American Journal of Energy Engineering
2022; 10(2): 21-34
http://www.sciencepublishinggroup.com/j/ajee
doi: 10.11648/j.ajee.20221002.11
ISSN: 2329-1648 (Print); ISSN: 2329-163X (Online)

Renewable Energy Development in India & Iran: A Comparative Review of Renewable Energy Policies

Zuhaib Tayar Mirza, Behrooz Vahidi*, Mehrdad Abedi

Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran

Email address:
zuhaib.mirza@autuni.ac.nz (Z. T. Mirza), vahidi@aut.ac.ir (B. Vahidi), abedi@aut.ac.ir (M. Abedi)
*Corresponding author

To cite this article:
Zuhaib Tayar Mirza, Behrooz Vahidi, Mehrdad Abedi. Renewable Energy Development in India & Iran: A Comparative Review of Renewable Energy Policies. *American Journal of Energy Engineering*. Vol. 10, No. 2, 2022, pp. 21-34. doi: 10.11648/j.ajee.20221002.11

Received: March 5, 2022; **Accepted**: March 28, 2022; **Published**: April 28, 2022

Abstract: All major developing nations have started to invest in renewable energy to promote a cost-effective and low emission way of power production. Policy planning and financial aspects are the key issues for renewable power development. Comparing two major developing countries, Iran and India, would provide a deeper understanding of the future trends and policy scenarios related to renewable energy. This paper provides a review of the governance structure, current renewable energy policies, legislation, economic policies, and incentives that would analyze the renewable energy development in both countries. The final section of the paper discusses the current status of renewable energy generation in both countries followed by comparative policy analysis. The results concluded from the paper are that India shows a much stronger commitment towards renewable energy with a higher percentage of generation, well-structured governance, and independent ministry which presides over the whole sector. Iran although new to the industry shows a lot of promise with better feed-in tariffs and an open market for independent investors and producers. The paper suggests lesser investment interest rates, better technical expertise, and incentives for off-grid producers for India while a more developed legislative structure for Iran along with the formation of subordinate research organizations.

Keywords: India, Iran, Human Development Index, Renewable Energy, Governance Structure, Economic Incentives

1. Introduction

WEO (World Energy Outlook) projects the world's primary energy needs to grow by 55% between 2005 -2030 at an average annual rate of 1.8% per year, a particular reference scenario has been defined by the WEO for this purpose. According to the calculations of WEO and the proposed scenario, fossil fuels are going to remain the dominant source of primary energy and would account for 84% of the total hike in demand between 2005 – 2030 [26].

Increasing fossil fuel use will also increase the international energy-related CO_2 emissions; a 52% increase in global emissions has been projected by WEO during the period 2005 – 2030 [26]. The only option which can cause a decrease or at least a halt in this ever-increasing global emission pattern; is the development of renewable energy.

Impressive developments and new trends were seen during the year 2016, these include stress on environmental pollution, low global fossil prices, a high price decline of renewable energy technologies, and increased research and development in the field of energy storage. All the mentioned developments are somehow linked to renewable energy although the effect may be negative in some cases [52].

As of 2015, the share of renewable energy increased significantly and reached a percentage of 19.3% of global final energy usage and this growth continued in the year 2016 [52]. Renewable sources of energy are no longer seen as alternative or gap-filling forms of energy but are regarded as mainstream sources of energy around the world. Rapid growth, particularly in the power sector, is regulated by several factors which include improvement in the cost competitiveness of renewable technologies, committed policy initiatives, easier access to loans, investments, and growing demand for energy development in emerging economies [51]. As of today, about 176 countries have policy targets specifically related to renewable energies and about 100 of these countries have feed-in policies for renewable energy

production [52], (Onifade *et al.*, 2021). Hache, argues that diffusion of renewable energy in the global energy mix would modify the national and international energy balance, it would cause a division in revenue and would have an impact on international financing and global economy but more importantly, it would help in forging geopolitics of low carbonized power and environmental pacts [22].

The goal of the authors is to present a comparison between India and Iran based on renewable energy policies. India and Iran are two significant developing nations located in Asia, both these countries are key players as far as regional politics and energy trading are concerned. India and Iran are trading partners in the energy sector. Although both these countries extensively use fossil fuels for the production of electricity, a few major differences are observed when the power sectors of these countries are studied and compared. The authors aim to study the renewable energy-based governance structure to comprehend the differences between the policies of a developing country like India which has a more open and diverse economy, a huge population and has been investing and developing renewable energy for quite some time, and a country like Iran with a more close and state-based economy, rich in natural resources like oil and gas but has been facing economic and political sanctions and has recently started to develop its renewable energy sector. This comparison of the governance structure and current policies would help the policymakers to predict and develop a generation plan for the future development of various other developing or underdeveloped nations. Funding is the main issue of any scientific research and renewable energy development is no exception to that fact. Funding sources, financial incentives, and fiscal policies of both nations have been compared so that an understanding related to these issues can be provided which would help inefficient use of financial sources, which indeed are a very important factor for developing and underdeveloped nations. A comparative analysis of the policies is also provided for both countries which analyse the policies of both countries keeping in mind the current political or demographic issues faced by both the nations, this way plan can be developed for other nations whose situation might be the same as the countries compared in this paper. Recommendations and conclusions have been presented after a thorough analysis and comparison of both countries. This paper tries to analyze all the dimensions of policy-based comparison of the mentioned countries, such a comparison would be a key in solving future energy puzzles and would help policymakers in accurately predicting future energy trends, this way the financial resources would be used in a much suitable and efficient manner while increasing the environmental feasibility of global power sector. The research was performed by extensively studying the administration, the policies, the economic policies, and incentives as well as the current status of both countries as far as renewable energy was concerned. International reports were consulted for data and the national energy plans and reports of both the respective countries were analyzed and compared. The authors also analyzed both the current and future policies of these nations and a brief analysis was also done which has been mentioned in the paper. The comparative analysis performed in the paper can be extremely beneficial for policymakers. By studying the policy and economic systems of the renewable industries of both the countries, cooperation in these fields can be increased, both countries are trading partners in energy and this trade can be introduced in the renewable energy field as well, this can open ways of investment and technical assistance for Iran and benefits like cheaper energy and investment for the eradication of energy poverty for India. Moreover, these countries and the analysis can be used as a model for various other developing and underdeveloped nations for the development of renewable energy in those particular countries and regions.

The study aimed to employ the technique of comparative study to understand the policy differences between two different countries. With a significant difference in the socio-economic backgrounds and energy resources of the countries, a comparative study of renewable energy policies will allow the policymakers in observing the shortcomings and strengths of the policies. In the long run, this approach will work as a feedback approach and will allow continuously betterment of the policies converging towards a common goal. The overall aim of the study is to contribute to the space of sustainable renewable energy studies with emphasis on renewable energy development in the developing world.

2. Literature Review

Gupta, argues that combining comparative methods with the theories of the policy process encourages theoretical refinement and also states that comparative policymaking in addition to the broader policy theory can promote theoretical development [21]. When a comparison is made between different countries working on the same technology under different circumstances, a positive contribution can be made to the overall global policy.

India and Iran are undoubtedly two of the major regional powers in Asia and arguably these countries possess an extremely vital position as far as the global economy, politics, and energy sector are concerned. Both India and Iran are developing nations with growing populations and developing industries, thus for both of these countries energy is an issue of paramount importance. The comparison can be validated by the fact that both nations possess a different and contrasting supply of energy and different international policies. India and Iran have long and stable business and cultural relations. India is one of the major importers of Iranian oil, and recently India is one of the countries which have been allowed to import Iranian Oil despite the recently imposed sanctions.

