ENERGY SECURITY IN MIZORAM:

POLICY PERSPECTIVE

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ENERGY SECURITY IN MIZORAM: POLICY PERSPECTIVE

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CERTIFICATE

This is to certify that **Ms. Lalhmingsangi** has prepared the dissertation titled "*Energy Security in Mizoram: Policy Perspective"* under my guidance and supervision for Master of Philosophy degree in Political Science, School of Social Sciences, Mizoram University. In preparing the dissertation, **Ms. Lalhmingsangi** has complied with all the requirements as laid down in the M.Phil regulations of the University. This dissertation is the original work of the scholar and has not been submitted for any degree to any other University.

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DECLARATION

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September 2021

I Lalhmingsangi, hereby declare that the subject matter of this dissertation is the record of work done by me, that the contents of this dissertation did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that this dissertation has not been submitted by me for any other research degree in any other University/Institute.

This is being submitted to the Mizoram University for the degree of Master of Philosophy in Political Science.

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ABBREVIATIONS

IEA	International Energy Agency
OPEC	Organization of the Petroleum Exporting Countries
MDoNER	Ministry of Development of North Eastern Region
GSDP	Gross State Domestic Product
GSVA	Gross State Value Added
LPG	Liquefied Petroleum Gas
GSI	Geological Survey of India
CEA	Central Electricity Authority
NEEPCO	North Eastern Electric Power Corporation
ONGC	Oil and Natural Gas Corporation
OIL	Oil India Limited
PWD	Public Works Department
MW	Megawatt
NOAA	National Oceanic and Atmospheric Administration
CSD	Commission for Sustainable Development
TCCA	Tuirial Crop Compensation Association
SOSA	Society for Social Action
PRISM	People's Right to Information and Development Society of Mizoram
FIR	First Information Report
PIL	Public Interest Litigation

CBI	The Central Bureau of Investigation
EIA	Environmental Impact Assessment
NGO	Non-Governmental Organization
NHRC	National Human Rights Commission
SIA	Social Impact Assessment
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change
NDC	Nationally Determined Contribution
MNRE	Ministry of New and Renewable Energy Sources
ZEDA	Zoram Energy Development Agency
BIP	Bureau of Industrial Promotion
IREDA	Indian Renewable Energy Development Agency
MNES	Ministry of Non-Conventional Energy Sources
DPR	Detailed Project Report
CPSU	Central Power Sector Undertakings
NISE	National Institute of Solar Energy
JNNSM	Jawaharlal Nehru Solar Mission
DDUGJY	Deendayal Upadhyaya Gram Jyotin Yojana
REC	Renewable Energy Certificate
NH	National Highway
UT	Union Territory

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CHAPTER-I

Introduction

Energy security, in a contemporary world, is an important determinant of a country's economy and that of relations between nations. The increasing dependence on energy in every aspect of life has made energy security a priority policy for states and countries. Energy has become an indispensable factor of the modern economy and is essential to the development of any country, state or society, of developed or developing. Different countries adopted different ways to secure their energy supply. Energy security is fundamentally linked with not only the economy but other policy issues such as environment, livelihood, and socio-cultural setup. Energy security will continue to be central to the continuation and survival of life in the future as the significance of energy and its demand is ever increasing.

Energy security is one of the most imperative and disputed features of state security in times of war and peace. A nation's economic growth is directly linked with energy and every state struggles to maintain a balance between demand for energy and supply. Interruption in energy supply results in an enormous economic cost and therefore, government places great emphasis on having the security of energy supply. In contemporary society, development and security are linked with technology and technology is dependent on energy.

1.1 Meaning of Energy Security

There are different perspectives on the meaning and concept of 'Energy Security' and the definitions vary with time, geography, geology, and with different people. The concept of energy security has different meaning for different countries. There is no universally accepted definition of the meaning of energy security. It is a concept developed in the context of geopolitics, economic development, and environmental change. However, they all share the fundamental idea that energy supply should be on par with the demand.

The standard interpretation of energy security simply meant a steady supply of energy, during the 20th Century with oil as the main source of energy.[1] But the concept of energy security is not static and changes with time as the nature of energy-related challenges evolved. A new explanation of energy security attempted to go beyond the main 20th Century explanation of an oil-centric steady flow of energy.

Today, energy security includes a wide range of issues that can be seen in the context of four A's: availability, accessibility, affordability, and acceptability as conceptualized by the Tokyo-based Asia Pacific Energy Research Centre in 2007.[2] It considers the political, social, economic, and environmental issues under which energy security policy is being pursued by nations.[3]

The United Nations' attention and priority on the need to provide a sustainable and environmentally friendly supply of energy to fuel global economic growth encouraged nations to work together to increase efficiencies not only in energy production and use but also towards social and environmental advantages. The increasing concern to make a green and clean economy has led to a transformation in the economy. Energy security concerns are now relatively associated with the renewable and carbon-controlled economy.

1.2 Energy Security- India's Perspective

The United Nations has defined energy security as the continuous availability of energy in varied forms, in sufficient quantities, and at affordable prices.[4]

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[1] Ashok Sharma. (2019). *India's Pursuit of Energy Security*. New Delhi: Sage Publications. p.2

[2] Aleh Cherp and Jessica Jewell (2014). The concept of energy security: Beyond the four As. *Energy Policy*. Volume 75, pp. 415-451.

[3] *Op. cit.*, Ashok Sharma, p.7

[4] Bruce G. Miller. (2017). Clean Coal Engineering Technology for advanced power generation in Bruce G. Miller. Clean Coal Engineering Technology (Second Edition). Oxford: Butterworth-Heinemann. pp. 261-308. Retrieved from https://doi.org/10.1016/B978-0-12-811365-3.09989-0 accessed on 3rd March 2020

Similarly, the International Energy Agency (IEA) defines it as 'the uninterrupted availability of energy sources at affordable prices.[5]

Dr. APJ Kalam as President of India has described energy security as ensuring the country to supply lifeline energy to all its citizens, at affordable costs at all times. He approached energy security based on several principles: conservation; secure access to all energy sources worldwide; and access to reliable, affordable, and environmentally sound energy.[6]

Energy Security as defined by the Planning Commission of India is the ability to supply lifeline energy to all the citizens irrespective of their ability to pay for it and at the same time, meet their effective demand for safe and convenient energy to satisfy their various needs 1st competitive prices at all times and with a prescribed confidence level considering shocks and disruptions that can be reasonably expected.[7]

The United Nations and IEA have defined energy security in its basic context where energy supply should be on balance with demand. For India, energy security is not limited to ensuring the continued availability of commercial energy at competitive prices to support economic growth but also meet the energy needs of the people through safe, clean, and affordable forms of energy. With India's growing energy needs, import dependency will become even more pronounced in the years to come, despite some significant recent oil and gas discoveries. Such heavy and growing reliance on energy imports makes a country vulnerable to external shocks. Therefore, the procurement of energy resources and supplies from abroad, measures to promote the introduction of new technologies in the energy sector and exploring renewable sources to provide energy in a sustainable manner are extremely urgent.

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[5] IEA- Energy Security reliable, affordable access to all fuels and energy sources. Retrieved from https://www.iea.org/topics/energy-security accessed on 1st March, 2020

[6] Parimal Raj, Arpit Saxena, Shashank Gupta. (2010). *Energy Security- An Indian Perspective: The Way Forward.* India: 8th Biennial International Conference & Exposition on Petroleum Geophysics. p. 2.

[7] *ibid*

1.3 Evolution of Energy Security

The origin of energy security problems goes back to the early years of the 20th century, with the supply of oil for armies of the European powers seeking supremacy at that time, particularly during the period of the two world wars. During these wars, energy security was considered equal to national security. It was indispensable to secure oil supplies to fuel the military equipment needed for war. The academic reflection on energy security goes back to the 1960s and matured with the oil crisis of the 1970s.[8]

Professionals and scholars started paying attention to energy security as there was a shift of power sources from primarily local energy sources to imported ones in developed countries. Without a doubt, there was increased productivity in many areas such as communication and transportation. Nonetheless, this shift accompanied with it substantial complications that were hardly known earlier. Nations that depend on others for energy sources became vulnerable to attacks on grounds such as oil fields, transportation lines, etc. The significance of energy security was further reflected with the breakout of World War II.[9] The two sides of the War fought over the control of oil fields to defend their own sources and routes of oil supply which proved that an uninterrupted supply of oil was significant for national security.

The importance of energy security escalated after World War II as a result of the increase in energy consumption. There was an increase in demand for energy in areas such as transportation, electricity production, and heating, especially in developed countries. This has led to a tremendous growth of imported oil from other countries which are mostly located in regions of the world such as the Middle East. There was heavy dependence on oil-exporting countries and such reliance on oil from foreign sources posed threat to the security of a nation.

The risks of such heavy reliance became obvious with the oil embargo imposed in October 1973 by the Arab members of the Organization of the Petroleum

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[8] *Op. cit.* Aleh Cherp and Jessica Jewell . p. 415

[9] Kaminla Proninska. *Energy and Security: regional and global dimensions.* SIPRI Yearbook 2007. p. 218

Exporting Countries (OPEC).[10] The oil-producing Arab countries imposed an embargo on countries that supported Israel during the Yom Kippur War also known as the Arab-Israeli War. There was a temporary cessation of oil shipments from the Middle East to the United States, Netherlands, Portugal, Rhodesia, and South Africa. It was in March 1974 that the embargo on the United States was lifted. This has resulted in the first oil crisis.[11]

The reduction in supply during the incident was actually small and only temporary but left a longer-term impact in reducing the rate of supply growth. The embargo caused oil supply disruption and lead to an energy crisis along with a major price increase. Subsequently, there was a long-lasting economic recession in the targeted countries throughout the remainder of the 1970s.[12]

Following the event, countries started changing their domestic energy policy and reassess their dependence upon Middle East oil. It became a practical concern to secure oil supplies for most countries around the globe. The United States also started increasing its domestic production of oil and there was a better emphasis on increasing energy efficiency. Finally, concerns over energy security during the oil crises of the 1970s also caused the creation of several international energy organizations and mechanisms.

The first oil shock not only accelerated an understanding of the idea of energy security but also instigate the formation of the International Energy Agency (IEA) in 1974 whose sole purpose is to bolster the stability of global energy security.[13] This period of energy security till the 1980s is considered classical and it centered on the stable supply of cheap oil.[14]

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[10] *ibid*

[11] Muhamad Hasrul Bin Zakariah (2011). The oil embargo following the Arab-Israel War of October 1973: British Economic Experience and Reaction. *Journal of Middle Eastern and Islamic Studies (In Asia)* p. 96

[12] *Ibid*

[13] IEA. History: From oil security to steering the world toward secure and sustainable energy transitions. Retrieved from https://www.iea.org/about/history Accessed on 4th March, 2020

[14] *Op cit.,* Aleh Cherp and Jessica Jewell. p. 415

After this, due to the stabilization of oil prices and the receding threats of political restraint or blockage, there was a decrease in academic interest in energy security during the late 1980s and 1990s. However, it was revived in the 2000s as a result of the rising demand in Asia, disturbances of gas supplies in Europe and the growing pressure on energy security policy to be pursued in a carbon-controlled environment.[15]

While most of the literature focuses on the energy-importing countries' interpretation of energy security, the interpretation of energy varies for country that imports and exports energy. For many energy exporting countries, international energy security means a steady flow of energy exports at a reasonable price that can guarantee not only new energy investments but also overall economic development. Energy exporting countries are focused on maintaining security of demand for their exports, which ultimately generates an overwhelming proportion of their government revenues.[16]

Energy security can be improved efficiently only through global cooperation and not isolation. It is rooted in the mutual interdependence of producing and consumer nations or export and importing countries. While the hope of every country is to achieve energy independence, it is next to impossible. So besides decreasing over dependency on imports, the aim for countries is constitute a much more effective international system to promote energy security, to lessen fear about the reliability of energy supplies.

1.4 India on Energy Security

India's thrust on energy security mainly emerged in the post-liberalization phase of the 1990s when India's liberalization policy accelerated India's economic growth and modernization process.[17] It was not until the late 1990s, under the former Prime Minister Atal Bihari Vajpayee, that energy security emerged as a policy priority for India. This phase could also be regarded as the first major push towards

[15] *ibid*
[16] *Opcit.,* Ashok Sharma. p.23
[17] *Opcit.,* Ashok Sharma. P. 28

diversification of sources and destination of energy for India and there was a steady growth in the economy. After this, the former Prime Minister, Man Mohan Singh emphasized energy security as the most important security concern, after food security.[18] Recently, with the change of ministry in India, the BJP-led NDA government has been taking measures to revitalize the Indian economy and deal with the developmental challenges.

As one of the fastest-growing major economies in the world, India is also the fastest-growing consumer of energy. Moving towards being the most populous nation, India does not have enough energy reserves to meet the mounting demand. Energy security has emerged as a priority policy issue for the last decade and a half, and the successive governments have also emphasized on addressing the challenges of imminent energy crisis. Unlike the past, where India's energy security policy focused only on managing supply, it has become more inclusive taking into account the political, social, and environmental issues. The quest for energy security in India could also be seen under the framework of four A's which is to make energy accessible to all the sections and sectors at an affordable price in a socially and politically acceptable carbon-controlled environment.[19]

1.5 North East India

The North-Eastern region of India is the agglomeration of seven states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, and Sikkim is also considered as a part of the North-Eastern region.[20] North East India is bestowed with natural resources like natural gas, oil, coal and has a huge hydropower potential which could provide a substantial amount of energy for India and its adjoining countries like Bangladesh, Pakistan, Myanmar, etc. As India's energy consumption is increasing rapidly and with India's lack of energy resources, India needs to tap its renewable energy potential. However, in spite of the huge energy or

[18] Edward Luce. *Head to Head in the Quest for National Energy Security*. Financial Times. November 17, 2004. Retrieved from www.ft.com/content/ accessed on 1st March, 2020

[19] Dr Ashok Sharma. *India's Quest for Energy Security*. The Pioneer. Feb 23, 2020. Retrieved from https://www.dailypioneer.com/2020/sunday-edition/india---s-quest-for-energy-security.html accessed on 1st June 2020

[20] North Eastern Council. About the North Eastern Council. Retrieved from https://web.archive.org/web/20120415001111/http://necouncil.nic.in/ accessed on 4th March, 2020

power potential in North East India, the entire region remains one of the most backward regions compared to other parts of India, with most of its energy reserves still left untapped. The region ranks as one of the lowest in terms of per capita energy consumption.[21]

1.6 Mizoram Profile

The literal translation of Mizoram is Land of the Highlanders and the people of Mizoram were originally known as the Lushais.[22] Mizoram was formerly called Lushai Hills District. The British annexation of Mizoram in 1890 resulted in the administrative division of Mizoram into two districts viz. North Lushai Hills District with Aizawl as its headquarter and South Lushai Hills District with its headquarter at Lunglei.[23] The Act of Parliament called The Lushai Hills District (Change of Name) Act, 1954 changed the name Lushai Hills District to Mizo District Council on 29th April, 1954[24]. After this, Mizo District Council remains a part of Assam till January 1971. Mizoram became a Union Territory with the implementation of the North-Eastern Areas (Reorganisation) Act, 1971 on 21st January 1972.[25] The Union Parliament passed the 53rd Constitution Amendment Bill 1986 and the State of Mizoram Bill 1986 on 17th August 1986, and accordingly, statehood was conferred on 20th February 1987.[26] With this, Mizoram became the 23rd state of the Indian Union.

Located in the North-Eastern part of India, Mizoram is sandwiched between Myanmar (Burma) in the East and Bangladesh in the west. In the north, are the Cachar district of Assam and the State of Manipur, while on the northwest lies Tripura.[27] The total geographical area of Mizoram is approximately 21, 087 sq. km.[28]

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[21] North Eastern Electric Power Corporation Limited. Power Potential in the North Eastern Region. Retrieved from https://neepco.co.in/projects/power-potential accessed on 1st June, 2020

[22] Y.D. Prasad (1987). Slavery in Modern India. A case Study of Early 20th Century in Mizoram. *Proceedings of the Indian Congress* . Vol. 48 p. 556

[23] R. Vanlalhmangaihsanga (2020). Political history of Lushai Hills since Pre-Colonial Era. *Mizoram University Journal of Humanities & Social Sciences.* Vol VI. Issue 1. p. 215

[24] *ibid.* p.220

[25] About Mizoram. *History.* Retrieved from https://mizoram.nic.in/about/history.htm accessed on 2nd June, 2020

[26] *ibid*

[27] *ibid*

It has a 404 km international boundary with Myanmar and 306 km with Chittagong hill tracts of Bangladesh.[29] It lies between 92.15 to 93.20 degrees (E) Longitude and 21.58 to 24.35 degrees (N) Latitude.[30] The Tropic of Cancer runs through the state at 23.30 degrees (N) at Maubuang, just at the southern periphery of the state capital, Aizawl.[31] The region falls under a high seismic sensitivity zone. A probabilistic method for seismic hazard assessment puts 60.25 percent of Mizoram under zone V and the remaining 39.75 percent under zone IV.[32]

As per the 2011 census, Mizoram has a population of 1,097,206. Out of these, there are 555, 339 males and 541, 867 are females.[33] The state's population forms only 0.09 percent of India's population. The total population growth of Mizoram during the last decade was 23.48 percent with a total population of 888, 573 in the 2001 Census.[34] The sex ratio is 976 females per 1000 males as per census 2011.[35] As per 2011 Census, In Mizoram, 571,771 people live in the urban region which is 52.11 percent while 47.89 percent of the total population lives in rural areas.[36] The population in Mizoram is thinly distributed with the density of the population recorded at only 52 persons per sq. km. while India is 382 persons per sq. km.[37]

The climate in Mizoram is quite pleasant, with temperatures ranging between 11 degrees Celsius to 21 degrees Celsius in winter and 20 degrees Celsius to 29 degrees Celsius in summer.[38] The weather in Mizoram is fairly comfortable throughout the year. It enjoys a temperate climate due to its strategic tropical location. The state receives heavy rain with an average annual rainfall of 2500 mm to

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[28] Mizoram Portal. *Mizoram at a glance.* Retrieved from https://mizoram.gov.in/page/know-mizoram Accessed on 2nd June 2020

[29] *ibid*

[30] Maps of India. Lattitudes and Longitudes of Mizoram.

[31] Envis Centre. *Tropic of Cancer passes through Maubuang, not Thenzawl*. Retrieved from http://mizenvis.nic.in/ViewGeneralLatestNews.aspx?format=Print&Id=2170 accessed on 3rd June, 2020

[32] Envis Centre: Mizoram Status of Environment and Related Issues. Retrived from http://mizenvis.nic.in/ViewGeneralLatestNews.aspx?Id=1130&Year=2015 accessed on 3rd June, 2020`

[33] Mizoram Population 2011 Census

[34] *ibid*

[35] *ibid*

[36] Census India. Mizoram Urban/Rural Population- Census 2011.

[37] *ibid*

[38] Mizoram State Climate Change Cell (2018). Climate Profile of Mizoram.

3000 mm. The average annual rainfall in the state capital, Aizawl, is 2394.96 mm.[39] Heavy monsoon rain usually begins from mid of April till October.

Development did not reach the Lushai Hills during the British rule in India. It was declared a Backward Tract along with some other hill districts under the Govt. of India Act, 1919.[40] Later, the tribal districts of Assam including the Lushai Hills were declared Excluded Area in 1935.[41] Even after India got Independence, situation in Mizoram did not improve much. The economic condition of the then Mizo District under the Assam government was pathetic as the state government did not bother to improve the economic conditions of the Mizos. Poverty, water scarcity, lack of electricity, hospitals and lack of other facilities were problems that people faced on a daily basis. Road transport was the only available form of communication linking Mizoram to other parts of the country that were in very poor shape. Before independence, Mizoram had only 6 foot wide pathways. [42] The first road built in Mizoram after Independence was jeepable road between Aizawl and Lunglei via Serchhip that began in 1950.[43] Lengpui Airport was not opened until 1998 to ease the state's bottleneck.[44]

The economic instability in Mizoram was one of the biggest factors behind the demand for the separation of Mizoram from Assam. In 1959, the then Mizo Hills, who were totally dependent on agriculture was devastated by a great famine, known as the Mautam Famine, to which the government appeared unconcerned.[45] The Famine was caused by the flowering of bamboos, triggering the rat population to grow in large numbers. After eating bamboo seeds, the rats made their way to the plantations, causing extensive damage to crops, attacked huts and houses. The inability of the Central and State government to meet the challenge Mizoram faced set the stage for an armed resurrection. It greatly contributed to the birth of the Mizo National Front (MNF), which fought for Mizoram's independence from the Indian

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[39] *ibid*
[40] About Mizoram. *History*. https://mizoram.nic.in/about/history.htm
[41] *ibid*
[42] Lianzela. *Post Independence economic development of Mizoram.* http://www.asthabharati.org/Dia_July99/lain.htm
[43] *ibid*
[44] *ibid*
[45] *ibid*

Union. After the MNF declared Mizoram independence from India on 1st March, 1966, Mizoram began its violent phase of freedom struggle.[46] Peace Accord was signed between the Government of India and the MNF on 30th June, 1986.[47]

During the twenty years of insurgency, law and order was maintained by the Indian Army.[48] During this period, not only did the economy of Mizoram suffer greatly, but the Indian Army committed atrocities against many civilians. The Army regularly violated the human rights and civil liberties of the people. Rape, murder, imprisonment and torture of the innocent were common. On seeing this, Brig. Thenphunga Sailo, a retired Army Officer, came to Mizoram and became a spokesman for civil liberties. Under his direction, The Human Rights Committee (HRC) was formed on June 22, 1974.[49] The human rights violations committed by the Indian army decreased significantly in a short period of time owing to the HRC's commitment.

Leaders of the Human Rights Committee later formed a new political party known as the People's Conference on April 17, 1975.[50] The party was led by the ideology of development logic concentrated its efforts on infrastructural development.[51] The party believed that economic self-sufficiency would bring an all-round development and political stability to the state. The party came into power in the Mizoram Legislative Assembly Election in 1978.[52] The creation of the new People's Conference Ministry occurred at the same time as the Sixth five-year plan commencement. To outline the strategic approach, a cabinet meeting was held in June 1978 and Brig T. Sailo presented the strategic plan, emphasizing that all future development plans should be geared towards the basic needs of self-sufficiency such as food production, sufficient supply of drinking water, generation of power and electricity in Mizoram, development of communication system, transport system and

[46] Sushil Kumar Sharma (2016). Lessons from Mizoram Insurgency and Peace Accord 1986. *Vivekananda International Foundation.* p. 4.
[47] *Ibid.* p. 6
[48] F. Lalramhluni (2020). Regionalism and Mizo Politics: a study of Mizoram People's Conference Party. *IOSR Journal of Humanities and Social Sciences.* Voulme 25, Issue 4. Series 6. p. 48
[49] *ibid*
[50] *ibid*
[51] Interview with Lalhmangaiha Sailo, President, Mizoram People's Conference (MPC) (Six basic needs and hydropower projects) on 22 May, 2021
[52] *ibid* p. 53

rural development.[53] The six basic needs are still referred today as it was the first integrated policy for development of the state towards self-sufficiency.

1.7 Review of Literature

'*Energy and Power in North East India'* by Subhadeep Bhattacharjee (2010) is perhaps the first book that addresses numerous problems related to the power sector in North East India. The states in North East still face severe power shortages throughout the entire region despite its power potential. The book discusses power scenarios in the North East States. It gives detailed statistics, diagrams, and pictures of the power sector in the region including its various constraints. It gives a special reference to the power status of Tripura. Technology suitable for the states to solve its energy problems was suggested. It presents the available natural resources in the North East Region and concluded that biomass and solar energy could be harnessed for decentralized power generation.

'*Energy Security and Environmental Sustainability'* by Surya Narain Yadav (2010) is a book that covers a variety of topics related to energy security such as the concept of energy and its crucial linkages with economy and environment. Development has a serious impact on the environment and has resulted in man-made climate change. The author stresses the need to reduce carbon gas emissions and suggested various ways to achieve sustainable development. He also highlights the significance of having strategic energy security. He analyzes how energy security plays a great role in the relationship between various countries particularly for the already conflicting countries such as China and the USA. He said that the creation of a peaceful and stable environment is usually limited to areas where strategic interests are not threatened. There is a continuous rivalry for energy among various countries and the book covers countries of China, Japan, and Korea's strategy concerning energy in Africa. Nigeria's increasing dependency on oil and its implications in the goal of sustainable development is examined. He also incorporated the energy crisis and the new mechanism of energy security.

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[53] *Op. cit.,* F. Lalramhluni. P. 50

'*Energy Security: An Overview'* is an article by Suwa Lal Jangu (2013) that presents an overview study of energy security in India. It explains the concept of energy security and energy security scenarios worldwide, including India and particularly North East was provided. It depicts energy starvation in India and the huge gap between demand and supply at the domestic level. The author analyzes the three dimensions of energy security and the goal to be achieved by all countries. The dilemma of energy security in India is related to its option, strategy, and policy of energy. The author's concern for sustainably ensuring energy security is reflected in the article by urging stakeholders to formulate an integrated and sustainable energy security policy.

The Indocentric Foreign Affairs Monthly Journal, World Focus March 2013 issue was dedicated to Energy Security: Indian Perspectives edited by G. Kishore Babu. The journal consists of 21 articles that deal mainly with the meaning and concept of energy security, India's energy scenario, its policies and challenges, and India's option to Clean Energy. In one of the articles, '*Energy Security in India: Domestic Issues'* written by Sampa Kundu, the energy scenario of North East India was covered. He mentions how the North-Eastern states have a huge potential in power generation. Yet, most of them are still left untapped. The journal mainly focused on the need for India to seek oil in overseas oilfields and establish friendly relations with certain oil-exporting countries. The various challenges and problems that India faced and ways to enhance energy security to achieve its objectives were proposed. The use of renewable sources of energy such as wind energy, solar energy, hydro energy, biomass energy, and urban waste energy were suggested to have clean energy.

Sunil Kumar Singal and Varun (2015) in the article, '*Small Hydropower for Sustainable Development: Promising Energy Potential for India',* discuss the suitability of small hydropower in developing countries for sustainable development. They point out the potential of small hydropower in India out of which only a small portion has been harnessed. Small hydropower developed in an environmentally sound and socially responsible manner is the best form of sustainable development and they considered small hydropower to be a promising renewable source of energy.

