ACADEMIA GREEN ENERGY

Brief Research Report
Published: 2024-08-26
https://doi.org/10.20935/AcadEnergy7316

Overview of energy policy in Iran: the proper path to clean energy

Maryam Hasheminejad[1], Hasan Raei[2], Abbas Maleki[2,*]

Academic Editor(s): Antonio Sanchez-Bayon and Amjad Anvari-Moghaddam

Abstract

This article evaluates the existing energy policy in Iran, focusing on the nation's heavy reliance on fossil fuels and the implications of such dependency. With one of the world's highest energy intensities, Iran's energy consumption significantly overshadows its economic output, largely due to subsidized energy prices that discourage efficient use. This study highlights the economic, environmental, and societal challenges stemming from this unsustainable energy consumption, including excessive natural resource depletion, environmental degradation, and economic inefficiencies. It proposes a strategic shift toward renewable energy sources, especially solar and wind carriers, outlining necessary domestic and foreign policy changes to facilitate this transition. The study's findings indicate that certain modifications to Iran's domestic and foreign policy are required. These include reorganizing energy pricing and regulations, increasing public awareness, enhancing energy efficiency, and promoting international collaborations to facilitate the advancement of cleaner energy technologies.

Keywords: *Iran's energy policy*, *clean energy*, *energy security*, *Iran's foreign policy*

Citation: Hasheminejad M, Raei H, Maleki A. Overview of energy policy in Iran: the proper path to clean energy. *Academia Green Energy* 2024;1. https://doi.org/10.20935/AcadEnergy7316

1. Iran and energy policy

Iran, as the world's leading holder of accumulated crude oil and natural gas, is heavily dependent on oil and gas products. The country possesses 9.11% of the world's proven natural gas reserves and 17.07% of its crude oil reserves, despite comprising just 1.08% of the global population [1]. The information presented in **Chart 1** indicates that Iran's primary energy consumption increased between 2012 and 2022, reaching a total of 12.16 exajoules in 2022. However, with reference to **Chart 2**, natural gas is Iran's main source of energy consumption.

In **Charts 3** and **4**, we discuss the trends in energy intensity and per capita energy consumption in Iran.

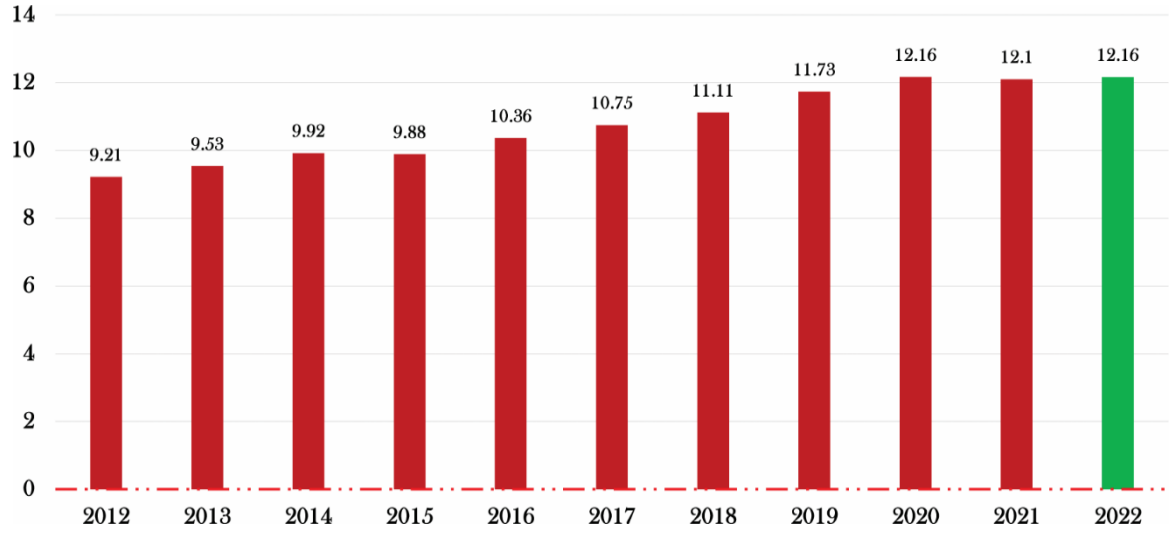

Chart 1 • Iran's primary energy consumption from 2012 to 2022 in exajoule [1].

[1]ECO College of Insurance, Allameh Tabataba'i University, Tehran 1436863113, Iran.
[2]Energy Engineering, Sharif University of Technology, Tehran 14565114, Iran.
*email: maleki@sharif.edu

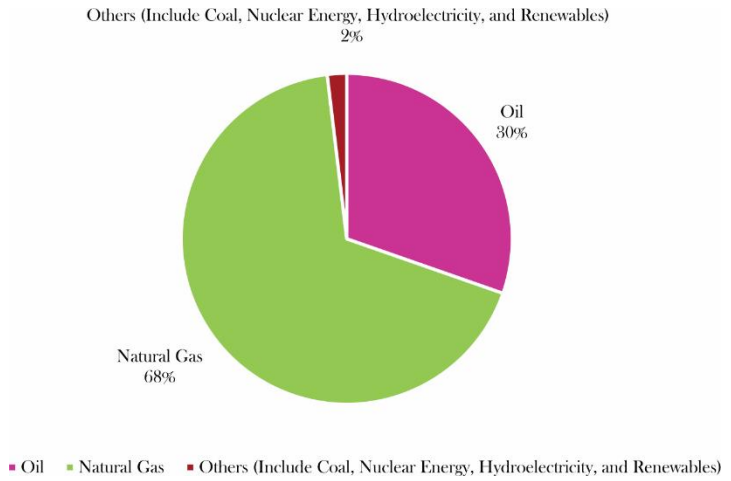

Chart 2 • Iran's primary energy consumption portfolio in 2022 [1].