Hua used comparative analysis to study renewable energy development in Australia and China, thus providing a very precise and effective pathway to study overall renewable policy development using comparative analysis [23]. HDI is a multi-dimensional index that rates and reflects the overall

human development of a country by analyzing three basic dimensions of knowledge, a decent standard of living, and healthy and long life. Iran ranks 69 on the world HDI list with an average HDI of 0.760 and thus included in the section of the countries with a high human development on contrary India ranks 131 on the list with an average HDI of about 0.610, thus included in the section of the countries with medium human development [59]. Although both of these countries are developing countries with emerging economies Iran is far ahead of India as far as HDI is concerned.

India's current GDP is 1.84 trillion USD and is ranked 11th in the world while Iran's GDP is 514 billion USD and is ranked 24th [43]. On the other hand, when GDP per capita is compared, Iran ranks 67th on the world list with a GDP per capita of 11,665 USD while India ranks way below on the list with a rank of 130 and a GDP per capita of 2,625 USD, the same situation is observed when GDP PPP per capita is compared, Iran, 73rd on the list, has a GDP PPP per capita of 11,596 USD while on the other hand India is ranked 126th with a GDP PPP per capita of 3,355. India doesn't do very good if the demographical figures are compared; India is the home to the world's second-largest population with a huge section of this population living way below the poverty line, India's current population is approximately equal to 1,339 billion with a population density of 450 per km^2 [57]. Out of these 1,339 billion people; 21% live in extreme poverty [46]. In contrast, Iran's population is about 81 million with a population density of 49.8 per km^2, as has been reported about 8% of the Iranian population lived below the poverty line in 2013 [58], [25].

India being a vast country is rich in natural resources such as coal and is ranked 3rd in primary coal production. India is ranked as the 3rd largest net electricity generating country with a generation of 330,861 MWs [13]. 66.2% of India's total electricity comes from coal-based (thermal) power plants. India's CO_2 emissions (the 3rd largest after China and the USA) are nearly 6% of the world's total; 53% of India's CO_2 emissions from fuel combustion comes from the power sector. Eco-Fys stated in a report that the intensity of the emissions of India's Coal-based power plants was 1.26 tCO_2/MWh in 2011 [5]. On the other hand, India has been able to successfully add about 11.785 GW of power generation capacity from renewable sources during January-November 2017. India's energy demand is expected to reach 15,820 TWh by 2040 and India is planning to meet its energy demand on its own [24].

Singh (2017), argues that the present Indian energy scenario has various problems such as energy deficit, energy inequity, and threats to energy security. Singh examines the renewable energy potential in India and states that Indian renewable energy policy has overextended its efforts for the rapid development of solar energy and the rest of renewable energy sources are at the back seat, moreover, it has been mentioned that national mission can be extremely significant as game-changers for energy policy. Sen et al., state that policymakers should not view renewable energy as just a substitute for traditional sources but as a part of a greater plan for achieving sustainable and inclusive growth for the energy independence of India [54]. Suitable policies, tax revisions, and efficiency improvement combined with R&D would help in the quick and cost-effective utilization of clean resources. A question also arises that whether renewable energy would be able to answer India's growing energy demands, Kumar, asserts that renewable energy has the potential to meet India's energy demand although extensive work is required for rapid scale diffusion of renewable energy, mitigation of the ever-increasing energy import dependence, Kumar further adds that time-bound R&D is essential to reduce cost and improve efficiency [36]. Gulagi et al. agree that renewable energy is a 100% achievable and real policy option. Moreover, Gulagi et al, also claim that a 100% renewable energy potential in 2050 is more cost-effective than current coal-based energy generation as renewable energy would help in reaching the climate targets and would promote reduced coal emission-based health care cost [20]. Policy framework remains paramount for the development of any technology and the Indian renewable energy sector is no exception to this fact, Jha and Puppala, argue that Indian renewable energy policies need to concentrate on better types of renewable energy and that Geothermal energy is India's best option as it the best as far as energy index is concerned and thus Indian renewable energy sector requires a policy up-gradation [35].

Iran is one of the richest countries on the globe as far as petroleum and gas reserves are concerned. It ranks 7th on the total petroleum production list and 3rd on the dry natural gas reserves list. Iran also ranks 15th on the total electricity generation list [13]. It should be noted that according to WRI climate data explorer, Iran's energy sector emits about 639.41 $MtCO_2$, out of which about 190 $MtCO_2$ is emitted by the power sector [61].

Mollahosseini et al., argue that fossil fuel is doomed to fail as far as reliability and sustainability are concerned as these fuels are closely linked to energy poverty, unemployment, health deterioration thus alternate sources of energy are paramount [40]. Ghorbani et al. believe that the main hurdles in the path of renewable energy development are policy-based such as mismanagement, fossil fuel subsidies [17]. The potential of renewable energy is argued to be very high, the results of the research prove that faster transition would cost less and 100% renewable energy future would be a much cost-effective way as fossil fuels would be used only to act as the backbone of the economy, water crisis would be solved and large scale emission reduction would be achieved [17]. Afsharzade et al., put forwards an argument that the development of renewable energy in Iran could be beneficial globally as Iran has been listed amongst the world's top CO_2 emitters adding to this argument, Afsharzade et al. state that proper exploitation of Iran's vast deserts could help in managing the energy needs of various other middle eastern countries and thus electricity export and revenue generation can be possible for Iran [1].

India and Iran seem to be two different countries as far as energy resources, renewable energy development, HDI, and other economic and demographic factors are concerned while

being quite different in these areas; Iran and India share a healthy business relationship that rotates around energy. Investigating the governance structure and the incentive policies would result in these countries learning from each other and would help them to contribute to the global emission mission while co-operating on regional and global levels. This paper aims at first comparing the governance structure followed by the incentive policies and finally would take a glance at the current status of renewable energy in both the mentioned countries.

3. Governance Structure

India showcases a much older and well-established governance structure as compared to Iran. Both India and Iran have set targets as far as renewable energy development and GHG (Greenhouse Gases) emissions are concerned. National targets have been set by both governments and compliance is imperative for all kinds of producers. The following sections would compare the legislative and governance structure of both countries in greater detail.

3.1. The Governance Structure of the Renewable Energy Sector in India and the Current Renewable Energy Policies

In the year 1992, the Government of India passed the legislation for the formation of MNRE, the world's first ministry committed to the development of renewable energy. MNRE is dedicated to expanding the contributions of renewable energy in all of India's end-use sectors and formulates policy and planning activities [4]. MNRE facilitates research, improves designs, promotes development, increases domestic manufacture, and strives for the deployment of new and renewable energy systems in rural, urban, industrial and commercial sectors. MNRE's missions consist of; making improvements in energy security, developing renewable energies, increasing the generation capacity of green energy, increasing the cost competitiveness of the energy, making energy more safe, accessible, and reliable. MNRE looks forward to making the per-capita energy consumption as close to the global average as possible by 2050 [5]. MNRE supervises various central institutions such as NIWE, NISE, SSS-NIBE, IREDA, and SECI [38].

India's Intended Nationally Determined Contribution (INDC) plans to base 40% of the total installed power generation capacity on renewable sources of energy by 2030 with support from the international community in the form of technology transfer and financing. This plan also includes the Government of India's ambitious target of achieving 175GW of RE by the year 2022. India also aims to reduce the GDP's emissions intensity by 33 to 35% from 2005 levels by 2030 [44]. As mentioned in a recent report by NITI AYOG (National Institution for Transforming India), India aims to deploy about 100 GW of solar energy which includes (utility-scale, distributed, off-grid/mini-grid), about 60 GW of wind energy, 5 GWs of small hydro and 10 GWs of Bio-energy. Moreover, NITI AYOG has also proposed business models for the deployment of 40 GW of rooftop solar by 2022; these 40 GW would be included in the proposed 100 GW of solar energy.

The twelfth five-year plan, proposed by the planning commission (later dissolved and replaced by NITI), continued the path of renewable development just like its predecessors. This plan made two important announcements;

1. The reduction of the emission intensity of GDP (Gross Domestic Product) with a proposed target reduction of about 20-25 percent by 2020 concerning the levels of 2005.
2. Addition of 30,000 MW of renewable energy capacity till 2017 [11].

