involves internal and external analysis, as seen in Fig. 10. They need to go through all the strategic management process and update the related energy strategies and actions.

This study proposes a strategic management framework and provides a detailed process for formulating energy strategies. The process in the framework looks general, which means that it can be used in another

sector besides energy. However, the identified elements in the framework are more specific to the energy sector. For instance, the segments of external environment analysis that consider the amounts of energy production and use.

The proposed strategic management framework provides a holistic methodology for formulating and managing energy strategies. The results of this study differ from previous studies as the resulting framework integrates all important concepts that need to be considered in the process of energy strategy formulation and management. In contrast, previous studies are only specific to one perspective in strategic management, such as scanning process or scenario planning. Therefore, the present study gives fresh insights into the strategic management field, particularly in the energy sector. In connection with the COVID-19 pandemic which affects the performance of the energy sector, the proposed framework would facilitate the policymakers to focus on which segments that are crucial to change according to the results of internal and external environment analysis.

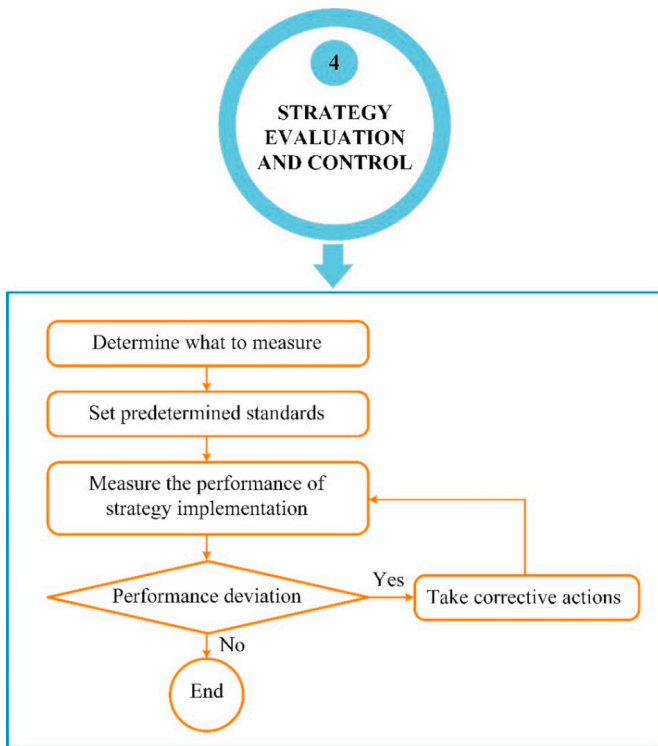


Fig. 22. Strategic management framework – Strategy evaluation and control.

method. The detail segments and elements of each aspect were identified according to several concepts in strategic management and energy planning. This study provides several contributions for academics and practitioners. For academics, this research will advance the development of research in the field of strategic management for global energy. The framework developed is proposed to address the existing research gaps in this field. For practitioners, the proposed methodology can be adopted by policymakers at the global, regional, national, state, city, districts, and sectors, such as intergovernmental organisations and government agencies, as a guide for analysing, formulating, implementing, and evaluating energy strategies globally. The policymakers can follow the actions and decisions that help them to achieve their goals. The method would minimise the effects of adversative conditions and changes.

A study that analyses current global energy based on the identified segments and elements of the framework would be valuable for practitioners—for instance, scanning global energy from an economic, political, sociocultural, demographic, technological, global, or environmental perspective. This study would give a detailed overview of the general environment analysis of the current condition in global energy. This analysis is an important step in strategic management by providing possible threats and opportunities in global energy implementation. Another potential research is a study that analyses internal environments such as tangible and intangible resources, capabilities, or core competencies of worldwide energy implementation. This study is essential to show the existing threats that can hinder the implementation and opportunities from advancing global energy implementation.

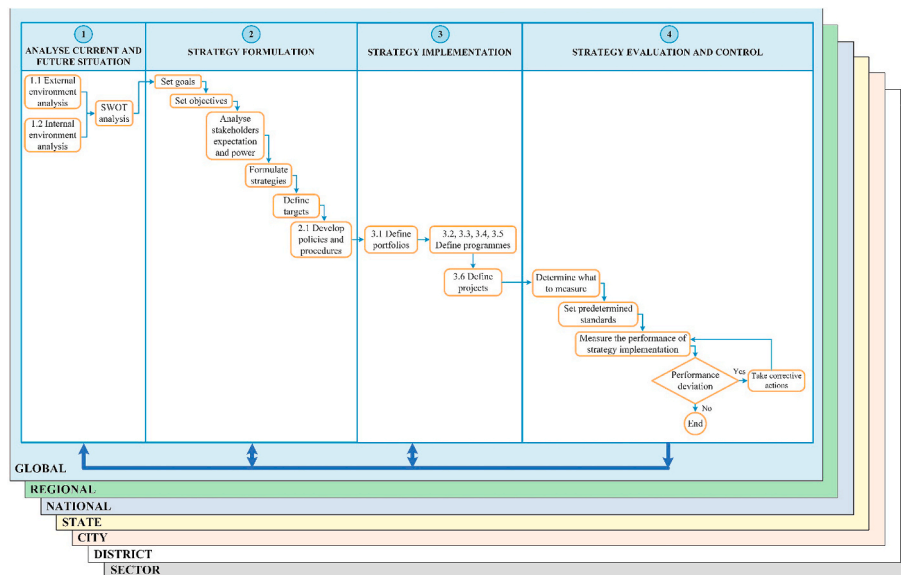


Fig. 23. An overview of the strategic management framework.

6. Conclusions

Policymakers at the global and national levels require an appropriate strategic management method to manage global energy. This method should integrate relevant aspects of strategic management into a unified form and provide sequential stages of how to develop global energy strategic management. Based on these ideas, a strategic management framework for global energy is developed. This framework would help practitioners to provide detailed structure and process for developing global energy strategies.

The strategic management framework was structured based on four aspects, including scope, strategic management process, model, and

Credit author statement

Abdoulmohammad Gholamzadeh Chofreh: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft. Feybi Ariani Goni: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft. Mehdi Davoudi: Formal analysis, Methodology, Writing – original draft. Jiří Jaromír Klemes: Formal analysis, Methodology, Resources, Project administration, Writing – review & editing, Funding securing. Seyed Mohsen Seyed Moosavi: Formal analysis, Methodology, Writing – original draft. Masoomeh Zeinalnezhad: Formal analysis, Methodology, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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