International Journal of Architecture, Energy and Urbanism
Volume 4, Issue 1, June 2026
https://ijaeu.globalpublisher.org/
https://globalpublisher.org/journals-1004/

An examination of the capabilities of the greater tehran area in utilizing renewable energy for environmental management and conservation

Atena GhelichKhani [1 *]
Department of Business Management, SR. C., Islamic Azad University, Tehran, Iran
*** Corresponding Author: atena.ghelichkhani@iau.ir**

ABSTRACT

The present study aims to examine the relationship between vital principles in the life cycle of humanity, as well as the capabilities of Tehran, a major metropolis, in utilizing renewable energies to better manage and preserve its environment, which is crucial for future generations. The findings indicate that environmental pollution, energy shortages, and global warming are serious global crises that have prompted researchers, industrialists, and world leaders to seek appropriate solutions and practical policies aimed at managing the use of non-renewable energy and, as much as possible, replacing them with new energies. To achieve the research objectives, recent developments and advancements in the past decade have been reviewed and evaluated to better understand the potential of Tehran as a major city. The most important solutions have been compiled and presented.

Keywords: Renewable Energy, Environmental Preservation, Metropolis of Tehran

1. INTRODUCTION

At the beginning of the 21st century, environmental issues, problems, and conflicts have assumed a more central and pivotal role in human life than in the previous century [1]. The reality is that, in the present era, human societies are exerting more pressure on the environment than ever before [2]. The energy crisis and pollution in major cities have become a severe issue for many years [3]. The gaps in optimizing energy consumption, the lack of planning, and the disregard for regional potential in supplying energy to various parts of the country are among the most significant challenges in the development of renewable energy in the country [4][5].

On the other hand, considering that the consumption of fossil fuels is the main cause of air pollution and climate change, the use of new and renewable energy leads to a reduction in air pollution and greenhouse gas emissions, as well as a decrease in dependence on oil, the preservation of the environment, and ultimately sustainable development. The main approach to sustainable development globally is the reliance on new and renewable energy [6]. According to findings, environmental pollution affects human well-being, and the continuation of such a trend, in addition to reducing the level of well-being in society, will create serious threats to the survival of future generations and the development process of countries [7]. According to Alshangian and Zuojingping, the environment, as one of the main components, influences policies and many other elements such as political, economic, and military power at the global level. Therefore, in recent decades, research on the relationship between optimal energy use and environmental protection has gained special importance. The growth of this type of energy began worldwide in the 1990s and saw a significant increase in the first decade of the 21st century. By 2011, 260 billion dollars had been invested in the renewable energy industry. The reasons for this growth can be found in factors such as the expansion of governmental support and policies, the increase in the price of conventional energy carriers, the sharp reduction in the cost of renewable technologies, and the existence of economies of scale in the production of this equipment. Policies at the national, state, provincial, and local levels have played an important role in the development of markets, investments, and the growth of industries related to renewable energy over the past two decades [8].

2. NECESSITY AND IMPORTANCE OF THE RESEARCH

Today, environmental protection and ensuring the sustainability and comprehensiveness of its development are the most serious challenges facing the global community. Therefore, the revival and maintenance of any form of life are synonymous with the possibility of better and longer life for humans on Earth. The relationship between humans and other creatures in the world is interconnected, so the extinction of one species can reduce one of the options for human life [9]. In Tehran, various types of pollution exist, making it rank second, and sometimes first, in the world in terms of pollution. It is evident that if fundamental actions are not taken to protect the province's habitats and natural resources, we will face serious environmental problems in the near future. Any harm to the social, cultural, and natural environment will affect all humans, even if we assume that this issue only concerns a limited group of people [10]. Optimal use of the environment in the country can ensure its sustainability, and neglecting it can lead to issues that endanger the entire range of the country's economic, social, cultural, and political development programs. Therefore, a correct understanding of the role of deterrent factors and reducing them while strengthening encouraging factors can lead to success in environmental protection [11]. The manifestation of environmental culture in society is when individuals see the environment as a vital and valuable phenomenon in all aspects and never harm its components, such as air, water, and land. If 20% of people own cars and pollute the environment by using fossil fuels, they also deprive others of breathing clean air. In reality, environmental culture means that you, I, and all members of society have equal access to resources [12].

3. REVIEW OF KEY CONCEPTS 3.1 REVIEW OF KEY CONCEPTS

3.1 Energy

Energy, in simple terms, is the ability to do work. Energy can be divided into two main categories: primary energy and secondary energy. Primary energy refers to energy that has not yet been converted into another form, such as crude oil. Secondary energy, on the other hand, refers to energy that has been converted from one form to another, such as gasoline derived from crude oil. Renewable energy refers to energy sources that exist in nature, are not limited, and do not pollute the environment when consumed, such as solar, wind, and hydro energy [13].

3.2 Renewable Energy

The concept of renewable energy encompasses a set of energy flows that, with few exceptions such as geothermal energy, originate from solar radiation. It is noteworthy that renewable energies do not have harmful environmental effects and are aligned with sustainable development [14].

3.3 Environmental Damage

Environmental damage is defined as harm caused to individuals or objects through the environment in which they live, where the environment itself is the source of damage, not the victim. Others believe that this damage results from pollution and is related to all forms of harm that contribute to the reduction of natural elements (water, air, noise). Upon closer examination, we often find rare elements involved in this damage. The harmful consequences of environmental damage are irreversible. The damage is collective in nature and has multiple causes [15].