As far as the energy policy and regulatory framework is concerned, The Electricity Act (2003) has played a very vital and pivotal role in the Indian power sector. This act revolutionized the Indian power industry by adopting various policies concerning; transmission, power market strategies, and renewable energy development.

Section 86, section 3 of the above-mentioned act, is concerned about the promotion of renewable energy by confirming; better grid connectivity, the sale of renewable energy, and the development of a nation-wide policy for the utilization of resources including renewable energy in a more optimized way [16]. Moreover, section 86 specifies the minimum percentage of purchases from renewable energy sources as well.

Section 5.2.20 of the NEP (National Energy Policy), adopted in 2005 promotes privatization in renewable energy, also 5.12.1 of the NEP targets capital cost reduction in renewable energy through competition [16].

Various other acts such as NTP (National Tariff Policy) (2006), NAPCC (National Action Plan on Climate Change) (2008), REC (Renewable Energy Certificates) mechanism, and various other amendments to The Electricity Act have passed regulations concerning renewable energy but this section of the power sector never had an independent legal framework for itself until 2015; till 2015, the renewable energy sector was governed by EA (Electricity Act), 2003 [34].

Through a separate law, MNRE can act with complete freedom and doesn't need to depend on other ministries for drafting, designing, or executing projects; this helps the NITI AYOG for its so-called "175 GW till 2022" plan [34].

INREA (The Indian National Renewable Energy Act), 2015, defines a specific institutional structure, which has proper roles for central and state governments. It defines various subsidiary organizations such as State Nodal Agencies, National Renewable Energy Committee, National Renewable Energy Advisors and their functions and powers [30].

As per the website of NIWE, there are about 14 renewable energy training institutions in India [45]. These institutions work under or in collaboration with the MNRE for R&D purposes. These institutions work at both central and state government levels.

Just like other countries with emerging economies, India also faces a difficult challenge of maintaining its economy while addressing the issues of climate change. Various efforts have been made by India at both international as well as domestic levels for the optimization of this situation.

GOI (Government of India) has voluntarily reduced the

emission intensity of its GDP by 20-25% by 2020 concerning the levels of 2005; GOI has made this stance on a global level on various international platforms [47]. Domestically, the Indian government designed and implemented the National Action Plan on climate change. This plan was implemented on a sector-by-sector basis. This approach was taken up by the 11th5-year plan, which also formulated an objective of improving energy efficiency by 20% till 2017 thus expressing concern for climate change as well [47]. According to UNFCC, total GHG emissions in 2007 for India were 1,722 million tonnes of CO_2, which is a 36% increase in the total GHG emission of 2000.

NDC (National determined Contribution) has set targets for the lowering of the emission intensity of GDP, increasing the share of renewable energy-based power generation, and creation of an additional carbon sink. It proposes to lower GDP-based emission intensity by 33-35% for the levels in 2005, a 40% increase in the share of green energy, and an addition of a carbon sink of 2.5 – 3 GT CO_2 [7].

3.2. The Governance Structure of the Renewable Energy Sector in Iran and the Current Renewable Energy Policies

Established in 1975, MOE (Ministry of Energy) is the main governmental body which formulates and implements the policies, law, and regulations related to electricity, renewable energy, water, etc in I. R. Iran. "TAVANIR" is a company established by the MOE to supervise the operation and development of the power industry in the country [10].

TAVANIR supervises the activities of various regional electrical companies; two of these companies which are important as far as renewable energy is concerned are SUNA (Iranian Renewable Energy Organization) and SABA (Iranian Energy Efficiency Organization). The former supervises renewable energy activities and the latter is an energy efficiency organization.

SUNA, the renewable energy of IRAN was established in 1996; initially, SUNA was only responsible for the research and evaluation of the renewable energy potential of Iran. Attracting non-governmental or public investors was also the responsibility of SUNA, SUNA provided the investors with a guarantee of purchasing the produced renewable power [10].

On 15/11/2016, the Iranian parliament passed an act of integration of the above-mentioned organizations i.e. SABA and SUNA, this act was submitted by the cabinet of ministers and was following both Article 8 of energy consumption and promotion of efficiency and renewable energies [53]. This new organization was named SATBA (Renewable Energy and Efficiency Organization) and finally, this act was approved by the guardian council on 1/1/2017.

An interesting positive difference can be observed between these two phases of the Iranian renewable energy sector i.e. the pre and post SATBA phases. The responsibilities of SUNA were to act as a regulatory authority for policy development, issuing of a license for renewable projects, and entering into power purchase agreements with the developers [10], whereas in article 1 of SATBA's establishment, it has been pointed out that this organization is recognized to promote efficiency, development and renewable energy by selecting the right infrastructure in the country, increasing efficiency and reducing the losses of transmission, distribution, and consumption, also it has been mentioned in the article 2 that SATBA has to play a pivotal role in the engagement and support of the private sector, setting the incentive policies and developing the renewable energies [53].

The sixth five-year development plan of the Iranian Government includes two main articles which point towards renewable energy development in the country. Section 9- Article 38- part 15; talks about replacing 10% of fossil fuels-based automobiles with electrical ones. Article 38 – Part 16; points out the financial help that would be provided for the conversion of waste into energy for the cities. Section 10 – Article 50; states that new and renewable energies to be promoted so that before 2020, 5% of the country's total demand should be provided by renewable sources. Preference should be given to Non-Governmental investments and it should be noted that the maximumutilization of domestic resources is achieved [32].

Studies have revealed that Iran was able to generate as much as 2000 MW of electricity by the end of the 5th five-year development plan (2010-2015) [42].

It was announced by the MOE of Iran that the ministry would increase the renewable energy generation capacity to 5000 MW by the end of 2018 and eventually to 7500 by the end of 2030. Moreover, the MOE stated that it would buy the energy produced by the renewable energy producers at a rate of 30% more than the standard rate [33].

About 77% of the total GHG emissions of Iran come from the energy sector. Iran has not yet developed an official national climate plan although it has signed UNFCC (United Nations Framework Convention on Climate Change) at Rio de Janerio Earth Summit in 1992 and has submitted required communications and also has ratified the Kyoto Protocol in 2005. The 5th five-year development policy of Iran proposed an impressive plan for climate change and sustainable development. A development plan for the year 2025 was designed namely "Vision of Iran", this plan promoted about 30% GHG emission reduction by 2025, the plan mentions that the percentage could increase if international support is present (Saidi, El Montasser and Ajmi, 2020) [9]. It is necessary to mention that Iran emits about 616.5 m tonnes of CO_2 per annum [6].

As far as project development policies for foreign investors are concerned, SUNA does not provide any assistance for site selection and feasibility issues. The investing and developing companies are expected to deal with these issues on their own and are expected to have analyzed the economic dimensions and the technical feasibility of these projects. SUNA has not announced the provision of assistance for land liaising and other inter-governmental assistances, although relevant introduction letters would be provided if necessary. After the establishment of the project, TAVANIR would analyze the grid connection issue and would issue a grid connection permit; plants with a capacity of more than 7 MW would have to deal with the relevant regional electrical company [12].

4. Funding and Incentive Support Comparison

4.1. Funding and Incentive Support in India

India has started to invest in the renewable energy sector on a large scale. Apart from direct investment for renewable energy, various economic policies have been developed to cut fossil fuel usage in the power sector.

GOI hosts the secretariat of ISA (International Solar Alliance); India has provided land and $30 million for this secretariat and has pledged to provide 5-year support as well. With approval from the cabinet on 28 December 2016, India became the first country to ratify the ISA treaty followed by 24 other countries [3].

