UNDERSTANDING THE PROSPECTIVE ROLE OF RENEWABLE ENERGY IN PAKISTAN'S ENERGY SECURITY STRATEGY UNDER VISION 2025: A QUALITATIVE INQUIRY

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ABSTRACT

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May, 2020

Pakistan confronts a high degree of energy insecurity demonstrated by concerns as demand and supply gap, heavy import reliance, scarcity of access to the grid, and high energy rates. As a highly populated developing nation, the country observes extensive energy use mainly through thermal sources carrying significant hazards for the environment, society, and economy. The significant portion of expensive imported fossil fuels in the energy mix has undermined the energy security of the country. The nation has abundant indigenous natural sources that are economical and useful in climate change mitigation like domestic biomass, wind, geothermal, and solar. However, they are not appropriately surveyed and executed due to the lack of skill, finance, and management. With no scarcity of energy policies and a growing consensus that renewable resources will be a fundamental answer to the query where energy quest is an excellent question for Pakistan. The only issue remains with the effective implementation of these policies. The national vision 2025 highlights the

necessity for enhancing energy security using indigenous energy sources in the domestic energy mix. This study analyses the concept of energy security along with its dimensions and parameters to ascertain the role of renewables in the country's current energy security mindset. The investigation also evaluates the suitability of the national vision 2025 for the nation's energy security through semi-structured indepth interviews. This research proposes energy security emerging as one of the most argued fields in International Relations (IR) with more attention on the environmental aspect than before, and furthermore, the impact of climate change is explicit in the debate. To overcome all these daunting challenges renewables, serve as a befitting resolution. Based on these findings, the study will suggest some policy ready suggestions and recommendations.

Keywords: Pakistan, Energy Security, Renewable Energy, Energy Policy, Vision 2025

ÖZET

PAKİSTAN'IN 2025 VİZYONU IŞIĞINDA YENİLENEBİLİR ENERJİNİN ENERJİ GÜVENLİĞİ STRATEJİSİ ÜZERİNDEKİ OLASI ROLÜ: NİTEL BİR ARAŞTIRMA

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Siyaset Bilimi ve Uluslararası İlişkiler Doktora Programı
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Pakistan; arz ve talep açığı, ağır ithalat bağımlılığı, şebekeye erişim kısıtları ve yüksek enerji tüketim oranları gibi hususlara bağlı olarak ortaya çıkan kritik derecede enerji güvensizliği ile karşı karşıyadır. Yüksek nüfuslu ve gelişmekte olan bir ülke olarak Pakistan'da çevre, toplum ve ekonomi için önemli tehdit unsurları barındıran termal kaynak tüketimine bağlı yoğun enerji kullanımı mevcuttur. Maliyeti yüksek ithal kaynakların enerji portföyündeki yüksek payı, ülkenin enerji güvenliğini zayıflatmıştır. Pakistan; biyokütle, rüzgar, jeotermal ve güneş gibi iklim değişikliğinin etkilerinin azaltılmasında faydalı ve ekonomik açıdan elverişli bol miktarda yerli doğal kaynağa sahiptir. Ancak söz konusu kaynaklar gerekli bilgi düzeyi, finansman ve yönetim eksikliği nedeniyle uygun şekilde geliştirilememekte ve kullanılamamaktadır. Mevcut enerji politikaları ve artan fikir birliği temelinde, yenilenebilir enerji

kaynaklarının Pakistan için kaçınılmaz bir çözüm olacağı aşikardır. Bu noktadaki tek sorun, söz konusu politikaların etkili bir şekilde uygulanmasıyla ilgilidir. Pakistan'ın 2025 ulusal vizyonu, ülkenin enerji portföyünde yerli enerji kaynaklarının payını artırarak enerji güvenliğinin iyileştirilmesi gereğini vurgulamaktadır. Bu çalışma, Pakistan'ın mevcut enerji güvenliği anlayışında enerji güvenliği kavramını temel boyutları ve parametreleri ile analiz etmektedir. Araştırma aynı zamanda, yarı yapılandırılmış derinlemesine mülakatlar aracılığıyla 2025 ulusal vizyonun Pakistan'ın enerji güvenliği açısından uygunluğunu değerlendirmektedir. Araştırmada, çevresel faktörlere öncekinden daha fazla önem verilerek enerji güvenliğinin Uluslararası İlişkilerin en çok tartışılan alanlarından biri olduğu vurgulanmakta ve iklim değişikliğinin etkilerinin alandaki tartışmalarda önemli bir role sahip olduğu belirtilmektedir. Bahsi geçen tüm bu zorluklar ile mücadele edebilmek için yenilenebilir enerji, uygun bir çözüm olarak görülmektedir. Bu bulgulara dayanarak, çalışma belirli politika önerileri sunmaktadır.