The book on *Environmental Protection in India: Socio-economic aspects* by Abhay Kumar (2005) highlights the economic condition of India, the challenges facing India after it got Independence in 1947, how the government's remedy to tackle these problems has in turn cause harm to the natural resources. It deals with the concepts of environment and development and their relationship and the resultant social movements. The author describes how much the government policy can affect not only the environment but the lives of its people, whose survival depends on the natural resources. He questions whether the developmental projects are really for the people especially the poor or if the contractors and superior officials that are benefiting from all of it. He examines the impact of large dams that displaces the poor people and explores the alternative theories of development.

'*India's Look East Policy: The energy security perspective'* is an article by S.L. Jangu (2016) in Look East to Act East Policy: Implications for India's Northeast edited by Gurudas and C.Joshua Thomas, discusses the role of North East India and Myanmar from an energy security perspectives. It describes India's policy shift towards Myanmar in search of alternative sources to meet its increasing energy needs. It also shows how the quest for energy sources in Myanmar stirred competition between China and India. Despite the huge potential to draw energy from Myanmar, India remains far behind compared to China. The author draws out how India should engage with Myanmar to ensure its energy security. He argues that development in the Northeast region can serve as a link between India and Myanmar in strengthening India's energy security and in the success of India's Look East Policy.

In the article, '*Climate Change, Energy Security and Sustainable Development',* R.B Singh and Sagar Khetwani (2017) analyze the disastrous effects of global warming and the need to adopt a sustainable development approach and clean energy. The article highlights that the Rio Summit was the first sincere effort taken to combat environmental problems. It shows how the mounting population in cities has put immense pressure on the environment. India's vision towards sustainable development and the challenges to ensure clean energy was also discussed. The paper highlights the urgent need to combat climate change and

provides an optimistic vision to solve energy security challenges and tackle global environmental issues.

The book, '*India's pursuit of energy security: Domestic Measures, Foreign Policy and Geopolitics*' (2019) written by Ashok Sharma, examines the dynamics of energy security of India. It analyzes the challenges faced by India to meet its rapidly increasing energy demand. The book depicts the nature of the gap between energy demand and supply in India. It also includes India's aim to ensure its energy security through a non-conventional and carbon-controlled environment. The author also mentions how hydrocarbon energy will continue to contribute to the majority of India's energy demand for a few decades to follow, despite the impressive efforts and progress towards providing renewable sources of energy. The book also covers India's quest for energy security abroad to meet its energy requirement due to insufficient domestic production. Ashok also analyzes certain problems associated with the attempt to diversify energy sources. India's exploration in other countries has also stir direct competition with China. The author then examines India's energy security geopolitics in the context of its complex relations with China.

The above literature shows that there is increasing awareness and concern for sustainability and energy security in India. However, in the case of the North East, limited publications are available on energy security especially in relation to Mizoram. There is no analysis being done in this regard. Thus, it requires an in-depth study and analysis to solve the problem being faced by the people of Mizoram due to energy shortage.

1.8 Statement of the Problem

Modern society can no longer run without energy. In the growing age of interconnectedness and globalization, industries and technology are rapidly developing. Dependence upon energy is increasing and domestic production is not enough to meet the growing demand of the country. Increasing energy import increases a nation's vulnerability to external shocks and threats. Domestic production must be increased while keeping in check its sustainability in terms of not only economic but social and environmental dimension.

Ever since Independence, the leaders in India were in a haste to raise the economic condition but even with the efforts and commitment towards achieving developmental goals, there is no doubt that India is still lagging in many areas. There is a wide gap in terms of development and energy supply in the rural and urban areas. With the rapid growth of population, India is the third-largest consumer of oil and is facing the critical challenge of meeting the escalating demand for energy. Despite the government's claims that all villages have electricity, there are still millions of people that lack access to electricity. India's definition of electrification is when the number of households electrified in a village is at least 10 percent and all the public buildings are electrified. So even when electricity reaches a village, it does not necessarily mean it reaches every home of the village.

The challenge for India is that the developmental agenda and ensuring energy security needs to be met through a carbon-controlled environment by remaining committed to low carbon emission. New energy security concern is not only limited to securing its sources but also with its consequences. India is not only energy starved in terms of availability, but the non-conventional sources of energy such as hydropower also are not cheap and it takes time to build them. India is faced with the dilemma of how much it should rely only on renewable energy resources to meet its mounting energy crisis.

Mizoram, located in the North eastern part of India is connected through National Highway 306 (earlier known as NH 54) with the rest of the country that runs through Silchar. NH 306 serves as the most important means of transportation of goods and passengers. It is the economic lifeline of the state. Whenever there are disruptions along the national highway, the state immediately faces several issues in terms of its supply including basic needs of the state such a food, oil and gas supply. The majority of the population still depends on agriculture and the energy consumption and demand is relatively low as compared to other states in India. Nevertheless, with the growth of industrialization and modernization, there is a steady growth of small-scale industries and factories in Mizoram and the electricity demand is increasing. The progress of a society largely depends on the availability of energy resources, but Mizoram is still overly dependent upon energy sources from

outside to meet its energy requirements. Development in relation to power sector is very slow. The state is not self-sufficient in terms of power generation and has to purchase from various power-generating sectors. The state's only source of power generation is through non-conventional and renewable sources of energy. It does not have the potential for generating electricity through conventional sources such as coal and petroleum. There are still many issues underlying power and energy supply in the state. Even the city often faces power cuts or outages.

The state has rich potential in renewable energy sources such as hydropower and solar. Hydropower is also the greatest contributor to the state's electricity supply. But only a few of it has been harnessed and there is a question on its sustainability aspects. The state needs to consider the present and future environmental impacts of the various sources of energy including its social equity. There is a requirement for research on alternative sustainable sources of energy.

1.9 Scope of the Study:

The study of the research shows the energy security scenario of Mizoram. It highlights an overview of energy policy and the energy demand and supply of the state. It also includes a study about the energy resources, prospects, and problems in the state. It focuses on the sustainability dimension of energy security and the need to implement development project while ensuring the dimensions of sustainability simultaneously. The study analyzes the efforts of both the state and the Union government in improving securing energy. It also explores the potential alternative, environmentally friendly, and renewable sources of energy in the state.

1.10 Methodology:

The study of the research is descriptive e and analytical in nature. Analysis of objectives of the study and answers to the research question is carried out based on social science and interdisciplinary methodologies. Therefore, both qualitative and quantitative methods are used in the study. The data and information are collected from both primary and secondary sources. Primary data is collected from annual reports, documents and interview based study. An interview was conducted with 8

respondents belonging to concerned stakeholders in energy sector, NGOs and government officials. Secondary data included books, newspapers, journals, and magazines.

1.11 Limitations of the Study

The study requires experts with knowledge in the related field to provide adequate information. Due to the pandemic only few of the respondents were willing to cooperate and contribute to the work. As a result, the researcher could not access to sufficient sample size and hence collected only eight reliable samples among all the interviews. In line with the above mentioned, there were no proper records kept among the organizations and stakeholders for future references which become one of the main obstacles. The duration of the work has thus, been prolonged and the study was limited to focus more on the quantitative aspects rather than the qualitative.

1.12 Objectives of the Study:

1. To present energy security scenario of Mizoram
2. To study the existing and potential energy resources in the state.
3. To assess the sustainability of energy resources in Mizoram in economic, environmental, and social aspects.
4. To examine the energy policy of the state.

1.13 Research Questions

1. What is the scenario of energy security in Mizoram?
2. Do energy resources meet the energy need of the state?
3. Are energy resources sustainable in terms of economic, environmental, and social aspects?
4. Does energy policy adequately address the challenges and ensure the state to become self-reliant?

1.14 Chapterization

Chapter I: Introduction

The introductory chapter discusses the theoretical, thematic, and methodological aspects of the study problem. It includes a review of literature, research methodology, and chapter plan of the study.

Chapter II: Energy Security Scenario

The second chapter presents the scenario of energy security from the global to local level. It includes resources, energy production and consumption patterns of the state.

Chapter III: Energy Resources

This chapter explores the existing and potential energy resources in the state, the conventional and non-conventional, renewable resources in Mizoram.

Chapter IV: Energy sustainability: economic, environmental, and social aspects.

This chapter assesses the sustainability aspect of energy from resource to production.

Chapter V: **Energy Policy of Mizoram**

The chapter examines the state's energy policy in ensuring the state becomes self-reliant in the energy sector.

Chapter VI: Summary and conclusion

The last chapter includes the findings of the research with concluding remarks and suggestions.

CHAPTER 2
ENERGY SECURITY SCENARIO

The first chapter is the introduction of the research work. It includes review of literature, objectives and scope of the study, the methodology used in the research along with the sequence of the chapters. It dealt with multidimensional aspect of energy security ranging from local to global level. A brief profile of the state of Mizoram is also presented in the first chapter.

Energy shortage puts development at a halt and many problems of the world today can be linked to the use of energy. Lack of energy impedes development particularly in poorest parts of the world. Energy could also be used as a political tool, as it has been in the past, in case of conflict with other countries. To have a better understanding of the problems associated with energy security in Mizoram, this chapter deals with the energy security scenario not only at the local but also at the global and national level.

2.1 Global Energy Security Scenario

The role of energy resources and its security have become more important than ever even in the field of international relations. Energy resources are no longer utilized only for domestic or technical purposes; but have become a priority policy for nations and determinants of relations among them. After the end of Cold War and the disintegration of USSR, energy security serves as a foreign policy priority for countries not only of energy-rich, but also energy-poor countries.[54] The significance that energy has in economic and social developments, for individual countries and their relations with others and for the world economy and environment, has made nations become more interdependent with one another than in any other area.

Meanwhile, for energy importing countries, particularly the industrialized ones, a sustained high oil prices can have a detrimental effect on their economy and also in the global economy. The threat for energy importing, developing countries is

[54] Suwa Lal Jangu (2013). India's Energy Security: an Overview. *Contemporary Social Scientist.* Vol V-2 & Vol V-1, p. 103

now more serious than before due to increasing oil prices and other energy import bills.

Ever since the first oil crisis in the 1970s, there has been transformation in the global economy. Energy security concerns facing different countries especially large energy consumers have significantly become more complex. Prior to the Industrial Revolution, the energy mixes were relatively homogenous and transition from one source to another was extremely slow. Today, owing to technological advancement, mechanical and analogue systems that were conventionally energized by oil-products are being replaced with automated and networked systems that run on electricity.[55] Without electricity, modern life has become unimaginable. The number of devices connected to Internet worldwide is also growing rapidly. There were an estimated 22 billion devices connected to Internet worldwide in 2018 and is forecasted to grow up to 50 billion by 2030.[56]

Due to improved distribution, the consumption rate of natural gas has also grown substantially. Over the last two centuries, natural gas was primarily used for lighting. Today it has a wide variety of uses in homes, business, industries and power plants. A 50% rise in global natural gas consumption has been projected by the US Energy Information Administration between 2010 and 2035.[57] These changes have ensured that electricity and natural gas, in addition to oil, has become key enablers of many facets of modern society.

The global primary energy markets still rely mainly on fossil fuels such as oil, coal and natural gas. In 2019, only around 16% of global primary energy came from low-carbon sources.[58] Nuclear energy and renewable sources such as wind, hydropower, solar, bioenergy, geothermal and wave and tidal are considered as low-

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[55] Ashok Sharma (2019). *India's Pursuit of Energy Security.* New Delhi: Sage Publications India Pvt Ltd. p-17

[56] Lionel Sujay Vailshery. *IoT connected devices worldwide 2030.* Statista. January 22, 2021. Retrieved from https://www.statista.com/statistics/802690/worldwide-connected-devices-by-access-technology/ accessed on 3rd March, 2021

[57] Energy Information Administration (2011). *Natural Gas: World Natural Consumption by region, Reference Case*. International Energy Outlook 2011.

[58] Hannah Ritchie and Max Roser (2020). *Energy.* Our world in Data. Retrieved from https://ourworldindata.org/energy mix#:~:text=We%20see%20that%20in%202019,and%204.3%25%20came%20from%20nuclear accessed on 2nd Oct, 2020

carbon sources. Although there is an increase in production of more and more energy from renewables each year; coal, oil and natural gas still dominate global energy mix. Fossil fuels contributed 84% of the world's energy consumption with oil as the highest at 33 %, coal accounting for 27% and gas 24%.[59] Although the overall global consumption of coal has decline substantially, it continues to play a significant role not only in iron and steel industries but remains a dominant contributor in generating electricity worldwide fuelling one-third of global electricity.[60]

It has been estimated that global energy trade, almost entirely based on fossil fuels, is bound to continue to accelerate rapidly. Trade in oil is likely to increase over the next few decades. The oil and gas industry will continue to play an important role and hydrocarbons is estimated to contribute to around 44% in 2050.[61] The mismatch between energy production and consumption will increase, linking counties and states closer together, but also posing new challenges. Moreover, the dependence of global energy markets on fossil fuels, which are finite and non-renewable in nature, brings with it globally destabilizing effects, mainly through price shocks and geo-political tensions. There is also a probable increase in vulnerability to disruptions of energy supply, as a result of politically motivated sabotage or technical mishap. The extensive use of fossil fuels posed serious threat to global security along with damaging environment concerns.

2.2 India's Energy Security Scenario

India is one of the fastest growing economies in the world. It has become fifth-largest economy in 2019. It ranks as the third largest economy in terms of Gross Domestic Product compared in Power Purchasing Parity at $11.33 trillion.[62] Due to the fast paced economic growth, it resulted in surging demand for energy. India's primary energy demand is expected to grow at a much faster rate than any major

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[59] Robert Rapier. Fossil Fuels still supply 84 percent of world energy- And Other Eye Openers from BP's Annual Review. *Forbes.* June 20, 2020

[60] IEA (2021). *Coal-Fuels & Technologies.* Retrieved from https://www.iea.org/fuels-and-technologies/coal accessed on 5th June, 2021

[61] Energy Transition Outlook 2017. *Oil and Gas Forecast to 2050*. Retrieved from https://eto.dnv.com/2017/oilgas accessed on 5th May, 2020

[62] *ibid*

economy with a CAGR of 4.2 per cent during 2017-2040.[63] Fossil fuels and in particular, coal sector continues to play a predominant role in India's energy mix. The fast growing economy and rapid population growth are the main drivers of these demands which are escalating every year.

The demand for hydrocarbon energy in India is much more that the production. There is an increasing energy demand but the indigenously available energy resources are limited. India has only 0.3 per cent of the world's total oil reserves.[64] It is not sufficient to meet the requirements in the long run. According to the Petroleum Planning & Analysis Cell, the country imported 270 Million Metric Ton of crude oil in 2019-20 valuing $120 billion.[65] The gap between demand and supply of oil in India is widening and there is no likelihood of the country's demand for oil to decrease in the near future. It is clear that India will continue to be a net importer of oil from its current reserves.

Natural gas reserve in India is also very limited. India has 43 trillion cubic feet (Tcf) of proven gas reserves in 2017 and ranks 22nd in the world.[66] It accounts only for about one per cent of the world's total natural gas reserves. India has proven natural gas reserves of 22.1 times its annual consumption. [67] It ranks fourth in the largest importer of liquefied natural gas in the world in 2017.[68]

India is also the second largest consumer of coal in the world.[69] Coal contributes the highest in India's energy mix. It is the dominant fuel for generation of power accounting for approximately 70% of India's electricity generation.[70] India

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[63] Ministry of Petroleum & Natural Gas, Govt. of India. *Annual Report 2019-20.* Energizing India's Progress.

[64] Worldometer (2016). *Oil Reserves in India.* Retrieved from www.worldometers.info>oil>india/ accessed on 10th June, 2020

[65] Abhimanyu Joon. Can India Imports make India Aatma Nirbhar? *Outlook.* 2020, 3 September.

[66] Worldometer. *India Natural Gas.* Retrieved from https://www.worldometers.info/gas/india-natural-gas/ accessed on 1st Feb, 2021

[67] *Ibid*

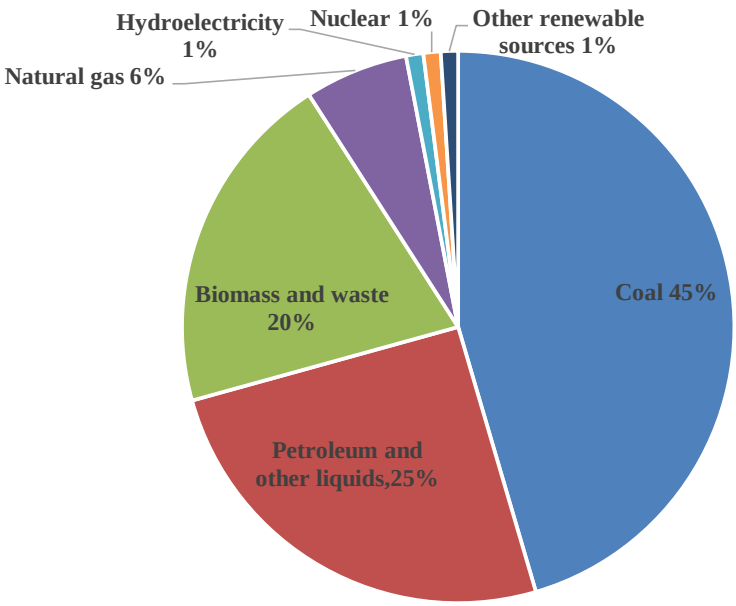
[68] Statista Research Department (2021). *India-Import volume of LNG into India FY 2012-2020.* Statista. Retrieved from https://www.statista.com accessed on 2nd Feb, 2021

[69] Coal Information 2019: Overview. retrieved from https://www.iea.org/reports/coal-information-overview accessed on 2nd Feb, 2021

[70] IEA. *India Energy Outlook 2021*. Retrieved from https://www.in.undp.org/content/india/en/home/sustainable-development-goals.html

has 107,727 million tonnes (MMst) of proven carbon stocks in 2016, making it fifth in the world and accounting for approximately 9% of the world's total coal reserves of 1.139.471 MMst.[71] India has proven reserves that are 111.5 times the annual consumption. If India's energy consumption follows the current course, it is estimated to run out of coal in the next 111 years excluding unproven reserves.[72] However, the increasing climate concerns and efforts to decarbonise the global energy mix have considerably reduced the importance of coal in recent years.

Fig 2.1 India total primary energy consumption by fuel type, 2019



Source: International Energy Agency, World Energy Outlook 2019

The energy profile of India is heavily dominated by fossil fuel based resources. The three major sources of energy in India are not only exhaustible but also contribute directly to global carbon dioxide emissions. India is currently the third largest carbon emitter in the world, accounting for 2.46 billion metric tonnes of

[71] Worldometer. *India Coal* https://www.worldometers.info/coal/india-coal/ accessed on 1st June 2021
[72] *ibid*

carbon, which is around 7% of the overall global carbon dioxide emission.[73] With the emerging global environment and climate concerns however, transforming the carbon economy into a green economy has become a priority. The renewable energy capacity In India has dramatically increased in the last few years as a response to it.

India is a country with over 1.2 billion people, which is over 17% of the world's population.[74] The country's energy consumption has increased at one of the fastest rates in the world. However, India as a country suffers from severe energy poverty and widespread power shortages. India's energy consumption has increased relatively quickly in recent years due to population growth and economic development. Given India's rapid economic growth, rapid urbanization and the improvement in the living standards of millions of Indian households, demand is likely to increase significantly. However, the country does not have sufficient domestic energy resources, mainly oil and natural gas, and has to import most of its growing needs. Heavy reliance on imports makes a nation vulnerable to threats such as price fluctuations or supply disruption due to geopolitical uncertainty. India's increasing reliance on imported energy sources will serve to deepen its energy-security worries.

2.3 Energy Security Scenario-North East India

The North Eastern region of India comprising eight states presents a complex picture of a diverse and culturally rich region in the midst of unity. Located in the easternmost region of India, it is a land where multiple indigenous communities reflecting diversity in lifestyles and social customs resides. The North East covers a geographical area of approximately 262,230 km^2, almost 8 per cent of India's total area, and shares long international border with China, Bhutan**,** Bangladesh and

[73] The wire staff . Study finds India's rich emit 7X more emissions than the poor. *Science the wire.* January 19, 2021. Retrieved from https://science.thewire.in/environment/india-carbon-emissions-rich-poor-households/ accessed on 20th May 2021

[74] Worldometer. *Indian Population (2021).* Retrieved from https://worldometers.info/ accessed on 17th May 2021

Myanmar.[75] It is connected to the rest of India by a narrow corridor known as the 'chicken neck'.

The northeast region has a subtropical climate due to its relief and the influence of the southwest and northeast monsoons. It receives almost 90% of the annual rainfall of the southwest monsoons. The mountainous regions of northeast India have abundant rainfall, averaging between 2,000 mm and 3,000 mm.[76] The region has rich natural resources, especially great potential for water resources mainly from the Trans-Himalayas, the Middle Himalayas and Sub-Himalayas, the Patkai-Purbanchal Hills in the northeast and the Karbi Hills -Jaintia-Meghalaya-Garo in the southern periphery, which account for 34% of India's total water wealth, although it only accounts for 7.9% of the country's total land mass. The rivers in this region support tremendous biodiversity as they are located at two biodiversity hotspots, the Indo-Burmese biodiversity hotspot and the Eastern Himalayan hotspot. The northeast region is under the Indo Burma Biodiversity Hotspot ranking 6th out of the 25 global biodiversity hotspots.[77]

North East Region is bestowed with not only water but other natural resources like natural gas, oil and coal. It is blessed with resources that are enough to provide substantial amount of energy to be used not only in India but also in its adjoining countries of Bangladesh, Pakistan and Myanmar.

The North East is the one of the most powerful yet unexplored region in India offering huge potential for renewable energy. Owing to its mountainous topography and perennial streams, the North East Region has huge potential for harnessing hydroelectricity. With the continuous improvement in infrastructure and communication facilities, the North east being one of the most promising hydro potential regions could soon become a power house of India.

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[75] Astha Bharati. *The North East of India*. Retrieved from http://www.asthabharati.org/Dia_Jan%2009/the%20N.E.%20ind.htm Accessed on 20th May, 2021

[76] K.R Dikshit & Jutta K. Dikshit . Weather and Climate of North-East India. *North-East India: Land, People and Economy.* July 2014. pp 149-173

[77] Jeev Prabha and Dr. Anju Jain. Northeast India: A Unique Biodiversity Hotspot. *North East India: The Untapped Tourism Industry.*

States in the North East shares the common problem of under development. They are one of the least developed regions in terms of economy and infrastructure development. Several development programs have been created by the Central Government to prevent poverty and underdevelopment in the region. In order to boost the Northeast's economy and achieve sustainable development, the Northeast Council (NEC) was established in 1971 by the Indian government[78] and the Ministry of Development of North Eastern Region (MDoNER) in 2001.[79] These states rely heavily on central government for financial support. They have been given special category status, protected by positive discrimination policies, with aid continuing to be provided under the plan when states only need to increase 10% of the budget and the remaining 90% are supported by central government.[80]

Despite the provisions made for the North East states, these states still suffers from low per capita income, low progress in industrial sector, and low capital formation. There is inadequate exploitation of natural resources and due to its remote location, there is lack of private and foreign direct investment and unemployment rate among the relatively high literate people is also very high. The Northeast is power starved in spite of its huge potential. Only about 2.92% of its hydropower potential, which is 1,727 MW, has been harnessed so far.[81]

With a population of over 45 million, the per capita energy consumption of the entire North East is one of the lowest in the country with its consumption lower than the national average. Four of the North East states of Assam, Nagaland, Manipur and Tripura are at the Bottom Five in terms of per capital electricity consumption in India. As per the data released by the Ministry of Power, India's per

[78] North Eastern Council. Retrieved fromhttps://udd.assam.gov.in/portlets/north-eastern-council-nec-scheme-0 accessed on 16th March, 2021
[79] Mdoner. About Ministry. Retrieved from https://mdoner.gov.in/index.php?linkid=111 Accessed on 16th March, 2021
[80] North East Council. *Regional Plan.* retrieved from http://necouncil.gov.in/about-us/nec-supported-institutions accessed on 20th March, 2021
[81] NEEPCO. Power Potential in the North Eastern Region. *Hydro Electric Power*. Retrieved from https://neepco.co.in/projects/power-potential accessed on 20th March, 2021

capita consumption of electricity is 1,181 kWh as of 2018 - 19 while Assam and Tripura are only 341 kWh and 514 kWh respectively.[82]

North East India has been under-represented in the mainstream of national political priorities for a long time. Due to lack of infrastructural development in the region, the region has been kept at economic disadvantage. Besides its geographical complications, due to the long-time exclusion of the North East in the national mainstream of energy sector, there is grave sense of deprivation in the region. This has ultimately alienated the people of North East with the rest of the country and vice versa.

Northeast India is a treasure trove of natural resources. Although being a storehouse of natural resources and energy potential, from hydropower to natural gas, including coal and oil, the advances in this sector have not been proportionate to the opportunities. As a result, there is a large power gap between availability and demand within the region. Low energy demand in the region due to scattered population and lack of industrial activities is partly responsible for inability to improve energy security in the Northeast. There is an imbalance between hydropower and thermal energy, both in terms of production and availability. The transmission and distribution sector also needs an upgrade. The existing transmission lines are in bad shape and it is the weakest link in the electricity industry in the North East. Huge transmission and distribution losses are one of the main challenges facing the energy sector in the region. Policy for proper utilization of the natural resources to improve productivity and capabilities of the Northeast area must be adopted while conserving its biodiversity.

2.4 Energy Security Scenario - Mizoram

Mizoram is one of the fastest growing economies among the Indian states. According to Indian Economic Research, Mizoram recorded an increase in gross

[82] Express News Service. Telling Numbers: Indians use 1181 kWh electricity per capita, wide gap among states. *The Indian Express.* Nov 25, 2019

domestic product (GSDP) of 13.04% in the 2018-19 financial year.[83] In Mizoram, however, the service sector (46%) has the largest share of the state gross value added (GSVA), agriculture and related sectors contributed 28%.[84] The industrial sector provided only 26 per cent of the total value of GSVA.[85] The slow industrial growth is largely due to insufficient power supply in the state. The main occupation of the people is agriculture.