A Green energy corridor worth Rs.380 billion is being set up to ensure the evacuation of renewable energy. PGCIL has sought a loan of US$1000 million from ADB. Various projects such as HVDC bi-pole links, real-time measurement, and interstate transmission systems associated with green energy would be funded using this loan. The IRDA Ltd, a non-banking financial institution associated with MNRE, sanctioned loans of about Rs. 70.270 billion and disbursed Rs.48.5 billionagainst the annual target of 100 billion and 60 billion respectively.

The mentioned loans were sanctioned for the development of about 1751.30 MW of installed capacity of power generation. IREDA raised funds of Rs. 9.9 billion from 1st April 2016 to 31st December 2016 from various international sources i.e. KFW (Kreditanstaltfür Wiederaufbau), JICA (Japan International Cooperation Agency), AFD (Agencefrançaise de développement), ADB (Asian Development Bank) etc. IREDA (*Indian Renewable Energy Development Agency*) has spent Rs. 62.5 million during the year 2015-16 on CSR activities which sums up to be about 1.94% of the average net profit of the last 3 years [3].

SECI (Solar Energy Co-operation of India) has been set up with a specifically authorized capital of Rs. 20 billion and GOI has provided budget support of Rs. 3 billion up to 31st December 2016.

Part IV, Sec. 23 of The National Renewable Energy Act proposes the establishment of a National Renewable Energy Fund. This fund shall be operated by the Central Government, the funds shall be provided by the National Clean Fund. Further, the added amount to the fund may be collected through international finances and other climate agreements. State governments may develop a State Green Fund for the promotion of renewable. The ministry also proposes to offer an initializing corpus to SGF (State Green Fund) from NREF (National Renewable Energy Fund) [30].

GOI has vowed to provide an 80% accelerated depreciation benefit for wind and solar power projects. An investor who can offset this tax liability can benefit indirectly from this depreciation. A capacity-based subsidy known as Viability Gap funding is also provided and spreads over 6 years [44]. Other incentives that are provided are GBI (generation-based incentives), provision of low-cost and longer tenure debt, interest rate subvention, etc. To bring down the cost of power from the infusion of dollar-denominatedcapital, GOI has been considering introducing dollar-denominated competitive bidding for solar power projects [44].

India being a coal-rich country relies heavily on coal for its energy needs but to improve the renewable energy position and reduce coal use, various taxes have been applied to coal usage. GOI assesses a cess of Rs.50 per tonne on domestic and imported coal [37]. In 2010-11, a revenue of Rs. 10.66 billion ($171.9 million) was obtained by coal taxes. This amount rose to 32.49 billion in 2011-12 and then to 38.64 billion in 2012-13. NCEF (National Clean Energy Fund) collected approximately 82 billion rupees in July 2012 [15].

In the year 2011 RPOs (Renewable energy purchase obligations) were introduced in the renewable energy sector by amending the Tariff policy, SERC (State Electricity Regulatory Council) was required to fix a particular percentage of power to be purchased from renewable power producers. A specific RPO is also fixed for solar power plants under the NSM (National Solar Mission), these solar obligations started from 0.25% in 2013 (phase 1) and might increase to 3% by 2022 (phase 3) [15].

MNRE agreed to provide generation-based incentives of Rs. 12.41 per kWh to the state utilities when they purchased solar power directly from the producers, 78 power plants were selected by the IREDA for this plan. GOI also provides a 30% subsidy on the capital and a soft loan at an interest of 5% for the producers who wish to invest in off-grid solar power plants [19]. MNRE provides various other subsidies apart from feed-in tariffs such as, about Rs. 37.5 million is provided for the development of small hydro projects (25 MW), apart from 45% of project cost or 22.5 million; fiscal tax incentives are also provided for biomass plants with a depreciation, claimable for power generation equipment of up to 100% in the first year.

MNRE also provides generation-based incentives of Rs. 50/kWh with a total capital of Rs.10 million for 4 years, these incentives are provided for grid-connected wind power plants [15]. The Union Cabinet has approved the raising of bonds worth US$366.2 million by the Indian Renewable Energy Development Agency (IREDA), these funds will be used in the development and commissioning of renewable energy projects in FY 2017-18. IL&FS Financial Services Ltd partnered with Jammu and Kashmir (J&K) Bank Ltd in December 2017 to provide finances for nine hydropower projects in J&K with a total budget of around Rs 200 billion (US$3.12 billion) and a generation capacity of 2,000 MW [30].

India does not maintain a central feed-in tariff policy however MNRE has issued a notice about procuring power from small solar and wind projects through feed-in tariff determined by respective State Electricity Regulatory Commissions. Large solar power has been primarily procured through a reverse auction process since the inception of the National Solar Mission [50]. Table 1 below illustrates the data related to feed-in tariff rates of the Indian state of Utter Pradesh since there are no feed-in tariff rates on the national level, therefore, state-based data has been considered for comparison [2].

Table 1. *India - Feed-in Tariff levels for Projects commissioned over 2014-19*[a].

Power plant type	The feed-in tariff (INR/kWh) (2019)
Biomass	
Rice Husk	7.51
Begasse	6.64
Solar farm	
Less than 5 MW	7.06
More than 5 MW	Set via bidding
Municipal Solid Waste	7.50
Small hydro	
Less than 5 MW	6.47
More than 5 MW	5.68

4.2. Funding and Incentive Support in Iran

Iran is a country with huge fossil fuel reserves as well as abundant potential for renewable energy, but Iran hasn't made a significant investment to fully explore and develop its renewable energy potential [42].

A recent change in policy towards a more systematic provision of incentives, revised and better feed-in-tariffs has pushed Iran into the limelight of the international renewable energy investment market. International investors are looking towards Iran as a new and attractive renewable energy market due to the recent development of regulatory regime and high feed-in-tariffs which are quite impressive when compared to other nations on the global level (Østergaard *et al.*, 2020) [48].

Iran has set a realistic target of attracting investments of about $10 billion; moreover, the government has also set an organized policy for this target which includes long-term PPA (Power Purchase Agreement) and high feed-in tariff rates [48].

Right from the 3rd five-year development plan renewable energy purchase obligations have been seen in Iran, as per article 62, this process continued and was improved in the 5th and 6th five-year plans. By approving article 133, part b, MOE permitted long-duration PPA with the renewable energy producers [41].

Till the year 1390 (2011), the obligatory purchase rate now based on article 62 which specified the rate to 1300 rials during peak and normal hours and 900 rials during 1-5 am (low peak hours). These rates changed during the year 1391 (2012) (as per 133, part b), 1863.2 rials (for stations connected to distribution grid), and 1792.2 (for power station connected to transmission grid), during the year 1393 (2014), the rates further increased to 4628 Rial/kWh for the generating station connected to the transmission system and 4480 Rial/kWh for power station connected to the transmission. This increased the nongovernment or private investors and resulted in a 50 MW increase in renewable energy generation [41].

SUNA (now renamed SATBA) pursues a policy of reducing the feed-in tariffs concerning the increase of installed capacities. The rates for the year 1394 (2015) have been mentioned in Table 2 [60].

Table 2. *Feed-in tariff rates Iran*[b].

Power plant type	The feed-in tariff (rial/kWh)
Biomass	
Landfill	2700
Anaerobic digestion	3500
Incineration	3700
Wind Farm	
Over 50 MW	3400
50 MW and less	4200
1 MW and less	5700
Solar farm	
Over 30 MW	3200
30 MW and less	4000
10 MW and less	4900
100 kW and less	7000
20 kW and less	8000
Others	
Geothermal	4900
Waste heat recovery from industrial processes	2900
Small hydro	
Rivers	2100
Water pipes	1500

The Iranian government has decided that from the beginning of the 11th year of PPA, the tariffs would be multiplied by a factor of 0.7 thus a 30% reduction would occur, although special provisions have been provided for wind energy. An electrical levy of 30 rials/kWh would be charged to the end-user, this levy would help in the accumulation of the budget for feed-in-tariffs [41]. To promote the utilization of domestic technologies, a bonus of 30% applies to the tariff for a power plant that uses local equipment, design, technology, etc. [18].

