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Knowledge-Based Leadership for Sustainable Energy Practices in Iran

Mozhdeh Afsharfar[1*], Jugindar Singh Kartar Singh[1], Najiya Alhajri[2]

[1] School of Business Management, Operations & Research, Asia Pacific University of Technology & Innovation, Kuala Lumpur, Malaysia
[2] Business Studies Department , University Technology of Applied Science, Muscat, Oman

Mozhdehafsharfar36@gmail.com, jugindar.singh@apu.edu.my, Najiya.Alhajri@utas.edu.om
Tel: 00989202150155

Abstract
Effective knowledge-based leadership is gaining importance due to the focus on sustainable development arising from technological advancements. This study investigated the function of knowledge-based leadership in managing sustainable energy in Iran. The issues addressed included sustainable energy, reliance on fossil fuels, energy disparities, and sociocultural barriers. This qualitative study involved six semi-structured interviews with key leaders. The findings pointed out the emergence of knowledge-based leaders capable of connecting education-industry gaps and promoting sustainable practices. Knowledgeable leaders can handle the complexities in the energy sector and invest in sustainable technologies to create a supportive environment in which sustainable energy can flourish.

Keywords: Leadership, knowledge-based Leadership, Sustainable Energy

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1.0 Introduction

Iran's electricity generation is projected to reach 317.10bn kWh in 2025 But only 10.6bn kWh is renewable energy (Statistica, 2025). Vast renewable energy opportunities, solar, tidal, wind, and geothermal are underutilized because of the lack of leadership and knowledge management (Menon et al., 2023). The exploitation of fossil fuels (98%) and energy subsidies (90%) lead to waste and economic losses, which result in unsustainable energy policies (Tabnak, 2024). The lack of integrated planning and modern infrastructure will waste 20,000 MW of renewable energy annually for $12 billion on liquid fuel for power plants, likely pushing Iran to an imminent energy crisis (JahanEghtesad, 2023).

Studies have revealed how green knowledge management and technology impact organizational sustainability by examining quantitatively the mediating role of knowledge-based leadership in IT companies (Al-Faouri, 2023). Another paper looked at visionary leadership and how good leadership might support growth in creativity and innovation in the prevailing structures and systems. It was also mentioned how such efforts meet obstacles and setbacks in implementing clean energy innovation (Joel & Oguanobi, 2024). The head of the Energy and Environmental Protection Commission of Iran underlines the importance of energy for economic growth and development. He points to the huge investments in this area. The report emphasizes that one should use engineering solutions and skilled personnel (JahanEghtesad, 2023). Another research by the head of energy optimization in the power sector highlighted enhancing energy consumption efficiency and adopting sustainable energy sources as alternatives to conventional energy (Farahmandpour, 2022). Nonetheless, prior research has not directly investigated the impact of leadership on effectively leveraging knowledge and managing resources. Given Iran's geographical circumstances, strong leadership can improve effectiveness, attain

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energy independence sustainably, and avert crises. Furthermore, there is a dearth of qualitative research regarding the assessment and analysis of decision-making authorities involved in knowledgeable leadership relating to the development and application of renewable energy. This qualitative research was done to study the significant role of knowledge-based leadership in the advancement and establishment of renewable energy projects for efficient production and conservation of energy. This research was done to shed light on various factors contributing to the underutilization of knowledge and management practices that are resulting in lower management of such valuable energy resources as oil and gas.

2.0 Literature Review

2.1 Theories and Theoretical Supports

The diffusion of innovation theory tells that people adopt innovations depending on cultural beliefs and social system socialization over time (Shaikh et al., 2019). Rogers (2003) identifies five factors influencing adoption: compatibility, complexity, observability, trialability, and comparative advantage. They shed light on how to integrate new technology organizationally and individually. The theory is adaptable across contexts, making claims for how to innovate and generate societal benefits (Min et al., 2019). As introduced by Downtown (1973), transformational leadership is one of the most important forms of modern leadership as it provides a base for the shared objectives of leaders and followers to promote motivation and morale. It differs from transactional leadership in that it sends the message of change by providing a clear vision and driving teams to exceed performance standards. Its role in driving innovation and sustainable growth for contemporary organizations is stressed by Putra et al. (2023).