The main conventional energy sources in Mizoram are firewood and wood chips, petroleum products and electricity.[86] Mizoram relied mainly on electricity imported from other states via grid lines. As per the National Sample Survey Report in 2007, electricity was already the main source of energy for rural lighting reported by 86% of households with only a few of the remaining households depending on kerosene, gas and other sources. Firewood and wood chips, the dominant cooking fuel in rural Mizoram, was used by around 70% of all households in rural areas, while around 29% use LPG and the remaining 1% from other energy sources.[87] However, the urban scenario differs as LPG is the main fuel for cooking at around 88% of households.[88] The energy scenario for urban lighting was close to that of 99.5% of households that consume electricity and the remaining 0.5% is used by gas and other sources.[89] However, there has been a dramatic change in rural-urban lighting scenario. As on 31st Dec 2019, all 704 census villages in Mizoram has been reported as electrified.[90]

Mizoram lags far behind the country's economic and infrastructure growth, which can easily be represented as per capita energy consumption, a vital indicator of development and growth. In all the demand sectors such as households, industry,

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[83] The NorthEast Now. *Mizoram registers 13.04 per cent growth in GSDP*. Retrieved from https://nenow.in/north-east-news/mizoram/mizoram-registers-13-04-per-cent-growth-in-gsdp.html accessed on 3rd Oct, 2020

[84] Economic Survey 2019-20. *Brief note on Mizoram Economy*. P 10

[85] *ibid.*

[86] Mizoram State Action Plan on Climate Change (2012-17) Mizoram, Directorate of Science & Technologies. p. 91

[87] *ibid.*

[88] *ibid.*

[89] National Sample Survey Organizations, Govt. of India. *National Sample Survey 61st Round 2004.2005.* April 2007

[90] DDUGJY & Saubhagya: *Status of Rural Electrification in Mizoram.*

farmers, etc. the per capita energy consumption of Mizoram is among the lowest in the country. The energy requirement of various consumers is different for different season, time, place and process and energy. Till now Mizoram is not exposed to any large industrial activities. The per capita electricity consumption during 2018-19 was 617 kWh against 1181 in India.[91]. The availability and access to clean, reliable, cheap and affordable power are important parameters for which the economic and social development of every developing country must be encouraged.

According to the 2001-2011 census, the Mizoram population increased by approximately 22.78% reaching 1,09,10,143.[92] As the total population of the state grows especially with the urban population increasing rapidly, the demand for electricity also increases day by day, with electricity being a key factor in achieving a higher standard of living.

With the state receiving heavy rainfall with an average annual rainfall of 2,500 mm to 3,000 mm, hydropower potential is certainly around 4500 MW, which is not only sufficient to meet local requirements, but also to leave the surplus for commercialization.[93] Despite the rich hydro potential, only 0.6% (29.35 MW) of its potential has so far been harnessed. The state covers its energy needs through its own sector of small hydropower plants, the deficit of which is supplemented by other power plants from Central Generating Stations. The state spends a lot for purchasing power from other states. It purchased about 95% of the total energy needs and the total power purchase bill to be paid in 2029-2020 is 329.87 rupees.[94] The lack of energy in the state is due to the minimal ability to generate energy locally, often resulting in power outages. The changing climatic conditions and inconsistent rainfall patterns in the state have made water inaccessible in times of water scarcity making hydropower generation unstable.

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[91] Press Information Bureau, Government of India, pib.gov.in
[92] Mizoram Population 2011 Census
[93] Power & Electricity Department, Govt. of Mizoram . *Hydropower & its Development.* Retrieved from https://power.mizoram.gov.in/page/hydro-power-potential-its-development accessed on 3rd Oct, 2020
[94] Power & Electricity Department, Govt. of Mizoram. *Annual Report 2019-20*. P. 25

As a result of its mountainous topography, Mizoram is faced with certain limitation. It is technically challenging to infiltrate electronic network into distant areas of the mountains. Likewise, energy sector of the state is accompanied by many other difficulties. It is linked with problems and delivery performances such as capacity increase, energy generation, transmission and distribution losses and low plant load factor. Mizoram is almost entirely dependent on other states and the Central government in terms of power and energy supply and in generating funds. The state is connected to the rest of the country through National Highway 306 which serves as an economic lifeline of the state. The state often faces disruptions in its supply due to economic blockade in the National Highway. Mizoram lacks security of energy supply as it has only one national highway connecting itself to the rest of the country. Due to the overly dependent nature of the state, the National Highway therefore serves not only as an economic lifeline but instantaneously becomes very important in geopolitical relationship and tension with neighbouring states.

States that rely too heavily on others and imports to meet their energy needs without alternatives are more vulnerable and have less power because energy is often used as a political tool. In this regard, energy security displays its immediate significance not only for economic security but also for civil security. Any disruption in the supply of energy may have an adverse effect on the wellbeing of the people at large. It may result in price rises, slow down development or even diminish the income of the people automatically. An importing state that feels vulnerable to the loss of imported oil or natural gas may feel pressured even in other areas of its non-energy related relationships with supplier states. The suppliers tend to have great influence on the economies of the importing countries, which can have political implications. Energy security means avoiding heavy dependency on one energy source and promoting the maximization of self-sufficiency through the use of local resources.

The significance of energy security cannot be stressed enough for a state like Mizoram with its developing economy and dependency upon others to meet its energy needs. The state needs development in almost every aspect. Population in the

state is increasing and with it, electricity consumption is also increasing day by day. Even though all villages in Mizoram are electrified, the average hours of power supply daily, during September 2019, in rural areas was only 15 hours.[95] Transmission and distribution loss, poor response time and restoration time is also another hindrance to quality of supply in the state. The state, including the other north eastern states, has problems which are not encountered in other parts of the country.

Exploration of oil and gas in Mizoram still remains unfruitful. Therefore, the state needs to tap its potential in other areas. One of the most suitable solutions to overcome this situation is to research and use innovative sources. To cope with the growing power demand due to various factors such as population growth, urbanisation and the introduction of industrial development and considering the current power crisis in the state, the state government has started to research possibility to increase energy production which focuses on installing renewable resources that are also kind to the environment. Not only through increasing production and generation, maximizing energy efficiency by replacing the use of firewood and LPG in scarcity areas, with electricity for cooking can also help in utilizing the state's resources to its full potential. Promoting the use of innovative energy options will not only reduce pressure on existing forest but also decrease carbon dioxide emission.

[95] Press Information Bureau. Government of India. *Electrification of villages.* Retrieved from https://pib.gov.in/PressReleseDetailm.aspx?PRID=1592833 accessed on 20th June, 2020

CHAPTER 3
ENERGY RESOURCES

The previous chapter highlighted the security scenario of energy and the related problems at the national and international level in general and Mizoram in particular. To have a better perspective of the energy scenario within the state, it is necessary to deal with the energy profile of the Mizoram including the existing energy resources and the potential that needs to be explored. This chapter emphasized the available renewable energy sources of the state to meet the growing energy requirements.

Humankind has come a long way and passed through many complicated stages in developing various energy sources, and the search for a more efficient energy source continues today. The projected increase in global energy demand over the next few years is substantial. Much of this growth will go to developing countries as the industries and economies still grow at a fast rate. In the long-term perspective, production and consumption patterns, energy mixing, and investment potential are both evolving and influence an altering geopolitical environment. There is no rapid and permanent solution to the challenge of global energy security. A series of issues related to energy security should not only be pursued to engage in a continuous dialogue, between nations in terms of political, regional, and global life but also in terms of dialogue and partnership between governments and industry. The need for affordable energy with cleaner alternatives will increase, which will be used more efficiently and economically for the majority of the world's population.

3.1 History of Energy

Energy has existed since the beginning of time. However, energy requirements were modest before the Industrial Revolution. In the past, man relied on basic forms of energy. The first source of energy was the sun, which provided warmth and light during the day. People got up and slept with the light, houses were built with respect to the sun and wind to heat, cool and light up. When fire was discovered, it was then used for many purposes, from the kitchen to an additional

source of heat and light. Fire was essential and coal, hay, dry manure and animal oil served as fuel and wood, in particular, remained as the chief global fuel for centuries. Animal and human muscles were mainly used for labour and transportation. Other sources of energy such as wind and water mills were available, but their overall contribution was limited.

3.1.1 Fossil Fuels- Coal

It was until the second half of the 18th century that a whole new energy was unlocked by the Industrial Revolution, namely fossil fuels.[96] During the 1600s more coal began to be mined, when wood became scarce in Europe, and at deeper depths. To pump water out of mines, Thomas Savery and Thomas Newcomen developed the first steam engines in the early 18th century and James Watt upgraded the efficiency of these engines. This new invention foreshowed the transformation from an agrarian economy to an industrial one. This new source of mechanical power began the Industrial Revolution, "one of the most profound social upheavals in history".[97]

Although wood and coal could power steam engines, coal became quickly a preferred fuel allowing immense growth in the scale of industrialization. Soon, the steam engine was improved for use in factories, riverboats, ships and railways.[98] People have found that these engines powered by coal are more affordable, reliable, and cheaper than water, wind, and horsepower. A half-ton of coal could produce four times the energy that the same amount of wood could produce. It was also cheaper to produce and despite its bulk, easier to distribute.[99]

In the first half of the 19th Century, when the Industrial Revolution reached the United States, several coal mines started operation. Wood began to be replaced by coal as it emits a lot more energy and was easier to transport compared to wood. **The use of coal grew progressively and exceeded the use of wood for energy,**

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[96] IEA. *History of Energy in the United States, 1635-2000.* Sept. 2008. Retrieved from http://www.eia.doe.gov/emeu/aer/eh/frame accessed June 20, 2021

[97] *ibid*

[98] Williams, James C. History of Energy. *The Franklin's Institute's Resources for Science Learning.* April 25, 2006. Retrieved from http://www.fi.edu/learn/case-files/energy accessed June 20, 2021.

[99] EKT Interactive. Hisotry of Oil- A Timeline of the Modern Oil Industry. Retrieved from https://ektinteractive.com/history-of-oil/ accessed June 15,2020

with the demand for coal quadrupled nationwide between 1880 and 1918.[100] A large amount of coal was required for iron and steel production as well as for the railway industry.

Coal was first used to generate electricity for homes and factories in the 1880s, and half a century later, in the early 1960s, it had become a main source of energy in electricity generation in not only the United States but around the world.[101] Coal continues plays a significant role in iron and steel production today and many countries still depend heavily on coal for generating electricity. Although effort to decrease coal consumption is prominent, it is projected to remain a major part of the energy mix in the near future.

3.1.2. Oil and Natural Gas

After coal, oil was the next chief source of energy to emerge. Oil and gas have been used in some way for thousands of years before modern times; such as in lamps or as a building material, with the first known oil wells being drilled in China in 347 AD or prior, transported through pipelines made from bamboo.[102]

The modern history of the oil and gas industry began in 1847 with a discovery by the Scottish chemist James Young. He observed the infiltration of natural crude oil into the Riddings coal mine and distilled from this infiltration thin, light oil suitable for lamps and thicker oil suitable for lubrication. He later distilled other liquids from coal including an early form of petroleum and eventually started the first commercial oil refinery and oil works in the world in partnership with

[100] *ibid*
[101] Fossil Energy Study Guide: Coal. p. 3

Umar Ali. The history of the oil and gas industry from 347 AD to today. *Offshore Technology*. 07, Mar 2019

Edward William Binney, producing oil and paraffin wax from locally extracted coal.[103]

In 1846, Canadian geologist Abraham Pineo Gesner discovered a liquid he labeled 'kerosene' that was cheaper and cleaner than other oils such as coal-oils and whale oil.[104] This oil was refined from coal, oil shell and bitumen, and it was used to light the streets of Halifax and soon the United States.[105] Due to its use in incandescent lamps, kerosene was the main refinery product for several decades until the advent of the electric lamp, which lowered its luminous value. Production declined even further as the rising popularity of automobiles established that gasoline was an important petroleum product. However, in many parts of the world, kerosene remains a common fuel for heating and cooking, as well as for lamps.

These early discoveries have spawned new businesses, and the coal industry tried to make oils developed by Young and Gesner. In 1859, the first modern oil well in America was drilled by Edwin Drake in Titusville, Pennsylvania.[106] The discovery of petroleum in Titusville led to the "oil rush" in Pennsylvania thus making oil one of America's most valuable commodities. The end of the 18th and the beginning of the 19th century marked the rise of large oil companies that dominate the oil and gas industry to this day.[107]

In the 20th Century, as a result of technological innovations, oil became the preferred energy source. Oil overtook coal and became the largest energy source by 1964.[108] The electric light bulb and automobile were the main drivers of this transformation. Demand for automobiles and electricity grew rapidly, as did the oil demand. Oil-powered ships, trucks and tanks, as well as military aircraft during

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[103] *ibid*
[104] Ingenium Channel. *The Discovery of Kerosene.* Retrieved from https://ingeniumcanada.org/channel/innovation/discovery-kerosene accessed on 10th Oct, 2020
[105] *ibid*
[106] Halfdan Carstens (2009).The Birth of the Modern Oil Industry. *GeoExpro.* Vol. 6. No. 3
[107] *Opcit.*Umar Ali.
[108] Samantha Gross (2020). Why fossil fuels are so hard to quit? Retrieved from https://www.brookings.edu/essay/why-are-fossil-fuels-so-hard-to-quit/ accessed on 8th October, 2020

World War I, demonstrated the role of oil not only as a strategic energy source but also as an important military asset.

Even though naturally occurring natural gas has been known since ancient times, its commercial use is of relatively recent. While natural gas was used almost exclusively as a light source for much of the 19th century, Robert Bunsen's invention of the so-called Bunsen burner in 1885 opened up enormous possibilities for the use of natural gas.[109] Since the construction of efficient pipelines began in the 20th century, the use of natural gas has increased.[110] By 1919, sales of gasoline exceeded kerosene.[111] Before 1920, natural gas produced along with oil was burned as a waste by-product. Ultimately, gas was used as a fuel for industrial and residential heating and power. Once its value was realized, natural gas itself became a valuable fuel.

3.2 Predominance of Fossil Fuels

Since the Industrial Revolution, fossil energy has become a fundamental driver of development in social, technological and economic aspects. Over the past half-century, the consumption of fossil fuels has changed dramatically. Since the 1950s, consumption has increased around eightfold and roughly doubled since 1980.[112] Fossil fuel continues to be a dominant energy source in the global energy mix. In the overall share of energy consumption in the world, fossil fuels contribute the highest in the energy system.

According to the BP Statistical Review of World Energy 2020, there are more than one trillion tonnes of proven coal resources worldwide.[113] However, only a few countries hold the largest deposits of coal in the world. These countries are capable of exploiting this natural asset for their industrial development. Out of the total

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[109] American Public Gas Association. A brief History of Natural Gas. Retrieved from 20th Oct, 2020 https://www.apga.org/apgamainsite/aboutus/facts/history-of-natural-gas accessed on 20th Oct, 2020

[110] *ibid.*

[111] EKT Interative. *History of Oil.* Retrieved from https://ektinteractive.com/history-of-oil/ accessed on 20th Oct, 2020

[112] Hannah Ritchie and Max Roser (2020). Energy. *OurWorldInData.org.* Retrieved from https://ourworldindata.org/fossil-fuels accessed on 3rd March, 2021

[113] Andrew Fawthrop. Profiling the top five countries with the largest coal reserves . *NS Energy.* 19th Oct 2020.

proved coal reserves of the world, more than 90% of them are found in just ten countries.[114] With more than one-fifth of the total proven coal reserves, the United States tops the list holding and approximately has 23% of the world's proven coal reserves which is 249 billion tonnes.[115]

India's coal reserve totalled around 106 billion tonnes in 2019 and is the fifth-largest proven coal reserve in the world. The reserves accounted for more than 9% of the total proven coal reserves in the world.[116] More than 70 percent of India's coal reserves are located in the eastern states of Jharkhand, Chhattisgarh, Orissa and West Bengal. Other significant coal-producing states include Andra Pradesh, Madhya Pradesh and Maharashtra.[117]

Following China, India is the second-biggest producer and consumer of coal. India produced 771Mt of coal, which is 7.9% of the world's total, in 2018.[118] India's coal consumption is very high and accounts for 12% of the world's total consumption. Its total coal production in 2018-19 fiscal amounted to about 730 million tonnes.[119] This makes India the second biggest importer of fossil fuel. In India, coal accounts for more than 70% of the country's electricity generation.[120]

Though India has a fairly good deposit of coal in its mines, considering the existing coal producing technology, it will not be enough to meet the demand in the future. Hence, India will have to depend upon other sources of energy such as oil, gas, nuclear and non-conventional sources such as wind, solar, etc.

Oil has become the lifeblood of the global economy. Proved oil reserves denote the amount of crude oil located in a particular economic region. To qualify, it must have the potential of being extracted under current technological constraints. There are only 15 countries that are homes to the largest of these reserves. India rank 24th in the world but its proven oil reserve is equivalent to 2.9 times its annual

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[114] Mining Technology (2020). Countries with the biggest coal reserves. Retrieved from https://www.mining-technology.com/features/feature-the-worlds-biggest-coal-reserves-by-country/#:~:text=More%20than%2090%25%20of%20the,producer%20and%20consumer%20of%20coal accessed on 4th March, 2021

[115] ibid

[116] *Opcit.* Andrew Fawthrop.

[117] ibid

[118] *Opcit.* Mining Technology (2020).

[119] ibid

[120] Iea. *India Energy Outlook 2021*. Retrieved from https://www.iea.org/reports/india-energy-outlook-2021 Accessed on 7th March, 2021

consumption.[121] The world derives over a third of its total energy production from oil. As a result, the countries that control the world's oil reserves often have disproportionate geopolitical and economic power. However, a diversified economy is always prudent and many countries are overly dependent on their oil wealth. As a result, many have suffered economically every time global oil prices fell impulsively and in extreme cases cause economic collapse and crisis.

In 2017, there were 6,923 trillion cubic feet (Tcf) of proven gas reserves worldwide.[122] The consumption equals 52.3 times its proven reserves. This means that world has around 52 years of gas left, with current consumption level and without unproven reserves.[123] The largest global consumer of natural gas is the United States, which consumed approx. 846.6 billion cubic meters in 2019. [124] In the United States, one of the highest natural gas consumers belong to the power sector where it is use to generate electricity.[125]

Dependence on fossil fuels is likely to decrease gradually as countries are starting to realise its adverse effects on the environment. Fossil fuels are the main contributor of many of the environmental problems as it released carbon dioxide in the air. Natural gas is considered to be less harmful as compared to coal and oil and therefore countries such as the US started replacing their coal usage to a more environmental friendly source. Nevertheless, it still emits carbon which maybe lesser but are not completely free of it. Depending on natural gas may only increase dependency on fossils which are still harmful overall. Most of the energy consumption is used for generating electricity as many development projects and daily life now runs on electricity. Therefore, a more sustainable energy sources needs to be used particularly in generation of electricity.

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[121] India oil reserves, production and consumption statistics. Retrieved from https://www.worldometers.info/oil/india-oil/ accessed on 5th March, 2021

[122] Natural Gas left in the world (BOE). Retrieved from https://www.worldometers.info/gas/#:~:text=There%20are%206%2C923%20trillion%20cubic,levels%20and%20excluding%20unproven%20reserves accessed on 5th March, 2020

[123] Worldometer. *World Gas Reserves.* Retrieved from https://www.worldometers.info/gas/ accessed on 6th March, 2021

[124]Worldometer. *World Natural Gas Statistics*. Retrieved from https://www.worldometers.info/gas/ accessed on 4th March, 2021

[125] "World Natural Gas Consumption in 2019, by country" Statista. Retrieved from https://www.statista.com/statistics/265407/world-natural-gas-consumption-by-country/ accessed on 6th March, 2021

3.3 Shift Towards Sustainable forms of Energy

The soaring and often unstable energy prices and growing concerns about environmental sustainability, particularly global warming, have highlighted the emphasis on sustainability in the global debate on energy security. Environmental pollution is a serious concern around the world. As the demand for limited fossil fuel reserves and the prices of fuels obtained from them continue to increase, renewable forms of energy are becoming attractive and profitable. The growing demand for energy in today's world, caused by a growing population, has raised concerns about energy limitations. This has led to a focus on more sustainable energy supply, which means efficient energy consumption, minimizing pollution and reducing consumption of fossil fuels.

The benefits of fossil fuels come with a devastating disadvantage. It has now been understood that burning of fossil fuels release carbon dioxide that warms the planet faster than anything seen before. With sustainability as the main driving force, the world is seeing a major shift in the total share of global energy spending towards clean energy technologies. All renewable energy sources are considered sustainable due to their low environmental impact. Renewable energy comes from sources that can be regenerated or replenished in a natural way. The main sources are water, wind, sun and geothermal biomass. All of them are mainly used to generate electricity. Renewable energy sources are considered zero (wind, water and sun), low (geothermal) or neutral (biomass) in terms of greenhouse gas emissions during their operation. However, the overall environmental impact of each source depends on the total life cycle emissions, including the production of equipment and materials, installation and impacts on land use.[126]

The world has seen a drastic change in the energy system over the last few years. Large oil companies around the world are now reshaping their portfolios and expanding into solar and power generation. Companies in the oil and gas industry are increasingly transforming themselves into energy companies with strong verticality. From a global perspective, this portfolio diversification is an important trend to be

[126] Environmental Impacts of Renewable Energy Technologies. Union of Concerned Scientists. March 5, 2013 Retrieved from https://www.ucsusa.org/resources/environmental-impacts-renewable-energy-technologies accessed on 15th March, 2021

recognized. In 2019, the share of renewable energies increased by 12.2% compared to 2018.[127] The consumption of renewable energies rose on average by 13.7% per year, making it the only category that has seen double-digit growth worldwide over the past ten years.[128] It has become the faster growing energy source globally and is expected to increase furthermore.[129]

3.4 Energy Resources - North East India

The Northeast region of India has an abundant mineral comprising chiefly of limestone, coal, natural oil and gas, uranium, and others. The total hydrocarbon deposits in the North-East region accounts for approximately 18% (7634 MMT) of country's projected hydrocarbon resources.[130] The first oil and gas exploration in India during the 19th Century traced back to Assam. Digboi-1 was the first commercial well drilled in September, 1889 by the Assam Railway & Trading Co. Ltd. Oil industry of India was officially born as a result of it and thus, opened a new chapter in exploration of oil in India. [131]

In the North Eastern Region, as per the Geological Survey of India (GSI), Coal Inventory in 2018, coal resources are found in the states of Assam, Sikkim, Arunachal Pradesh, Meghalaya and Nagaland. The Region is blessed with 846.48 million tonnes of coal against 186 billion tonnes of reserves in the country. With these reserves, approximately 240 MW/day can be generated for a period of 100 years.

The North-East Region is also estimated to have around 195.68 billion cubic feet of natural gas reserves capable of generating 7500 MW for 10 years.[132] The contribution in natural gas production by NE sector is about 15% of the total

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[127] Robert Rapier. Renewable energy growth continues at a blistering pace. *Forbes.* Aug 2, 2020.
[128] *ibid*
[129] Center for Climate and energy solutions. Renewable Energy. Retrieved from https://www.c2es.org/content/renewable-energy/#:~:text=Renewable%20energy%20is%20the%20fastest%2Dgrowing%20energy%20source%20globally%20and,2017%20(see%20figure%20below) accessed on 15th March, 2021
[130] **Ranjan Chowdhury.** Oil & Gas scenario in North East India and role of Oil India. ***The Hills Times.*** **October 21. 2020**
[131] *ibid*
[132] North Eastern Electric Power Corporation Limited. *Power potential in the North East Region.* 4/8/2020 https://neepco.co.in/mse accessed on 30th Oct,2020

production in India.[133] The states of Assam & Arunachal Pradesh contribute about 67% of the total natural gas production in the North East.[134]

Assam and Meghalaya have a huge reserve of coal which is known as 'Black Gold'. Limestone has the highest mineral reserve in Northeast regions followed by coal, oil and natural gas. Brahmaputra and Barak rivers are the two largest river basins in Northeast India. According to a survey of GSI, the Brahmaputra and Barak rivers and floodplains are a rich reservoir of oil and natural gas.

Since the 1990s, the government has shown an interest in finding more sustainable sources of energy than traditional ones and efforts have been made to achieve this. Often overlooked in major development programs, the Northeast has drawn attention in discussions about energy security over the past decade. The Brahmaputra is one of the largest rivers in the world (5,800,000 sq. km.), 33% of which flow into India. [135] At 5,300 meters above sea level, the river rises from the Chema-Yung-Dung glacier in the Kailas Mountains in southern Tibet. [136] It covers 1,625 km through China, 918 km through India and 337 km through Bangladesh and finally flows into the Bay of Bengal via a canal that is shared with the Ganga River. In India, the river basin is distributed Arunachal Pradesh (41.88%), Assam (36.33%), West Bengal (6.47%), Meghalaya (6.10%), Nagaland (5.57%) and Sikkim (3.75%). The total length of the river in India is 41,723 sq. km. [137]

A preliminary ranking study was conducted by the Central Electricity Authority (CEA) in 2001 on the hydroelectric potential of various river basins in India and ranked the Brahmaputra highest.[138] With a main focus on the Northeast, the Ministry of Power launched a 50,000 MW hydro initiative in 2003. The Northeast Council's Sectoral Summit on the Power Sector held in January 2007 has adopted the

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[133] *ibid*
[134] *Ibid*
[135] Brahmaputra. Hydro Meteorological Observation stations Map. Retrieved from https://indiawris.gov.in/wiki/doku.php?id=brahmaputra Accessed on 6th March, 2021
[136] N. Vagholikar and P.J. Das.(2010) Damming the Northeast. P 1
[137] *Ibid* p.2
[138] *Opcit*. N. Vagholikar and P.J. Das, Damming the Northeast.

"Pasighat Proclamation on Power" and identifies the priority of Northeast Region's hydropower potential towards the country's energy security.[139]

North East India has been referred to as the "Powerhouse of India" due to its hydropower potential which is yet to be explored. Among the states of the North East, Arunachal Pradesh has the highest hydropower potential. It has the largest untapped hydropower potential of 47 GW in the country. [140] As of April, 2021, it has an installed hydroelectric capacity of 755.14 MW. [141] World Bank estimates place the Northeast region at the forefront of the country's hydropower. [142] According to the estimates of North Eastern Electric Power Corporation (NEEPCO), together, the Northeast states have about 60,000 MW of hydroelectric generation capacity which accounted for nearly 40% of the total potential of the country.[143]

If fully exploited, this potential can be shared with other regions of the country. It could also be a boon to factories, industries, roads, communications and other development, and it could also be used to power remote mountain areas in these regions. There is a need of infrastructural and technological development to mitigate the impact of these incidences for economic development.