The Iranian government has decided to extend PPAs for 20 years with an annual tariff adjustment based on the euro exchange rate. A transmission service rate will be added for those power producers who are directly connected to the distribution grid. Investors are allowed to sell the electricity they produce across the country in any legal form approved by the ministry, this process can be continued even after the period of PPA comes to an end [18].

Tariff for the biomass will be increased in a coefficient that will be announced by a work-group subject to article 5 of the Economic Council act.

Although Iran shows promise in the field of renewable energy development analysis of the sources that would fund this development is very critical. According to Forbes, in April 2017, Iran's deputy economy minister M Khazaei announced that an investment of about 3.6 billion USD had been made by various European companies since 2016, a few examples of these investments have been listed below [14];

Norway's Saga Energy made a deal worth 2.9 billion dollars with an Iranian state-owned company named Amin Energy for the development of over 2 GW of solar power plants over the next 5 years.

Norway's Scatec Solar has mentioned that it is in talks for the development of a 110 MW solar project worth 132

[a] Rates have been specified just for the year 2019

[b] Briefing renewable energy in Iran, Watson Farley & Williams, PCD, 58231623v1, May 2016

million USD and this project might expand to 500 MW.

It has been reported that various Danish companies have agreed to invest over 1 billion USD in the Iran renewable energy sector.

'Quercus', a UK-based company has agreed to invest 500 million Euros for the development of a 600 MW solar project, various other German, Swiss, and Italian companies have also been reported to have started making deals for solar power development and investment in Iran's renewable energy sector.

According to a report by Energy Pioneers Ltd, there is an opportunity for an investment of about 24 billion USD by 2020 [48]. Apart from the foreign investment which remains the main pillar behind Iran's development plans for its renewable energy sector, nongovernment domestic investment and funding sources can also be observed. According to IEA and Iran'sfeed-in tariff policy, 2011, the funding for the guaranteed purchase of electricity generated from renewable sources would be secured and paid by the value of saved fuel based on the import of liquid fuel price and natural gas export prices [27].

5. Current Scenario and the Status of Renewable Energy Development in Both Countries

5.1. Current Status of Renewable Energy Generation in India

According to the official website of the ministry of power, the total installed capacity (as of 31.12.2017), is 330,861 MW. Figure 1 represents the electricity generated by fuel type. As is show-n, about 13.6% of the total power is generated by Hydro and 18.2% is generated by renewable sources of energy [8].

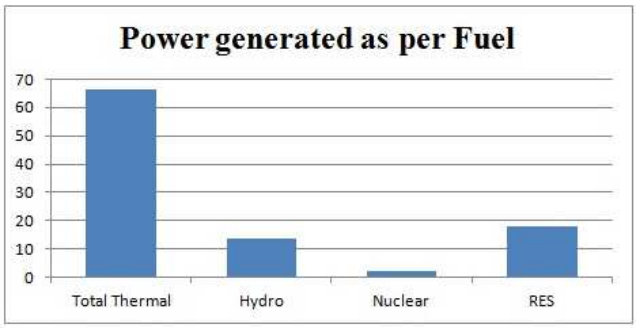


Figure 1. *Fuel based power generation in India (as of 22/1/2018)*[c].

The power generated by the renewable sources during April-December, 2016, was equal to 64,584 MU (Million Units) and a growth of about 26.28% was observed for the generation in 2016.

The respective values represented in the above figure for the thermal, hydro, nuclear, and renewable sources are as follows; 66.2%, 13.6%, 2%, and 18.2%. Table 3 below shows the cumulative developments of various renewable energy systems as of 31st December 2016.

[c] Data Source: Ministry of Power, GOI

Table 3. *Cumulative developments of various renewable energy systems in India*[d].

Sector	Cumulative achievements (31/12/2016)
Grid-Interactive Power (MW)	
Wind Power	28700.44
Solar Power	9012.66
Small Hydro Power	4333.85
Bio-Power	7907.34
Waste to Power	114.08
Total	50068.37
Off-Grid/Captive Power (MWEQ)	
Waste to energy	163.35
Biomass co-generation	651.91
Biomass Gasifiers	
Rural	18.34
Industrial	168.54
SPV systems	405.54
Watermill	18.81
Aero-generators / Hybrid	2.97
Total	1403.70
Other renewable energy systems	
Family Biogas	49.40

GOI in submission to UNFCC on INDC has stated that India will achieve 40% cumulative power from non-fossil fuel resources by 2030 [28].

According to the IEA, 2015, India ranks 7th on the list of the world's highest hydro-electricity producers with a production of 138 TWh which is about 3.5% of the world production and an installed capacity of about 40 GW. India displays quite impressive figures in the wind and solar section as well, as it ranked 5th and 10th on those lists respectively. India has a production of 43 TWh and 6 TWh for wind and solar power respectively. The installed wind power capacity of India is 25.1 GW and for solar power, the capacity is about 5.1 GW [49].

NOTE: Revised statistics of 2016 have shown an impressive increase in these numbers.

5.2. Current Status of Renewable Energy Generation in Iran

In the year 2015, the total annual generation of Iran reached 274.4 TWh with a 4.6% increase concerning the previous year. Figure 2 shows the power generation of Iran based on fuel utilized.

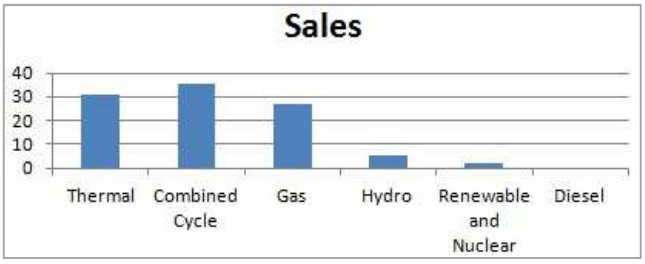


Figure 2. *Fuel based power generation in Iran*[e].

The respective percentages of the above-mentioned power generating station are as follows; Thermal - 31.2; combined cycle - 35.5; Gas - 26.7; Hydro – 5; Renewable and nuclear – 1.8 and Diesel – 0.3%.

[d] MNRE, Annual Report 2016-17

[e] Data Source: Energy statistics, Iran, 2015

In the year 2015, the renewable energy sector in Iran experienced negative growth of 4.8%. In the year 2015, about 10,957.5 MW of the total electricity generated in Iran was reported to be generated using water, wind, solar and biomass, out of which about 10,778 MW was generated using hydropower. Table 4 below shows the renewable energy distribution based on various power sources in Iran.

Table 4. *Cumulative developments of various renewable energy systems in Iran*[f].

Sector	Generation (MW)
Wind power	135.5
Solar Power	0.584
Geothermal	5 (by 2018)
Total	141

6. Comparison of Governance Structure, Policies, and Financial Aspects

Comparison of the policies, the governance structure, and the financial dimensions of the renewable energy sector of Iran and India provides a contrasting picture; this sort of comparison can help the policymakers in understanding the situations, the development trends, and issues faced by countries in the field of renewable energy development. Table 5 provides the summary of the comparison.