2.2 Knowledge-based Leadership in Adoption of Sustainable Energy

Knowledge-based leadership and sustainable energy development are interdependent concepts that drive innovation, efficiency, and environmental sustainability, creating pathways for a sustainable future. By fostering a culture of learning, knowledge sharing, and innovation, knowledge-oriented leaders enable organizations to adopt environmentally sustainable practices and reduce environmental risks and costs (Chopra et al., 2021). Knowledge-based leadership integrates green knowledge into organizational strategies, promoting the development of sustainable technologies and raising awareness about sustainability's importance (Al-Faouri, 2023). In Iran, knowledge-based leadership is pivotal for addressing energy challenges, formulating strategies, and engaging diverse stakeholders to promote sustainable energy development (Al-Faouri, 2023).

Studies conducted to determine the optimal share of renewable and non-renewable energies in the path of sustainable growth and calculate Iran's economic growth have accepted that fossil energies are considered endogenous entities. In the next stage of production, the share of sustainable energies between 2010 and 2022 should have been 8% of the energy consumed. By the end of 2022, due to the weakness in the application of knowledge in management, it was only 4%. Therefore, the path of sustainable growth in the use of renewable energies, which should have been 1.2%, requires an average growth of 26% during this period. This makes the failure to achieve the predicted figures more evident than ever, highlighting the necessity of knowledge-based leadership and the use of expertise (Eslamloueyan & Ustadzad, 2013).

Through educational and cultural initiatives, knowledge-based leaders in Iran enhance public awareness of sustainable energy's benefits, fostering acceptance and participation across diverse communities. The "Mehrban Solar Village" project in Yazd province exemplifies the successful implementation of sustainable energy, reducing costs, creating employment, and positioning rural areas as models for renewable energy adoption (Shirvani, 2019). Collaboration between knowledge-based companies and government initiatives in Iran underscores the critical role of leadership in advancing the culture of sustainable energy utilization and production.

RQ1: 1. How can knowledge-based leadership influence the development and implementation of sustainable energy in Iran?

2.3 Barriers and Challenges to the Development of Sustainable Energy

Iran faces multifaceted challenges in sustainable energy development due to internal inefficiencies and external pressures.

Several internal factors include the energy management system and awareness of the need for knowledge-based management. High T&D losses are 19%, whereas in inefficient countries such as Germany, they are only 4%. Higher energy consumption, rudimentary industrial processes, and a demand for improved transformation efficiency cause the need for updated infrastructure and science-based policies. However, a lack of coordinated decision-making process, low level of private sector participation, and insufficient investment in infrastructure prolong these problems (Farahmandpour, 2022). Externally, sanctions prevent the efficient import of technology and FDI, thus hampering the emulation of successful global energy models.

Nevertheless, Iran has many geopolitical advantages and rich resources; it suffers from exposures arising from mono-product economies. Problematic political and ideological positions have also contributed; practical concerns such as knowledge are given less attention. Adding to the mentioned issues, irregularity and poor coordination could be seen in Iran's energy policies, especially regarding sustainable energy. In industries and agriculture especially, the scarcity of knowledge, employment thwarts economic diversification and employment availability. In addition, enormous resources have been channeled into nuclear energy, while more attention needs to be paid to developing renewable energy sources. To solve these problems, it is crucial to use knowledge-based leadership. With the country's favorable geographical location, Iranian natural resources, and strong background in technology, it can take a leading position in the energy market (Hatami, 2022).

In Iran, several issues persist despite being approved for implementation, including a knowledge-centric gap. Challenges include the monopoly of profits by the Ministry of Energy, conflicting performance-driven approaches, and the establishment of parallel

organizations since 1995. Additionally, there's reliance on fossil fuels, incorrect subsidy policies, and the construction of combined cycle power plants without considering regional climate (Sadeghi et al., 2023).
RQ2: What barriers and challenges do knowledge-based leaders face in developing and implementing sustainable energy in Iran?