Exploitation of resources in the North East India is not only limited by certain technical constraints, but also faces a serious criticism and protests from local people, environmentalists, NGOs, and civil societies in the region. The social and environmental impact of the construction of dams, mainly on the Brahmaputra and Barak rivers, has generated conflicts and debates in society, in legislative assemblies and in parliament. Furthermore, the dams on the Brahmaputra and Barak rivers, the Loktak and Tipaimukh dams in Manipur and on the Gomti rivers met with strong resistance from the population.[144] In Sikkim, the Tashiding Hydropower Project on

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[139] Ibid, p-12
[140] AK Verma. India's true hydropower potential remains untapped. *The Hindu* . May 14, 2020
[141] IBEF. *About Arunachal Pradesh: Information on Geography, Industries & Economy.* Aug 6, 2021
[142] World Bank (2007). India-Development and Growth in Northeast India: The Natural Resources, Water and Environment Nexus. Washington DC.
[143] North Eastern Electric Power Corporation Limited. *Power Potential in the North East Region.* Retrieved from https://neepco.co.in/projects/power-potential accessed on 3rd May, 2021
[144] Mirinchonme Mahongmao, Noklenyangla & Subhash Kumar (2017). Natural Resources and socio-economic development in North East India. *Journal of North East India Studies,* 7(2). p. 90

the Rathang Chu River, a tributary of the Rangit River, has been the subject of violent protests by local people, monasteries and Buddhist monks. .[145] This is because the river is considered sacred by monks and Buddhist communities. The negative impact of this hydroelectric power plant on the ecology and ecosystem of rivers was another major concern of the communities. However, the project was planned and preceded together with two other HEP Ting Ting and HEP Lethang, despite strong opposition from the communities.

Undoubtedly, the North East India region is rich in natural resources, especially water and forests, and has the potential to be one of the richest regions in India. However, despite some progress in some North eastern states, overall growth has remained low in recent years, the poverty rate is high, progress of industry is slow, and many of them reports degradation of natural resources depleting the assets that identified as the greatest growth and development potential in the Northeast region. Thus, in recent years, the region has lost the acceleration in economic growth seen in many other parts of India. The agricultural sector in the region is in decline and the diversification of services and production is insufficient. Moreover, contrary to popular belief, the lack of development in the past was not caused by a lack of money. Indeed, sufficient resources have always been made available to the region, but a significant proportion of the resources allocated to the various programs have not actually been allocated to these programs.[146]

3.5 Energy Resources - Mizoram

The growth of load in Mizoram is more or less stagnant due to inadequate industrial growth. The development of modern systems of transport and communication is relatively a new phenomenon in the state. People of the area were isolated in the womb of the hills till the advent of the British. The development of transport and communication was not a priority in the state. Owing to its hilly terrain, there is a lack of adequate transportation. So the state is not easily accessible. Construction of the road was already a challenging task as the state is covered with

[145] India together. *The fate of Sikkim's sacred river hangs in balance.* 28th Oct, 2014
[146] Opcit., Mirinchonme Mahongmao, Noklenyangla & Subhash. p. 95

narrow hills of around 90%.[147] As a result, the cost of construction of non-conventional energy sources is also extremely high in the state. Such factors have led to development within the state, move at a snail's pace.

Geologically, Mizoram is part of the Assam-Arakan Basin, consist mainly of sedimentary rocks and belong to the Bhuban Surman Group from the Late Oligocene to the Lower Miocene age.[148] Mizoram has mineral resources such as limestone, sandstone, clay, coal, oil, but not enough to influence the national mineral map till today.[149] Mizoram accounts for less than 1% of the national mining production. There are no chief deposits of economic importance for the state. Except for the minor ones, no mineral production has been reported at Mizoram. Coal was reported to have been found in Bawrei, Thinghlun and Zawlnuam in Mamit District and Rotlang West in Lunglei District. However, it cannot become an economically viable production.[150]

3.5.1 Mizoram: Exploration of Oil and Natural Gas

Mizoram is in the number one category of proven commercial oil production zone, valued at approximately 170 million tons of untapped crude reserves.[151] Mizoram's strategic location in the Assam-Arakan region and the large gas reserves on the India-Bangladeshi border, as well as Myanmar's gas reserves in almost the same region as Mizoram, increase the likelihood of the state becoming a major source of natural gas and oil. Mizoram has a probability of petroleum deposits or a reported oil and gas presence in similar geological structures in Tripura and Assam. India's largest exploration company, Oil and Natural Gas Corporation (ONGC), confirmed the presence of petroleum in Bilkhawthlir, Kolasib District. ONGC began exploring the village of Meidum in Kolasib District in 2011 and reported the

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[147] Mizoram-*The Land of the Hills.* Retrieved from https://www.alightindia.com/mizoram accessed on 3rd March, 2020

[148] M.F. Hussain and B. Bharali (2019). Whole-rock geochemistry of Tertiary sediments of Mizoram Foreland Basin, NE India: Implications for source composition, tectonic setting and sedimentary processes. *Acte Geochim 38,* p 897

[149] Rahu; Verma (2015). Mineral Based Industries in Mizoram: An Appraisal. *Development Perspective In North East India: Micro and Macro Studies.* pp 373-380.

[150] Interview with Lalremmawia, Deputy Controller of Mine,(Geology & Mining) (Minerals and oil and gas exploration in Mizoram) on 8th Dec, 2020

[151] *Opcit.* Rahul Verma. p-375

possibility of finding 5,52,674 standard cubic feet of gas per day from the exploration site of Meidum.[152]

Oil and Natural Gas Corporation Limited (ONGC) proposes carrying out the exploratory drilling on block AA-ONN-2001/2, located in the New Exploration Licensing Policy (NELP) block area of the Kolasib and Mamit district of Mizoram.[153] The ONGC carried its exploration in an area of approximately 5,340 km², which corresponds to approximately 58.9% of the area of the state.[154] The oil exploration sites in Mizoram were divided into several blocks and other national companies involved in oil exploration venture were Oil India Limited (OIL) and Reliance Natural Resources Ltd.

OIL received Block-2, AA-ONN-2014/1 with an area of 3,213 sq km.[155] It starts about 50km north of Aizawl and ends 6 km east of the city of Hnahthial. The block includes part of the district of Aizawl, Serchhip, Lunglei and Mamit. The Development and Production License (PEL) was signed on May 22, 2007.[156] Reliance Energy Ltd has received block no. 3 (sq. Km. 3619) and block 4, AA-ON J/2 (sq. Km. 255) was also awarded to ONGC in 2008. However, Reliance Company was axed for failure to undertake any exploration and the southern parts of the state remain a vacant block.[157] On 29 October 2019, Vedanta signed a contract and fixed the status of an area of 3 km². However, no work has been carried out so far.[158] According to the agreements with these companies, 12% of oil products and 10% of gas products go to the whole state of Mizoram as royalty.

OIL highly anticipated finding hydrocarbon deposits in Mizoram, particularly natural gas. Rupiyot Phukan, the ILO's chief explorer manager, said that good quality

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[152] ONGC has found hydrocarbon deposits in Mizoram. *The Economic Times.* March 30, 2016 Retrieved from https://economictimes.indiatimes.com/industry/energy/oil-gas/ongc-has-found-hydrocarbon-deposit-in-mizoram/articleshow/51614089.cms?from=mdr accessed on 20th June, 2020
[153] Mizoram Pollution Control Board. *Environmental Impact Assessment Report for Proposal of 3 Exploratory drilling wells in Existing NELP Block AA-ONN- 2001/2, Kolasib & Mamit District.*
[154] ibid
[155] OIL. 7th Coordination Meeting of OIL & Natural Gas exploration in Mizoram.
[156] *ibid.*
[157] *ONGC has found hydrocarbon deposit in Mizoram*. The Economic Times. Mar 30, 2016
[158] *Opcit.* Lalremmawia, Deputy Controller of Mine.

natural gas deposit has been found in Maubuang area, but the amount is not profitable for commercial purposes. Drilling was done at Maubuang, approximately 40 km south of Aizawl, and the Keifang area in the eastern district of Aizawl, but no positive results have been obtained. [159] The drilling at Aibawk-1 and Keifang also proved inconclusive. To date, no company has been able to complete its work during the license renewal period. Therefore, despite the hopes of Mizoram to become a major oil-producing state of the country, there has been no successful exploration to date.[160]

In India, it is observed that the industry sector accounted for the highest share of energy consumption and is followed by the domestic sector. However, in Mizoram, it is observed that most of the electrical energy is consumed by the consumers belonging to the domestic category. In Mizoram, there is only a little development, particularly in the industrial sector. The industry sector in Mizoram consists of mining and quarrying, manufacturing, construction and electricity, gas, water supply and utility services.[161] Mizoram is one of the least developed states in terms of industrialization, production and exports. There are no industries powered by coal and the state energy demand is mostly met through its renewable sources.

As per the 2011 Census, Mizoram is the 5th smallest state. Nonetheless, it is one of the North-Eastern states in India which offers opportunities for high growth and rapid development. However, it is still one of the least developed states in India. India has a population that supports around 17% of the world's population. But the energy consumption is only around five percent of the world's consumption. Its per capita consumption of energy and electricity is less than one-third of the world's average.[162] Meanwhile, the per capita electricity consumption of Mizoram is even lower than the national average.

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[159] OIL optimistic of finding hydrocarbon deposits in Mizoram. *Business Standard"*Sept 07. 2017 https://www.business-standard.com/article/pti-stories/oil-optimistic-of-finding-hydrocarbon-deposits- in-mizoram-117090700767_1.html Accessed on 18th Feb.2021

[160] *Ocpit.*, Lalremmawia, Deputy Controller of Mine.

[161] Mizoram registers 14.82 pc growth in GSDP. *Business Standard.* June 13, 2019

[162] India needs quadrupling per-capita energy consumption to get into upper-middle income country club: Economic Survey. *The Economic Times. July 04, 2019*

3.5.2 Mizoram Major Source of Power: Hydropower

In Mizoram, the power sector is a vital component of the state's growth-driving mechanism. It is one of the most important contributors to the state's energy security. For modernization and increasing the growth of the socio-economic status of the people, electricity plays an important role. Power is required to run not only industries and offices but households rely on it too. It plays a key role not only in the sustainable development but also in the promotion of the living standards of the people. It directly influences a state's economic well-being and contributes to the overall development of the country. Electricity is a necessity as the development and living standards of the people are measured in terms of electricity consumption. A state must have an efficient, resilient and financially sustainable power sector to fuel growth and prosperity. With the availability of reliable, quality power at an affordable price, there is bound to be development in all sectors of the economy especially agriculture and industries.

Before Mizoram became a Union Territory in 1972, there were no significant projects that could help in the growth of its economy. The signing of Peace Accord between the Government of India and the MNF became a turning point in the development history of Mizoram.[163]

In Dec 1962, electricity was generated for the first time in Aizawl using a 75 kW DG set.[164] However, it was merely for lighting the house and with few beneficiaries. Mizoram was economically very backward lacking the very basic needs including power supply. Power supply was never a priority of the state policy especially the state being a disturbed area since March 1966. It can be said that the planned development of the power sector in Mizoram did not begin until 1975-76, when the Assam State Electricity Board in Mizoram ceased to operate. [165] All activities relating to power development was under the Assam Electricity Board till March, 1975. The Power & Electricity Department was then created in 1975 but was merely a division under the State Public Works Department (PWD) till its

[163] Directorate of Information & Public Relations. Peace and progress with special reference to Mizoram. Retrieved from https://dipr.mizoram.gov.in/post/peace-and-progress-with-special-reference-to-mizoram accessed on 20th Feb, 2021

[164] Power & Electricity Department. Annual Report 2019-20. p. 7

[165] *ibid*

separation.[166] It was separated in the early 1980 and the responsibility for generation, transmission and distribution of power throughout the state is now in the hands of The Power & Electricity Department. It became a full-fledged department in 1983.[167] It is also responsible for the maintenance of the power distribution network to cater quality power supply to its consumers.

The state is witnessing reforms with the scheme designed by the government over the last few years. The central and state government is committed to providing quality life to the people within the state. It had started the programme "24x7 Power for All" in 2016 as a step towards this direction as electricity supply serves as an important means of providing quality life to the people.[168] As per the 2011 Census, there were about 2.21 lakhs households in the state. Out of these, 1.14 lakhs households of 98.28 per cent living in urban area were electrified, 0.02 lakhs were un-electrified.[169] In rural areas, out of 1.05 lakhs households, 0.72 lakhs were electrified and the remaining 0.33 lakhs of 31.43 per cent were un-electrified.[170] In 2019, it was reported that there were no un-electrified households in the state of Mizoram.[171]

Around 45% of India's energy need is derived from domestic stocks of coal, which is mainly for electricity.[172] Mizoram presents a different scenario with hydropower as the dominant contributor of power supply. As per the 18th Electric Power Survey, the power requirement of Mizoram is 201 MW but the allocated share is only 152 MW against a Peak demand of 110MW.[173] There are 259961 consumers. Mizoram power generation is not sufficient to meet its needs and the state's power deficit is supplemented from various Central Sector Generating Stations. Mizoram has purchased about 95% of its total power requirement from different generating

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[166] Power and Electricity Department. *Profile.* Retrieved from https://power.mizoram.gov.in/page/profile Accessed on 3rd March, 2021
[167] Power & Electricity Department. *Annual Report 2019-20.* P 7
[168] 24x7 Power For All (2016). *A Joint Initative of Government of India and Government of Mizoram.*
[169] *ibid*
[170] *ibid*
[171] DDUGJY & Saubhagya: Status of Rural Electrification in Mizoram.
[172] International Energy Agency. World Energy Outlook 2019. *India total primary energy consumption by fuel type.*
[173] Power & Electricity Department. Annual Report 2019-20. P 7

stations. The power purchase bill to be borne by Mizoram in the year 2019-20 is Rs. 329.87 crore.[174]

Mizoram has 11 state's own Hydel Generation Stations with installed capacity of 29.35 MW and these stations generate around 40MU annually.[175] Out of these, Serlui-B hydropower project, located near Bilkhawthlir, Kolasib district, is the largest hydro plant in Mizoram. It generates 2.85 MW, Teirei generates 1,744MW, Kau Tlabung-1.0MW, Khawiva-0.75MW, Tuipui-0.2MW, Maicham II- 0.7MW.[176] Apart from these, Mizoram also has a share of power from Tuirial Hydro Electric Plant which generates 58.1 MW owned by NEEPCO. However, the share of free power as a home state is only 12 per cent (6.972 MW) of the total generation of Tuirial HEP.[177] The remaining (around 51 MW) is purchased from NEEPCO. Altogether they produce 65.344 MW. But this is not sufficient to meet the state requirement. The peak load of the state is at around 110 MW, with a shortfall of around 45 MW of power the state purchase it from outside sources.

Mizoram also has Thermal Power Plant at Bairabi (22.92 MW) and Diesel Power Station (0.5MW) at Lengpui. However, they are kept as stand by due to its high running cost.[178]

Fig 3.1 State's owned hydro power generation stations

Sl No	**Name of Hydel Station**	**Location**	**Install Capacity in kW**	**Commissioning year**
1	Serlui 'A'	Aizawl	2x250 & 1x500	24/4/1984
2	Khawiva	Lunglei	3x350	12/08/1988

[174] *Ibid.* p *25*
[175] *Ibid.* p 21
[176] *Ibid*
[177] Malsawmdawngliana (Executive Engineer in P&E Dept). Interviewed on 12th Dec, 2020
[178] Power & Electricity Department. Annual Report 2019-20. P 21

3	Tuirivang	Muallungthu	3x100	14/8/1989
4	Tuipui	Champhai	2x250	15/12/1991
5	Maicham l	N. Vanlaiphai	2x1000	01/05/1996
6	Teirei	W. Phaileng	3x1000	10/12/1999
7	Tuipanglui	Tuipang L	2x1500	17/12/04
8	Kau Tlabung	Thenhlum	2x1500	05/05/2005
9	Lamsial	Farkawn	2x250	26/08/08
10	Maicham II	N. Vanlaiphai	2x1500	11/11/2009
11	Serlui 'B'	Bilkhawthlir	3x4000	2010
	TOTAL		**29.35**	

Source: Power and Electricity Department, Govt. of Mizoram 2019

Special attention has been paid to the development of renewable energies in the entire north-east region through a separate allocation of 10% of the budget under the several renewable energy programs for the construction of on-grid and off-grid solar systems for wind energy, small hydropower projects, biogas plants, etc. in the region.[179]

In 2003, the Government of Mizoram adopted 'Renewable Energy Policy 2003 Power Produced through Non-Conventional Energy Sources' with a view to promote generation of grid-grade power through Non-Conventional Energy Sources in the context of non-polluting, renewable inputs like solar, wind, small hydel, biomass and other wastes. Since then, there has been an increase use of renewable energy particularly solar energy. In 2017, Mizoram Solar Power Policy was adopted with focus on Ensuring Sustainable Energy Mix for the state. Mizoram has a total estimated renewable energy potential of 9261 MW from various sources such as Small Hydro Power (168.90 MW), Biomass (1MW), waste to energy (2 MW) and Solar Energy (9090 MW).[180]

[179] Ministry of New and Renewable Energy. Annual Report 2019-20. P 92
[180] *Ibid.* p 92

Energy has been used since human existed. The search for a better alternative energy source is continuing till today. Good energy source was measured per its efficiency in the earlier times, thus fossil became a dominant source for a long time now. Countries with rich fossils have started using it as a weapon. As time passed, the negative effects of fossil fuels on energy have been realised. The advantageous climatic condition in Mizoram offers opportunity to increase its non-conventional energy especially with the cost of planting renewable energy declining. The trend towards a heavy reliance on fossils is on the right track given competition from cheap natural gas and a growing international focus on reducing emissions and increasing the use of renewable energies. While it will take time for this resource to be completely removed from the world's largest energy mix, steps have been taken and changes are taking place at the local and national levels.

People in Mizoram lived a rather simple life with simple technology for a long time. It was not until Mizoram attained statehood that development and diverse energy sources reached the majority of the people. The state is estimated to have potential in many energy resources. The state energy demand is mainly electricity, oil and gas. There are no coal-fuelled industries or factories. Fossil fuel extraction within the state still bears no fruitful result till today. The geographical location of Mizoram and its mountainous topography makes it difficult to explore the resources and transporting big machines for the venture of oil and gas is very difficult. The exploration cost is also very expensive as a result of it. Furthermore, even if successful explorations were conducted, the cost would be very high leaving little profit to the investors. Due to these reasons, companies are hesitant to take the risk and also there has been no successful exploration till date. Therefore, tapping the renewable sources such as solar or hydropower potential seems to be the best alternative for the state to improve its energy security.

CHAPTER 4

ENERGY SUSTAINABILITY: ECONOMIC, ENVIRONMENT AND SOCIAL ASPECTS

The previous experience in development has led to the realization of the harmful effects on the environment. From this discovery came the concept of sustainable development. As such, the idea of sustainable development implies a condemnation of the current development path, especially from an ecological point of view. As energy is the main factor of economic development and poverty eradication, assessment of the sustainability of energy production and consumption is vital. Many of the energy sources are exhaustible with a major negative impact on the environment. The ultimate question of its sustainability emerges as energy production has an enormous impact on the environment and is heavily dependent on limited resources. Energy sustainability is about providing adequate, reliable and affordable energy that is compatible with social and ecological requirements.

Development is often pursued at the expense of environment, social and economic sustainability. Sustainable development calls for sustainability in all the three dimensions and cannot be realized if they are taken separately. The previous chapter discussed the energy resources of Mizoram that could potentially promote its security. This chapter explains the concept of sustainability and its dimensions, the evolution of sustainable development and energy as a key component of development. It also addressed the environmental impact of energy in general. The chapter focuses on the need to consider all the aspects of sustainability and failure of Mizoram to emphasise the social impact in its pursuance of energy security and development.

4.1 Sustainability: Meaning and Definition

Sustainability simply meant the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.[181] Sustainability as a concept identifies the environment as an exhaustible resource. The

[181] Mitchel Grant. Sustainability. *Investopedia October 12, 2020*

environment and its resources must be taken care of as it not only affects the well-being but also survival of all living things. A clean and healthy environment protects biodiversity and the ecosystems on which human life and all other forms of life on earth depend.

However, sustainability is not only limited to environmentalism.[182] In addition to natural resources, social and economic resources are also needed to have prosperity. Rooted in most explanations of sustainability, concerns about social justice and economic development are also found.

4.2 Emergence of Sustainable Development

Although the concept of sustainability is a relatively new phenomenon, the movement as a whole has its origins rooted in social justice, conservation, internationalism, and other earlier movements with a rich history.[183] Many of these ideas were brought together in a call for "sustainable development" at the end of the 20th century.[184]

In 1983, Norwegian Prime Minister Gro Harlem Brundtland was appointed by the United Nations to head the new World Commission on Environment and Development.[185] Even after years of efforts to raise living standards and eradicate poverty through industrialization, the effort bears no productive result for many countries that continues to deal with the extreme poverty. Economic development at the expense of environmental health and social justice did not seem to lead to lasting prosperity. It was clear that the world had to find a way to balance ecology with prosperity. Four years later the Brundtland Commission published its final report "Our Common Future" in 1987 and coined the term "sustainable development".[186]

The Brundtland Report famously defined sustainable development as development that meets the needs of the present without impairing the ability of

[182] Mc Gill University. What is Sustainability. P 1.
[183] *ibid*
[184] *ibid*
[185] *ibid*
[186] *ibid*

future generations to meet their own needs.[187] It implies that the actions of present societies should not be a threat to the cultures or living standards of future generations.

The Brundtland Commission has successfully linked environmental protection with social and economic issues on the global development agenda.[188] Sustainability is a holistic approach that takes into account the ecological, social and economic dimensions and recognizes that they must be considered altogether for sustainable well-being. The Brundtland Report highlighted the need for integrated and sustainable solutions to a wide range of issues related to population, biodiversity, industry, energy security and much more.

Sustainable development is gradually becoming a goal that many countries strive to achieve. Sustainable development for the energy system is becoming increasingly important for policymakers around the world to promote economic development, energy security and prevent climate change.

4.3 Energy Sustainability

These three elements of sustainability- environment, economic and social dimensions are also the fundamentals of energy security. Sustainable development requires these three elements of energy systems' sustainability to be assessed simultaneously. If these three factors are taken separately, they tend to lead society to move in different directions. For instance, economic development can be realized at the cost of the environment or social sustainability but would only lead to deterioration in the long run. It is a challenging task to balance these factors but global sustainable development requires the achievement of economic, environmental, and social balance simultaneously**.**

Sustainable energy is, therefore, defined as the provision of uninterrupted energy services in an affordable, equitable, efficient and environmentally benign

[187] 1987: Brundtland Report. Retrieved from https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html

[188] *Opcit* . Mc. Gill University. P. 1

manner.[189] It has been proposed as the ultimate goal of a developing country's energy policy. Energy sustainability encompasses the sustainable provision of energy services, which in turn presupposes that energy services are provided to all people in such a way that they are sufficient today and in the future to meet basic requirements, not damaging to the environment and adequate to societies and people.

4.4 Impact of Fossil Fuel Consumption

Currently, global energy consumption contributes significantly to environmental pollution, climate change and global greenhouse gas emissions. Climate change and energy has become a dominant topic in today's news. The energy and environmental issues are closely related as it is almost impossible to produce or use energy without affecting the environment. Many of the environmental problems are directly related to energy production and consumption including air, water and thermal pollution apart from climate change and solid waste disposal.

The three main global energy sources such as coal, oil, and gas have been identified as the primary causes of the greenhouse effect, which is responsible for global warming.[190] While coal is an alternative fossil fuel with a potentially longer lifespan than the other fossil fuels, it has, unfortunately, generates more pollutants than them. More carbon dioxide is released by coal when burned rather than oil or gas.[191]

The late 18th or 19th century was marked by scientists as the beginning of the current warming.[192] This was when coal was commonly used for the first time. The increasing consumption of fossil fuel to gasoline, diesel and kerosene and in many other forms has speeded up the global warming trend. The main cause of air

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189 Mary Wales (2018). Energy and Pollution: Where do we pollute the most? *Better Planet.*

190 Understanding Global Change. Retrieved from https://ugc.berkeley.edu/background-content/burning-of-fossil-fuels/ accessed on 15th April, 2021

191 Benjamin Kahane. Coal: The dirtiest of fossil fuels. Retrieved from https://aytzim.org/resources/jeg/359 accessed on 15th April, 2021

192 Mary Wales (2019). How much has the earth warmed since the Industrial Revolution? *Better Planet.*

pollution in urban areas results from emission of the combustion of fossil fuels. The burning of fossil fuels is a major source of greenhouse gas emissions. Several water pollution problems are related to energy consumption such oil spills. Solid waste is also a by-product of some forms of energy use.