Table 5. *Comparison of policies, governance structure, and financial aspects.*

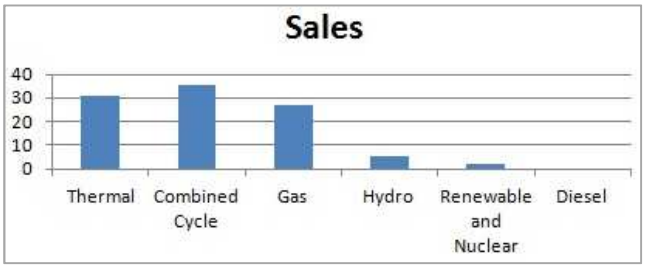
India	Iran
Governance Structure	
Separate ministry, MNRE a. Facilitates research, design improvement, and domestic manufacture b. Promotion of renewable energy use in rural, urban areas, industrial and commercial sectors c. Separate subsidiary organizations for the R&D purposes	SATBA, a subsidiary organization that works under the MOE a. Initially formed for research and evaluation b. After 2016, aims to support the private sector, development of incentive policies c. No subsidiary organizations dedicated to research
Legislation and Policies	
a. Separate law and legislation passed in 2015 1) Can act independently without requiring permission from other ministries 2) Defines State Nodal Agencies, National Renewable Energy Advisors and Committees 3) Established 14 national training institutes for research, development, and training b. Renewable energy to be used to power 40% of the country's power demand by 2030 c. Increasing the installed renewable energy capacity to 175 GW by the end of 2022	a. No separate laws have been passed b. 6th five-year plan includes replacing 10% of fossil-fuel-based vehicles c. 5% of the country's total power demand to be fulfilled by renewable energy by 2020 d. Preference to be given to non-government investors e. Renewable energy generation capacity has been predicted to reach 7000MW by 2030
Financial aspects	
a. Various funding sources both domestic and international b. Domestic sources include Green Energy Corridor setup, loans from PGCIL, SECI budget setup by Government of India, Coal Taxes and NCEF fund generation c. International Funding sources include IREDA fundraisers from organizations like KFW, ADB, JICA, etc d. GOI to provide 80% of the accelerated depreciation benefit e. GBI, low cost and longer tenure debt, and interest rate subvention to be provided f. Tariff policies amended with the introduction of RPOs g. Solar obligation to be increased up to 3% by 2022 h. MNRE to provide Rs 12.41/KWh to state utilities for solar power purchase, 30% subsidy on capital plus soft loan provision with 5% interest rate for off-grid investors i. Subsidies and fiscal benefits announced j. Impressive GBI of Rs 50/KWh with a capital provision of 10 million Rupees for 4 years for grid-connected wind power plants	a. The funding sources are predominantly foreign b. After recent policy developments, a target of attracting investment worth 10 billion USD has been set c. It was announced that 3.6 billion USD worth of foreign investment was attracted in 2017 d. Feed-in tariffs have been increased by 3 times in the last few years e. 30% bonus to be provided to the power developers using domestic materials f. MOE has announced that it would buy renewable energy from the producers at 30% more than the standard rate. g. Reports have mentioned potential of 24 billion USD worth of investment till 2020

Table 6. *Feed-in Tariff Comparison.*

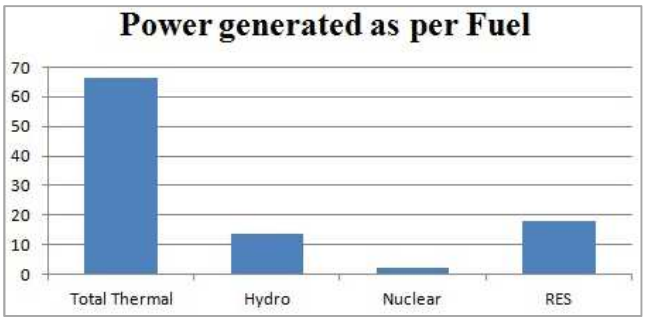
Power plant type	Iran - The feed-in tariff (rial/kWh)	India - The feed-in tariff (rial/kWh)
Biomass		
Landfill	2700	n/a
Anaerobic digestion	3500	n/a
Incineration	3700	n/a
Rice Husk	n/a	7.51
Bagase	n/a	6.64

[f]Energy statistics, Iran, 2015

Power plant type	Iran - The feed-in tariff (rial/kWh)	India - The feed-in tariff (rial/kWh)
Wind Farm		
Over 50 MW	3400	n/a
50 MW and less	4200	n/a
1 MW and less	5700	n/a
Solar farm		
Over 30 MW	3200	Bidding Process
30 MW and less	4000	Bidding Process
10 MW and less	4900	7.06 (5 MW)
100 kW and less	7000	7.06
20 kW and less	8000	7.06
Others		
Geothermal	4900	n/a
Waste heat recovery from industrial processes	2900	n/a
Municipal Solid Waste		7.50
Small hydro		
Rivers	2100	n/a
Water pipes	1500	n/a
Less than 5 MW	n/a	6.47
5 -25 MW	n/a	5.68



Iran Generation Statistics



Indian Generation Statistics

Figure 3. *Comparison between India and Iran power generation.*

Table 7. *Cumulative Renewable Energy Comparison*[g].

Sector	India (2016)	Iran (2015)
Grid-Interactive Power (MW)		
Wind Power	28700.44	135.5
Solar Power	9012.66	0.584
Small Hydro Power	4333.85	n/a
Bio-Power	7907.34	n/a
Waste to Power	114.08	n/a
Total	50068.37	
Off-Grid/ Captive Power (MWEQ)		
Waste to energy	163.35	n/a
Biomass co-generation	651.91	n/a
Biomass Gasifiers		n/a
Rural	18.34	n/a
Industrial	168.54	n/a
SPV systems	405.54	n/a
Watermill	18.81	n/a
Aero-generators / Hybrid	2.97	n/a
Total	1403.70	
Other renewable energy systems		
Family Biogas	49.40	
Geo-thermal	n/a	5

[g]Data has been taken from the previous sections

7. Comparative Policy Analysis

After studying the current renewable energy-related policies, respected governmental structures, fiscal and financial dimensions of both the mentioned countries; an analysis of the policies and future trends of both countries has been provided, which is as follows:

Indian renewable energy policy development plan is over ambitious and arguably unachievable, India Government has proposed the development of 175 GW of renewable energy by the end of 2022; this announcement was made before the occurrence of two main events which hampered the growth of the Indian economy; GST tax issues and demonetization. In 2015-16, India's GDP growth rate was 8.1%; in the same year NITI AYOG passed the 175 GW renewable energy development plan, since 2015, India has witnessed a drop in GDP growth with current growth at 6.6%, the lowest since 2012. In 2018 INR dropped to 73.96 in comparison with the USD which is its lowest value ever (TWB, 2016) (Live). Currently, India's total renewable energy generation capacity is 70 GW, which employs that India must add 105 GW in less than three years with national elections coming in 2019 as well. Another factor that suggests that this figure of 175 GW is unattainable in the next few years is the issue of energy poverty in India. There is little doubt in the fact that renewable energy requires heavy capital investment, and also we cannot ignore the fact that nearly 250 million people in India lack access to basic electricity. India is dealing with two issues at once, increasing renewable generation capacity while trying to pull out this population from energy poverty.

India would have to divert a huge amount of taxpayers' money or foreign investment towards renewable development as it cannot expect any financial assistance from the energy-deprived populous. India would have to provide subsidies for this section and this would lead to the utilization of more financial resources. India would either have to provide more interesting and attractive offers to foreign investors or it would have to increase the taxes on energy to pay for renewable energy development and also decrease energy poverty. Indian renewable policy development also talks about increased privatization of the sector, this might help in increasing the generation capacity but then provision of subsidy-based cheap electricity would not be possible. Coal is a very important factor as far as the Indian power industry is concerned, coal is the main fuel used in India for power production. It is cheap, readily available, and free from any international politics, unlike oil. India might use coal power plants to eradicate its energy poverty which indeed seems a good option but coal causes pollution. India thus faces a dilemma, a situation where India must increase its power generation capacity to support its economic and population growth and also to eradicate the energy poverty which its population is facing. India must invite investments both domestically and internationally to compensate for the possible lack of capital for the development of renewable energy.