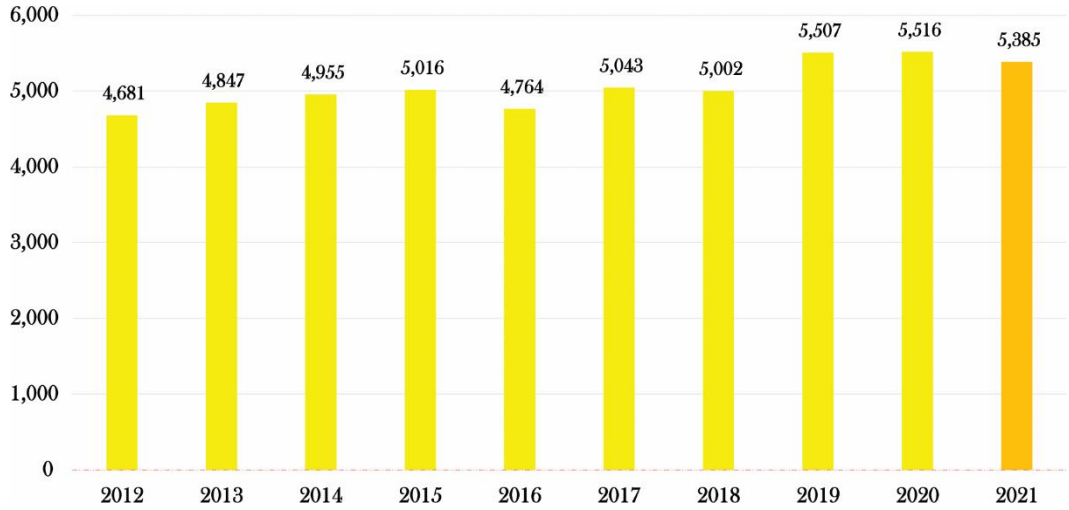

Chart 3 • Total energy supply per unit of GDP in Iran (MJ/thousand 2015 USD) [2].

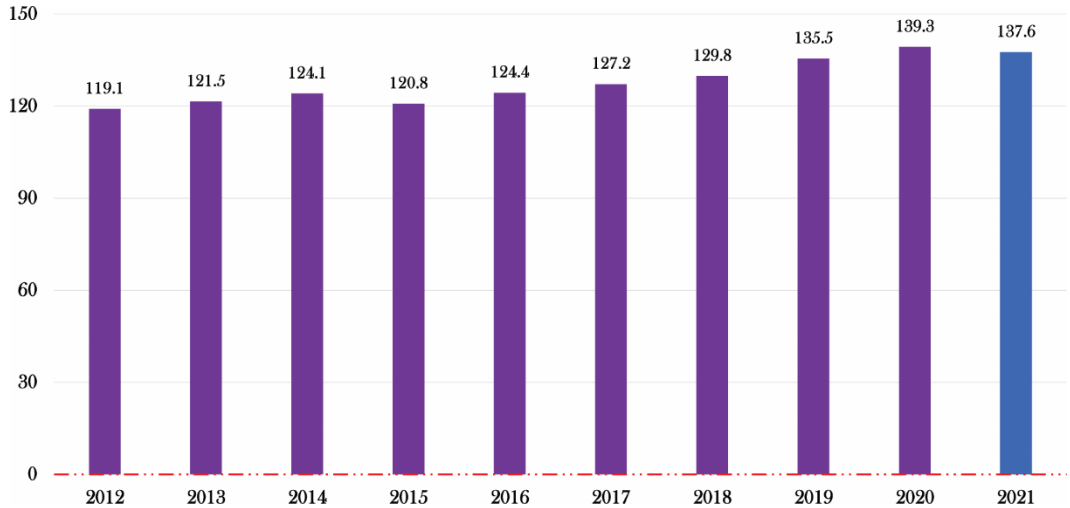

Chart 4 • Primary energy consumption per capita in Iran (gigajoule per capita) [1].

Iran owns significant recoverable reserves of crude oil and natural gas, amounting to 157.8 billion barrels and 32.1 trillion cubic meters, respectively (**Tables 1** and **2**). This positions Iran as the fourth largest global holder of crude oil and the second largest holder of natural gas [3].

Table 1 • Iran's crude oil reserves from 2012 to 2020 (billion barrels) [3]

	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Proven reserves	157	157	157.8	157.8	158.4	157.2	155.6	155.6	157.8

Table 2 • Iran's natural gas reserves from 2012 to 2020 (trillion cubic meters) [3]

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Proven reserves	33.6	33.8	34	34	33.5	33.2	31.9	32	32.1

As of the conclusion of 2022, Iran's crude oil and natural gas production amounted to 3.822 million barrels per day and 259.4 billion cubic meters (bcm), representing 4.1% and 6.4% of the global crude oil and natural gas production, respectively [1]. Iran has had a notable rise in the consumption of crude oil and natural gas, with figures increasing from 1.745 million barrels per day and 173.4 bcm in 2014 to 1.912 million barrels per day and 228.9 bcm in 2022 (**Charts 5** and **6**). From the data presented in **Chart 4**, it can be observed that Iran has consistently maintained a positive balance between natural gas production and consumption over the preceding years. Notably, in 2022, Iran's natural gas consumption reached a substantial magnitude, surpassing the natural gas consumption of the African continent (162.5 bcm) and Central and South America (161.7 bcm) [1].

Iran's heavy consumption of natural gas has hindered its ability to establish a significant position in the global natural gas market. In certain years, Iran has had to rely on gas imports from neighboring nations to meet its natural gas demands.