It is now widely recognized that anthropogenic climate change is happening and will continue even if substantial efforts are made to reduce greenhouse gas emissions. While warming is not uniform everywhere, the increasing trend in global average temperature indicates that more areas are warming rather than cooling. Monitoring global temperature trends provides a crucial indicator of the impact of human activity particularly, the greenhouse gas emissions on Earth. Since the 19th century, the Earth's average temperature has risen by more than 1.2 degrees Celsius.[193]

Several agencies record the year 2020 as the hottest year. While NASA's Goddard Institute for Space Studies records 2020 as the hottest year, and tied with 2016 (record for the previous hottest year), National Oceanic and Atmospheric Administration (NOAA)'s National Environmental Information Centers in the US said 2020 was the second warmest year since 1880 when it started keeping records.[194] It is important to note that the seven warmest years on earth have taken place since 2005. According to the NOAA Annual Climate Report 2020, the total temperature of the earth and ocean has risen by an average of 0.08 degrees Celsius for per decade since 1880; however, the average growth rate since 1981 which is 0.18 ° C has more than doubled. [195]

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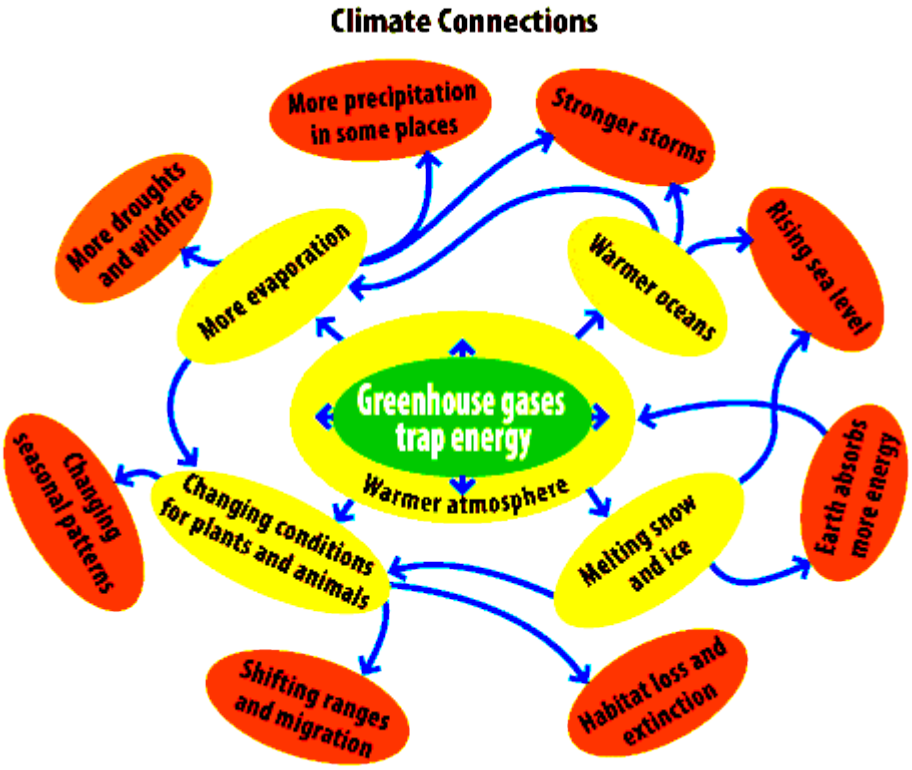
[193] *Tied for Warmest Year on Record, NASA Analysis Shows*. NASA TV. Jan 14, 2021. 2020 Retrieved from https://www.nasa.gov/press-release/2020-tied-for-warmest-year-on-record-nasa-analysis-shows accessed on 24th April, 2021

[194] Andrea Thompson (2021). NASA says 2020 Tied for Hottest Year on Record. *Scientific American.*

[195] *Explained: This is why 2020 was one of the hottest years on record.* The Indian Express. Jan 18, 2021 Retrieved from https://indianexpres.com/ accessed on 14th June 2021

Fig.4.1 Environmental impact on climate and its connections



Source: US Environmental Protection Agency, 2019

Energy production has an enormous impact on the environment and is mainly based on limited resources. Human influence can be negative or positive, and human beings, even unintentionally, have the most harmful impact on the environment. Unfortunately, short-sighted development plans and ignorance of environmental damage have seriously disrupted the ecological balance of the region and made the existence of the earth itself unstable. The increasing population coupled with a scarcity of resources also requires the preservation of environmental quality and economic progress. The need for sustainability becomes much clearer when the environment is viewed as something that can harm people and all living things if not properly cared for. It is, therefore, imperative to use the environment and its resources judiciously and to safeguard them for the benefit of the earth, the environment, humanity and all living beings.

4.5 Energy as Part of Sustainable Development

At first, energy did not play an essential role in the discussion about sustainable development. However, after that Stockholm Conference and another major event that followed, namely the Rio and Johannesburg Conferences, energy gradually became a central issue.[196] At the Stockholm conference, energy was identified as a source of environmental pollution, which links energy directly to the environmental dimension of sustainability. The Stockholm Action Plan deals directly with the environmental impact of energy consumption and production, as well as the environmental impact of various energy systems.[197]

At the 1992 Rio conference, energy was not directly on the agenda; the Rio Declaration on Environment and Development did not include energy with a separate chapter in Agenda 21. However, energy was widely covered in Agenda 21 chapters and provided a strong argument for moving from unsustainable to sustainable energy management approaches. [198] It shows the need to balance economic growth, energy use and its environmental impact, and to put energy at the center of economic growth in the face of environmental dilemma.

The Sustainable Development Commission (CSD) was set up at the Rio conference, but it was not until 1997 that energy finally entered the CSD agenda.[199] It was only at the ninth session of the Commission for Sustainable Development (CSD9) that energy was first discussed as an integral part of the United Nations system. This was significant as the conclusions of the ninth session paved the way for the 2002 World Summit on Sustainable Development in Johannesburg.[200]

Following the work of the CSD9, the third ground breaking conference in Johannesburg in 2002 explicitly and directly referred to energy as a central theme of sustainable development, with energy and the three dimensions of sustainable development repeatedly emphasized.[201] In contrast to the Rio Declaration on

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[196] B. Davidsdottie (2012). Sustainable Energy Development. *Comprehensive Renewable Energy*. Vol 7, 2012 p-273-297
[197] *ibid.*
[198] Energy Management in Agenda 21. Retrieved from https://www.grdc.org/ accessed on 16th June 2021
[199] *Opcit.*, B. Davidsdottir.
[200] *ibid*
[201] *ibid*

Environment and Development, the Johannesburg Implementation Plan explicitly treated energy as a specific issue rather than an aspect of other issues. Moreover, it strongly emphasizes social attributes of energy consumption and access to high quality energy, identifying it as a basic human right for the first time. Thus the social dimension was brought out in addition to the existing environmental and economic dimensions.[202]

The cumulative impact of these three conferences has cemented the concept of Sustainable Energy Development as a central element of all three dimensions of sustainable development by addressing the relationship between energy and the environment (as defined in Stockholm), economy (as defined in Rio) and society (as defined in Johannesburg). The use and development of energy have become a specific problem over time, rather than a subset of other problems that intersect with the three dimensions of sustainable development.[203]

The concept was developed out of a recognition that current pattern of economic growth has caused serious environmental problems such as air and water pollution, soil and land degradation, loss of biodiversity and unprecedented climate change. It also recognized that social concerns, such as lack of energy services, ill sanitation and healthcare, gender inequality in education and economic activities, have been accompanied with the practice of growth-oriented development paradigm. The goals that sustainable development aims to achieve include poverty eradication, health safety, gender equity, education, environmental protection and so forth. The concept of sustainable development is generally understood as an economic growth or improvement without undermining environmental sustainability and social development.

The extent to which countries can achieve sustainable development varies as countries differ in terms of size, wealth, standard of living, political and administrative systems. Although wealth and advanced technologies can help developed countries pursue sustainable development, it is not always the case. The motivations and desires of societies and countries for progress and advancement

[202] *ibid*
[203] *ibid*

seem to be inherent and these efforts usually require increased energy consumptions and thus lead to a corresponding increase in emissions.

4.6 India: Dams and its impact

With the realization of the need for a more sustainable energy source the rate of renewable energy in the energy mix increases. However, it must be noted that not all renewable energy are sustainable. No other infrastructure has been more criticized than dams for its harmful social and environmental impact. After the devastating World War II, western nations were forced to focus their efforts on economic development. Developing countries that have historically been impoverished by their colonial rulers and have now been revived by the decolonization process have also seen the opportunity for the first time to record the course of their economic development. As a result, dams became the symbol of economic development after countries started realizing that the availability of adequate infrastructure facilities was vital for economic growth.[204]

After India got Independence in 1947, several steps were taken to raise the economic and living conditions of the people as India has suffered a major setback during the nearly 200 years of British rule. India resorted to building dams and Jawaharlal Nehru committed to the development of large dam projects in India with the hope of fostering national economy from colonial backwardness.[205] The constructions of dam have many benefits and one of the greatest advantages is the generation of hydroelectricity. With its large population that was increasing rapidly, demand for electrical power supply was increasing and hydroelectricity was seen as a perfect solution which would improve the living standards of the people.

Many governments all over the world committed to the construction of dams for hydropower development keeping in mind the environmental concern. Dams built for hydroelectricity provide a dependable source of electricity fulfilling the needs and demands of power supply. However, there is a controversy over the adverse effects on environment and human impacts. The effects it entails are not all alike depending

[204] Arun Kumar Nayak (2010). Big dams and protests in India: A study of Hirakud dam. *Economic & Political weekly.* Vol LV. No. 2. p.1.
[205] Ajit Ranade. Buidling Temples of Modern India. Mumbai Mirror Aug 8, 2020

on the size, capacity and location of the dam and as such its benefits and ecological hazard differs accordingly.

No matter the advantages, the constructions of dam have its own risks relative to social, environmental and economic aspect of the people in the affected areas. There is a long list of protest movements against construction of dams across the country. Besides a number of environmental problems, dam building is one of the significant causes for development related displacement. Large dams have displaced almost 30 million people in India.[206] Compensations were paid in cash and it became subjected to corruption and exploitation. The displaced people sometimes received nothing for their land. After opposition to dam projects became a trend in the 1980s, dam projects began to be successfully organised.[207] Since the 1990s, the government became more inclusive and became more responsive to the demands of the protest movements.[208]

Small hydropower projects are seen to be less damaging and harmless to the environment and the people in the affected areas as compared to large dams. But the effect is still the same for the affected villages whether small or large dams and the people affected by small dams are often ignored as they are smaller in number and their voices are too weak to be seriously considered as they tend to attract lesser attention.

4.7 Mizoram: Sustainability Aspects of Hydropower Projects

The government policies and development schemes are a major contributor of environmental degradation and perplex to the people's lives. Many of the projects are seen as benefiting only the upper sections with power, ignoring the poor who are weak and helpless. In India, a number of environmental movements were born out of protest movements against the development projects. The environmental movements in India at the initial stage were not started as a result of environmental concerns but as a reaction to the suppression and exploitation on their rights over natural resources. The movements were based on survival of livelihood that went on to include environmental concerns. With the growing realization of the effects that

[206] Ashok Swain. Mega Dams are a trend that the world stopped following long ago, but why hasn't India yet?. Outlook. 20th Sept, 2017
[207] *Ibid*
[208] *Ibid*

development has on the environment and people in its affected areas, efforts have been made towards lessening its impact. Despite India's long history of various incidences that shows the struggle of many poor people in particular to displacements of dam affected areas, the government is seen to repeat the mistakes of the past in the case of Mizoram too.

Many development projects of the government encompass negative environment and social implications. In the pursuance of economic development, the other aspects of sustainability are often neglected. In Mizoram, the government has invested in developing hydropower to improve its power insufficiency and provides better access to a clean and affordable energy to its citizens. However, the sustainability in carrying out the project was questionable.

Hydropower is the most important and widely used renewable source of energy presenting about 16 percent of total electricity production in the world.[209] Mizoram is also one of the states in India blessed with various sources of renewable energy particularly hydropower potential. The state has started exploring its resources and Mizoram having rich potential in hydropower, has taken steps for its successful implementation. However, despite hydropower being considered a clean and reliable source of energy in many countries, they are known to have huge impact on local wildlife and ecosystems, submerging land and displacing local residents.

While hydroelectric powers are viewed as ecological, renewable, and economical, they are not without harm. The effects of the hydropower project are diverse, including socio-economic, environmental and geopolitical. Many of the hydroelectric power projects are very controversial and it has also been protested by residents, academics, researchers, social activists and NGOs in many places and Mizoram is with no exception. In addition, a serious cost-benefit analysis, a sound environmental impact assessment and democratic public hearings have also been questioned. In Mizoram, one of the biggest false claims of compensation and corruption is also strongly interlinked with hydropower project.

Mizoram has hydropower potential of around 4,500 MW, sufficient not only to meet the demands of the state but also leave surplus for marketing outside the

[209] Oying Doso and Sarsing Gao. An overview of small hydropower development in India. *AIMS Energy 2020.* Vol. 8. Issue 5. P 896

state. Yet, only 0.6% (29.35 MW) of this capacity has been utilized so far.[210] The state government gives priority to the development of the state's hydropower potential and prepared and notified as such on August 16, "Mizoram 2010 Hydroelectric Power Policy" 2010 for all round development of Mizoram to harness the potential of water in the most ecological, environmental and sensible manner.

4.7.1 Energy sustainability in Mizoram in relation to Hydropower

In Mizoram, Tuirial hydro-electric power project and Serlui-B hydro-power project are the two major hydropower projects. As per the Aggrieved Dam Affected People (ADAP) of Turial hydro-electric power project, the villages of Ratu, Mauchar, Saipum, Palsang, N Khawdungsei, Serzawl, Lungmuat, Bukpui, Saiphai, Hlimen, Darlawn, Khawruhlian, N Chaltang, Nisapui and Thingtherh are affected by the project.[211] Serlui-B hydel project located in Bilkhawthlir, Kolasib district of Mizoram, submerged the Builum village as a result of the construction of the dam. According to the Builum Inquiry Commission, the project has a dubious distinction of creating the first official 'dam refugees' in Mizoram where rehabilitation of the affected villagers took place at a new site Bawktlang near Kolasib.

The 60 MW Tuirial Hydro Electric Power Project has been constructed as a Central Sector Project and implemented by North Eastern Electric Power Corporation (NEEPCO) under the Ministry of Power. Located near Kolasib in Mizoram, the Tuirial dam is an earth-fill and gravity dam having two 30 MW turbines. It is the second largest earthen dam in the world and the largest in India.[212] It is also the first and only large hydropower project in Mizoram.

The Detailed Project Report (DPR) for the Tuirial Hydropower Project was prepared by Central Water Commission in 1991 and completed in 1992. The Mizoram government has initiated a talk with the then Japan Bank for International Cooperation (JBIC) (formerly the Overseas Economic Cooperation Fund - OCF) to avail the debt component of the project so as to manage the project under the state

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[210] Power & Electricity Department, Govt. of Mizoram. Hydro Power potential & its Development. Retrieved from https://power.mizoram.gov.in/page/hydro-power-potential-its-development accessed on 15th May, 2021

[211] Linda C. *Mizoram hydro projects violating safeguards.* The Assam Tribune. September 15, 2010.

[212] 6 facts to know about Tuirial Hydro Project. Northeast Now. 17 Dec 2017 Retrieved from https://nenow-in.cdn.ampproject.org/v/s/nenow.in/north-east-news/6-facts-know-tuirial-hydro-project.html/ accessed on 15 Nov,2020

sector. JBIC however, expressed its inability to finance the project under the state sector. As a result, in early 1996, NEEPCO was invited by the Govt. of India in consultation with Mizoram government to undertake the project under the Central sector. Consequently, a Memorandum of Understanding was signed by Govt. of Mizoram and NEEPCO in May 1996.[213]

NEEPCO completed the pre-construction and infrastructure work immediately after taking over.[214] The original Cabinet Committee on Economic Affairs permit for the project was granted on July 16, 1998 at an estimated cost of Rs 368.72 crore with a completion schedule of 8 years.[215]

In 2001, construction of project works was started according to the drawn up plan. However, on June 2004, after completion of about 30% of the project activities and 95% of Design & Engineer, the works were halted due to agitation by the Tuirial Crop Compensation Claimant Association. Consequently, the project works were suspended due to the law and order problem.[216] The project took almost two decades to complete the project and was built at the cost of Rs 1302 crore in the end.[217] NEEPCO reported that the works of the project were stopped w.e.f 9.6.2004 following demand for crop compensation by Tuirial Crop Compensation Association (TCCA) deterioration in Law and Order around the projects and upward revision of the cost estimate.

The then government in power, Congress Ministry issued Notification to compensate affected landowners for their land.[218] On 3rd March 1997, Rs 431 lakhs was agreed to be compensated to 48 landowners whose land was to be submerged. After a change in Ministry**,** the Mizo National Front issued another notification 'Acquisition of land for submergence area measuring about 4850 Ha'.[219] On 20th Aug, 2001, the number of people to be compensated doubtfully increased to 1,026 when it was revised. The new compensation amounts to Rs 4,797.43 lakhs. This

[213] Central Electricity Regulatory Commission. New Delhi. Petition No. 15/GT/2018 Date of Hearing: 8.8.2018 Date of Order: 9.10.2018
[214] Order in Petition No. 15 / GT / 2018 in 1996.
[215] *Tuirial hydro power project to be commissioned this month.* Business Standard. Nov 15, 2017
[216] *Opcit.*, Central Electricity Regulatory Commision.
[217] Sudheer Singh. *PM Modi to inaugurate Rs 1302 crore hydro power project in Mizoram*. The Economic Times. Dec 15, 2017
[218] Notification vide No K.12011/1/96-Rev Dt.3.3.1997
[219] notified No. 12011/3/96-REV Dt 20.8.2001

raised suspicion as even the near Village Councils could not identify many of the newly claimed landowners. It was claimed that the real land owners were to be compensated little for their land, while the suspicious landowners were to be given large amounts.[220]

All the major works of the project were proceeding satisfactory till 9.6.2004 with 30% of the project works completed. The expenditure till such time was Rs 233.67 crore. Tuirial Crop Compensation Association (TCCA) launched and agitatation against the project demanding payment of crop compensation for the standing crops in the reverine reserve forest area which is not payable as per the Govt. of India norms.[221] NEEPCO reported that the reason for the discontinuation of project was a result of the high compensation demand.

Due to this controversy, the anti-corruption watchdog in Mizoram, Society for Social Action (SOSA) and People's Right to Information and Development Society of Mizoram (PRISM) submitted First Information Report (FIR) and Public Interest Litigation (PIL) against false compensations in regard to Tuirial Hydel project that consequently led to failure of the project otherwise. Vanlalruata, President of PRISM, submitted PIL on 12th Dec, 2006 to Gauhati High Court.[222] However, this petition was rejected as documents could not be provided by PRISM on time. On 23rd April, 2007, PRISM again submitted FIR to the CBI on the same matter. However, Mizoram government refused to grant permission for its investigation. SOSA also submitted PIL to Gauhati High Court and it was accepted on 26th March 2008. After court hearing, on April 21st 2010 order the CBI to investigate into the case.[223]

The Central Bureau of Investigation (CBI) investigation revealed that nine persons were charged by CBI, out of whom relatives of the then former chief

[220] Interview with Vanlalruata, President, PRISM (FIR on Turial comensation claims) on 20th June, 2021

[221] CCEA revises Tuirial Hyrdo project cost. *Business standard.* BS Reporter. Kolkalta/guwahati. Jan 20 2013 https://wap-business--standard-com.cdn.ampproject.org/v/s/wap.business-standard.com/article-amp/companies/ccea-revises-tuirial-hydro-project-cost 111010500030_1 accessed on 30 June 2021

[223] CBI in Tuirial Project chhui dawn. *Zozam Weekly,* dated 9 May, 2010

Minister, Zoramthanga and government officials were included for their involvement in the compensation fraud. The CBI investigation found that Rs 20,046,475 was compensated fictitious landowners.[224]

While there was a multidisciplinary tripartite committee for Tuirial hydropower project to oversee the effective implementation of the proposed safeguards measures in the areas of ecology, forestry and wildlife. There is no nothing mentioned regarding protection of people from impact by the dam. A public hearing is mandatory under the terms of the Environmental Impact Assessment (EIA) prior to commencing any major project. For this reason, residents and experts are questioning its legality as there has never been a public hearing. It is also mandatory that all project related information is made available to people in local languages which neither NEEPCO nor the state did.[225]

The affected village of Saipum objected to the commissioning of a power project of the NEEPCO in their own village, when the Prime Minister scheduled its inauguration on Dec 16, 2017.[226] The All NGO committee claimed that public hearings on environmental issues were never held and the NEEPCO failed to provide compensation to a large number of families who were displaced by the project and those who lost agricultural land.[227]

4.7.2 Serlui-B hydropower project: Displacement of Builum Village

Serlui-B hydropower plant is an earthfill and gravity dam on the Serlui River located near the village of Bilkhawthlir in Kolasib District of Mizoram.[228] Serlui-B is a 293 m long and 51 m high earthfill dam with 145 m long head race tunnel. It has a 135 m long pressure tunnel with a semi-underground powerhouse.[229]

The DPR was approved in February 1999 and in December 2003 Bharat Heavy Electrical Limited and Mecon were awarded a turnkey contract.[230] Construction started in 1998, but was discontinued in 2004 due to unfavourable

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[224] CBI Names 9 in Tuirial Porject chrgesheet. *SInlung NorthEast India.* July 31, 2012
[225] *Opcit.* Linda C.
[226] *Mizoram villagers object to commissioning of hydro power project by PM*. The Economic Times. Dec 14, 2017
[227] *Ibid*
[228] Kolasib District. Serlui B Hydel Project. Retrieved from https://kolasib.nic.in/ accessed on 17th April, 2021
[229] Environmental Justice Atlas. Serlui-B Hydropower Project, Mizoram, India. 4.08.2014
[230] *Ibid*

geological conditions on the site of the dam, technical issues, a high compensation cost and law and order complaints. In 2011 the cost of the project was revised to 913.23 crore, and work was resumed. It is the largest hydroelectric power station owned by the state. Since the project is a state sector project, all of the energy produced is used by Mizoram, in contrast to centrally funded energy projects where the government share is only 12%. The Serlui-B hydropower project consists of 3 units that can each produce 4 MW of power and forms a catchment area of 53 sq. km. [231]

The Serlui-B hydropower project led to the first case of displacement in Mizoram where families of Builum were resettled at Bawktlang.[232] The villagers were however not resettled out of willingness but more so force to evacuate their homes. It presents another case where the rights of displaced persons are neglected, with the government allegedly stopping all facilities for residents of Builum village in an attempt to force them to leave the village.[233]

When 80 families from Builum accepted resettlement package offered by the Govt. of Mizoram, they move out of their homes to resettle at Bawktlang. However, 24 families refused to accept the rehabilitation benefits in protest at the failure of the government to provide adequate compensation for the loss of their houses, agricultural lands and farms and gardens. They refused to leave their homes as resettling in the new place would only result in the same ending, starvation since the compensation offered was not enough to start a new life.

The state government on the other hand rejected the allegation that the victims had not been adequately compensated. Instead, the state government took punitive measures to force residents to leave their homes. However, families in Builum alleged that they had not been given compensation even after storing of water in dam began. The families refuse to leave their home until the government grant their demands. The 24 familes were notified by the District Commissioner of

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[231] *Ibid*
[232] *Ibid*
[233] Paritosh Chakma. Mizoram: *Builum village's deprived of basic facilities to force them to vacate homes.* June 13, 2009

Kolasib on June 11 stating that they had to build a temporary house on the site surveyed within one week of the notice, evacuate their homes and move in it.[234]

The families claimed that rehabilitation is not what they need most but for the government to compensate them according to their lands' worth. They claimed that resettling in Bawktlang was not a better option as they were not given enough compensation. Builum VC treasurer R Zoramsiama said that his land worth was calculated to be only Rs 700 for 9 bighas of his cultivated land while others with the same area of land were given Rs 4/5 lakhs.[235] The same was claimed by Young Mizo Association (YMA) President that there was an unequal compensation with the same area of land. While some without land were paid Rs. 4/5 lakhs he was given only Rs. 7000 for his land. They were not told on how the estimates were enumerated and were also denied to such information. They argue that even though they refused to sign their land off, the compensation was still finalised without their approval. They claimed that while genuine landowners were incapable of acquiring their Land Settlement Certificate (LSC), there were many without land obtaining LSC. The villagers also alleged that irregularities in the assessment of the compensation claims were due to the fact that the officials carried out the assessment without visiting the premises. [236]

Roluahpuia Pautu, YMA secretary said that as per the government stay order in 1990, they have stopped working in their field and demanded compensation for the loss of seven years after the government cancelled the stay order in 1997.

The human rights activist Vanramchhuangi (Ruatfela Nu) visited Builum on 10th June and expressed her view that development at the expense of exploiting the poor is never a true development.[237] According to her, the villagers of Builum had been denied basic facilities such as ration supply, school, water facilities, healthcare and electricity for the last one year. There were over 30 children who were deprived of their rights to education for about two and a half years after the government had

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[234] The Zozam Weekly. 22 June, 2009 Retrieved from http://zozamweeklynews.blogspot.com/2009/06/nunna-hrui-thlung-ru-tuikhuahin-chimpil.html?m=1 accessed on 20th May, 2021

[235] *ibid*

[236] PupuZou. *Row over Serlui Hydel Project in Mizoram*. Zolengthe. May 14, 2009.

[237] *Opcit.* The Zozam Weekly.

reportedly shut down the school at Builum village in 2006. As most of the agricultural lands have been submerged, the villagers have no source of income to survive. Yet, the government adds to their misery by stopping supply of ration under the Public Distribution System. They did not have electricity or clean drinking water supply and has fallen sick as a result of it.

On June 15, 2009, a complaint was filed with the National Human Rights Commission (NHRC), by the Asian Centre for Human Rights, a human rights organization. The complaint alleged that the state government had arbitrarily withdrawn all basic facilities from Builum such as rice and water supply, schools, healthcare facility and electricity. This was done to force the villagers to leave their homes.[238] The North East Students Organisation (NESO) vice chairman Lalmuanpuia Punte has also reported to the NHRC. Thereafter, the state government of Mizoram constituted a commission in June 2009 to attend to the demand of these 24 aggrieved families along with other issues related to the matter. Builum Inquiry Commission was set up under P&E Department on 19th June 2009 under the chairmanship of Pu SL Sailo IAS (Retd). Pu SL Sailova also expressed his discontentment of the rehabilitation offered to the villagers.[239] He asserted that that there was no proper rehabilitation and there was the presence of corruption at all levels.[240]

On 15th June, 2009 an agreement was met between the authorities and the families of the remaining Builum village. As per the agreement the families would leave their home before 30th June and government would provide them with vehicles for their evacuation. They would also be compensated for the loss during 1990-97 and government jobs would be given to all these families.