2.4 Benefits of Sustainable Energy in Iran

Energy supply needs to be listed at the top of development plans for developing nations. The high utilization of fossil fuels in economic activities both exhaust resources and cause atmospheric pollution. Sustainable energy sources should replace conventional ones because they offer several benefits including affordable prices and broader supply availability alongside reduced emissions and sustainable progress for economies (Golabi, 2011). Knowledge-based leadership is necessary to continuously progress sustainable energy development in Iran in terms of economic, environmental, and social problems. In economic terms, renewable electricity from wind and solar, for example, is cheaper than electricity generated from fossil fuels, thereby allowing the country to avoid fluctuating fuel prices and encourage the inflow of foreign direct investments. For example, changing from 1% of the energy consumed from fossil fuels generates a worth of € 3 million in foreign investment in Iran annually. Furthermore, the renewable energy industries offer far more employment opportunities than conventional energy industries, with the solar industry employing almost 250000 workers nationwide (Moore et al., 2017).

Environmentally, the shift from conventional energy sources lessens the impacts of climate change and exhaust emission, water pollution, and related adverse health impacts of conducting fossil fuels. It is in parity with the current endeavors of governments around the world to save non-renewable resources and the resultant environment and play a part in the conservation of scarce natural resources (Sahoo et al., 2023). In this context, Fig.1 shows the growth trend of per capita energy consumption in Iran between 1971 and 2014. Population growth has led to more energy production from fossil fuels, making it one of the countries that produces CO2 (Hosseini et al., 2019).

Socially according to the United Nations, sustainable energy promotes equality as it provides employment opportunities in the energy sector, allowing people to work near their homes. Knowledge management empowers leadership to create access to the right knowledge resources, thereby aiding innovation. It also helps energy companies respond to global effects on the environment. Using theories like the diffusion of innovation can help organizations achieve the strategy of increasing their levels of innovation while working on the daily provision of services (Priesner, 2024).
RQ3: What are the benefits of implementing and developing sustainable energy in Iran

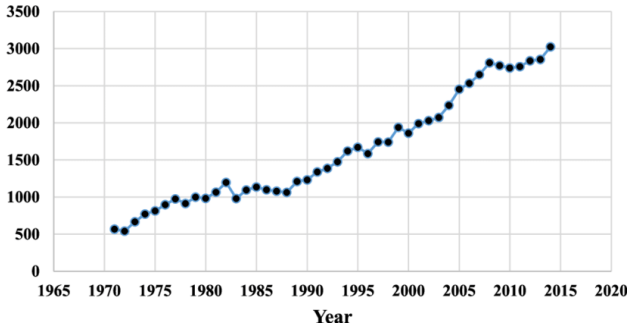

Fig. 1: Rising trend of individual energy consumption
(Hosseini et al., 2019)

3.0 Methodology

3.1 Research design

The "Research Onion" introduced by Saunders et al. (2019) serves as the foundation for the research study. This study follows the philosophy of interpretivism which interpreted the impact of knowledge centrality in leadership on sustainable energy development and implementation. The research approach that was adopted in this study was an inductive approach which allowed the study to derive insights by grouping data into themes, facilitating the understanding of knowledge-based leadership dynamics in sustainable energy development. The chosen research strategy was a descriptive qualitative approach to collect primary data through semi-structured interviews with 6 people from Iran's sustainability sector authorities and professionals, focusing on detailed observations and using non-numerical data to explore how leadership and expertise influenced sustainable energy adoption. For this study, a cross-sectional time horizon was appropriate (Creswell, 2013).

3.2 Data Collection and Sampling and Data Analysis

The data collection approach involved conducting individual interviews that were recorded. The translation from Persian to English was checked by a professional and transcripts were generated using a translation tool. The sampling strategy implemented was non-probability judgmental sampling, commonly referred to as purposive sampling. Six qualified participants were identified as experts with a strong focus on sustainable energy knowledge and issues. The analysis of the research followed a six-step thematic analysis

framework as described by Creswell (2013), which examined the interview data to identify recurring codes and patterns. Themes were identified and named. Furthermore, participants were chosen from a uniform and homogeneous population comprising public sector employees. Kuzel (1992) noted that 6 to 8 interviews are suitable for a homogeneous sample, while around 12 to 20 are needed for a purposive sample with maximum variation. This Indicated that typically 5-12 interviews are adequate for a single project. In this research, saturation point was used as the determining factor.

4.0 Findings

4.1 RQ1; Knowledge-based Leadership's Impact

The findings responding to Research Question 1 explain the impacts of knowledge-based leadership on sustainable energy in Iran. Thematic coding identified three themes from participant interviews namely resource optimization, creating a systematic structure, and societal conceptualism.