3.4 Environmental Protection

Optimal and appropriate use of the environment in a way that preserves its quality from a human life perspective [16].

4. RESEARCH BACKGROUND

Regarding the background of domestic research conducted:

In a study conducted on the cities of northern Iran, it was shown that if the compactness of a city's shape increases by 1%, the amount of carbon dioxide emissions will decrease by 8.8% [17].

Global oil reserves are expected to be depleted within the next forty years, making it our critical responsibility to increase energy reserves. In this regard, researchers have explored hydrogen energy and fuel cells. In the case of geothermal energy, it has been stated that energy is one of the most important drivers and the fundamental force of human life, and the history of human civilization is based on innovations and discoveries aimed at converting various

forms of energy into one another. The Earth is a rich source of clean and environmentally friendly thermal energy, which is utilized and exploited under the term geothermal energy. Geothermal energy is the thermal energy stored in the Earth's solid crust, derived from the heat of molten materials and the decay of radioactive substances deep within the Earth. In other words, geothermal energy refers to the heat that naturally exists underground and can be converted into energy needed by humans [18].

Researchers have studied biomass and have stated that biomass is the most important renewable source for energy production and reducing pollution caused by fossil fuel consumption. Emilian and his colleagues indicated that biomass energy could be a suitable option for replacing fossil fuels. These authors evaluated biomass resources in Khorasan Razavi Province, which is one of Iran's key agricultural, livestock, and poultry centers [19].

Wave energy is a renewable resource. This energy is replenished after extraction by the interaction of wind with the ocean surface. A researcher named Ketabdar investigated the feasibility of harnessing wave energy from the waters of Iran's seas and stated that the unconventional use of fossil fuels has led to an increase in greenhouse gases and severe pollution in cities. Seas and oceans are clean, inexpensive, and renewable sources of non fossil energy. The author also noted that Iran, with its extensive maritime borders in the north and south, has good access to renewable ocean energy resources. However, despite this potential, expert studies and research in this area have not yet been conducted [20].

By examining the environmental and economic aspects, the implementation of the Tehran City Council's law, which aims to provide 10 to 20 percent of the required energy from renewable sources, was discussed. For this purpose, solar water heaters were used to provide the energy needed to heat water in buildings licensed by the Municipality of Tehran's District 11. The results of the mentioned study showed that using solar water heaters could save 421 thousand cubic meters of natural gas, which, if exported to neighboring countries, would result in an annual profit of 210 thousand dollars [21].

5. RESEARCH BACKGROUND

- A review of the research background related to the research topic
- Investigation and study of renewable energies and their utilization in the metropolis of Tehran
- Actions taken to protect the environment in Tehran Province

6. RESEARCH BACKGROUND

In the present research, credible and acceptable websites such as SID, Civilica, and Google Scholar were consulted to collect the most recent articles related to the topic from the past decades, and their findings were evaluated. The research also utilized the latest tables and charts from the Renewable Energy Organization and other related entities in the city of Tehran.

6.1 Study Area

The study area covers the metropolis of Tehran, which has a geographical area of over 730 square kilometers. Tehran's geographical location is between 35 degrees and 35 minutes

to 35 degrees and 59 minutes north latitude and 51 degrees and 5 minutes to 52 degrees and 53 minutes east longitude. The metropolis of Tehran is divided into 22 districts, 122 neighborhoods, and 376 blocks, with an estimated population of around 8 million people. Figure 1. Shows the location of the metropolis of Tehran [22].

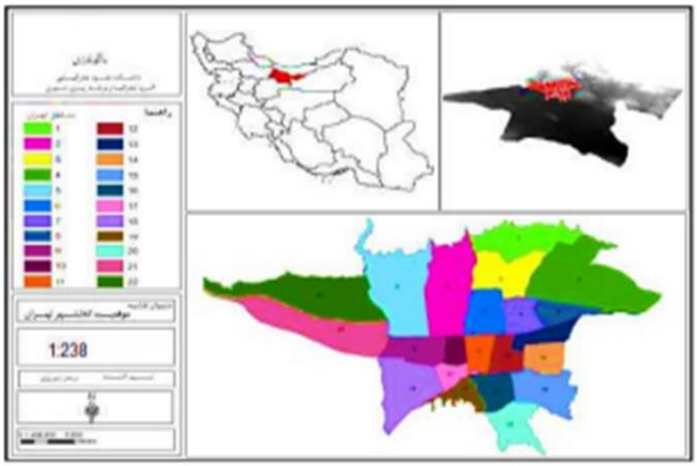


Figure 1. Location of Tehran metropolis
Source: Tehran Municipality, website: www.tehran.ir