The environmental impact of development is a well aware issue and efforts have been taken by government around the world to utilize a more sustainable form of energy sources. In India, Environmental Impact Assessment (EIA), a study to predict environmental impact of a proposed project, was made mandatory in 1994.[241]

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[238] Caecilie Mikkelsen (2010). The Indigenous World 2010. p 632.
[239] Mizoram Human Rights Report 2009 (2010). Zo Indigenous Forum.
[240] *Opcit.* Linda C.
[241] Centre for Science and Environment. Understanding EIA. Retrieved from https://www.cseindia.org/understanding-eia-383 accessed on 24th May, 2021

However, Social Impact Assessment (SIA) was made mandatory only in 2013 by the Rights to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.[242] The impact of development projects on economic and social well-being were ignored for a long time.

Although initiatives have been taken to reduce the impact of development activities, the government continues to engage in large-scale hydropower projects without due regard for their social or environmental impact. Government policy generally includes compensation, rehabilitation and relocation in the form of houses and land. However, the effects of these measures are small and insignificant compared to the loss of tribal identity, land and homes, and biodiversity. Furthermore, most development projects in India that force indigenous peoples to put their livelihoods and jobs at risk have delayed the distribution of compensation and assistance for resettlement and rehabilitation. The government is often seen as insensitive to other related issues of these hydroelectric projects. Public hearings must be held and affected locals must be made aware of the implications in order to reduce misunderstandings and disagreement. Compensation is also seen as a measure of personal gain. Senior officials are often part of such frauds, and these corrupt acts have hampered many developments in the state.

A memorandum presented to the Chief Minister on September 28, 2010 by the Sinlung Indigenous Peoples Human Rights Organization and the Sinlung Peoples Collective stated that the impositions of hydropower projects in Mizoram are undemocratic and forced upon them. Project proposals were not transparent in the entire planning process. The affected people have not received any information about these dams that were otherwise supposed to connect, inform and educate them. Information has become expensive property in the hands of a handful of powerful groups who were never to be affected by the dam, but who demand financial compensation, contract jobs, and other project benefits.

It was claimed that Serlui-B hydel project not only force their people out of their land but alienated from their stable livelihood system, and deprived them of their democratic rights. In addition, majority of compensations out of Serlui B

[242] Centre for Science and Environment. Social Impact Assessment and Social Impact Management Plan (SIMP). An Indicative Structure. p. 4

project and Tuirial Multipurpose Hydro Electric project were seized by the rich and influential people who were never affected by the projects. They request the government to reconsider its policy on dams and take into account the welfare of its people and their rights.[243]

The underlying assumption behind sustainable development is that poverty reduction is important to achieve social development goals. Energy is a key component in improving the living standards of the people and eradicating poverty. Energy plays an important role in enhancing social development in many different ways. Access of modern energy sources can be an important instrument to reduce poverty and health risks associated with unavailability and poor quality of energy sources**.** Modern energy services also can reduce the burden of household works done by women and children.

However, the way in which energy is produced and consumed has a profound impact on sustainability of natural environment and also socio-economic dimensions. Development mostly comes at the expense of environment; however, it should be done in a way that would be least destructive to environment and with least possible social impacts. Sustainable development should include the environment, social and economic sustainability, of which the government remains ignorant unless they get enough representation and media coverage. Energy sustainability must provide the people with better access to electricity or energy sources with a more affordable and reliable outcome thus improving their standards of living. The hydropower projects in Mizoram did not address many of these as public hearings are not held beforehand and the people demands are not heard. Moreover, in Mizoram, compensations seem to be the main cause of conflict which the government can easily solve. However, compensations are seen merely as a way of gaining wealth where the rich and influential people benefitted from such projects instead of the genuine landowners. The government need to consider not only the environmental impact but also address the socio-economic impact of these hydropower projects.

[243] *Mizoram anti-dam protest in Aizawl*. Sinlung North East India. 29th Sept 2010

CHAPTER 5

ENERGY POLICY OF MIZORAM

India's energy policy is largely determined by a growing energy deficit, a rapidly growing economy and the need for a reliable energy supply. Rising standards of living, the need for cheap and sufficient electricity supplies and clean fuels for cooking, limited domestic fossil fuel reserves and increasing imports characterized the country's energy policy. Indoor, urban and regional impacts require the adoption of cleaner fuels and technologies. The expansion of alternative energy sources, especially renewable energies, is being promoted more and more.

With the depletion of fossil fuel resources, the use of renewable energy sources such as solar, wind, biomass, small hydropower etc. emerge as an alternative source of energy. It is commonly recognized that electricity, being the main driving force of growth in contemporary world, is the force behind development of energy sector. However, the demand for electricity always surpasses the supply. The Indian energy sector is therefore, in great need of renewable energy sources to meet its future energy needs, taking into consideration a sustainable and pollution-free environment. To integrate renewable energy into a competitive electricity market, India has introduced various subsidy systems and policies so as to promote renewable energy in its rationalized energy sector.

5.1 India's Commitment Towards Renewable Energy Resources

The United Nations General Assembly has adopted 17 Sustainable Development Goals (SDGs) on 25th September, 2015 under the official agenda, "Transforming our world: the 2030 Agenda for Sustainable Development", and India being a signatory to the resolution of the 2030 Agenda for Sustainable Development, adopts 17 Sustainable Development Goals (SDGs).[244] India has made significant improvement in meeting the United Nations Sustainable Development Goals, in particular Goal 7 (affordable and clean energy) on delivering access to energy. The

[244] Sustainable development goals-India

SDGs cover a broad range of social and economic development issues, but, energy is at the heart of many of the Sustainable Development Goals- from expanding access to electricity, to improving clean cooking fuels, from reducing wasteful energy subsidies to curbing deadly air pollution that each year prematurely kills millions around the world. India's energy and emission intensity of its gross domestic product (GDP) have declined by more than 20% during the last decade.[245]

This is on the same track with the country's commitment to reduce the emission intensity of its GDP by 2030. India is an active player in international forums of fighting climate change. It has pledged to reduce its GDP emission intensity by 33-35 per cent by 2030 under the Nationally Determined Contributions (NDC) adopted during the Paris Agreement.[246] The Paris Agreement is an agreement under the United Nations Framework Convention on Climate Change (UNFCCC). Its purpose is to solve problems related to the greenhouse gas mitigation, adaptation and finance. It is a legally binding international treaty on climate change adopted by 196 Parties at the Paris Conference (COP) 21 in Paris on December 12, 2015.[247]

India's NDC under the Paris Agreement focuses on reducing the intensity of its economic emissions and increasing non-fossil fuels shares in its energy generating capacity. While the emission intensity of India's GDP has declined in line with the target levels, progress towards a low-carbon electricity supply has been challenging.

Transitioning from carbon intensive fossil fuels to low carbon energy source has become a priority policy for any country as energy is the largest source of greenhouse gas emissions. Reliable, clean and affordable energy is a prerequisite for economic growth and is one of the main pillars of the Sustainable Development Goals. India is committed to increasing the use of clean energy sources and has already implemented several large-scale sustainable energy projects and is strongly promoting green energy.

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[245] International Energy Agency. *India 2020 Energy Policy Review*

[246] Pooran Chandra Pandey. *India Plans to Recue to Emissions Intensity of GDP by 33 to 35 percent by 2030 from 2005 Levels.* Climate Scorecard. July 9, 2020

[247] ENVIRONMENT:7.d.Paris Agreement. *United Nations Treaty Collection.* Chapter XXVII, 12 December 2015

5.2 Renewable Energy Policies in Mizoram

At the central level, the Ministry of New and Renewable Energy Sources (MNRE) manage policy measures.[248] State governments contribute to this by providing infrastructural facilities for wheeling of power and purchasing electricity from renewable energy. MNRE has formulated a comprehensive renewable energy policy for the integral development of the sector that covers all relevant aspects. The overall objectives of the policy draft are to meet minimum energy demand through renewable energy sources, decentralized energy supply in agriculture, industry, commerce and households in rural and urban areas, and supplying grid quality.

Renewable energies are becoming an increasingly important source in the energy mix and fulfil the dual goal of energy security and sustainable energy. Mizoram has good potential to promote and develop renewable and non-conventional energy projects, especially solar projects and small hydropower plants. The state has prepared a liberal policy to promote renewable energies. The renewable policies of Mizoram are devoted to tap the potential of the state's renewable energies in an environmental friendly and sustainable manner.

The spread of various renewable energy technologies has been supported by various Indian Government policies and support measures. The Indian government wants to create a "green city" in every state of the country that runs on renewable energy.[249] Green City will anchor environmental-friendly power through solar roof systems in all of its homes, suburban solar parks, waste incineration plants and electro mobility enabled public transport. Aizawl has already been declared a 'solar city' under the MNRE program for solar/green cities.[250]

5.3 Policy Framework for Promotion of Renewable Energy in Mizoram:

Policy frameworks are crucial to the success of renewable energy. Policies in Mizoram are directed towards the overall development and promotion of renewable energy technologies and their applications. The policies are meant to encourage the private sector to engage in renewable energy activities. As such, the guidelines are

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[248] Ministry of New and Renewable Energy, Government of India. Retrieved from https://mnre.gov.in/the-ministry/what-does-the-ministry-do/ accessed on 12th July, 2021

[249] Mayank Aggarwal. *India is planning a 'green city' powered by renewable energy in every state.* Dec 30, 2020

[250] 24X7 Power For All (2016). *A Joint Initative of Government of India and Government of Mizoram.*

mainly financial, fiscal incentives or specific guidelines to encourage or enforce utility companies to buy renewable energy, promotes to create renewable energy projects, companies that manufacture renewable energy plants, or private ones and government organizations to undertake research and development relating to renewable energy.[251]

The government of Mizoram is committed to using the renewable energy potential of the state in order to meet the increasing energy demand in an environmentally friendly and sustainable manner. For the promotion of renewable energy in the state, Renewable Energy Policy of 2003, Hydro Electric Power Policy of Mizoram 2010 and Mizoram Solar Power Policy 2017 have been issued under preparation of Zoram Energy Development Agency (ZEDA), Government of India.

5.3.1 Renewable Energy Policy 2003 Power Produced through Non-Conventional Energy Sources

The Government of Mizoram adopted 'Renewable Energy Policy 2003 Power Produced through Non-Conventional Energy Sources' in 2003 with the objective to promote generation of grid-grade power through Non-Conventional Energy Sources in the context of non-polluting, renewable inputs like solar, wind, small hydel, biomass and other wastes.[252] It was meant to encourage energy generation from increasing energy sources in order to cater the increasing demand of power and its price.

Under this policy, all power producing generating 10 kW to 24 MW of grid-grade electricity from Non-Conventional Energy sectors such as solar, wind, electric generators, small hydroelectric plants, biomass, combustion, biomass co-generation, waste recycling, etc. will be eligible producers under this Policy. This policy authorizes Zoram Energy Development Agency (ZEDA) to be the nodal agency. It was authorized to test all devices/equipment related to renewable energy and energy saving devices to be use/sale in Mizoram State for quality control. The agency shall facilitate clearances for the project for producing electricity from Non-Conventional Sources as the State and Central levels on the lines of facilitation provided by Bureau

[251] Lalthantluanga (Assistant Engineer ZEDA) Interviewed on 8th Dec, 2020
[252] VOL- XXXII Aizawl, Wednesday, 15.10.2003 Asvina 23, S.E 1925, Issue No. 289

of Industrial Promotion (BIP). The agency shall also facilitate grant of loans to such projects by Indian Renewable Energy Development Agency (IREDA) and subsidies by the Ministry of Non-Conventional Energy Sources (MNES), Government of India.[253]

The 2003 Renewable Energy Policy was meant to facilitate excellent opportunities for increased investment in renewable energy sector, technology up gradation, induction of new technology, etc. in the state.[254] As Mizoram has been depending mainly on electricity imported from Central sector generation/other states through grid lines, the availability of such power are limited and unreliable due to various reasons. Therefore, price of such power will go on increasing rapidly. The policy was framed to promote energy generation from Non-Conventional Energy Sources and investment in this sector from eligible producers.

The policy made no restriction on the legal form of power producing entrepreneur. It permits companies, cooperative, partnerships, individuals, charitable societies, Non- Governmental Organizations, etc. to be eligible producers provided they undertake to generate electricity from Non-Conventional Energy sources. Renewable energy equipment and materials were to be exempted from States sales tax to make it more investor friendly. The underlying goal of this policy was to promote all forms of renewable energy in Mizoram but without setting target to achieve.[255] Although there was no proper step taken in terms of implementation of renewable energy through this policy, it was significant in that it was the first policy of the state to promote and encourage renewable energy in Mizoram.

5.3.2 Hydro Electric Power Policy of Mizoram 2010

The topography of the state provides for ideal conditions for development of hydro-electric power projects. There are two major types of rivers in Mizoram according to their direction of flow, rivers which flow in North direction namely, Tuivai, Tuivawl, Tlawng, Tut, Serlui and Tuirial and rivers flowing in Southern direction namely Kolodyne, Tuichang, Tuipui, Tiau and Mat.[256] Apart from the

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[253] *ibid*

[254] Interview with Lalthantluanga Chenkual, Assistant Engineer, (Policy and works of ZEDA) ZEDA, on 8th Dec, 2021

[255] *ibid*

[256] Hydro electric Power Policy of Mizoram-2010. No.B.24013/10/2009-P&E. 16.08.2010

major rivers, the state has many small river rivulets which are perennial in nature and providing ideal condition for developing projects in the category of Micro/ Mini and Small Hydro Electric Project.

Mizoram hydro-electric power policy of 2010 has authorize Power & Electricity Department, Govt. of Mizoram to be the nodal agency for developing hydropower in Mizoram for projects beyond 25 MW at present.[257] Under this policy, all state government approvals or consent for power related projects are conveyed by the Secretary of Power, Govt. of Mizoram to a person duly authorized by him. The nodal agency for projects below 25 MW is Zoram Energy Development Agency (ZEDA). However, due to lack of manpower and resources, all projects related to hydropower are performed by the Department of Power & Electricity, Govt. of Mizoram through ZEDA.

The state government has liberalized the policy of developing hydropower projects in the state. In line with the central government's policy of increasing electricity from hydropower projects, the state government has opened the door to investigate, prepare a Detailed Project Report (DPR), and then implement hydropower projects. As a result, Central Power Sector Undertakings (CPSU) such as NEEPCO Ltd, National Thermal Power Corporation (Hydro) Ltd. and central government organizations such as Brahmaputra Board have been allowed to conduct investigative activities in various locations.

The state government has passed the policy and decision to develop the state's available hydropower potential in the most environmental, eco-friendly and sensible way for an all-round development of Mizoram. As a result, the following fundamental decision applies to every project development:

i) Prior approval / approval from the state government must be obtained by the developers in order to implement any hydropower project in the state.

ii) The Detailed Project Report of the project must be approved by the state government prior to implementation by the developers.

iii) Without exception, the state government must be involved from the stage of formulation / investigation of the project.

[257] *Ibid. p.4*

iv) The state governments are to be taken into full confidence by the central government and the developers in all matters.

v) In developing the project, preference will be given to the investigating agency.

The policy enables any interested developer, including private developers, to submit their offer to the state government through the State Nodal Agency.

5.3.3 Solar Power Policy of Mizoram 2017

Conventional power generation using fossil fuels have a negative impact on the climate as they are the major source of greenhouse gas emissions that causes global warming. They are also fast depleting and can be exhausted. Therefore, a global change towards sustainable renewable energy generation has been observed. India is blessed with abundant solar energy and is harnessed efficiently; the country is capable of producing trillion-kilowatts of electricity.[258] Solar energy is extremely beneficial as it is not only non-polluting and environmentally friendly but can be generated locally.

Located in the tropical region, Mizoram receives an average solar insolation of approximately 4.5 kWh/m2 and has approximately 300 sunny days. [259] The temperature favors the construction of solar power plants within the state as the state has a cool natural breeze to cool the plants. The solar potential of Mizoram calculated by the National Institute of Solar Energy (NISE) is approximately 9.09 GWp.[260]

In order to tap the potential of the converging revolution in solar energy and to take advantage of the Jawaharlal Nehru National Solar Mission (JNNSM) and Deendayal Upadhyaya Gram Jyotin Yojana (DDUGJY) established by the Indian government, the state government has decided to adopt its solar policy, namely 'Solar Power Policy of Mizoram-2017.'[261]

This policy contains provisions aimed at creating a favorable environment for potential solar power developers to make the best possible use of solar power. This in turn is intended to do justice to the goal of the government of Mizoram to offer its

[258] Solar Power Policy of Mizoram-2017. p. 4
[259] Ministry of New and Renewable Energy, Govt. of India. Annual Report 2019-20.
[260] *Opcit.,* Solar Power Policy-2017, p. 5
[261] Vol-XLVI Aizawl, Wednesday 8.3.2017 Phalguna 17, S.E.1938, Issue No.59

consumers a competitive, reliable power supply and also to guarantee a sustainable fuel mix in the long term.

Mizoram has a total estimated renewable energy potential of 9261 MW from various sources such as Small Hydro Power (168.90 MW), Biomass (1MW), waste to energy (2 MW) and Solar Energy (9090 MW).[262]

The policy has the following objectives

i) To encourage, develop and promote solar power generation

ii) To develop Mizoram into an investor friendly state.

iii) To promote decentralized and distributed generation.

iv) To promote grid connected and off-grid solar applications.

v) To promote all technologies of harnessing solar energy.

vi) To create employment opportunities.

vii) To promote R&D and innovations, skill development in the sector.

The policy was made to be applicable for all solar energy based project (Solar PV/ Solar thermal) in the State of Mizoram.

The policy aims to use the existing potential for generating solar power on unused roof areas and at the same time to promote green and clean electricity in order to reduce dependence on conventional energy sources. Any person, firm, corporation, institution or registered company, including public utilities, is eligible to sell electricity to Distributive Licensee/Power & Electricity Department or to third party and for own consumption. All private individuals, residential, commercial, institutional, government or semi-government, industrial units are entitled to set up solar power plants on the roof within a prescribed capacity limit. Consumers of grid-connected rooftop projects can generate solar power for their own consumption and feed excess power into the grid via a bi-directional export/import meter.

5.4 Implementation of Renewable Energy Sector by ZEDA

Zoram Energy Development Agency is an independent body established by the government of Mizoram which became operational in 1999.[263] It was exclusively meant to undertake all programmes in the field of Non-Conventional & Renewable

[262] Ministry of New and Renewable Energy, Govt. of India. Annual Report 2019-20.
[263] Zoram Energy Development Agency. About ZEDA. Retrieved from https://zeda.mizoram.gov.in/page/about-zeda accessed on 15th June, 2021

Energy Sources. In order to implement the centrally funded and sponsored scheme in the related field, ZEDA interacts with the Ministry of New & Renewable Energy (MNRE), Government of India. It is the state department for Renewable Energy Certificate (REC) accreditation.[264]

Since its inception, ZEDA has been undertaking various steps for the promotion and implementation of renewable energy in Mizoram. Several schemes have been successfully carried out for a more efficient energy use, out of which the solar policy of 2017 has been the most effective. However, there are several obstacles the agency faced as a result of lack of experts and staffs.

5.4.1 Biomass

Biomass are non-fossil fuel including wood, animal manure, and agricultural byproducts, especially in power plant for generating electricity.Biomass has been used as an energy source since humans have been creating fire. People who were the first to use wood and animal manure plant burn them to produce biomass energy. Today, biomass in the form of wood and wood products is still a widely used energy source in many countries or regions of the world. It can be used for household consumption and at a grid scale via power stations, where it is often used as a substitute for fossil fuels with much higher life cycle carbon emissions.

In Mizoram, particularly for many living in rural areas, firewood continues to be the predominant source of fuel due to lack of cheaper alternatives. Biomass is used primarily in the form of burning wood. Traditional cookstoves or chulhas are very inefficient because they have poor air flow and insulation. As a result, they consume a lot of biomass and produce high levels of indoor air pollution.

To reduce the pressure faced on local forests by reducing the amount of wood the chulhas consumed, and to decrease the negative health impacts associated with exposure to toxic smoke, efforts to improve the efficiency of cook stoves have been increasingly popular. Steps have been taken in India to improve the use of biomass energy especially in rural areas where women are exposed to the risks of health consequences due to inhalation of smokes produced by traditional chulhas. Women

[264] *Ibid*

and children suffer disproportionately from spending more time indoors and doing essentially all of the cooking.

In Mizoram, around 47.89% of the total population live in rural areas as per the 2011 Census.[265] There has been an increase usage of LPG even in rural areas. According to the performance of states and UTs on indicators of SDG 7, Mizoram scores 100% per percentage of households electrified, 114.07% per percentage of LPG and PNG connection against number of households in 2020-21.[266] However, not everyone has an easy and convenient access to LPG supply particularly in remotest corner of rural areas. Moreover, every time there is a blockade in National Highway (NH 306 an economic lifeline of the state connecting Mizoram to the rest of the country) due to any factor, the state automatically faces a huge problem in getting supply especially in LPG supply. As a result, people residing in rural areas are reluctant to depend entirely on LPG. Many households in rural areas choose to depend on use of firewood even if they have LPG connection due to its affordability and accessibility.[267]

Therefore to improve the lifestyle of the people in rural areas and women in particular who are involved in kitchen, initiative has been taken to reduce the burden as a remedy and sustainability. In India, National programme on improved chulha was introduced in December 1983.[268] Improved cook stove is one of the most simple, inexpensive and widely used technology to improve combustion, efficiency of biomass and reduction of air pollution.

In Mizoram, improved biomass cook stoves has been distributed with subsidy by ZEDA. Using biomass cook stoves reduce carbon emission by 90%, with twice the energy efficiency of traditional cook stove. It is designed in such a way to help

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[265] Census India. Mizoram Urban/Rural Population- Census 2011.
[266] SDG India Index 3.0 (2020-21). Performance of States and UTs on Indicators of SDG 7.
[267] *Opcit.*, Interview with Lalthantluanga Chenkual
[268] National Programme on Improved Cook stoves in India. Retrieved from http://www.nzdl.org/cgi-bin/library.cgi?e=d-00000-00---off-0envl--00-0----0-10-0---0---0direct-10---4-------0-0l--11-en-50---20-about---00-0-1-00-0-0-11-1-0utfZz-8-10&cl=CL1.9.2&d=HASHaa4ee1268ca3dcbf3567b7.8&gt=1 accessed on 12th July, 2021

reduce the use of firewood and decrease deforestation. A total of 2000 cook stove have been distributed mainly in the reserve forest areas.[269]

5.4.2 Issues and challenges

Biomass energy is considered renewable as forest can replenish itself; however, they are not clean and cannot be relied on for large scale projects. In 2003 two biomass gasifier with 100 kW each was planted at Mamit to generate electricity.[270] But it proved to be unsuccessful due to difficulty in collecting large amount of wood to fuel the plant. Possible deforestation, difficulty in transportation due to mountainous terrain etc., are the other difficulties of using biomass energy in Mizoram.[271] Improved cookstove is also designed solely for cooking purpose and does not give off heat on the sides like traditional chulhas. For this reason, many people in Mizoram do not it prefer over traditional chulhas as it does not serve multipurpose functions.

In Mizoram, waste to energy could not be utilized on a large scale owing to shortage of manpower. Moreover, municipal waste in Aizawl is also not enough to generate energy. Segregation of waste is still a challenge in the state. Except for a few private households, there is no proper step taken for its utilization in this sector.

Biogas is also a very good alternative to CNG or LPG for people engaging in animal husbandry. However, the department of AH&Vety, Govt. of Mizoram has not receive funds for the promotion of biogas plants in Mizoram since 2017.[272] Many of the users are facing problems in its maintenance and as a result, there are only a few people who still use biogas in Mizoram through government funded schemes. It requires large amount of dung to produce gas which is available only in a few areas such as Sihphir, Lungdai and that too in farms only.

5.4.3 Wind Energy

Mizoram is a mountainous region alleged to have potential for generating power from wind. There is an on-going assessment by ZEDA to determine the potential of wind energy in the state. Wind Resource Assessment (WRA) stations has

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[269] Proposal for Strengthening of ZEDA. Oct 2018
[270] Proposal for Strengthening of ZEDA. Oct 2018
[271] *Opcit.*, Lalthantluanga Chenkual
[272] Interview with Dr. H. Laltlanmawia, Director AH & Vety, Govt. of Mizoram (Schemes and projects related to biogas) on 10th June, 2021

been planted in several areas, such as Chalfilh, Reiek, Hmuifang, Women's Polytechnic, with Chalfilh having the greatest identified potential of around 400-500 KW.[273]

Mizoram, despite being a mountainous region and having wind energy potential, large wind mills cannot be planted due to its rocky terrain and poor road condition. The best alternative lies in wind-solar hybrid project.[274] Two demonstration projects of wind solar hybrid have been placed at Cheural (8 kw), two at Pukpui (5kW), and one at Tuipang (5kW).[275] However, only an assessment project for identifying the potential has been carried out.

5.4.4 Issues and Challenges

Wind turbines come in a variety of sizes depending upon the amount of electricity produced. In Mizoram, large utility scale-turbine cannot be planted due to rocky terrain and limited infrastructure. A single turbine measures up to 40m and requires quite a large area for planting the mill. As a result, it is a difficult task to identify spaces large enough to plant them. Therefore, micro windmills are the only suitable alternative.[276]

Adding more to the challenges, identification of sites with wind energy potential and planting windmills are time-consuming as it requires a reasonably steady supply of wind all year round. It needs appropriate site with enough wind energy potential and a large vacant land for planting the windmill. Wind energy also requires a lot of manpower and technical support to which ZEDA is lacking as a result of being a small body.[277]

5.4.5 Hydropower

The state generation is heavily dependent on hydropower. Initiatives have been taken by the government to construct hydropower plants. Mizoram has 11 small

[273] Proposal for Strengthening of ZEDA. Oct 2018
[274] *Opcit.*, Interview with Lalthantluanga Chenkual
[275] *Ibid*
[276] *Opcit.*, Interview with Lalthantluanga Chenkual
[277] *ibid*

hydro power generation stations. Apart from these, Mizoram also has a share of power from Tuirial Hydro Electric Plant which generates 58.1 MW owned by NEEPCO.[278] However, the share of free power as a home state is only 12 per cent (6.972 MW) of the total generation of Tuirial HEP. There are four on-going hydro power projects and seven projects being planned for execution in Mizoram.