In Iran, due to its diverse climate and strategic reserves, resource optimization refers to a clear understanding of knowledge and scientific principles, which necessitate effective management as a decisive factor in the precise utilization of resources. Acknowledges the value of numerous resources of Iran, mainly due to the four seasons climates for renewable energy generation. According to Participant #1, "All four of these chapters are relevant to this discussion". Participants #3, #4, and #5 pointed out that knowledge-based leadership is the key to efficient resource management and sound development of the energy sector in Iran.

The findings show that knowledge-based leaders play a crucial role in creating a systematic structure capable of implementing targeted legislative reforms, clearly defining specific tasks in energy organizations within an organized framework of long-term roadmaps to lead the implementation and development of sustainable energy processes. Speaking of energy methods that have no scientific base, participants #1 and #6 noted inefficiencies due to decentralized and disparate practices. As Participant #1 stated, "The advancement of sustainable energy use in Iran has largely been based on experimentation, with minimal reliance on scientific knowledge." This points to the need for long-term planning for more sustainable actions. Social conceptualism can be strengthened as a key advantage for society in the development, production, consumption, and awareness-raising of sustainable energy. Knowledge-based leaders, by raising awareness and creating a need for sustainable living, minimize socio-cultural resistance. Similarly, Participant #4 refers to cultural and social constraints and emphasizes that "The need for energy in Iran has not been culturally and socially embedded as a necessity yet."

4.2 RQ2; Barriers of Knowledge-based Leaders in The Development of Sustainable Energy

Participants' findings also highlighted important challenges. First, the misalignment between education and industry needs shows that Iran's education system does not effectively equip individuals with the requisite skills for sustainable energy development. There is a gap in curricula at universities and the competencies needed for leadership in energy initiatives.

Second, the lack of adequate financing has prevented the raising of resources for the project of sustainable energy, including financial support. Funding or tools are not given to leaders to implement and perpetuate energy initiatives. Participant #1 emphasizes: '... Private investors must go beyond immediate financial gain. As opposed to short-term profits, there should be a refocusing to broader economic contributions that are beneficial to society..."

Thirdly, leaders face cultural and social resistance due to barriers arising from society's lack of understanding of and limited acceptance and adoption of sustainable energy solutions and energy consumption models and lack of targeted activities

Media awareness for a sustainable society. Participant #1 highlights the media's potential role in addressing this issue: '... The media's influence is significant in promoting the use of sustainable energy and ensuring that planning continues for years...'

In addition, the lack of international relations is directly influenced by ineffective policies and political issues including sanctions that prevent sustainable energy infrastructure development in Iran. Participant #6 states: '... Leaders who want to grow in knowledge-based organizations face challenges such as proper infrastructure for sustainable energy development due to existing sanctions and international relations...'"

4.3 RQ3; Benefits of Development and Implementation of Sustainable Energy

The finding shows the development of sustainable energy in Iran offers several benefits. In a political and geopolitical sense, it enables national security, promotes diplomatic relations, and builds regional/global standing through the extirpation of fossil fuel dependency and positioning the country as a major player in green tech in the region. Participant #6: "...In Iran, with our abundant oil, reducing our dependence on it would be beneficial. If there is a conflict or a price increase, solar energy will still be there, and energy prices will be more stable...".

In addition, Social Welfare pertains to the enhancement of well-being and quality of life for a community, achieved through fair access to resources such as energy, improved public health, and alleviated energy poverty due to the execution of sustainable energy programs. Participant #5 mentioned, "If we can develop and make optimal use of energy in rural and underprivileged areas, this energy could become one of our main income sources, allowing us to conserve it and reduce our dependence on selling oil and gas, thus uplifting rural regions…"

Economic growth is found as another benefit, more job opportunities, a sustainable growing economy, and more economic activity in line with increasing GDP in Iran, which can lead to more domestic/foreign direct investment in sustainable energy projects, which helps to strengthen the local economy and polish the economic cycle and employability. The shift towards sustainable energy

strengthens innovation, which leads to creating a competitive advantage environment for new businesses or startups in this field. Participant #6 and #3: "…sustainable energy development opens up a new market for society, leading to greater youth engagement and social well-being..."