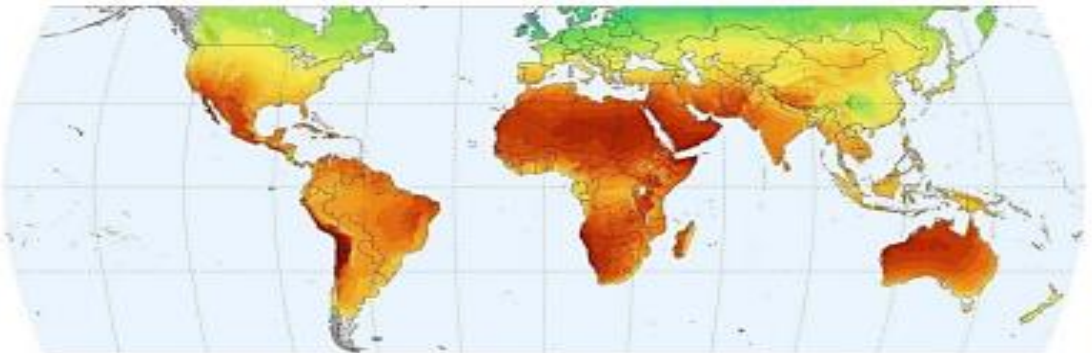
7. RESEARCH BACKGROUND

As a result of reviewing and collecting research conducted over recent decades, it has been established that Iran has vast capacities for utilizing various forms of renewable energy. Different cities across the country, including the metropolis of Tehran, possess significant potential for employing various types of renewable energy. Given the issues of global warming and air pollution in most days of the year in major cities, broad actions and the establishment of fundamental and systematic infrastructure are necessary to utilize the potential of different regions to replace renewable energy with non-renewable energy sources. Using renewable energy can also mitigate one of Tehran's major problems air pollution and, with proper management of non-renewable energy consumption, a healthy and pollution-free environment can be created for future generations. According to studies, every 10% increase in the urbanization rate leads to a 1% increase in renewable energy consumption in developing countries. Additionally, every 10% increase in the urbanization rate results in a 2.4% increase in non-renewable energy consumption in these countries. Therefore, in developing countries, the impact of urbanization on non-renewable energy consumption is greater than on renewable energy consumption. This is due to the higher dependence of heating systems and public and private transportation in developing countries on non-renewable energy, which must gradually change. This also indicates a lower awareness and knowledge of the population regarding consumption patterns and a lower level of technology in these countries. Although non-renewable energies like fossil fuels were preferred until recently, their excessive consumption and some undesirable properties have caused significant issues. Some of the disadvantages of consuming these types of energies include [23]:

- Although oil, natural gas, and coal are abundant in nature, excessive consumption has led to a significant depletion of their reserves. Moreover, replacing these resources is impossible as it takes millions of years for hydrocarbon chains to form.
- The hydrocarbons present in fossil fuels release greenhouse gasses such as methane and carbon dioxide, which contribute to ozone layer depletion.
- In addition to this, harmful gasses like carbon monoxide and sulfur dioxide cause acid rain.
- Fossil fuels contribute to global warming, a problem faced by the entire world.

7.1. Solar Energy

Figure 2. shows the amount of solar radiation in different regions of the world. With over 300 sunny days in more than two-thirds of its area and an average radiation of 4.5-5.5 kilowatt hours per square meter per day, Iran is recognized as one of the countries with high potential for solar energy (2008, Center of Iran Statistical). Based on studies, in an area of about 2000 square kilometers, it is possible to install over 60 gigawatts of solar power plants. In Iran, besides power generation, this energy is used in small photovoltaic systems for street lighting, traffic lights, telecommunication systems, and electricity supply to rural and off grid areas. Iran's photovoltaic power plants, with a total capacity of 69 kilowatts, are located in Tehran, Alborz, and Tabriz provinces; while the total energy produced from these plants, along with wind power plants, in 2013 was equivalent to 0.2 million barrels of crude oil, with a 50% increase compared to 2012 (Ministry of Energy, 2013). As can be seen, Iran's geographical region, compared to many other countries in the region and the world, has a good position for utilizing solar energy, and paying attention to this characteristic is one of the important steps toward more efficient use of energy resources [24].



The upper row represents the total annual solar radiation, and the lower row represents the total daily solar radiation, both measured in kilowatt-hours per square meter."

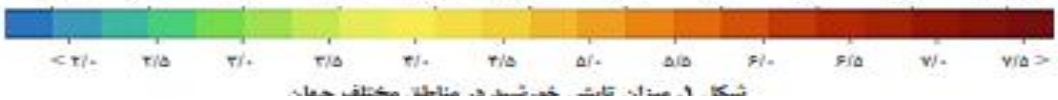


Figure 2. The amount of solar radiation in different areas World source: SOLAR GIS

Figure 3. shows the utilization of solar energy in the metropolis of Tehran.

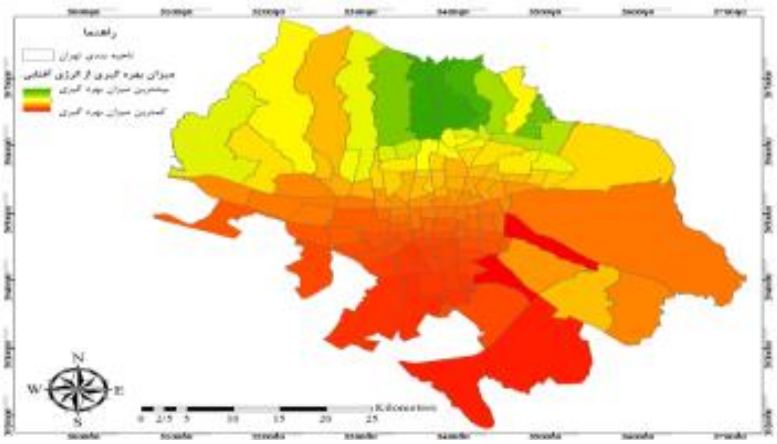


Figure 3. : Spatial distribution of solar radiation potential in Tehran based on zoning analysis.
Global Solar Atlas., Tehran Solar Information, Retrieved in 2019.

The results indicate that the northern part of Tehran has suitable potential for the application of various solar systems and biomass energy, considering the available materials in the region. Chart 1 displays the average total hours of sunshine at the northern Tehran station. [25].