Fig 5.1 On-going hydel projects in Mizoram

Sl No	Name of Hydel Station	Installed Capacity (MW)	Status
1	Tlawva	2x2.5	Physically completed. Commissioning under progress
2	Kawlbem	2x2	Work in progress
3	Tuiriza	1x0.1	Completed in June 2019
4	Tuiching	1x0.1	Completed in July 2019

Source: Draft Perspective Plan, P&E Dept., Govt. of Mizoram (2020)

Fig 5.2 Status of Hydel Projects planned for execution in Mizoram

Sl No	Name of Hydel Station	Proposed Installed Capacity (MW)	Status
1	Tuirini	24	DPR completed. Posted for BRICS funding
2	Tuivawl	25	Additional S&I works and updation of DPR being prepared by WAPCOS
3	Mat Sekawi	70	Fund for additional S&I works and updation of DPR being sought from Govt. of Mizoram
4	Iva	3	DPR prepared, submitted to Government for A/A
5	Ngengrual	1	DPR being prepared and is in final

[278] P&E Department, Govt. of Mizoram. Annual Report 219-20. p. 21

			stage
6	Khawiva-II	0.7	DPR being prepared and is in final stage
7	Tlawva Augmentation	0.5	DPR sent to MNRE

Source: Draft Perspective Plan, P&E Dept., Govt. of Mizoram (2020)

5.4.6 Issues and challenges

Almost all the hydro power plants of Mizoram have seasonal operation due to non-availability of water in lean period.[279] They are the biggest source but are not reliable to be the only source of power generation all year round. Even though they are non-polluting, they have environmental impact to some extent. Large forest lands are covered for construction of dam destroying biodiversity in the forest area submerged by water**.**

Construction of dams has been protested in many parts of India and Mizoram included, thus slowing down and sometimes even halted the project. It also led to displacement of the village of Builum in Mizoram, resulting in loss of their homes and agricultural land.

In addition to these challenges, even though policies are framed with intention to encourage all sectors to invest and utilized renewable energy, the reality presents a different picture. The government often fails to take fast measures in implementing hydropower project. There is no political will-power. Detail Project Reports are often rejected with no explanation, which seems to be a common practice when new government takes over. It takes over a year to prepare these reports with huge expenses incurred.[280]

[279] Mizoram State Action Plan on Climate Change (2012-17) Mizoram, Directorate of Science & Technologies. p. 90

[280] Malsawmdawngliana, Executive Engineer, P&E Department, Govt. of Mizoram (Mizoram on energy security and hydropower projects) on 12th Dec, 2020

5.4.7 Solar Energy

In 2010, Ministry of New and Renewable Energy, Govt. of India launched Jawaharlal Nehru National Solar Mission under National Action Plan on Climate Change.[281] Eight Missions were launched with Solar Mission as one of them. This Mission aimed at achieving 20,000 MW (20 GW) from solar energy by 2020. Fortunately, this was achieved earlier than estimated by 2015; so the target was revised and increased to achieve 100 GWp by 2022.[282] Every state was expected to have a solar policy to achieve the target.

Under Solar Power Policy of Mizoram 2017, a minimum target of 80 MW from ground mounted solar, 50 MW through Rooftop solar System, is envisaged.[283] Power & Electricity Department, Govt. of Mizoram has constituted a working group on solar power generation.[284] The group is working in co-ordination with ZEDA for identification of locations, survey, framing of project reports etc. on Solar Power Plants within the State.

Mizoram's first solar power plant has been commissioned at Tlungvel.[285] The grid connected 2 megawatt solar photovoltaic (SPV) solar power plant made Mizoram enter the solar map of the country. Vankal located in Khawzawl district which have a capacity of 20 MW and 5 MW solar plant near Saitual town are also currently constructed as a part of accomplishment of the Solar Power Policy.[286]

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[281] Jawaharlal Nehru National Solar Mission (JNNSM). Dec 11, 2020 Retrieved from https://www.jagranjosh.com/general-knowledge/jawaharlal-nehru-national-solar-mission-jnnsm-1607682253-1 accessed on 12th July, 2021

[282] ZEDA. Solar Power Policy of Mizoram 2017. P 4

[283] *ibid*

[284] Vide No. T-15010/1/2015-E-in-C (P)/ T & R /28 Dt 24.10.2016

[285] *Mizoram enters solar map of country with 2 megawatt power plant*. Business Standard. Retrieved from *https://www.business-standard.com/article/pti-stories/mizoram-enters-solar-map-of-country-with-2-mw-photovoltaic-120120500494_1.html accessed on 15th June, 2021*

[286] Draft Perspetive Plan of P&E Dept. Govt of Mizoram (2020)

Fig. 5.3 Solar Power Plant (Tlungvel)

Source: Zoram Deveopment Agency (ZEDA), 2020

Fig 5.4 Progress of Solar energy under ZEDA in Mizoram

Sl No	**Item Description**	**Capacity**	**Funding/Scheme**
1	Plant	3538 kWp	MNRE and State under JNNSM
2	SPV Street Lighting System	5000 Nos.	MNRE and State under JNNSM
3	SPV Street Lighting System	300 Nos.	Under CSR Scheme
4	SPV Home Lighting System	5395 Nos.	Under MNRE
5	SPV Home Lighting System	3964 Nos.	Under MNRE
6	Solar Lantern	8331 Nos.	Under MNRE
7	Solar Lantern	2181 Nos.	Under State Fund
8	SPV Solar Power Packs	6176 Nos.	Under MNRE

Source: Draft Perspective Plan, P&E Dept. Govt. of Mizoram (2020)

Table 5.1 On-going solar projects in Mizoram

Sl No	Item Description	Capacity	Funding/Scheme
1	SPV Rooftop Systems for Government building in Kolasib district	555kWp	Under MNRE
2	Installation of Grid connected SPV Rooftop systems for residential buildings	3000 Nos.	Under MNRE

Source : Draft Perspective Plan, P&E Dept., Govt. of Mizoram (2020)

Recently, there has been an increase usage of solar power among the public. YK Solar, a private enterprise based in Tuikhuahtlang, Aizawl has set up solar energy store in 2018. Initially, their monthly sales often did not reach Rs. 1,00,000. But now, their sale record shows that there has been considerable increase of solar power users among the people in Mizoram.[287] Those who are aware of the benefits seem to be willing to invest in solar power products even if the initial cost may seem high.

Mizoram has made mandatory of the state government buildings including institutes to install solar rooftop solar. Central government offices are also required to install solar panels in an attempt to boost solar rooftops. A net metering policy has also been introduced so that any consumer who wants to rely on solar energy can feed surplus electricity that they generates into the grid and be compensated for it. ZEDA has also promoted the use of solar energy and has provided several solar lamps, solar pump, heaters, etc. to several villages in the state.[288]

5.4.8 Issues and challenges

Use of solar energy for water heating has tremendous opportunity in Mizoram. Solar water heater can be used in place of electric geyser. Though few

[287] Interview with Zaithanpuii, YK Solar, (About YK Solar store and sales) on 10th June, 2021
[288] Solar Power Policy for Mizoram. Retrieved from https://www.jetsor.in/solar-policy-for-mizoram/ accessed on 22nd July, 2021

demonstration projects have been undertaken in the state majority of the solar water heating potential has been left untapped. Though the number of solar energy user have increased, the initial cost of purchasing a solar system is high; as a result it has not been explored by most of the commercial and residential segments.[289]

Even though solar energy can be stored in batteries, large batteries are expensive and most solar energies can be used only during the day. For large-scale production, solar photovoltaic panels require a lot of space which is not suitable for most buildings as they are not compatible to accommodate bigger number of solar panels.[290] Moreover, solar power plants are not popularised as subsidy on off-grid solar power plants are provided only to government departments, institutions and public utilities and not available to private and commercial sectors.

Recent IEA analysis shows that in 2018, India's investment in solar PV was greater than in all fossil fuel sources of electricity generation together. Large-scale auctions have contributed to swift renewable energy development at rapidly decreasing prices. By December 2019, India had deployed a total of 84 GW of grid-connected renewable electricity capacity. By comparison, India's total generating capacity reached 366 GW in 2019. India is making progress towards its target of 175 GW of renewables by 2022.[291] In September 2019, the prime minister of India, Narendra Modi, announced that India's electricity mix would eventually include 450 GW of renewable energy capacity.

Mizoram, with its renewable potential is deemed to contribute significantly towards the country's target of achieving renewable goals. The state has no successful exploration of conventional energy sources or industries worth mentioning. Households remain the biggest electricity consumer and therefore, the state renewable energy is enough to meet the demand of the state. The state has formulated policies that are supposed to be most suitable for the promotion of renewable energy in Mizoram. However, real problem lies in its implementation. The

[289] *Opcit.* Interview with Lalthantluanga Chenkual.
[290] Interview with Lalhriatrenga Chhangte, B.E Mining & Advocate (Energy Security and problems in Mizoram) on 14th June, 2021
[291] Nandini Jhalani. India looks likely to miss the 2022 renewable energy targets. *Mongabay*. June 3, 2020

state must address the issues and challenges associated with the implementation of renewable energy in Mizoram and strive towards its successful application.

CHAPTER 6

FINDINGS AND CONCLUSION

Energy security is a keystone to modern society that has the ability to influence state's relation. The interpretation of energy security has undergone many changes since its conception. The concept of energy security was simply interpreted as a steady supply of oil during the 20th Century, but now it has been defined in the context of four A's: availability, accessibility, affordability and acceptability.

Energy has become an indispensable factor of the modern economy and is essential to the development of a society. The increasing reliance on energy in daily life and overall development has made energy security a priority policy for states and countries. Different countries adopted different ways to secure their energy supply. Energy security is fundamentally linked with not only the economy but other policy issues such as environment, livelihood, and socio-cultural setup.

Energy security for India is to ensure the continued availability of commercial energy at competitive prices to support economic growth and at the same time meet the energy needs of the people through safe, clean, and affordable forms of energy. With India's growing energy needs, import dependency will become even more pronounced in the years to come, despite some significant recent oil and gas discoveries. Such heavy and growing reliance on energy imports makes any country vulnerable to external shocks. Therefore, the procurement of energy resources and supplies from abroad and measures to promote the introduction of new technologies in the energy sector and exploring renewable sources are extremely urgent.

Energy has been used since the beginning of time with a continuous search for better alternatives. Fossil fuels have been dominating the energy mix ever since the Industrial Revolution. This was because good energy source was measured in terms of its efficiency. Energy has become not only a tool of development but also utilized as a political weapon as there are only a few countries blessed with such resources. Heavy reliance on import of fossil fuels not only increase vulnerability but also has an adverse effect on the environment. Burning of fossil fuels contributes the

highest to global warming. As a result, there is a growing shift towards renewable energy around the world and steps have been taken not only at the international but national and local levels are also moving towards the right direction.

Mizoram is one of the states in North East India with a huge potential in renewable energy that could contribute towards the goal of energy security and sustainability. It is the 23rd state in India to have its statehood. But development in the region has been slow. Due to its long struggle and fight against the Indian Union for its independence, the state suffered greatly in terms of economy and social life. Development was halted during the twenty years of insurgency. The people were deprived of the very basic needs such as food, power supply, water supply, transportation and communication. Electricity was generated in December 1962 for the first time in Mizoram. However, development in the power sector was stagnant until the Power & Electricity function as a separate body. The responsibility for generation, transmission and distribution of power throughout the state is now in the hands of the Power & Electricity Department, Govt. of Mizoram which became a full-fledged department in 1983.

Mizoram is one of the fastest growing economies among the all the states in India. With the increasing population and overall advancement in technology and modernisation, the energy scenario of the state has also been changing and the consumption of energy is also increasing rapidly. However, Mizoram is not yet exposed to any large industrial activities. While the industry sector accounted for the highest share of energy consumption in India, majority of the electricity demand in Mizoram goes to the household sector. The service sector remains the greatest contributor to its GSDP and the industrial sector contributed only 26 per cent in 2018-19. The industry sector in Mizoram consists of mining and quarrying, manufacturing, construction and electricity, gas, water supply and utility services. While energy consumption increases every year, the entire North East region including Mizoram still has one of the lowest per capita energy consumption in the country. The per capita energy consumption of Mizoram during 2018-19 was only 617 kWh against 1181 kWh in India.

Despite electricity consumption being relatively low compared to the rest of the country, the state is not self-sufficient in terms of power generation. It depends almost entirely on central generating stations to meet its deficit. The state spends a huge amount for purchasing power from other states. During 2019-20, the state purchased about 95% of the total power needs with a bill amounting to Rs. 329.87 crore. The lack of energy in the state is due to the minimal ability to generate energy locally, often resulting in power outages.

Mizoram has achieved its goal of electrifying all villages in 2019. Despite the state reportedly having 100 per cent electrified village, the average power supply in rural areas remains only 15 hours a day. Transmission and distribution loss, poor response time and restoration time is also another hindrance to quality of supply in the state. The state has a rich hydropower potential yet only a small amount has been harnessed so far. Due to its mountainous topography, construction of non-conventional energy sources is expensive and there is difficulty in transportation due to narrow roads. The changing climatic conditions and inconsistent rainfall patterns in the state have made water inaccessible in times of water scarcity and makes hydropower generation unstable.

Till now, all energy such as oil, gas and electricity are purchased from outside sources and the state dependency on imports is not declining. The state has no alternative energy source to depend on in case of disruption of such supplies from outside sources. The state has a rich potential in renewable energy, despite that, only a few of it has been harnessed so far.

Mizoram is located in the Assam-Arakan Basin consisting mainly sedimentary rocks; it has mineral resources such as coal, oil, limestone, sandstone and clay. However, there are no minerals discovered enough to influence India’s mineral map to date. Mizoram is in the number one category of proven commercial oil production zone, valued at approximately 170 million tons of untapped crude reserves. Mizoram's strategic location in the Assam-Arakan region and the large gas reserves on the India-Bangladeshi border, as well as Myanmar's gas reserves in almost the same region as Mizoram, increase the likelihood of the state becoming a

major source of natural gas and oil. Mizoram has a probability of petroleum deposits or a reported oil and gas presence in similar geological structures in Tripura and Assam. The presence of petroleum has also been confirmed by India's largest exploration company, Oil and Natural Gas Corporation (ONGC) in Bilkhawthlir, Kolasib District.

Oil exploration sites were divided and separate blocks were allocated to different companies with a time frame to carry out oil exploration venture in Mizoram. Exploration was carried out by ONGC and OIL in separate zone, yet their exploration was not successful during the allotted time. RELIANCE and Vedanta were also allotted another zone for exploration but no exploration was made on their part. The exploration companies are considering the worth of investing in exploration of oil in Mizoram due to its high expenditure. Due to the mountainous topography and poor road condition of Mizoram, it is difficult to transport the machineries required for the exploration. As such, no company has been able to complete their work during the license renewal period. Therefore, despite the hopes of Mizoram to become a major oil-producing state of the country, there has been no successful exploration to date.

In Mizoram, the power sector is a vital component of the state’s growth-driving mechanism. In India, more than 50 per cent of the country’s energy demand is derived from coal, mostly for generating electricity while in Mizoram, the scenario differs. Hydropower is the greatest contributor of power in the state. It is one of the most important contributors to the state’s energy security. There are 11 state’s own hydel generation stations in Mizoram with an installed capacity of 29.35 MW. Mizoram also has a share of free power of 12 per cent from NEEPCO owned Tuirial Hydro Electric Plant.

With the realization of harmful effects that fossil fuels entails, the idea of sustainable development was born. In order to have sustainable development, environmental, economic and social sustainability must be implemented simultaneously. While development is meant to bring about changes in the uplifting

the poor and raising the living standards of the people, many of development projects in India have been carried out at the expense of environment and social equity. The environmental impact of development was realized a little sooner than the social impact and efforts have been taken by government to utilize a more sustainable form of energy sources. As such, Environmental Impact Assessment (EIA), a study to predict environmental impact of a proposed project, was made mandatory in 1994. However, Social Impact Assessment (SIA) was made mandatory in India only in 2013. The impact of development projects on especially on economic and social well-being of affected people were ignored for a long time.

The study also reveals that though environmental impacts of development projects are realised, the social impact are neglected otherwise in Mizoram. Sustainability is not only limited to environmentalism but also towards social and economic justice. No public hearings were held prior to the construction of hydropower projects in Tuirial hydropower projects. Compensations were awarded differently to different people with the same area of land and were denied information regarding how the values of land are measured. There was no transparency on the part of the government. This resulted in misunderstanding between the officials and the affected landowners. The problem escalated to become a big hindrance to the success of the project. Environment, economic and social sustainability must be implemented simultaneously to bring about sustainable development.

This study reveals that the involvement of NGOs and social activists, anti-corruption body played a significant role in bringing about social equity. It was with their efforts that the case of alleged misappropriation of funds was investigated. Human right activists have also reported the violation of human upon the villagers of Builum to the National Human Rights Commission. An inquiry commission was then established to look into the matter.

Mizoram has great potential in hydropower of about 4500 MW and initiatives have been taken up by different ministry in the government. Yet the projects were often somehow halted or delayed. One of the biggest factors that contributed to this

is the problem of compensation. This paper studied the case of Turial and Selui-B hydropower project as they were the biggest projects of hydropower to be completed. Due to maladministration, the largest hydropower project in Mizoram- Turial was infamously known for its fake compensation claims. The CBI investigation has revealed that a sum of Rs 20,046,475 was paid to fictitious landowners in the case of Turial hydropower project where relatives of the then, Chief Minister were a part of it. In Mizoram, heavy and fake claims of compensations often resulted in extra cost of project making projects very expensive. It has become one of the main factors that hindered any development project within the state.

Since there are no other viable energy productions on which the state can depend to improve its energy security, renewable energy sector is the best alternative that the state can utilize to contribute towards meeting its energy insufficiency without harming the environment. Adding to the limited infrastructure, the mountainous topography makes exploration of fossil fuels in the state very difficult and expensive. So even if explorations were successfully conducted, the cost would be very high without much profit to the investors. It is highly unlikely for these explorations to turn into an economically viable production even in the near future. As a result, tapping renewable energy resources are more practical and realistic to meet the urgent energy deficit.

The state government has adopted three policies for the promotion of renewable energy, Renewable Energy Policy of 2003, Hydro Electric Power Policy of Mizoram 2010 and Mizoram Solar Power Policy of 2017. The policies have been framed with an objective to best promote and attract investors. However, a number of factors have led to inability of the policy and potential of the state to be utilized.

ZEDA has been authorized to undertake all programmes in the field of non-Conventional and Renewable Energy sources. Due to lack of manpower, projects relating to hydropower are performed through ZEDA by Power & Electricity Department, Govt. of Mizoram. The agency has successfully carried out various

programmes and schemes. It has successfully implemented a 2 MW solar plant at Tlungvel, which marks the state's entry into the solar map of India.

However, the state is lagging behind to provide technical support in terms of proper and adequate installations, maintenance and repair of renewable energy systems due to insufficient or technical incompetency. ZEDA lacks manpower to successfully implement renewable energy in the state. Technical experts are needed for maintenance of installed renewable energy products which is currently lacking in Mizoram.

The agency solely relies on central sanctioned funds and the state government has no involvement. For the promotion of renewable energy resources, public awareness is lacking at the moment. According to the nodal agency, ZEDA there are no funds sanctioned towards public awareness to educate the benefits of solar products in general and also of the sponsored schemes in particular. Lack of awareness among the public on the need and benefit of new and renewable energy system needs to be remedied through proper media channels.

The Prime Minister of India has initiated International Solar Alliance for mostly sunshine countries lying in completely or partly between Tropic of Cancer and Tropic of Capricon. Mizoram being a state that is run through by the Tropic of Cancer, has a great chance potential especially with the government investment in this sector. However, only a few of its potential has been tapped so far. Although there is an increase usage of solar energy among the people, majority of the people are not aware of the benefits of using solar energy.

The study also finds that the change in Ministry is a major hindrance to the successful implementation of projects in the state. Even fully prepared Detailed Project Reports are overlooked when new government take over. Preparation of DPR for hydropower requires time and money, and for the government to reject it without valid reason shows government's lack of enthusiasm and political will towards improving energy security.

Suggestions

The government should consider not only the environmental impact but also the social and economic equity of the affected population. All the aspects of sustainability must be considered simultaneously.

Lack of awareness among the public about renewable energy, solar in particular, must be remedied trough proper media channels, seminars or advertisements. The government should involve the people for the successful implementation of its policies.

There is a lack of technical experts to maintain the renewable energies. The government should organise workshops or training programs and produce more experts in the area. Renewable energy sector can provide new employment opportunities and boost the associated economic activities.

Mizoram cannot depend solely on a single source of energy. Diversification of energy sources is required. Efforts of diversification should aim at increasing domestic energy generation and reduce dependency on a small number of supplies. Hydropower cannot be used during off season and solar power at night. The state needs to tap and develop all of its potential renewable resources to promote the twin goals of sustainability and security.

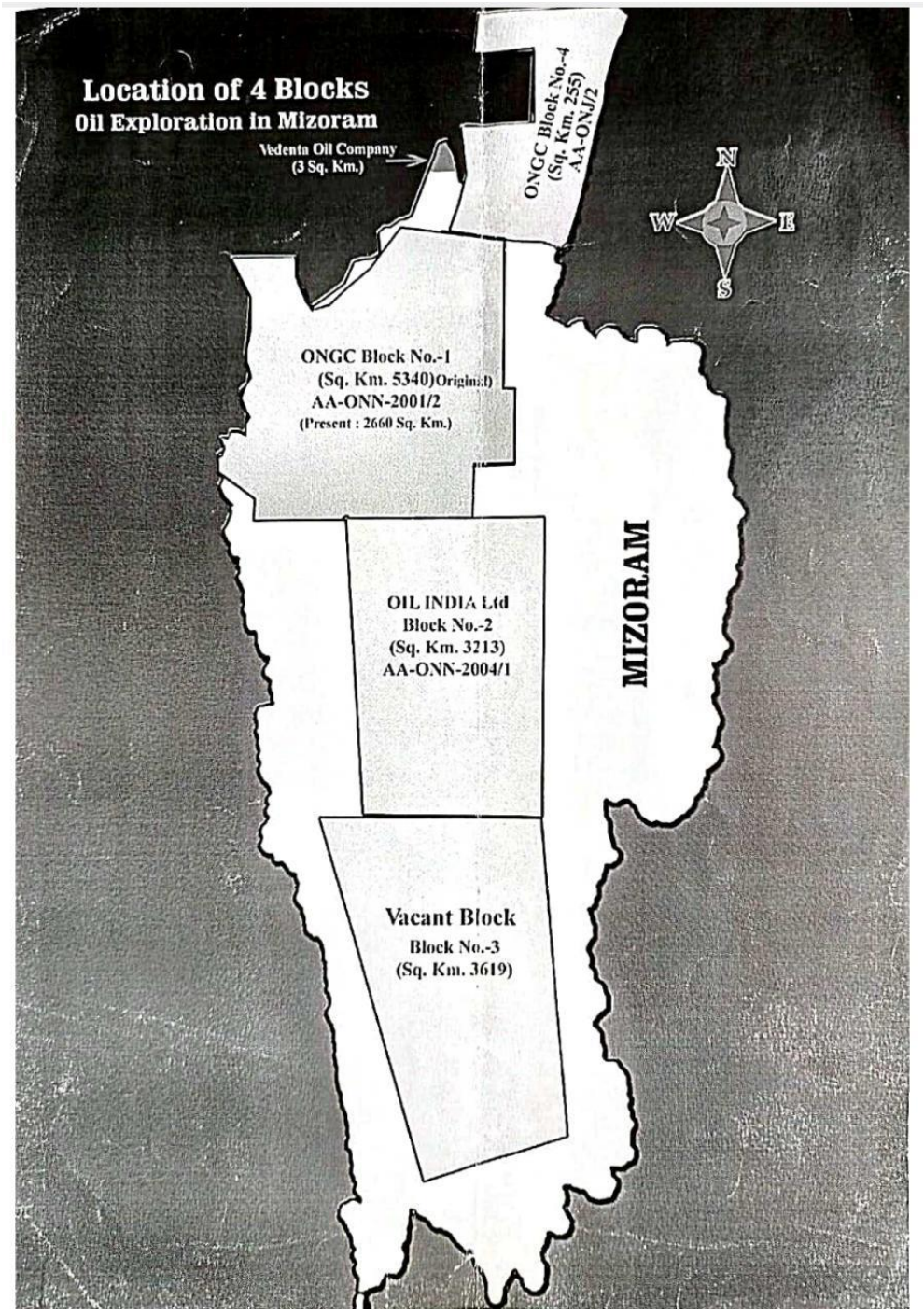
While there is a huge upfront installation cost of renewable energy, they are much more reliable and cost effective in the long run. While the cost of fossil fuels may appear lower, it is important not to overlook the additional costs involved. The associated risks of using fossil fuels must not be forgotten. Fossil fuels such as oil and gas are subject to periodic fluctuations, and can result in a huge impact on the economy. The higher share of renewable energies in the energy mix reduces the risk of price fluctuations. Increase use of renewable energy must be encouraged.

Both the central government and the state nodal agency should offer more subsidy schemes to the people for installation of rooftop PV system. This will encourage people to exploit renewable energy and cut their electricity bill.

Fossil fuels are the preferred fuels for economic growth around the world due to their abundance and ease of management. Although the preference is likely to be maintained in the near future, the consumption of these fuels must be controlled not only for their limited availability, but also for their relatively negative impact on the environment. Worsening climate change and the challenges of global warming require investments in renewable energy. Although global warming and climate change in Mizoram may not be as severe in other parts of the world, it has become very noticeable. Replacing fossil fuels with renewables while conserving them would be beneficial to the future generation and of the environment. The concern should not only be limited to securing energy supply but also securing it in a sustainable manner.