5.0 Discussion

This first RQ supported that knowledge-based leadership was critical on the path towards sustainability of energy around the world, especially in Iran, through resource optimization, systematic structures, and societal conceptualism. However, there were favorable conditions for renewables in Iran, but poor knowledge management remained an inhibitor to potential. Specialized expertise on the part of leaders improved efficiency, and systematic structures helped eliminate errors and facilitated innovation. However, there was a gap between the availability of science and coherent policies. Knowledge-based leadership supported long-term planning and subsidy reforms, leading to a cultural change toward sustainability (Fry et al., 2022). The evidence supports transformational leadership theory and emphasizes knowledge methods combined with experienced-based strategies to achieve success while making fundamental strategic choices. (Putra et al., 2023).

The second RQ identified four key challenges for these leaders: misaligned education, lack of financial support, cultural resistance, and weak international relations. Not only did Iran's educational systems fail to equip leaders with the technical and strategic skills required for energy transitions (Hashemi et al., 2021), but the composition of the Iranian student body itself exposed several weaknesses. Profit-driven priorities and oil dependence were the sources of financial constraints (Rezaei et al., 2019). A lack of protection for these sustainable practices was fueled by cultural resistance, which was exacerbated by poor media outreach that lagged societal acceptance of sustainable practices. Sanctions and limited flow of information hindered technological progress (Stevens & Schott, 2023).

The third RQ focused on sustainable energy development and had political, social, and economic benefits. Politically, it supported Iran by stabilizing its economy and supplying energy exports, contributing globally to geopolitical influence (Wang & Zhang, 2022). Socially, it alleviated electricity shortages, improved rural electrification, and enhanced welfare through the provision of reliable energy. Investing in renewables generated jobs, increased GDP, and boosted productivity (Gardner, 2024). It optimized universities and start-ups, further strengthening economic value chains. These elements, taken together, addressed Iran's energy problems and contributed to long-lasting stability and development. Research findings validate the diffusion of innovation theory which stresses how innovation presence combined with organizational expansion and adaptability drives technology adoption (Min et al., 2019).

6.0 Conclusion, Recommendations, and Limitations

In conclusion, the study aims to analyze the role of Knowledge-based leadership in sustainable energy development and its application in Iran. The knowledge-based leaders can take advantage of the country's multifaceted stock and mitigate weaknesses, including lack of funds, political rivalry, and passive culture. This leadership style also provides excellent backing for a long-term development plan for the society then gains awareness of sustainable energy. However, shifting towards sustainable energy does not only gain Iran in geopolitical terms but also contributes to socioeconomic development and makes Iran a potential powerhouse of the world in the case of energy. As a result of its focus on leadership and expertise-based management, the study offers hope for a sustainable future by pointing out direction towards a decreased reliance on fossil fuels and an increase in national welfare. For future studies, it is crucial to investigate the issue of sustainable energy development from both micro and macro perspectives.

The limitations of this study primarily included the impact of regional geopolitical tensions in Iran, which hindered access to government officials for interviews. Second, the security and political sensitivity of energy-related issues led interviewees to focus solely on scientific management issues. Research should explore the leadership and management styles essential for addressing economic and educational factors in sustainable energy advancement. It is recommended that future studies incorporate collaboration with engineers to develop solutions to economic challenges, utilizing creativity and available resources to establish Iran as a leader in the sustainable energy market. Additionally, involving key authorities and more professionals in the sustainability field will provide more accurate insights for data collection. In addition to all the issues and challenges raised, the necessary studies can be conducted regarding the proposal to merge energy organizations that cause parallel work or have similar responsibilities in Iran.

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Paper Contribution to Related Field of Study

There were both theoretical and practical implications that contributed to this study. From a theoretical perspective, it added to the study of the Diffusion of Innovation Theory and Transformational Leadership Theory by emphasizing the leading role played by knowledge-based leadership in the development of sustainable energy in Iran. Moreover, it offered the requirements for sustainable energy implementation and the challenges related to the organizational benefits of sustainable energy development in the global energy market,

Iran's economic prosperity, etc. Iran officials and stakeholders in the country's energy sector should focus on the presence of knowledgeable leaders. Not only could this approach increase scientific authority, but it also helped to turn the concept of sustainable economic development into a competitive advantage.

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