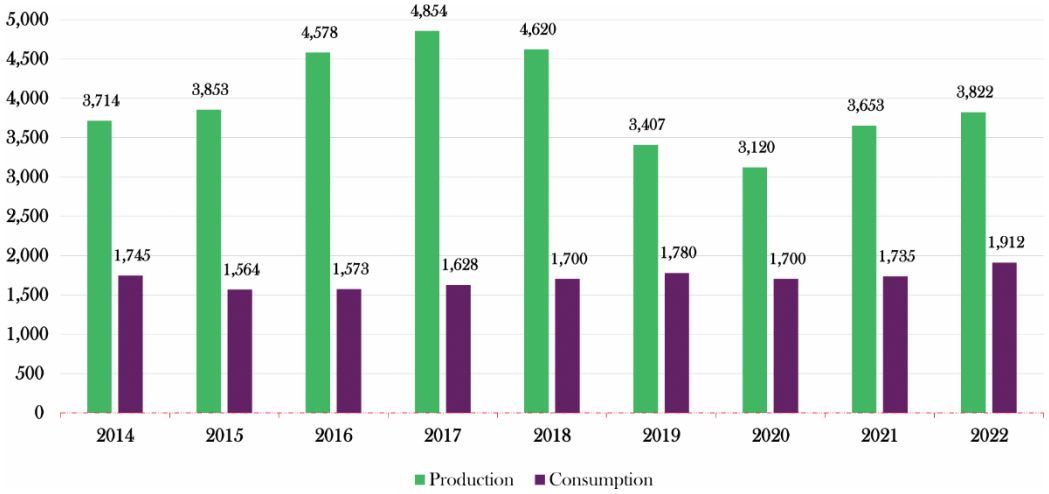

Chart 5 • Iran's crude oil production and consumption from 2014 to 2022 (thousand barrels per day) [1].

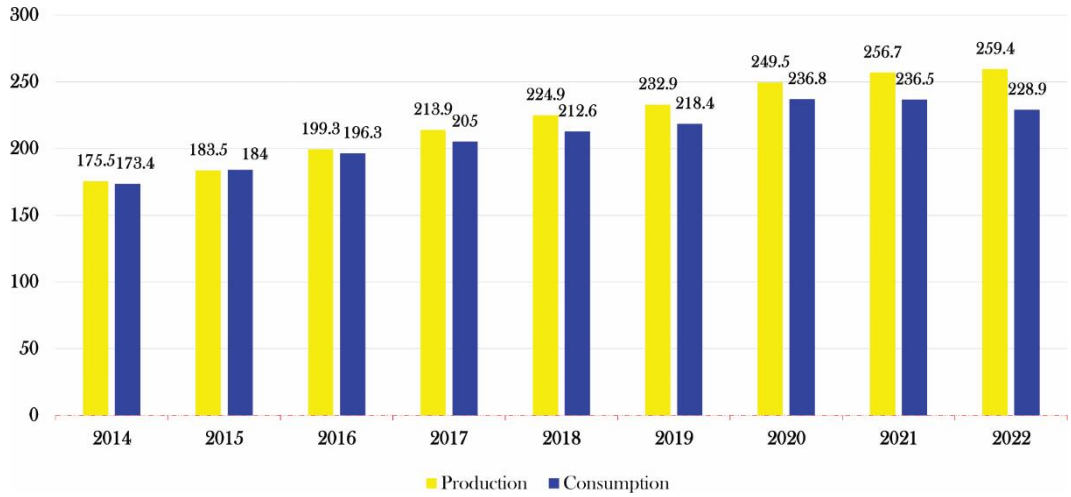

Chart 6 • Iran's natural gas production and consumption from 2014 to 2022 (billion cubic meters per year) [1].

Iran's substantial reliance on fossil fuels has resulted in a notable increase in carbon dioxide emissions attributed to energy consumption. Based on the findings of the British Petroleum, Iran ranked as the seventh highest global emitter of carbon dioxide, with an emission of 667.4 million tons attributed to energy consumption in 2022 (**Chart 7**).

In 2021, Iran produced 256.7 bcm of natural gas, of which 241.2 (~94%) was used for domestic needs (**Table 3**). Despite the rich resources of natural gas, only 17.3 bcm of Iran's natural gas was exported through pipelines to Turkey, Armenia, Azerbaijan, and Iraq in 2021. In 2019, the residential and commercial sectors consumed 35% of natural gas, industrial sectors (including petrochemicals) consumed 27%, and electricity generation consumed 26%. Natural gas consumption has increased significantly in recent years due to the substitution of liquid fuels with natural gas, more installation of domestic gas pipelines, and the development of the energy-intensive industrial sector [4]. Among all sectors, the residential sector is the largest consumer of energy. To increase natural gas exports, Iran will need to design policies that enhance efficiency, reform domestic consumption patterns, and attract investment.

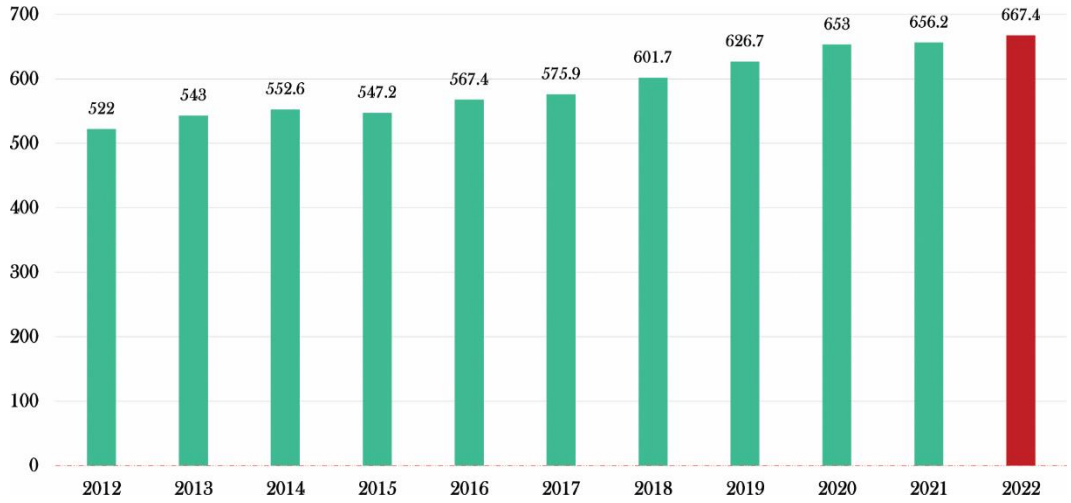

Chart 7 • The amount of carbon dioxide emissions due to Iran's energy consumption, 2012–2022 (million tons) [1].