On the other hand, when Iranian policies are analyzed, we can find that targets set by the Iranian government are not over-ambitious at all. The issues faced by Iran are quite different than those faced by India, Iran's international relations policies and political situation are not as stable as India's. Iran must deal with US-based sanctions and thus new foreign investment needs to find new ways to enter Iran. Iran has to sign bilateral and multilateral financial agreements to provide security to foreign investment. A renewable energy-rich Iran is in the interests of European renewable energy developers as nearly all Iran's neighbors lag in renewable energy and thus Iran can be a pathway in reaching those regions either by more investment, technical assistance, or even simply by grid connectivity. Iran has to work on the development of a better and more efficient renewable energy-based administrative structure, Iran has almost no energy poverty and 100 percent of its population has access to electricity, moreover, Iran's main fuel for electricity generation is Natural Gas which in itself is the most environmentally feasible amongst all fossil fuels and Iran also has the world's second-largest natural gas reserves, these factors would allow Iran to transfer to a much more renewable energy-oriented power industry without worrying about energy issues in the country. Iran has huge solar energy potential with average solar radiation of 4.5-5.5 kWh/m^2 and up to 300 sunny days a year over 2/3 of its total area (IPG), it was observed from the financial and policy-based discussion that wind-based policies are more aggressive for a short-term development, it is suggested that solar power policies and GBI if improved can attract more foreign investors and developers which would result in a boost to the renewable energy sector of Iran.

8. Recommendations and Conclusion

Renewable energy development is a very efficient option to fulfill the ever-increasing energy demand and to reduce GHG emissions. As was explained in the paper, both India and Iran have set up renewable energy targets to increase their installed capacities, both the countries have introduced acts and laws at national and provincial levels, moreover, both countries have provided economic incentives as well. Iran applies a more central and unified approach for the implementation of renewable energy policies whereas India has a more structured and hierarchal system of policymaking and policy implementation.

In comparison to the Iranian government, the Indian government seems more serious and proactive in the implementation of renewable policies. India is facing a much tougher scenario as far as environmental regulations and energy demand is concerned. Both countries have a low penetration of non-hydro renewable energy in their primary energy mix. India is providing an impressive incentive for solar and wind farms. Iran is relatively new in this industry but after the removal of sanctions, Iran has started to receive international attention and investments. These investments along with national policy up-gradation promise a better future for Iran. Iran has set up a very impressive feed-in tariff system to encourage independent power producers. Openness to international financial investment for the development of new renewable projects can be witnessed in both countries. India seems to have a much larger source of funds due to its political situation and its diverse economy. Iran, on the other hand, has also shown good initial progress in being able to attract foreign investment from Europe.

India displays a well-structured governance pattern and legislation with a separate ministry dedicated to renewable energy development and separate concerned departments. Iran has a single organization (SATBA) that supervises the development of renewable energy.

This paper makes the following recommendations:

1. Reduction of interest rate along with accelerated depreciation for wind and solar farms for both countries.
2. Increasing GBI and feed-in tariff rates along with privatization of the sector would allow more foreign and domestic investment along with more work opportunities for local educated youth.
3. A more efficient legislative system with more administrative support has been recommended for Iran. This would reduce the difficulties faced by foreign and non-governmental investors.
4. Legislative upgrades for the SATBA organizationare also recommended along with the promotion of domestic research and development programs by the formation of subsidiary research organizations.
5. Laws related to RPO implementation need to be strengthened moreover penalties must be announced for parties that do not comply with the regulations.

6. Off-grid power producers must be encouraged by both countries by providing more tax benefits and economic incentives.
7. Iran must find new and reasonably reliable sources of investment which can provide long-term investment.
8. India can also be a good partner for Iran as far as technical expertise and export in the field of renewable energy is concerned. Both countries can help each other and being trading partners, issues related to the transfer of funds and investments can be resolved quite easily without having to look for new avenues.

List of Acronyms

EA	Electricity Act
GBI	Generation Based Incentives
GDP	Gross Domestic Product
GHG	Green House Gases
GOI	Government of India
HDI	Human Development Index
INDC	Intended Nationally Determined Contribution
IREDA	Indian Renewable Energy Development Agency
ISA	International Solar Alliance
MNRE	Ministry of New and Renewable Energy
MOE	Ministry of Energy
NAPCC	National Action Plan on Climate Change
NCEF	National Clean Energy Fund
NEP	National Energy Policy
NISE	National Institute of Solar Energy
NITI –AYOG	National Institution for Transforming India
NIWE	National Institute of Wind Energy
NREF	National Renewable Energy Fund
NSM	National Solar Mission
NTP	National Tariff Policy
PGCIL	Power Grid Corporation of India Limited
PPA	Power Purchase Agreements
REC	Renewable Energy Certificates
RPO	Renewable energy Purchase Obligation
SABA	Iranian Renewable Energy Organization
SATBA	Iranian Renewable Energy and Energy Efficiency Organization
SECI	Solar Energy Corporation of India
SERC	State Electricity Regulatory Commission
SGF	State Green Fund
SSS – NIBE	SardarSwaran Singh National Institute of Bio-Energy
SUNA	Iranian Energy Efficiency Organization
UNFCC	United Nations Framework Convention on Climate Change
WEO	World Energy Outlook

Units

All the units used in the article are as per the SI system of units,

Currency Units used:

1. Rupee: Standard currency unit of India.
2. Rial: Standard currency unit of Iran.

References

[1] Afsharzade, N., A. Papzan, M. Ashjaee, S. Delangizan, S. V. Paseel, H. Azadi (2016), "Renewable energy development in rural areas of Iran", *Renewable and Sustainable Energy Reviews*, 65, 743-755.

[2] Agency, I. E. (2015, April 03). *Uttar Pradesh renewable energy feed-in tariff 2014 - 2019 levels*. Retrieved May 09, 2019, from IEA: https://www.iea.org/policiesandmeasures/pams/india/name-140455-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SG9tZTwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljeWVzIGFuZCBNZWFzdXJlczwvYT4gJnJhcXV

[3] Annual, M. (2016), "Annual Report2016", New Delhi: Ministry of Renewable Energy.

[4] Arora, D. (2010), "Indian Renewable Energy Status Report, Background report for DIREC", NREL.

[5] Bhushan, C. (2015), "Heat on Power: Green Rating of Coal Based Power Plants", New Delhi: Centre for Science and Environment.

[6] BP. (2017), "BP statistical review of world energy", British Petroleum.

[7] CAT. (2018), India, Retrieved February 22, 2018, Climate Action Tracker, https://climateactiontracker.org/countries/india/

[8] CEA. (2017), Executive Summary, Retrieved March 1, 2018, CEA, Central Electric Authority www.cea.nic.in

[9] Climate, G. R. (2015), Global Climate Legislation, March 2018, Grantham Institute, London School of Economics and Political Science, http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/05/Global_climate_legislation_study_20151.pdf

[10] CMS. (2016), Renewable energy in Iran, February 13, 2018, SATBA, www.satba.gov.ir/en/news/844/Renewable-Energy-Reports-2016

[11] Commission, P. (2017), "Twelfth Five Year Plan", February 16, 2018, Planning Commission India, http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol2.pdf

[12] Dentons. (n.d.) (2018), Renewable energy projects in Iran: Solar Focus, Dentons, www.dentons.com

[13] EIA. (2016). Energy Source, January 12, 2019, EIA Beta, https://www.eia.gov/beta/international/?fips=IN&trk=m

[14] Forbes. (2017, October 24). Iran Renewable Energy, December 12, 2018, Forbes, https://www.forbes.com/sites/dominicdudley/2017/10/24/iran-renewable-energy/#5201e64f4d00

[15] *GBI Wind.* (2018), March 1, 2018, IREDA: http://www.ireda.gov.in/writereaddata/operational guidelines.pdf

[16] GEF, M. (2015), "Renewable energy in India: Growth and Targets", GEF National Workshop, MNRE, New Delhi.

[17] Ghorbani, N., A. Aghahosseini, C. Breyer, (2017),"Transition towards a 100% Renewable Energy System and Role of Storage technologies: A Case Study of Iran", *International Renewable Energy Storage Conference, IRES, 2017,* Dusseldorf, Germany: Energy Procedia. (pp. 23-30), 135 (2017).