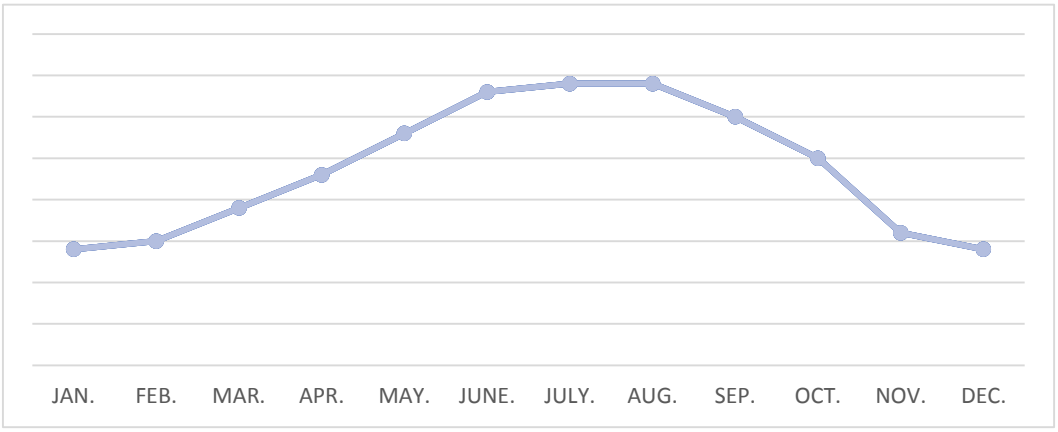


chart 1. shows the 17 year average total sunshine hours at the North Tehran station (1998-2005)."

Based on the findings, in some areas of Tehran, energy parks can be established based on regional strategies. These parks are environmentally friendly, and their main objective is the exchange of information and education on various aspects of environmental issues and providing scientific solutions for solving them. These parks focus on conserving energy resources and utilizing renewable energy. Other goals of these projects include reducing environmental pollution, replacing fossil fuels with renewable energies, and generating income and attracting tourists and recreational visitors (Tehran Parks and Green Spaces Organization, 2001). According to the studies and feasibility assessments conducted in District 1 of Tehran Municipality, it was found that this urban area has appropriate wind and solar radiation

potential. Sustainable design principles and management will be implemented in this area, and after initial studies, Niloufar Park was selected due to its location, size, and existing potential. By establishing an energy park in Niloufar Park in District 1, considering the existing ecological attractions and developing them, many individuals and citizens can be attracted to this area. Since the eco-park addresses environmental education and renewable energies, it can play both an educational role and attract various tourists and nature enthusiasts. In general, Mahmoudabad area has strengths such as natural location and good views, suitable topography, the presence of tall trees, and the area's size, which are important for establishing an energy park. Figure 4. shows images of the construction of the Niloufar Energy Park (Ahmadi Bafandeh; Aghdasi, 2012).

Figure 4. Pictures of the construction of Nilofer Energy Park

7.2. Wind Energy

Wind is one of the main indicators of solar energy and consists of moving air. A small portion of the sun's radiation that reaches the atmosphere is converted into wind energy. The oldest method of harnessing wind energy dates back to ancient Iran. The Iranians were the first to use wind power to rotate the water wheel (Doulab) or water well wheel, which enabled them to lift water from wells to irrigate their fields. It is likely that the first wind machine was built by ancient Iranians, while Greeks used it for grinding grains, and Egyptians, Romans, and Chinese utilized wind energy for sailing and irrigation [26]. According to the national wind atlas and the technological capacity of wind turbines, the final production potential of electricity from wind energy in Iran is estimated to be around 15,000 megawatts. According to the statistics of the Renewable Energy Organization of Iran, wind energy has had the highest growth rate among various energy sources since 1990, with an average annual growth of over 26% [27]. However, the full potential of wind energy has not yet been fully exploited worldwide. According to forecasts by the International Energy Agency, by 2030, wind energy will become the second-largest source of electricity generation among renewable energy sources [28].

7.3. Hydropower Energy

Hydropower is considered one of the most important sources of renewable energy production in Iran, holding the largest share in the country's clean energy generation. Iran ranks 35th among different countries in the world in terms of hydropower production. In 2013, with the commissioning of two 260 MW units at Siah Bisheh, the operational capacity of the country's hydropower plants reached 10,266 MW. In Chart 2, the power production capacity

of hydropower plants is shown, indicating a decline in production rates in recent years due to drought, inefficient production methods, and lack of access to necessary equipment [29]. Among other methods of electricity generation, wind power has had the highest growth rate in the 21st century, with global wind power generation quadrupling between 2000 and 2006. Wind power capacity in Iran was 130 MW in 2009. Figure 5 shows the wind atlas of Iran and the location of Tehran in comparison to other major cities (Yari, 2016).