Table 3 • Iran's natural gas statistics in 2021 (billion cubic meters per year) [3]

Production	Consumption	Import	Export
256.7	241.1	1.7	17.3

The US sanctions have had a significant impact on Iran's economy, particularly on its oil exports. These sanctions have restricted Iran's ability to export oil to many countries, leading to a decrease in revenue and economic challenges for the country. This is a complex geopolitical issue with various implications for both Iran and the global economy.

The outlook for Iran's oil exports is influenced by factors such as geopolitical dynamics, international agreements, and global energy demand. Currently, Iran faces significant challenges due to the US sanctions that limit its ability to export oil to many countries. These sanctions have resulted in a decrease in Iran's oil exports and have negatively impacted its economy. However, the situation is subject to change. There have been discussions and negotiations between Iran and other countries to potentially ease or lift the sanctions. If such negotiations are successful, it could lead to an increase in Iran's oil exports. Moreover, global energy demand plays a crucial role in determining the outlook for Iran's oil exports. As the world transitions toward cleaner and renewable energy sources, the demand for oil may decrease over time. This shift in energy preferences could impact Iran's oil exports in the long term. It is important to note that predicting the future of Iran's oil exports is challenging, as it depends on various geopolitical and economic factors. The outcome will be influenced by ongoing negotiations, changes in global energy demand, and the evolving dynamics of international relations.

Iran has historically been an important oil supplier to China. Despite the US sanctions, China has continued to import oil from Iran, albeit at reduced levels compared to before the sanctions were imposed. China has been one of the few countries willing to defy the US sanctions and maintain trade relations with Iran, including oil imports. China's reliance on Iranian oil is driven by its growing energy needs and the favorable terms it can negotiate due to the limited number of buyers for Iranian oil. However, China has also faced some challenges in its oil trade with Iran, including difficulties in payment transactions and insurance coverage due to the sanctions. It is important to note that the situation regarding Iran's oil exports to China can change due to evolving geopolitical dynamics, international agreements, or changes in US policies. **Chart 8** illustrates Iran's crude oil exports.

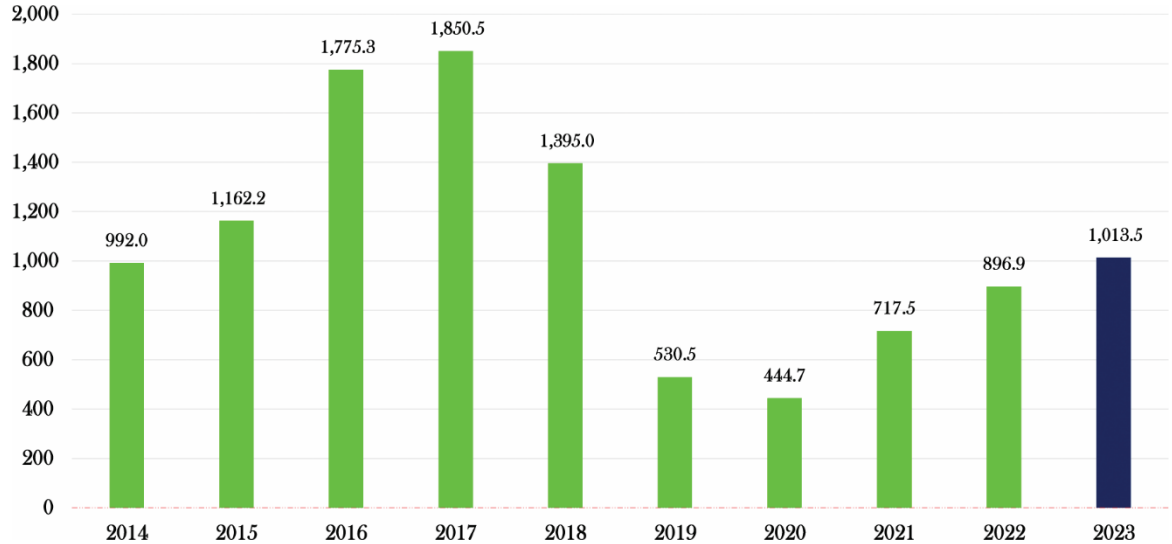

Chart 8 • Iran's crude oil export from 2014 to 2023 (thousand barrels per day) [5].

2. Renewables in Iran

The utilization of fossil energy provides significant benefits in terms of the reliability and resilience of the power grid, as well as its extensive application in the field of transportation. Renewable energies are considered by some experts to be more reliable and safer than fossil energy due to their local reception. While fossil fuels have caused significant concerns in regions, such as Europe and East Asia, it appears that these energy sources can provide the energy security of hydrocarbon carriers. However, the urgency of climate change and global warming has compelled Iranian decision-makers to prioritize the adoption of renewable energy sources without delay.