[18] GOV, S. (2017), Investment in clean and renewable energy, March 1, 2018, SATBA, www.satba.gov.ir/en/history

[19] GSR, R. (2014), "Global Status Report Renewable, 2014", March 2018, Global Status Report, REN21, http://www.ren21.net/Portals/0/documents/Resources/GSR/2014/GSR2014_full report_low res.pdf

[20] Gulagi, A., D. Bognadov, C. Breyer, (2017), "The Demand for storage technologies in Energy Transition Pathways Towards 100% Renewable Energy for India", *11th International Renewable Energy Conference, IRES, 2017,* Dusseldorf, Germany: Energy Procedia, (pp. 37-50).

[21] Gupta, K. (2012), "Comparative Public Policy; Using the Comparative method to Advance our Understanding of the policy process", *The Policy Study Journal,* Vol. 40.

[22] Hache, E. (2018), "Do renewable energies improve energy security in the long run?", *International economics*.

[23] Hua, Y. e. (2016), "Development of renewable energy in Australia and China: A comparison of policies and status", *Renewable energy,* 85, 1044-1051.

[24] IBEF (2018), Indian Renewable Energy Industry Analysis, January 01, 2018, India Brand Equity Foundation, https://www.ibef.org/industry/renewable-energy-presentation

[25] IDA (2018), Islamic Republic of Iran, November 26, 2018, The World Bank, https://www.worldbank.org/en/country/iran/overview

[26] IEA. (2007),"China & India - Insights", World Energy Outlook, IEA.

[27] IEA. (2018), Iran Feed-in Tariff, March 3, 2018, International Energy Agency, https://www.iea.org/policiesandmeasures/pams/iran/name-32118-en.php

[28] IEA. (2017), "Key World Energy Statistics", International Energy Agency.

[29] IEA. (2018, March 1). *Iran Feed-in Tariff*. Retrieved March 3, 2018, from International Energy Agency: https://www.iea.org/policiesandmeasures/pams/iran/name-32118-en.php

[30] INREA, M. (2015), National Renewable Energy Act 2015, December 2018, MNRE, https://mnre.gov.in/file-manager/UserFiles/draft-rea-2015.pdf

[31] IPG, The Renewable Energy Market of Iran, December 2, 2018, International Persian Group, http://ipg-co.com/blog/the-renewable-energy-market-of-iran.html

[32] IRAN. (2017), "6th five-year plan of I. R. Iran, Economical, social and cultural development plan", IRAN.

[33] ISNA, March 1, 2018, ISNA, https://www.isna.ir/news/95040117231/%D9%88%D8%B9%D8%AF%D9%87-%D9%88%D8%B2%D8%A7%D8%B1%D8%AA-%D9%86%DB%8C%D8%B1%D9%88-%D8%A8%D8%B1%D8%A7%DB%8C-%DA%A9%D9%85%DA%A9-%D8%A8%D9%87-%D8%AA%D9%88%D8%B3%D8%B9%D9%87-%D8%A7%D9%86%D8%B1%DA%98%DB%8C-%D8%AA%D8%AC%D8%AF

[34] Jai, S. (2015), National Renewable Energy Act to change the landscape of RE, February 21, 2018, Business Standard, https://www.business-standard.com/article/economy-policy/national-renewable-energy-act-to-change-landscape-of-re-115072001013_1.html

[35] Jha, S. H., H. Puppala, (2014), "Prospects of renewable energy sources in India: Prioritization of Alternate sources in terms of Energy Index"*Energy*.

[36] Kumar, S. R. (2016). CO_2 emission reduction potential assessment using renewable energy in India. *Energy*.

[37] Live, P. S. (2018), U.S. Dollar to Indian Rupee Spot Exchange Rates for 2005 to 2019 from the Bank of England, December 1, 2018, Pound Sterling Live, https://www.poundsterlinglive.com/bank-of-england-spot/historical-spot-exchange-rates/usd/USD-to-INR

[38] MNRE, (2018), Ministry of Renewable Energy, February 2018, from www.mnre.gov.in

[39] MNRE, (2016), Year-end Review, March 1, 2018, National Informatics Centre, GOI, http://pib.nic.in/newsite/PrintRelease.aspx?relid=155612

[40] Mollahosseini, A. H., S. A. Jabbari, M. Figoli, A. Rahimpour, Ahmad, 2017. "Renewable energy management and market in Iran: A holistic review on current state and future demands", *Renewable and Sustainable Energy Reviews*, Elsevier, vol. 80 (C), pages 774-788.

[41] MOP. (2014), Energy Balance Sheet, Ministry of Power, Iran, http://isn.moe.gov.ir/getattachment/0aaa09c6-c3f4-4af4-a905-80f12fd332be/%D8%AA%D8%B1%D8%A7%D8%B2%D9%86%D8%A7%D9%85%D9%87-%D8%A7%D9%86%D8%B1%DA%98%D9%8A-%D8%B3%D8%A7%D9%84-1393

[42] Moshiri, S., S. Lechtenböhmer, "Sustainable energy strategy for Iran", Wuppertal Institute for Climate, Environment and Energy.

[43] Nation-Master, Economy: India and Iran compared, November 26, 2018, NationMaster, www.nationmaster.com/country-info/compare/India/Iran/Economy

[44] NITI. (2017), "Report of the expert group on 175 GW RE by 2022", National Institution for Transforming India, New Delhi.

[45] NIWE. (2015) List of Renewable Energy Training Institutions in India, National Institute of Wind Energy, http://niwe.res.in/information_reti.php

[46] Ortiz-Ospina, M. R. (2017), Global Extreme Poverty, November 26, 2018, Our World in Data: https://ourworldindata.org/extreme-poverty

[47] Pahuja, N., N. Pandey, K. Mandal, C. Bandyopadhyay, (2014), "GHG Mitigation in India: An overview of the current policy landscape", working paper", World Resources Institute, Washington DC.

[48] Pioneers, E. (2015), Iran's Renewable Energy Sector, https://static1.squarespace.com/static/5599163ee4b07172a30a4fca/t/575ee2b04c2f85ce6900c887/1465836210111/Renewable+report+-+executive+summary.pdf

[49] PowerMin. (2018), Power Sector at a Glance, March 1, 2018, Power Ministry, www.powermin.nic.in/en/content/power-sector-glance-all-india.

[50] Prateek, S. (2018, 02 03). *Feed-In Tariffs to Make a Comeback in India for Small Solar and Wind Projects*. Retrieved 05 09, 2019, from Mercomindia.com: https://mercomindia.com/feed-in-tariff-solar-wind/

[51] REN21, (2016), "Renewables - 2016", Global Status Report, REN21, 2016.

[52] REN21, (2017), "Renewables 2017", - Global Status Report, REN21, 2017.

[53] SATBA, (2016), Vision and Mission, February 2018, SATBA, satba.gov.ir/en/about/satba/visionmission.

[54] Sen, S., S. Ganguly, A. Das, J. Sen, S. Dey, (2015), "Renewable Energy Scenario in India; Opportunities & Challenges" *African Earth Sciences*, 2015.

[55] Singh, R. (2017) "Energy sufficiency aspirations of India & the role of renewable resources: Scenarios for future", *Renewable and Sustainable Energy Reviews*, 2017.

[56] TWB, (2016), GDP growth (annual%), December 13, 2018, The World Bank Data, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=IN

[57] UNData, (2017), India - United Nations, November 26, 2018, United Nations Data Portal, http://data.un.org/en/iso/in.html

[58] UNData. (2017), Iran - United Nations, November 26, 2018, UNData: http://data.un.org/en/iso/ir.html

[59] UNDP, (2016), "Human Development Report", United Nations, 2016.

[60] Williams, W. F. (2016), "Briefing Renewable Energy in Iran", WFW, Watson Farley and Williams.

[61] WRI, CAIT, February 24, 2018, Climate Data Explorer, World Resources Institute, www.cait.wri.org/profile/Iran.