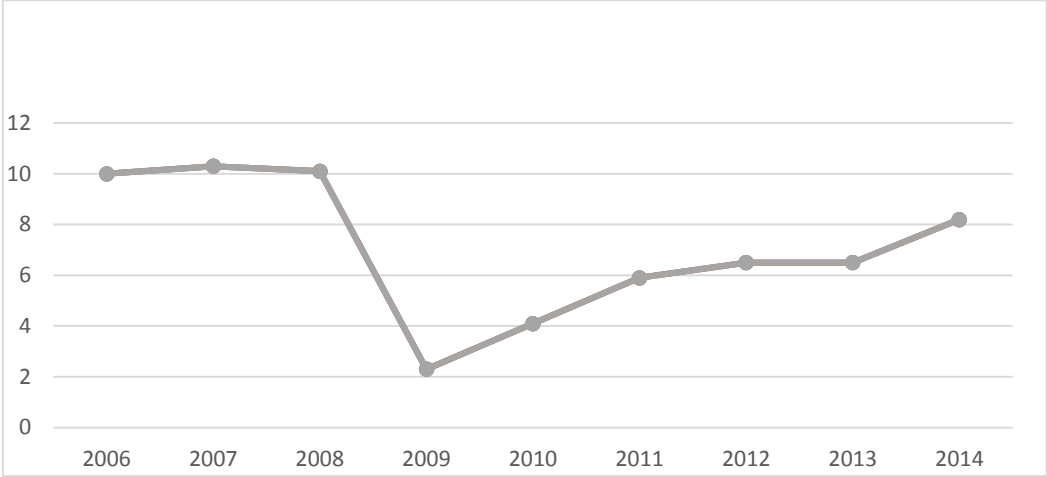


Chart 2. Annual Hydroelectric Power Output in Iran, 2006-2014.
Source:Atabi et al ,2004, 86-69

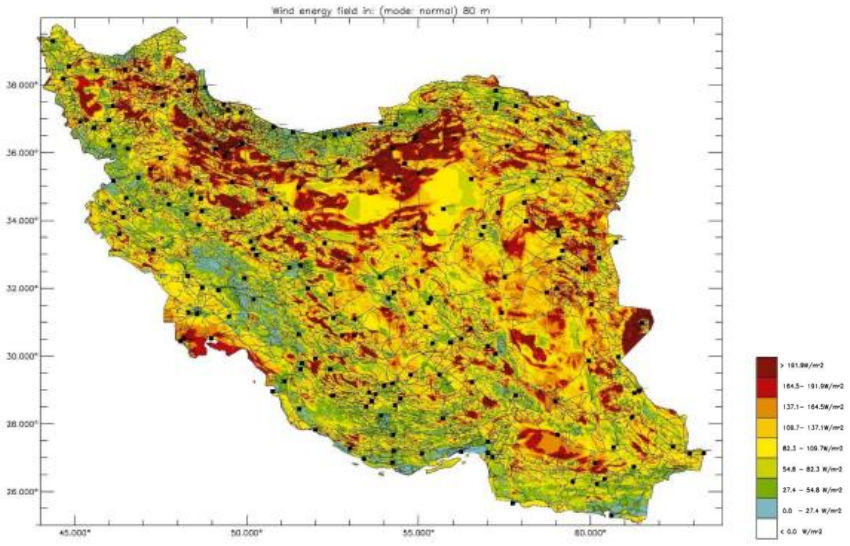


Figure 5. : wind Atlas

7.5. Geothermal Energy

The thermal energy present in the Earth's solid crust is called geothermal energy. The Earth's core is a massive source of thermal energy that reaches the surface in various forms, such as volcanic eruptions, hot springs, or through conduction. Generally, areas of the Earth that have the following three key characteristics may have good potential for geothermal energy exploitation: 1. A porous environment, 2. An intermediate fluid, 3. A heat source. Geothermal potential areas coincide with volcanic and seismic zones of the world [30]. Unlike other renewable energies, geothermal energy is not limited by seasons, time, or specific conditions, and can be harnessed continuously. Additionally, the cost of electricity from geothermal power plants is competitive with that produced by conventional fossil fuel power plants, and is even considerably cheaper than other types of renewable energy [31]. According to Milad Yari's research on the utilization of renewable energies in various regions of Iran in 2016, geothermal energy is found in five forms in nature:

- Hot water sources
- Dry steam sources
- Subsurface pressure sources
- Hot dry rock formations
- Magmatic sources

Electricity generation is one of the most practical uses of geothermal energy. In our country, near geothermal reservoirs with temperatures above 200 degrees Celsius, power plants can be built that have no environmental pollution and can significantly increase the national power grid's capacity. Considering the country's reliance on fossil fuels for urban heating, exploring and constructing hot water transmission pipelines from geothermal sources as a substitute for fossil fuels is highly cost-effective and requires policy implementation by the government. In short, the future of geothermal energy in Iran, with proper investments and policies, is very promising. However, for broader adoption, challenges such as drilling issues and the need for skilled workforce training should be addressed in government support policies. Government support and subsidies, alongside innovative companies and building owners/developers, are the main drivers. Additionally, the necessary knowledge and skills should be developed [32]. The advantages of using geothermal energy include (Ghorhe Ghahi and Ghasemi Ghasemvand, 2016):

- No air pollution
- No contamination of groundwater resources
- No need for large land areas
- Savings on fossil fuel consumption
- Long access times

Researchers conducted a study titled "Examining the Adoption of Emerging Technologies and Geothermal Heat Pumps in Tehran" and concluded that while geothermal heat pumps are known worldwide as a technology with high initial costs and low operational costs and energy consumption, in Iran, since housing developers are the main decision-makers for choosing heating and cooling systems, the primary consideration is the initial cost or the ratio of the initial cost to the added value on the building's price. In the current situation, the low operational cost and energy consumption do not significantly impact the acceptance of this

technology in residential buildings. Therefore, the high initial cost is the main barrier to adopting this technology at present. According to the study's findings, the application of this technology in small and medium-sized buildings has little chance of acceptance under current conditions. However, in large buildings, due to the superior quality of output air and the advantage of independent operation, it has a high potential for acceptance. As public concern about environmental issues grows, the demand for low-energy buildings will increase. This study examined new buildings in Tehran. Considering the impact of climatic conditions on the initial installation and operation costs of geothermal heat pumps and the differences in conventional heating and cooling systems in other climatic regions of the country, future research in these regions is recommended. Therefore, the high initial cost remains the main barrier to the adoption of this technology in the current context. According to the study's findings, the application of this technology in small and medium-sized buildings has little chance of acceptance under current conditions. However, in large buildings, due to the superior quality of output air and the advantage of independent operation, it has a high potential for acceptance [33].