Iran's strategic geographical location and its position on the solar belt have endowed it with a substantial capacity for harnessing solar energy. Moreover, Iran possesses diverse wind patterns that can be used to provide environmentally friendly power. The country is evaluating the potential of utilizing renewable energies. Supporting such energy carriers can enhance the diversification of Iran's energy portfolio, thereby bolstering the security of energy supply and meeting the demands of consumer sectors. Additionally, it can contribute to the reduction of environmental pollutants. **Figure 1** shows the annual average solar radiation and wind speed maps of Iran.

Table 4 provides a concise overview of the advantages and obstacles associated with the implementation of renewable energy in Iran's energy industry.

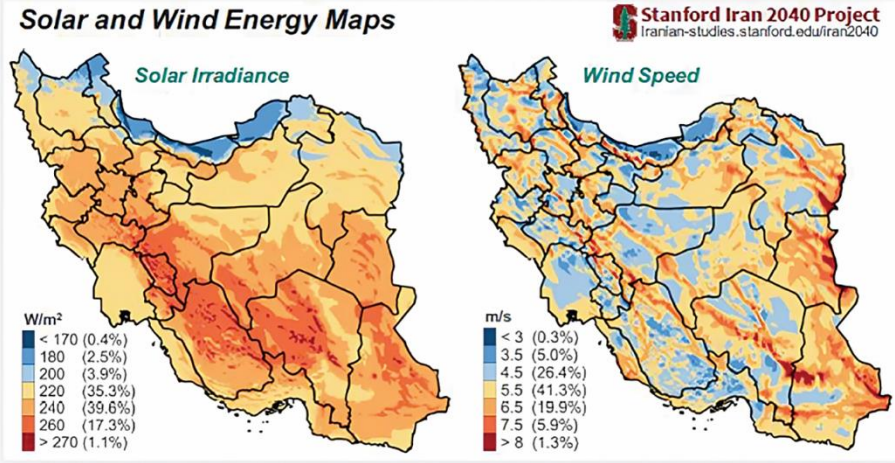

Figure 1 • Annual average solar radiation and wind speed maps of Iran [6].

Table 4 • Opportunities and challenges of renewable electricity in Iran

	Opportunities	Challenges
Strategic	• Improving energy security by diversifying the energy portfolio • Movement in the path of energy transition • Increasing the export of fossil fuels, especially natural gas • Earning foreign exchange earnings • The possibility of selling excess electricity • Reduce water consumption • Increase network reliability	• Providing the necessary equipment
Economic–Financial	• Reducing the cost of electricity bills in the household sector • Reducing the cost of setting up solar panels and wind turbines • The possibility of financing small-scale power plants with the method of providing factoring • Employment	• Lack of investment • Not giving financial incentives • Expensive battery
Technical	• Using the capacity of the wind and sun as permanent energy sources • Iran's capacity in terms of wind speed and solar radiation • Short setup time	• Short useful life of solar panels and wind turbines • Limitation in the field of spatial and temporal positions • The need to use a battery for storage • Difficulty in transporting the equipment

	• The possibility of creating decentralized power generation centers	• Inability to provide basic load
Social	• The presence of a positive view in the elite spectrum of society	• Lack of proper information among the general public
Political	• Putting the development of renewable power plants on the agenda of governments	• Lack of practical framework • Complex bureaucracy • Lack of support for private investment • Unequal competitive conditions between renewable and fossil power plants • Lack of support from the Ministry of Power
Environmental	• Reducing the consumption of fossil fuels • Reducing carbon dioxide emissions	• Threatening the life of animals and plants by occupying significant space and creating environmental pollution after the renewable power plant facilities are worn out due to the toxic substances they contain

The primary impediment to progress in the development of renewable energy sources is the government's provision of natural gas to thermal power plants at a significantly reduced cost, around one thousandth of its true market value. Under these circumstances, it is evident that renewable energy sources will not be able to establish a significant presence, and the country will persist in relying on fossil fuels. To address this issue, it is recommended that the government and relevant government entities provide fuel to power plants at a market price without any subsidies. In return, the government should compensate the final supplier company for the difference between the regulated price and the actual cost, as stipulated by the applicable laws.

3. Limitations of Iran's energy policy and its repercussions

Iran's high energy consumption is caused by the way energy is priced and distributed. Keeping energy carrier rates flat for four years, five years, and ten years would be disastrous in a country with an inflation of 20–50% [7]. Currently, Iran annually consumes 650 million barrels of oil products valued at $58 billion, about 300 billion cubic meters of gas worth $96 billion, and 330 billion kilowatt-hours of electricity costing at least $33 billion [1]. If we subtract the value of gas consumed by power plants from the value of electricity produced, the total value of consumed energy will be about $171 billion per year, which is a terribly large number. Iran's aggregate energy consumption, encompassing crude oil, natural gas, and electricity, equates to around 7 million barrels of oil daily. With a GDP estimated at $400 billion [8], Iran's economic ranking fluctuates between 20th and 25th globally, depending on currency parity calculations. Consequently, Iran exhibits one of the highest energy intensities (the ratio of energy consumption to GDP), reflecting a disproportionate energy consumption relative to its GDP [9]. Iran's electricity consumption, ranging from 320 to 330 billion kilowatt-hours [10], places it among the top 12 nations. This consumption exceeds that of populous countries like Mexico, Indonesia, Italy, the UK, and Turkey. Iran uses twice the electricity of Egypt, which has a population of 100 million, and two and a half times that of Pakistan, with 240 million people. The primary issue with Iran's energy consumption and management is the absence of regular, annual adjustments to energy prices in line with inflation. As energy becomes increasingly cheaper yet more valuable, Iran sees an annual 6% rise in energy consumption [11]. Without significant costs, there is little incentive to optimize energy use. The consequences of excessive energy consumption are manifold:

a. A significant portion of finite national resources is being depleted.

b. Economic growth and development are hindered by a shortfall in exports.

c. There is a need to invest in 4,000–5,000 megawatts of power plant capacity annually.

d. The environment suffers due to the affordability and abundance of energy.

e. Air, water, and soil pollution, along with overextraction of groundwater, are exacerbated by low-cost energy.

f. Iranian households adopt unsustainable lifestyles, characterized by high energy use for heating, cooling, and transport.

g. High domestic energy consumption impairs industrial and production sectors due to energy shortages.