Appendix-I

Map of oil exploration blocks



Appendix II

Photo: Serlui B HEP (12 MW)

Photo: Tuirial Hydropower Project

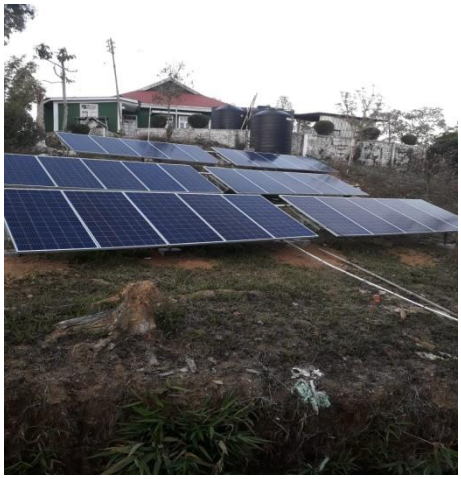
Appendix III

Solar Panels on Government Buildings in Mizoram (ZEDA)

DCF Office, Lunglei

District Court, Champhai

DFO Office, Mamit



DFO Office, Lunglei

Appendix IV

Solar Lamp Distribution in Schools (ZEDA)

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Malsawmdawngliana, Executive Engineer, P& E Dept, Govt. of Mizoram on 12th Dec, 2020

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ABSTRACT

ENERGY SECURITY IN MIZORAM: POLICY PERSPECTIVE

A DISSSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PHILOSOPHY

Lalhmingsangi

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Regn No.: MZU/M.Phil./601 of 12.06.2020

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ABSTRACT

ENERGY SECURITY IN MIZORAM: POLICY PERSPECTIVE

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The increasing dependence on energy in every aspect of life has made energy security a priority policy for states and countries. It has become vital for economic growth and the significance of energy security is even more for the developing world than developed countries. Different countries have chosen different ways of securing their energy supply. Energy security is fundamentally linked with not only the economy but other policy issues such as environment, livelihood, and socio-cultural setup. Energy security will continue to be of central importance for the continued existence and survival of life, as the importance of energy and its demands continue to grow.

The standard interpretation of energy security simply meant a steady supply of energy, with oil as the main source of energy during the 20th century. However, the concept of energy security is not static and changes over time as the nature of the energy-related challenges evolve. So, a new explanation of energy security attempted to go beyond the main 20th century explanation of oil-centered steady flow of energy.

Today, energy security includes a wide range of issues that can be seen in the context of four A's: availability, accessibility, affordability, and acceptability as conceptualized by the Tokyo-based Asia Pacific Energy Research Centre in 2007. It considers the political, social, economic, and environmental issues under which energy security policy is being pursued by nations.

India's energy security can also be defined as ensuring the continued availability of commercial energy at competitive prices to support economic growth and at the same time, meet the energy needs of the people through safe, clean, and

affordable forms of energy. India is however, one of the largest importers of energy and with its growing energy needs, import dependency will become even more pronounced in the years to come, despite some significant oil and gas discoveries. Therefore, the acquisition of energy resources and supplies, measures to promote the introduction of new technologies in the energy sector and research on renewable energy sources for a sustainable energy supply are therefore urgent.

India's push for energy security came mainly in the post-liberalization phase of the 1990s, when India's liberalization policy accelerated India's economic growth and modernization process. However, it was only in the late 1990s, under former Prime Minister Atal Bihari Vajpayee, that energy security emerged as a policy priority for India. This phase can also be considered as the first major push for the diversification of energy sources and destinations for India and there has been a steady growth of the economy. After that, former Prime Minister Man Mohan Singh emphasized energy security as the most important security concern, after food security.

1.8 STATEMENT OF THE PROBLEM

Modern society can no longer run without energy. In the growing age of interconnectedness and globalization, industries and technology are rapidly developing. Dependence upon energy is increasing and domestic production is not enough to meet the growing demand of the country. Increasing energy import increases a nation’s vulnerability to external shocks and threats. Domestic production must be increased while keeping in check its sustainability in terms of not only economic but social and environmental dimension.

Ever since Independence, the leaders in India were in a haste to raise the economic condition but even with the efforts and commitment towards achieving developmental goals, there is no doubt that India is still lagging in many areas. There is a wide gap in terms of development and energy supply in the rural and urban areas. With the rapid growth of population, India is the third-largest consumer of oil and is facing the critical challenge of meeting the escalating demand for energy. Despite the government's claims that all villages have electricity, there are still millions of people that lack access to electricity. India’s definition of electrification is when the number of households electrified in a village is at least 10 percent and all the public buildings are electrified. So even when electricity reaches a village, it does not necessarily mean it reaches every home of the village.

The challenge for India is that the developmental agenda and ensuring energy security needs to be met through a carbon-controlled environment by remaining committed to low carbon emission. New energy security concern is not only limited to securing its sources but also with its consequences. India is not only energy starved in terms of availability, but the non-conventional sources of energy such as hydropower also are not cheap and it takes time to build them. India is faced with the dilemma of how much it should rely only on renewable energy resources to meet its mounting energy crisis.

Mizoram, located in the North eastern part of India is connected through National Highway 306 (earlier known as NH 54) with the rest of the country that runs through Silchar. NH 306 serves as the most important means of transportation of goods and passengers. It is the economic lifeline of the state. Whenever there are

disruptions along the national highway, the state immediately faces several issues in terms of its supply including basic needs of the state such a food, oil and gas supply. The majority of the population still depends on agriculture and the energy consumption and demand is relatively low as compared to other states in India. Nevertheless, with the growth of industrialization and modernization, there is a steady growth of small-scale industries and factories in Mizoram and the electricity demand is increasing. The progress of a society largely depends on the availability of energy resources, but Mizoram is still overly dependent upon energy sources from outside to meet its energy requirements. Development in relation to power sector is very slow. The state is not self-sufficient in terms of power generation and has to purchase from various power-generating sectors. The state's only source of power generation is through non-conventional and renewable sources of energy. It does not have the potential for generating electricity through conventional sources such as coal and petroleum. There are still many issues underlying power and energy supply in the state. Even the city often faces power cuts or outages.

The state has rich potential in renewable energy sources such as hydropower and solar. Hydropower is also the greatest contributor to the state's electricity supply. But only a few of it has been harnessed and there is a question on its sustainability aspects. The state needs to consider the present and future environmental impacts of the various sources of energy including its social equity. There is a requirement for research on alternative sustainable sources of energy.

1.9 SCOPE OF THE STUDY:

The study of the research shows the energy security scenario of Mizoram. It highlights an overview of energy policy and the energy demand and supply of the state. It also includes a study about the energy resources, prospects, and problems in the state. It focuses on the sustainability dimension of energy security and the need to implement development project while ensuring the dimensions of sustainability simultaneously. The study analyzes the efforts of both the state and the Union government in improving securing energy. It also explores the potential alternative, environmentally friendly, and renewable sources of energy in the state.

1.10 METHODOLOGY:

The study of the research is descriptive e and analytical in nature. Analysis of objectives of the study and answers to the research question is carried out based on social science and interdisciplinary methodologies. Therefore, both qualitative and quantitative methods are used in the study. The data and information are collected from both primary and secondary sources. Primary data is collected from annual reports, documents and interview based study. Interview was conducted with 10 respondents belonging to concerned stakeholders in energy sector, NGOs and government officials.

Secondary data is collected through books, newspapers, journals, and magazines. Due to insufficiency of secondary data, primary data is focused more.

1.11 Limitations of the Study

The study requires experts with knowledge in the related field to provide adequate information. Due to the pandemic only few of the respondents were willing to cooperate and contribute to the work. As a result, the researcher could not access to sufficient sample size and hence collected only eight reliable samples among all the interviews. In line with the above mentioned, there were no proper records kept among the organizations and stakeholders for future references which become one of the main obstacles. The duration of the work has thus, been prolonged and the study was limited to focus more on the quantitative aspects rather than the qualitative.

1.12 Objectives of the Study:

1. To present energy security scenario of Mizoram
2. To study the existing and potential energy resources in the state.
3. To assess the sustainability of energy resources in Mizoram in economic, environmental, and social aspects.
4. To examine the energy policy of the state.

1.13 Research Questions:

1. What is the scenario of energy security in Mizoram?
2. Do energy resources meet the energy need of the state?
3. Are energy resources sustainable in terms of economic, environmental, and social aspects?
4. Does energy policy adequately address the challenges and ensure the state to become self-reliant?

1.14 Chapterization

Chapter I: Introduction

The introductory chapter discusses the theoretical, thematic, and methodological aspects of the study problem. It includes a review of literature, research methodology, and chapter plan of the study.

Chapter II: Energy Security Scenario

The second chapter presents the scenario of energy security from the global to local level. It includes resources, energy production and consumption patterns of the state.

Chapter III: Energy Resources

This chapter explores the existing and potential energy resources in the state, the conventional and non-conventional, renewable resources in Mizoram.

Chapter IV: Energy sustainability: economic, environmental, and social aspects.

This chapter assesses the sustainability aspect of energy from resource to production.

Chapter V: **Energy Policy of Mizoram**

The chapter examines the state's energy policy in ensuring the state becomes self-reliant in the energy sector.

Chapter VI: Summary and conclusion

The last chapter includes the findings of the research with concluding remarks and suggestions.

FINDINGS

Energy security is the keystone to modern society and determines state's relation. The interpretation of energy security has undergone many changes since its conception. The concept of energy security was simply interpreted as a steady supply of oil during the 20th Century, but now it has been defined in the context of four A's: availability, accessibility, affordability and acceptability.

Energy has become an indispensable factor of the modern economy and is essential to the development of a society. The increasing reliance on energy in daily life and overall development has made energy security a priority policy for states and countries. Different countries adopted different ways to secure their energy supply. Energy security is fundamentally linked with not only the economy but other policy issues such as environment, livelihood, and socio-cultural setup.

Energy security for India is to ensure the continued availability of commercial energy at competitive prices to support economic growth and at the same time meet the energy needs of the people through safe, clean, and affordable forms of energy. With India's growing energy needs, import dependency will become even more pronounced in the years to come, despite some significant recent oil and gas discoveries. Such heavy and growing reliance on energy imports makes any country vulnerable to external shocks. Therefore, the procurement of energy resources and supplies from abroad and measures to promote the introduction of new technologies in the energy sector and exploring renewable sources are extremely urgent.

Energy has been used since the beginning of time with a continuous search for better alternatives. Fossil fuels have been dominating the energy mix ever since the Industrial Revolution. This was because good energy source was measured in terms of its efficiency. Energy has become not only a tool of development but also utilized as a political weapon as there were only a few countries blessed with such resources. Heavy reliance on import of fossil fuels not only increase vulnerability but also has an adverse effect on the environment. Burning of fossil fuels contributes the highest to global warming. As a result, there is a growing shift towards renewable energy around the world and steps have been taken not only at the international but national and local levels are also moving towards the right direction.

Mizoram is one of the states in North East India with a huge potential in renewable energy that could contribute towards the goal of energy security and sustainability. It is the 23rd state in India to have its statehood. But development in the region has been slow. Due to its long struggle and fight against the Indian Union for its independence, the state suffered greatly in terms of economy and social life. Development was halted during the twenty years of insurgency. The people were deprived of the very basic needs such as food, power supply, water supply, transportation and communication. Electricity was generated in December 1962 for the first time in Mizoram. However, development in the power sector was stagnant until the Power & Electricity function as a separate body. The responsibility for generation, transmission and distribution of power throughout the state is in the hands of the Power & Electricity Department which became a full-fledged department in 1983.

Mizoram is one of the fastest growing economies among the all the states in India. With the increasing population and overall advancement in technology and modernisation, the energy scenario of the state has also been changing and the consumption of energy is also increasing rapidly. However, Mizoram is not yet exposed to any large industrial activities. While the industry sector accounted for the highest share of energy consumption in India, majority of the electricity demand in Mizoram goes to the household sector. The service sector remains the greatest contributor to its GSDP and the industrial sector contributed only 26 per cent in 2018-19. The industry sector in Mizoram consists of mining and quarrying, manufacturing, construction and electricity, gas, water supply and utility services. While energy consumption increases every year, the entire North East region including Mizoram still has one of the lowest per capita energy consumption in the country. The per capita energy consumption of Mizoram during 2018-19 was only 617 kWh against 1181 kWh in India.

Despite electricity consumption being relatively low compared to the rest of the country, the state is not self-sufficient in terms of power generation. It depends almost entirely on central generating stations to meet its deficit. The state spends a huge amount for purchasing power from other states. During 2019-20, the state purchased about 95% of the total energy needs with a bill amounting to Rs. 329.87 crore. The lack of energy in the state is due to the minimal ability to generate energy locally, often resulting in power outages.

Mizoram has achieved its goal of electrifying all villages in 2019. Despite the state reportedly having 100 per cent electrified village, the average power supply in

rural areas remains only 15 hours a day. Transmission and distribution loss, poor response time and restoration time is also another hindrance to quality of supply in the state. The state has a rich hydropower potential yet only a small amount has been harnessed so far. Due to its mountainous topography, construction of non-conventional energy sources is expensive and there is difficulty in transportation due to narrow roads. The changing climatic conditions and inconsistent rainfall patterns in the state have made water inaccessible in times of water scarcity also makes hydropower generation unstable.

Till now, all energy such as oil, gas and electricity are purchased from outside sources and the state dependency on imports is not declining. The state has no alternative energy source to depend on in case of disruption of such supplies from outside sources. The state has a rich potential in renewable energy, despite that, only a few of it has been harnessed so far.

Mizoram is located in the Assam-Arakan Basin consisting mainly sedimentary rocks; it has mineral resources such as coal, oil, limestone, sandstone and clay. However, there are no minerals discovered enough to influence India's mineral map to date. Mizoram is in the number one category of proven commercial oil production zone, valued at approximately 170 million tons of untapped crude reserves. Mizoram's strategic location in the Assam-Arakan region and the large gas reserves on the India-Bangladeshi border, as well as Myanmar's gas reserves in almost the same region as Mizoram, increase the likelihood of the state becoming a major source of natural gas and oil. Mizoram has a probability of petroleum deposits or a reported oil and gas presence in similar geological structures in Tripura and

Assam. The presence of petroleum has also been confirmed by India's largest exploration company, Oil and Natural Gas Corporation (ONGC) in Bilkhawthlir, Kolasib District.

Oil exploration sites were divided and separate blocks were allocated to different companies with a time frame to carry out oil exploration venture in Mizoram. Exploration was carried out by ONGC and OIL in separate zone, yet their exploration was not successful during the allotted time. RELIANCE and Vedanta were also allotted another zone for exploration but no exploration was made on their part. The exploration companies are considering the worth of investing in exploration of oil in Mizoram due to its high expenditure. Due to the mountainous topography and poor road condition of Mizoram, it is difficult to transport the machineries required for the exploration.

As such, no company has been able to complete their work during the license renewal period. Therefore, despite the hopes of Mizoram to become a major oil-producing state of the country, there has been no successful exploration to date. In Mizoram, the power sector is a vital component of the state’s growth-driving mechanism. In India, more than 50 per cent of the country’s energy demand is derived from coal, mostly for generating electricity while in Mizoram, the scenario differs. Hydropower is the greatest contributor of power in the state. It is one of the most important contributors to the state’s energy security. There are 11 state’s own hydel generation stations in Mizoram with an installed capacity of 29.35 MW. Mizoram also has a share of free power of 12 per cent from NEEPCO owned Tuirial Hydro Electric Plant.

With the realization of harmful effects that fossil fuels entails, the idea of sustainable development was born. In order to have sustainable development, environmental, economic and social sustainability must be implemented simultaneously. While development is meant to bring about changes in the uplifting the poor and raising the living standards of the people, many of development projects in India have been carried out at the expense of environment and social equity. The environmental impact of development was realized a little sooner than the social impact and efforts have been taken by government to utilize a more sustainable form of energy sources. As such, Environmental Impact Assessment (EIA), a study to predict environmental impact of a proposed project, was made mandatory in 1994. However, Social Impact Assessment (SIA) was made mandatory in India only in 2013. The impact of development projects on especially on economic and social well-being of affected people were ignored for a long time.

The study also reveals that though environmental impacts of development projects are realised, the social impact are neglected otherwise in Mizoram. Sustainability is not only limited to environmentalism but also towards social and economic justice. No public hearings were held prior to the construction of hydropower projects. Compensations were awarded differently to different people with the same area of land and were denied information regarding how the values of land are measured. There was no transparency on the part of the government. This resulted in misunderstanding between the officials and the affected landowners. The problem escalated to become a big hindrance to the success of the project. Environment, economic and social sustainability must be implemented simultaneously to bring about sustainable development.

This study reveals that the involvement of NGOs and social activists, anti-corruption body played a significant role in bringing about social equity. It was with their efforts that the case of alleged misappropriation of funds was investigated. Human right activists have also reported the violation of human upon the villagers of Builum to the National Human Rights Commission. An inquiry commission was then established to look into the matter.

Mizoram has great potential in hydropower of about 168.9 MW and initiatives have been taken up by different ministry in the government. Yet the projects were often somehow halted or delayed. One of the biggest factors that contributed to this is the problem of compensation. This paper studied the case of Turial and Selui-B hydropower project as they were the biggest projects of hydropower to be completed. Due to maladministration, the largest hydropower project in Mizoram- Turial was infamously known for its fake compensation claims**.** The government is responsible for such scams as it is impossible to sign off the files required without the involvement of high officials. The CBI investigation has revealed that a sum of Rs 20,046,475 was paid to fictitious landowners in the case of Turial hydropower project where relatives of the then, Chief Minister were a part of it. In Mizoram, heavy and fake claims of compensations often resulted in extra cost of project making projects very expensive. It has become one of the main factors that hindered any development project within the state.

Since there are no other viable energy productions on which the state can depend to improve its energy security, renewable energy sector is the best option that the state can utilize to contribute towards meeting its energy insufficiency without

harming the environment. Adding to the limited infrastructure, the mountainous topography makes exploration of fossil fuels in the state very difficult and expensive. So even if explorations were successfully conducted, the cost would be very high without much profit to the investors. It is highly unlikely for these explorations to turn into an economically viable production in the near future. As a result, tapping renewable energy resources are more practical and realistic to meet the urgent energy deficit.

The state government has adopted three policies for the promotion of renewable energy, Renewable Energy Policy of 2003, Hydro Electric Power Policy of Mizoram 2010 and Mizoram Solar Power Policy of 2017. The policies have been framed with an objective to best promote and attract investors. However, a number of factors have led to inability of the policy and potential of the state to be utilized.

ZEDA has been authorized to undertake all programmes in the field of non-Conventional and Renewable Energy sources. Due to lack of manpower, projects relating to hydropower are performed through ZEDA by Power & Electricity Department, Govt. of Mizoram. The agency has successfully carried out various programmes and schemes. It has successfully implemented a 2 MW solar plant at Tlungvel, which marks the state's entry into the solar map of India.

However, the state is lagging behind to provide technical support in terms of proper and adequate installations, maintenance and repair of renewable energy systems due to insufficient or technical incompetency. ZEDA lacks manpower to successfully implement renewable energy in the state. Technical experts are needed

for maintenance of installed renewable energy products which is currently lacking in Mizoram.

The agency solely relies on central sanctioned funds and the state government is not involved in it. For the promotion of renewable energy resources, public awareness is lacking at the moment. According to the nodal agency, ZEDA there are no funds sanctioned towards public awareness for spreading information on the benefits of solar products in general and also of the sponsored schemes in particular. Lack of awareness among the public on the need and benefit of new and renewable energy system needs to be remedied through proper media channels.

The Prime Minister of India has initiated International Solar Alliance for mostly sunshine countries lying in completely or partly between Tropic of Cancer and Tropic of Capricon. Mizoram being a state that is run through by the Tropic of Cancer, has a great chance potential especially with the government investment in this sector. However, only a few of its potential has been tapped so far. Although there is an increase usage of solar energy among the people, majority of the people are not aware of the benefits of using solar energy.

The study also finds that the change in Ministry is a major hindrance to the successful implementation of projects in the state. Even fully prepared Detailed Project Reports are overlooked when new government take over. Preparation of DPR for hydropower requires time and money, and for the government to reject it without valid reason shows government's lack of enthusiasm to development.

Suggestions

The government should consider not only the environmental impact but also the social and economic equity of the affected population. All the aspects of sustainability must be considered simultaneously.

Lack of awareness among the public about renewable energy, solar in particular, must be remedied trough proper media channels, seminars or advertisements. The government should involve the people for the successful implementation of its policies.

There is a lack of technical experts to maintain the renewable energies. The government should organise workshops or training programs and produce more experts in the area. Renewable energy sector can provide new employment opportunities and boost the associated economic activities.

Mizoram cannot depend solely on a single source of energy. Diversification of energy sources is required. Efforts of diversification should aim at increasing domestic energy generation and reduce dependency on a small number of supplies. Hydropower cannot be used during off season and solar power at night. The state needs to tap and develop all of its potential renewable resources to promote the twin goals of sustainability and security.

While there is a huge upfront installation cost of renewable energy, they are much more reliable and cost effective in the long run. While the cost of fossil fuels may appear lower, it is important not to overlook the additional costs involved. The

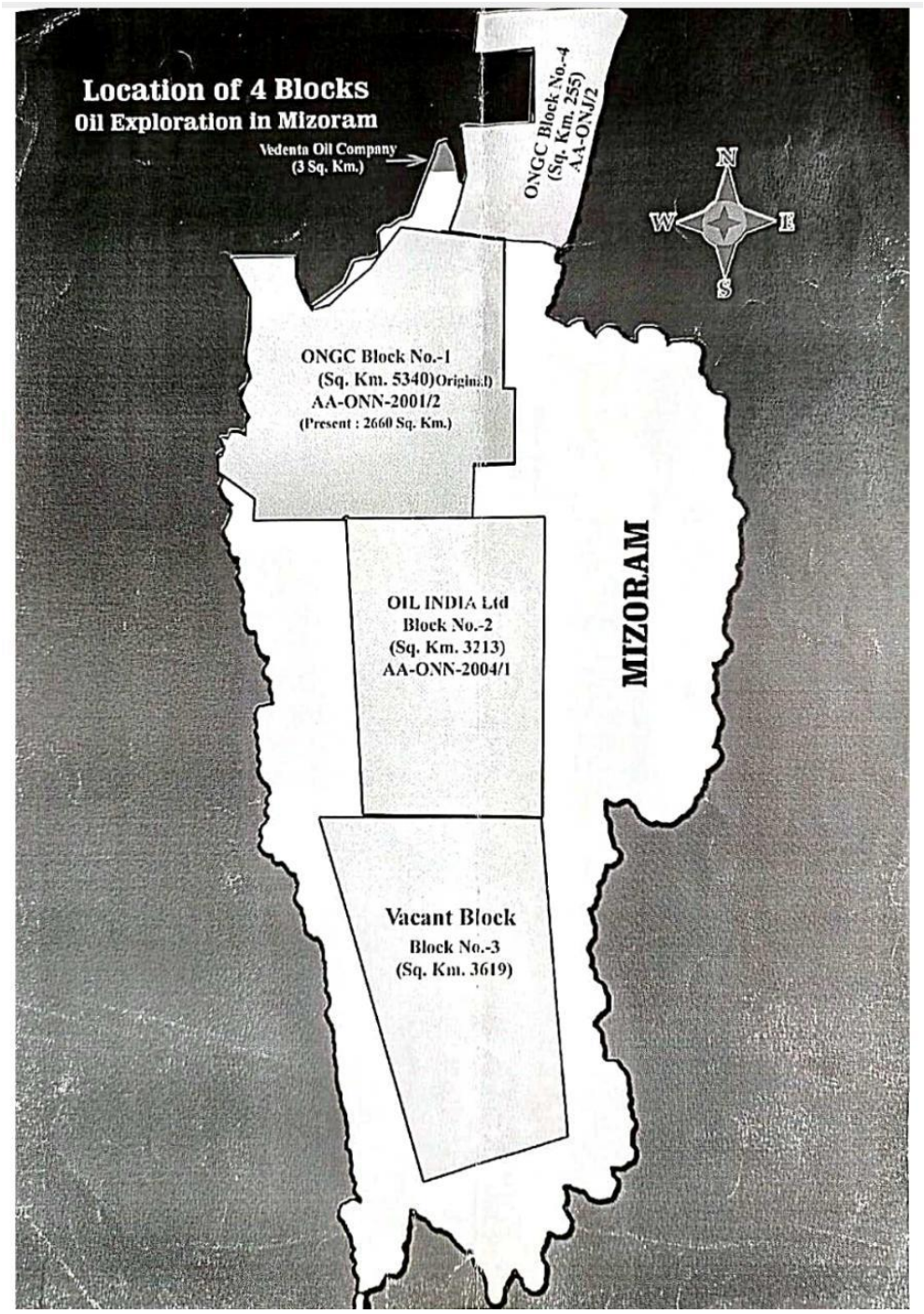
associated risks of using fossil fuels must not be forgotten. Fossil fuels such as oil and gas are subject to periodic fluctuations, and can result in a huge impact on the economy. The higher share of renewable energies in the energy mix reduces the risk of price fluctuations. Increase use of renewable energy must be encouraged.

Both the central government and the state nodal agency should offer more subsidy schemes to the people for installation of rooftop PV system. This will encourage people to exploit renewable energy and cut their electricity bill.

Fossil fuels are the preferred fuels for economic growth around the world due to their abundance and ease of management. Although the preference is likely to be maintained in the near future, the consumption of these fuels must be controlled not only for their limited availability, but also for their relatively negative impact on the environment. Worsening climate change and the challenges of global warming require investments in renewable energy. Although global warming and climate change in Mizoram may not be as severe in other parts of the world, it has become very noticeable. Replacing fossil fuels with renewables while conserving them would be beneficial to the future generation and of the environment. The concern should not only be limited to securing energy supply but also securing it in a sustainable manner.

Appendix-I

Map of oil exploration blocks



Appendix II

Photo: Serlui B HEP (12 MW)

Photo: Tuirial Hydropower Project

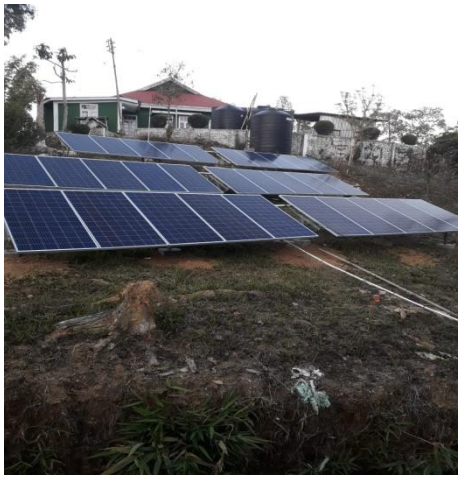
Appendix III

Solar Panels on Government Buildings in Mizoram (ZEDA)

DCF Office, Lunglei

District Court, Champhai

DFO Office, Mamit



DFO Office, Lunglei

Appendix IV

Solar Lamp Distribution in Schools (ZEDA)

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