7.6. Biomass Energy

Biomass is a type of energy that is used as a fuel source due to its abundance in various countries. Biomass refers to cellulosic materials such as agricultural waste, household waste of cellulosic origin, paper waste, and forest residues. With the increasing demand for energy and the rapid depletion of natural resources for biomass production, improving the efficiency of energy generation from this diminishing source is essential [34]. Waste production in Iran is close to 40,000 tons per day, of which less than four percent is recycled, and the rest is buried in landfills. This amount of waste leads to the pollution of water, soil, and air, generates greenhouse gases, and contributes to global warming—one of the primary global concerns today. Studies show that there is a potential to produce 400 megawatts of biomass energy in Iran. Among the advantages of implementing biomass energy projects in Iran is their applicability across all provinces, particularly in major cities like Tehran, which produces about 7,700 tons of waste daily (Yari, 2016). Biomass has the potential to produce electricity, heat, liquid fuels, gaseous fuels, and various useful chemical applications [35]. The main sources of biomass in Iran include solid agricultural residues, animal manure, urban biodegradable waste, and municipal wastewater. Based on statistical potential, these resources are abundant in Iran. In Tehran, 6,500 to 7,000 tons of waste are collected daily, with non-recyclable materials being buried in Kahrizak, where they are composted to produce chemical fertilizers. However, landfilling waste not only pollutes the air in the Kahrizak region but also contaminates groundwater due to waste infiltration into the soil. By establishing a waste-to-energy plant, waste disposal issues can be addressed while producing approximately five megawatts of electricity (Azarm, 2016). With the growing demand for energy and the rapid depletion of natural resources for biomass production, improving the efficiency of energy generation from this diminishing source is crucial. Biomass is currently the largest source of renewable energy, accounting for nearly 11 percent of the world's total energy consumption. Numerous studies have been conducted on the potential of biomass production for energy at local, regional, and global levels. Many studies have estimated that the use of biomass for energy production could

significantly increase from current levels (Nasrin Owtadi, Amin Ahmadpour, Yousefi, 2012). One type of biomass composition is municipal waste. Managing municipal waste can be a challenge for a country or city, but it can also serve as a source of energy. The amount of waste produced in Tehran exceeds 7,600 tons. The potential for energy production using waste is shown in Figure 15, indicating that the northern regions, which produce the most waste, have the highest potential for energy production from waste. Figure 6 shows the potential for energy production using waste in the metropolitan area of Tehran (Moazen, 2023).

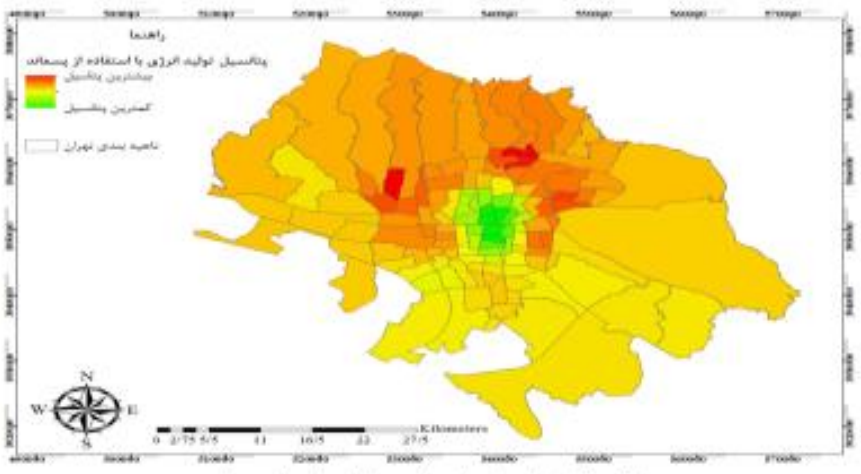


Figure 6. Tehran's Waste-to-Energy Potential

8. OVERVIEW OF ENERGY DISTRIBUTION IN IRAN

Figure 7. shows that solar energy has the highest potential, while wind energy has the lowest potential. In terms of various regions, across all areas of Tehran except the central districts (6, 7, and 12) where solar energy has the highest potential, waste-derived energy has the highest potential, and wind energy has the lowest potential. The final model, developed within the framework of a self-regenerative sustainable development approach, can be utilized in energy planning and policy-making in the metropolitan area of Tehran to promote the use of renewable energies (Moazen, 2023).