In developed countries, energy costs account for about 10–15% of household expenses [12]. In contrast, Iranian households, benefiting from substantial energy subsidies, may spend less than 4% on average. The government is reluctant to adjust energy prices, but as energy is a critical economic resource, consumption cannot be effectively controlled or optimized without realistic pricing. There are domestic policy requirements and foreign policy approaches that Iran should follow for reaching the goal of utilizing cleaner energies [13].

4. Energy policy requirements in Iran to enhance the approach

Based on the data from the International Energy Agency, global oil production reached an average of 101.8 million barrels per day in 2023. Additionally, statistics from the Global Carbon Project indicate that oil production in the same year will result in the emission of 12.1 billion tons of carbon dioxide. Carbon dioxide accounts for 33% of the overall pollution. In order to adhere to the Paris Agreement of 2015, which aims to restrict the global average temperature increase to 1.5°C, it is imperative to swiftly and significantly reduce the production of harmful gases.

The conclusion of COP28 represents a significant milestone in global climate diplomacy. From the heart of the world's oil-rich regions, a call was made for the reduction of demand for the primary energy source of the 20th century. Secretary-General Simon Stiell of the UNFCCC declared that we were unsuccessful in concluding the oil screen during the Dubai meeting, but we did manage to signify the commencement of the "end of oil". Given that Iran and other oil-rich nations in the Persian Gulf possess substantial reserves and benefit from cheap production costs, they are capable of enduring until the depletion of oil resources, sometimes referred to as the "end of oil". In a typical scenario, when global oil demand decreases, countries with high production costs will be forced out of the market. Regardless, the energy transition will necessitate significant alterations to the operational framework of the oil industry, a framework that has profoundly influenced its interaction with the global economy over the past five decades. In October 1973, members of the Organization of Arab Petroleum Exporting Countries (OAPEC) ceased oil exports to the United States and other European nations that were backing Israel, as a direct retaliation for America's support of Israel during the conflict with the Arab nations. Prior to this embargo, the cost of each unit of oil was approximately three dollars per barrel. After a few months, the price surged to $13. The oil shock of 1973 and the Iranian Revolution of 1979 are widely regarded by Western commentators as the primary catalysts for the evolution of Western energy policy over the past 50 years.

Now, half a century later, it is imperative for the global community to conduct a thorough examination of the oil crisis that occurred in 1973. The dynamics of the global oil market since 1973 have always depended on the quantity and method of supply and demand growth. However, given the current emphasis on climate limits, it is imperative to halt this trend. While some argue for a consistent demand, others advocate for a significant and rapid reduction in world oil demand. The primary concern in this scenario will be the displacement of oil-exporting nations from the market and the resulting consequences.

The transition of Iran from a reliance on oil and gas resources to a more diverse energy portfolio necessitates the establishment of a favorable environment for the investment and development of renewable energy infrastructure. It needs planning to transition from fossil oil to renewables. It would be better for Iran to shift its usage from crude oil and its products to natural gas. After implementing such plan, transitioning from gas to renewables would be easier. To successfully transition in Iran, it is crucial to raise awareness about the importance of energy among Iranian households through various media channels, such as radio, press, and social networks. Additionally, aligning energy prices with official inflation rates on an annual basis, improving insulation, utilizing suitable building materials, and adopting architectural designs that are suitable for tropical climates without excessive use of iron and glass in building facades are essential steps. Furthermore, it is imperative to discover an innovative design for chillers and solar coolers specifically tailored for tropical regions. This can be achieved by promoting the installation of solar panels on building roofs and facades, potentially through the provision of subsidies or by sourcing cost-effective panels from China. Additionally, the adoption of solar thermal collectors for solar chillers and heating should be encouraged. Moreover, the utilization of water coolers in central areas of the Iranian plateau and the expansion of rail transportation as an alternative to road travel are essential measures to be taken [14].

5. Energy policy and foreign policy

Now, we examine Iran's adherence to foreign and energy policies in relation to two specific countries as examples. We have selected China as the primary purchaser of Iran's crude oil and Iraq, as Iran's nearest neighbor following the downfall of Saddam Hussein's regime.

1. In 2014, President Xi Jinping explained the specific requirements of the energy revolution at the sixth meeting of the Central Leading Group for Financial and Economic Affairs, emphasizing that there is a need for the country to change its energy production and consumption policies to ensure energy benefits and security. In this regard, in December 2016, the Chinese government published a long-term strategic plan (2016–2030) called the Energy Production and Consumption Revolution Strategy, which outlined the practical steps needed to promote and achieve the energy revolution. The report of the 19th National Congress of the Chinese Communist Party in 2017 emphasizes the shift from rapid growth to long-term economic and social development (high-quality development) [15]. According to the China National Petroleum Corporation, it is predicted that the share of coal in the energy mix of the country will fall sharply to 44% by 2030 and 8% by 2060 [16]. In this regard, China's power mix is projected to transition from 30% renewable energy in 2022 to 88% by 2050. Oil consumption is expected to decrease by half from its peak in 2027 by 2050, while natural gas consumption will peak in the 2030s and then return to current levels by the middle of the century. Additionally, China will solidify its position as the global leader in green energy by significantly expanding its renewable technology infrastructure and exporting it worldwide [17].