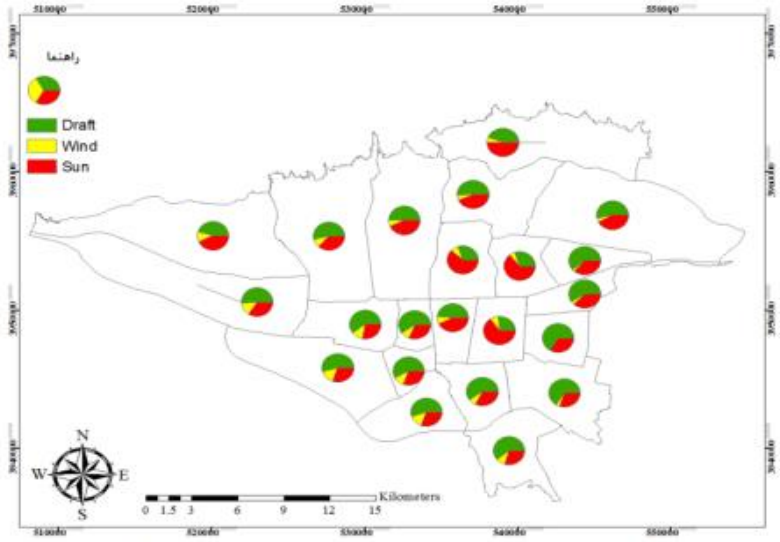


Figure 7. Optimized Energy Model Based on Regional Resource Assessment

9. OBJECTIVES OF USING RENEWABLE ENERGIES

Based on conducted studies, the primary objectives of using renewable energies are as follows [36]:

- The inexhaustible and renewable nature of these energies (unlike energy derived from fossil fuels),
- Reduction of environmental pollution,
- Easy access to renewable energy sources,
- Comparing investments in power plants and energy production facilities in the non-renewable and renewable sectors, as well as the construction, equipping, and operational duration of these two, indicates lower costs and more cost-effective establishment of renewable energy plants and their faster operation, highlighting another advantage of focusing on renewable energy.

10. NECESSITY OF USING RENEWABLE ENERGIES

The necessities include the following (Gharahi Ghehi & Ghasemi Ghasemvand, 2016):

- Reducing environmental pollution,
- Preventing the depletion of fossil fuel reserves,
- Economic savings,
- Enhancing energy supply security,
- Creating jobs and developing remote areas,
- Solving the problem of urban waste,
- Decentralized generation reducing reliance on nationwide energy transmission networks.

11. PROBLEMS OF NOT USING RENEWABLE ENERGIES

The problems arising from not using renewable energies are stated as follows (Yari, 2016):

- Lack of public readiness,
- Temporal distribution and randomness,
- Absence of supportive policies,
- Insufficient investment,
- High initial and final costs.

12. CONCLUSION

The utilization of renewable energy sources in Iran is relatively low compared to the use of non-renewable energies, with a high dependency on oil and gas resources in the country. As Iran holds a significant position in the use of oil and gas resources, it is hoped that in the near future, it will achieve acceptable development in exploiting renewable resources. By managing the use of non-renewable energies and replacing them with renewable energies, a healthy environment free from danger and pollution can be achieved, reducing major issues such as air pollution in major cities, especially Tehran, and providing a safe, pollution-free environment for future generations. Additionally, it is essential to seriously consider the proposed suggestions regarding the use of green and oxygen-producing walls in future constructions and the geothermal heat pump technology in Tehran, and strive to overcome the barriers to their development. Based on the conducted analyses and proposed solutions, among the existing renewable energies in Iran, wind and solar energy are the best and most suitable options for meeting the country's energy needs. Considering Iran's numerous sunny days and sunlight availability throughout most of the year, solar energy is the most appropriate and optimal option for providing clean and renewable energy. However, this requires proper and principled infrastructure, which relies on the effective management of skilled individuals and the support of the government in providing the necessary funding to replace the mentioned energy with non-renewable energies.

13. ACKNOWLEDGEMENTS

I would like to express my utmost gratitude and respect to esteemed professors Dr. Majid Khazali and Dr. Maryam Behzadi for their valuable guidance throughout this article.

REFERENCES

[1] White, R. (2004). *Controversies in Environmental Sociology*. London: Cambridge University Press.
[2] Cudworth, E. (2003). *Environment and Society*. London and New York: Routledge.

[3] Sciarretta, M., Back, L., Guzzella, L. (2004). "Optimal Control of Parallel Hybrid Electric Vehicle," *IEEE Transactions on Control Systems Technology*.

[4] Tanakian, S., Pirisahragard, H., Amiri, M. (2018). Importance of Using Wind Energy in Sistan Plain as Modern Energy, Second National Conference on Knowledge and Technology of Agricultural Sciences, Natural Resources, and Environment of Iran, Tehran.

[5] Jalelei, N., Abed, M., Tajbar, H., Parshkouhi, H. (2014). Evaluation of Wind Speed and Power for Renewable Energy Efficiency in Lahijan and Bandar Anzali, Gilan Province, First National Conference on Electrical Engineering, Islamic Azad University, Langarud.

[6] Hajipour, K., Forouzan, N. (2014). The Impact of Urban Form on Energy Consumption in the Residential Sector (Case Study: Shiraz), *Fine Arts Journal of Architecture and Urban Planning*, Vol. 83, No. 4, p. 8.

[7] Azam, M., & Ahmed, A. M. (2015). Role of Human Capital and Foreign Direct Investment in Promoting Economic Growth: Evidence from Commonwealth of Independent States. *International Journal of Social Economics*, 42(2), 98-111.

[8] Sajid, M. (2016). Toxicity of Nanoscale Metal-Organic Frameworks: A Perspective. *Environmental Science and Pollution Research*, 23(15), 14805-14807.

[9] Valaei, E. (2005). Patterns of Behavior with Nature (Environment) from the Perspective of the Quran and Tradition, PhD Thesis, Department of Quranic Sciences and Hadith, Islamic Azad University, Science and Research Branch, Supervisor: Dr. Mohammad Ali Lesani Fesharaki.