The energy transformation in China can present both advantageous prospects and potential risks for Iran. Traditionally, the Iranian energy industry has played a crucial role in Iran's economic collaboration with China. China's status as a prominent energy importer gives its relationship with Iran, a country that exports energy, considerable importance. China's oil imports are projected to rise by 2 million barrels per day, reaching a total of 10 million barrels per day by 2030 [18]. Nevertheless, the anticipated decline in China's oil consumption and imports poses a significant threat to Iran, as it diminishes the country's future prospects for energy exports. However, there are also numerous prospects. Considering China's energy security plan, which aims to achieve diversification in both energy sources and transmission channels, as well as taking into account China's estimated energy requirements by 2050 [19], Iran can capitalize on this opportunity by exporting its oil to China in exchange for acquiring advanced technology and expertise in the renewable energy sector. Furthermore, given the projected increase in China's gas demand until the 2030s and its significant role in China's energy consumption, Iran has the opportunity to commence gas exports to China, particularly as Iran's renewable energy consumption portfolio expands. Thus, there is even more potential for collaboration in creating alternate transportation pathways that reduce the vulnerability of the Strait of Hormuz and the limitations of the Strait of Malacca. China is expected to

increase its annual gas imports by 70 billion cubic meters by 2030 [20]. This growth would be facilitated by the Iran–Pakistan–China and Iran–Central Asia–China corridors, presenting opportunities for collaboration. Iran has the potential to provide China with technology transfers for coal-fired power facilities and explore opportunities for long-term collaboration in energy networks.

2. Currently, Iran has the position of being the principal energy exporter to Iraq since Iraq depends on Iran to fulfill 20% of its energy requirements [21]. This makes Iran the leading energy provider for Iraq. In the next ten years, Iraq will need a total of 50 gigawatts of energy [22]. If Iran's exports remain unchanged, Iraq's domestic energy production is forecasted to reach 36 gigawatts, resulting in a decrease in Iran's share of Iraq's energy supply from 20% to 14%. Furthermore, it is probable that Iran's competitors in the region will strive to obtain a greater portion of the Iraqi energy market, making it necessary for Iran to adopt a strategic strategy.

6. Conclusions

The paper concludes that Iran's current energy policy is unsustainable and necessitates comprehensive reform to align with global trends toward sustainability and economic viability. It advocates for a transition from fossil fuels to renewable energy sources as a crucial strategy for economic stability, environmental sustainability, and energy security. To achieve this, Iran must implement realistic energy pricing, invest in renewable energy infrastructure, and promote energy conservation practices among its populace. Additionally, leveraging international partnerships, particularly with major energy consumers like China, could provide the technological and financial support needed for this energy transition. Ultimately, adopting these recommendations would not only address the immediate challenges of high energy consumption and environmental impact but also position Iran as a leader in sustainable energy in the region.

In contrast to other commodities, empirical evidence and advancements in scientific knowledge have demonstrated that market regulations and protocols are incapable of achieving equilibrium in the realm of energy generation and consumption. The historical record of human endeavors to utilize energy carriers in a sustainable manner clearly demonstrates that the absence of a central energy strategy makes it unfeasible to initiate and mitigate the persistence of sporadic crises in this domain. Hence, it is advisable for the energy sector of the country to establish a supranational institution in order to effectively coordinate and align the vision, mission, goals, policies, and strategies of various energy sectors. The integration of policies in energy matters is crucial. The division of energy affairs in Iran into three distinct categories and the allocation of responsibility for their progress to the Ministry of Petroleum and Power, as well as the Iranian Atomic Energy Organization of Iran, has resulted in the inefficient utilization of resources, duplication of efforts, and occasional unnecessary rivalry.

The government should minimize its involvement in entrepreneurship related to the production, transmission, and distribution of energy carriers. If this issue is acknowledged, the government would prioritize deliberating on the macro-policies of the energy sector. Therefore, it is recommended:

- While Principle 44 of the Iranian Constitution permits the private sector to engage in several areas of production, including infrastructure, it imposes significant limitations on activities in the upstream sector of the oil and gas industry. Under such circumstances, the government has the option to grant permission to all private enterprises to engage in the production, export, or importation of various energy sources, such as crude oil, petroleum products, different forms of natural gas, electricity, and coal. However, energy carriers should be made available to consumers in the open market without being restricted by compulsory energy rates and at a mutually agreed-upon price.
- Big industries can take direct action to supply their energy needs. This means that if they can produce electricity at a lower cost than the cost of buying electricity from the government, these industries will put the construction of small-scale power plants on the agenda.

One crucial aspect of advancing renewable electricity is to authorize the construction of renewable power plants for the nation's key sectors by satisfying the following three prerequisites:

- It is advisable for enterprises that consume large amounts of energy to construct wind- and solar-generating facilities in order to meet their electricity requirements. If these power plants generate an excess of electricity beyond the industry's requirements, it will be supplied to the power grid. The power grid will then be obligated to provide the same amount of electricity to the industry during other hours as needed.
- Highly energy-intensive industries should build wind and solar power plants to supply their electricity needs. If these power plants produce electricity over the industry's needs, they will deliver it to the grid, and the power grid will be obliged to deliver the same amount of electricity to the same industry in other hours required by the industry.
- The Ministry of Energy should transmit the electricity produced by self-supplying renewable power plants at zero tariffs through the national grid.
- In case of electricity deficit in other sectors, the Ministry of Energy should not allocate the electricity produced by the self-supplying power plants for purposes other than the intended use of the power plant.

Funding

The authors declare no financial support for the research, authorship, or publication of this article.

Author contributions

Conceptualization, A.M.; methodology, M.H.; software, H.R.; validation, A.M., M.H. and H.R.; formal analysis, H.R.; investigation, M.H.; resources, A.M.; data curation, H.R.; writing—original draft preparation, M.H.; writing—review and editing, M.H.; visualization, H.R.; supervision, A.M. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

Data availability statement

Data supporting these findings are available within the article, at https://doi.org/10.20935/AcadEnergy7316, or upon request.

Institutional review board statement

Not applicable.

Informed consent statement

Not applicable.

Sample availability

The authors declare no physical samples were used in the study.

Additional information

Received: 2024-05-17

Accepted: 2024-08-06

Published: 2024-08-26

Academia Green Energy papers should be cited as *Academia Green Energy 2024*, ISSN 2998-3665, https://doi.org/10.20935/AcadEnergy7316. The journal's official abbreviation is *Acad. Energy*.

Publisher's note

Copyright

References

1. Energy Institute. Statistical review of world energy; 2023. Available from: https://www.energyinst.org/__data/assets/pdf_file/0004/1055542/EI_Stat_Review_PDF_single_3.pdf
2. IEA. Iran; 2024 [cited 2024 May 10]. Available from: https://www.iea.org/countries/iran/efficiency-demand
3. BP. Statistical review of world energy; 2022. Available from: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf
4. Center for Development Research and Foresight in Iran. Energy situation in Iran (production, consumption and trade), translated by Ebrahimifar Y; 2021. Available from: https://civilica.com/doc/1784779/
5. International Monetary Fund. Crude oil exports for Iran, Islamic Republic of [IRNNXGOCMBD], retrieved from FRED, Federal Reserve Bank of St. Louis; 2024 May 3 [cited 2024 May 10]. Available from: https://fred.stlouisfed.org/series/IRNNXGOCMBD
6. Azadi P, Nezam Sarmadi A, Mahmoudzadeh A, Shirvani T. The outlook for natural gas, electricity, and renewable energy in Iran. Stanford Iran 2040 Project; 2017. Available from: https://www.researchgate.net/profile/Pooya-Azadi/publication/316560095_The_Outlook_for_Natural_Gas_Electricity_and_Renewable_Energy_in_Iran/links/591b9de74585153b614fa7ec/The-Outlook-for-Natural-Gas-Electricity-and-Renewable-Energy-in-Iran.pdf
7. Movahed MS, Rezapour A, Vahedi S, Gorji HA, Bagherzadeh R, Nemati A, et al. The impact of inflation and its uncertainty on pharmaceutical prices: evidence from Iran. Iran J Pharm Res. 2021;20(3):94. doi: 10.22037/ijpr.2020.114071.14646
8. Emami M, Haghdoost A, Ahmadi-Gohari M, Mehrolhassani MH. Constructing scenarios for the Iranian health system using dynamic system modeling; 2024. doi: https://doi.org/10.21203/rs.3.rs-4004750/v1
9. Moshiri S. The effects of the energy price reform on households' consumption in Iran. Energy Policy. 2015;79:177–88. doi: 10.1016/j.enpol.2015.01.012
10. Guyol NB. The world electric power industry. Berkeley (CA): Univ of California Press; 2023.
11. Ata B, Pakrooh P, Pénzes J. Driving factors of energy related CO2 emissions at a regional level in the residential sector of Iran. Sci Rep. 2023;13(1):17598. doi: https://doi.org/10.1038/s41598-023-44975-x
12. Alkon M, Harish SP, Urpelainen J. Household energy access and expenditure in developing countries: evidence from India, 1987–2010. Energy Sustain Dev. 2016;35:25–34. doi: https://doi.org/10.1016/j.esd.2016.08.003
13. Abbasian E, Suri A. The inefficiency of energy pricing policy: the case of Iran. Int J Environ Res. 2019;13:943–50. doi: 10.1007/s41742-019-00221-9
14. Barkhordari S, Fattahi M. Reform of energy prices, energy intensity and technology: a case study of Iran (ARDL approach). Energy Strat Rev. 2017;18:18–23. doi: 10.1016/j.esr.2017.09.004
15. Zhang S, Chen W. China's energy transition pathway in a carbon neutral vision. Engineering. 2022;14:64–76. doi: https://doi.org/10.1016/j.eng.2021.09.004
16. Zhaoyuan X, Ishwaran M. Overview: high-quality energy for high-quality growth: China's energy revolution in the new era. In: Shell International B.V., The Development Research Center (DRC) of the State Council of the People's Republic of China, editors. China's energy revolution in the context of the global energy transition. Cham: Springer; 2020. p. 1–39.

17. Jianlong Y, Haigh M. Special report 2: research on China's energy demand revolution. In: Shell International B.V., The Development Research Center (DRC) of the State Council of the People's Republic of China, editors. China's energy revolution in the context of the global energy transition. Cham: Springer; 2020. p. 213–85. doi: 10.1007/978-3-030-40154-2_3

18. Kapustin NO, Grushevenko DA. Global oil market: an outlook to 2030. How will the balance of supply and demand change over the next ten years? Int J Oil Gas Coal Technol. 2023;33(4):315–35. doi: 10.1504/IJOGCT.2023.132497

19. Zhai H, Gu B, Zhu K, Huang C. Feasibility analysis of achieving net-zero emissions in China's power sector before 2050 based on ideal available pathways. Environ Impact Assess Rev. 2023;98:106948. doi: 10.1016/j.eiar.2022.106948

20. Xie M, Yi X, Liu K, Sun C, Kong Q. How much natural gas does China need: an empirical study from the perspective of energy transition. Energy. 2023;266:126357. doi: 10.1016/j.energy.2022.126357

21. Bekheet HN, Al Sudany NK, Najm SS. Iraqi economy and renewable energy projects between economic necessity and investment challenges. Int J Prof Bus Rev. 2023;8(8):71. doi: 10.26668/businessreview/2023.v8i8.3435

22. Naji AS, Enawi HH, Mahmood AAA. Renewable energy resources in Iraq: a review. J Univ Babylon Eng Sci. 2023; 31(4):1–14.