[10] Tome, J. (2001). *Cultural Development and the Environment*. Translated by Mohammad Shareghpour, Tehran: Ghazal Publications.

[11] Harvey, T. (1995). An Education 21 Program: Orienting Environmental Education Towards Sustainable Development and Capacity Building for Rio. *The Environmentalist*, Vol. 15.

[12] Poornajaf, A. (2007). Evaluation of Environmental Factors Related to Public Health in Ilam City.

[13] Yazdanpanah, M., & Janidi, A. (2020). Sustainable Architecture with a Focus on Renewable Energies, International Conference on Interdisciplinary Studies in Management and Engineering, Tehran.

[14] Gharahi Ghehi, & Ghasemi Ghasemvand, Y. (2016). The Impact of Renewable Energy on the Environment.

[15] Mohsenzadeh, (et al.) (2009). *Environmental Law (Theories and Practices)*, Khorsandi Publications, First Edition.

[16] Dolatabadi, H. (2003). *Environmental Culture*, Contemporary Culture Publications, First Edition.

[17] Khalili, L., Khalili, M., Ahmadi, E., & Rezaei, M. (2019). Optimization of Location and Capacity of Distributed Energy Storage Systems (DESS) to Meet ADN and DG Needs, Sixth National Congress of Recent Advances in Electrical and Computer Engineering of Iran with a Practical Look at Renewable Energies, Tehran.

[18] Arabzadeh, S., Shamseddini, N., Pourfadakari, S., & Maleknia, H. (2013). Hydrogen Energy and Fuel Cells, Second National Conference on New and Clean Energies, Hamedan.

[19] Izadiyari, A. (2013). Biomass: A Superior Renewable Energy Source in Sustainable Management, Second International Conference on Waste Management, Recycling, and Biomass, Simatin Management Services Institute, Faculty of Management, University of Tehran, Tehran.

[20] Alasvand, G., & Kenaan, S. (2013). Sea Wave Energy, Its Extraction Methods, and Environmental Impact, First National Conference on Environment, Energy, and Biological Defense, Environmental Advocacy Group - Mehr Arvand Higher Education Institute in collaboration with Islamic Azad University, Meybod, and the National Biological Defense Headquarters.

[21] Yazdanpanah Daroo, Pour Rostami, Yousefi, & Hoseinzadeh. (2017). Comparative Study of Enhancing Energy Security Using Renewable Energies; A Geopolitical Comparison of Iran and Japan with a Strategic Management Model. *Human Geography Research*, 49(3), 713-731.

[22] Hashemi, L., Lahijanian, A., Moeinoddini, M., Mazaher, M., Moghaddamnia, & Arjmandi. (2019). Presenting a Model for Enhancing Environmental Management Performance in Tehran Metropolis. *Geography and Urban-Regional Planning*, 9(33), 189-212.

[23] Naghdi, K., Kaghazian, & Lashkarizadeh. (2022). The Impact of Urbanization on the Consumption of Renewable and Non-renewable Energies in Developing Countries. *Environmental Science and Technology*, 23(11), 25-36.

[24] Moazen. (2024). Urban Energy Modeling for Achieving Self-Renewing Cities (Case Study: Tehran Metropolis). *Earth Knowledge Research*, 15(1), 99-113.

[25] Ahmadi Bafandeh, M., & Aghdasi, A. Designing an Energy Park in Niloofar Park, District 1, Tehran Municipality.

[26] Yari, M. (2016). Study of the Use of Renewable Energies in Various Regions of Iran.

[27] http://suna.org.ir

[28] International Energy Agency (IEA), 2011, Renewable Energy Technologies: Solar Energy Perspectives. OECD/IEA.

[29] Goudarzi, Abbasi, Maleki et al. (2017). Policy Making in the Islamic Republic of Iran for Optimal Utilization of Renewable Energy Resources. *Strategic Public Policy Studies*, 7(23), 159-174.

[30] Ahmadpour, A. (2014). Introduction to Types of Renewable Energies and Their Benefits. Bandar Imam Petrochemical Company.

[31] Tabak, J. *Solar and Geothermal Energy*. Facts on File | 209 | ISBN: 0816070865 | 206 pages.

[32] Brohmann, B., Feenstra, Y., & Heiskanen, E. (2007). Factors Influencing the Societal Acceptance of New, Renewable, and Energy Efficiency Technologies: Meta-Analysis of Recent European Projects. Paper Presented at the European Roundtable for Sustainable Consumption and Production, Basel, June 20-22, 2007.

[33] Bagheri Moghadam, Khosravi, Sahafzadeh, Mohajeri et al. (2021). Assessment of Emerging Technology Acceptance; A Case Study of Geothermal Heat Pump Technology in Tehran. *Strategic Public Policy Studies*, 11(38), 84-110.

[34] Ootadi, N., Ahmadpour, A., Yousefi. (2012). Review of Biomass Energy Production Methods, Third Iranian Bioenergy Conference (Biomass and Biogas), Energy Thinkers Kimia, Tehran.

[35] Azarm, B. (2016). Renewable Energies and the Need for Their Development to Reduce Environmental Pollution. *Applied Science Studies in Engineering*, Vol. 2, No. 4, pp. 60-69.

[36] Nazarpoor, M.T., & Manzoori, M. Use of Renewable Energies and Native Architectural Patterns, Case Study of Sirous District, Tehran.