Anahtar Kelimeler: Pakistan, Enerji Güvenliği, Yenilenebilir Enerji, Enerji Politikası, Vizyon 2025

I dedicate this dissertation to my family and friends.

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PREFACE

The dissertation lies before you is on "Understanding the prospective role of renewable energy in Pakistan's energy security strategy under vision 2025: A qualitative inquiry," the foundation of this qualitative inquiry is based on Semi-structured In-depth interviews conducted among policymakers, managers, officers, individuals to understand and examine Pakistan's potential of achieving its vision 2025 targets in terms of energy security. It has been written to accomplish the graduation conditions of the Political Science and International Relations doctoral program at the Izmir University of Economics (IUE) Turkey.

The IUE research ethics committee approved the project. The research questions were formulated with my supervisor, Prof. Mehmet Efe BİRESSELİOĞLU. It was indeed a mammoth task to conduct an extensive study like this, but it has allowed me to respond to the questions posed in the investigation. Fortunately, both Prof. BİRESSELİOĞLU and my Co-supervisor Prof. Kentmen-Çin have regularly answered my questions, encouraged and goaded me to complete my work.

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I hope you enjoy reading it.

IZMIR

…/…/2020

Athar Rashid

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LIST OF ABBREVIATIONS

AEDB: Alternative Energy Development Board

APERC: Asia Pacific Energy Research Centre

CCI: Council of Common Interest

CPEC: China Pakistan Economic Corridor

CPPA: Central Power Purchasing Agency, Islamabad

DISCOS: Distribution Companies

ENERCON: National Energy Conservation Centre

FDI: Foreign Direct Investment

GENCOS: Generation Companies

GoP: Government of Pakistan

IDIs: In-depth interviews

IEA: International Energy Agency

IPI: Iran Pakistan India

IRENA: International Renewable Energy Agency

MDGs: Millennium Development Goals

MNA: Member of National Assembly

MoE: Ministry of Energy

NEECA: National Energy Efficiency & Conservation Authority

NEPRA: National Electric Power Regulatory Authority

NEPRA: National Electric Power Regulatory Authority

NESPAK: National Engineering Services Pakistan

NTDC: National Transmission & Despatch Company

OECD: Organization for Economic Cooperation and Development

OGDCL: Oil and Gas Development Company Limited

OGRA: Oil and Gas Regulatory Authority

PAEC: Pakistan Atomic Energy Commission

PCRET: Pakistan Council for Renewable Energy Technologies

PEPCO: Pakistan Electric Power Company

PNRA: Pakistan Nuclear Regulatory Authority

PPIB: Private Power and Infrastructure Board

PPL: Pakistan Petroleum Limited

PSO: Pakistan State Oil

SES: Sustainable Energy Security

SME: Small and Medium Size Enterprises.

SOEs: State-Owned Companies

SOS: Security of Supply

T&D: Transmission and Distribution

TAPI: Turkmenistan-Afghanistan-Pakistan-India

WAPDA: Pakistan Water and Power Development Authority

CHAPTER 1: INTRODUCTION

1.1. The Significance of Energy Security for Pakistan

Energy is one of the primary services in the present times, the utilization of which has developed into an essential component of human development. With industrialization, modern forms of energy have evolved like hydroelectricity, nuclear, coal, oil, gas, and renewables. The only difference with pre-industrial communities is the sheer amount of energy required by the modern world, which has phenomenally increased. In the present-day world, power dominates all spheres of life from domestic to commercial. Energy is needed to produce electricity for utilizing multiple types of equipment in one's daily life and to power engines in the form of oil/petroleum to run cars as well as machinery. In the modern world, energy helps in growing food, powering homes, and producing endless daily products. There is also an emerging problem of population density, which is increasing at an exponential rate, and so is energy consumption. In the wake of this evolving challenge, everyone is struggling to sustain and reuse energy. With science and technology, renewable and sustainable energy solutions like biomass, wind, solar, and hydropower possess global acceptance and implementation. Beyond any doubt, energy has a crucial role to play in the growth of any nation in the world. Energy usage is indispensable for human wellbeing from powering factories, computers, cars, and to keep people fresh in hot summer days.

Energy has an important role to play in a nation's economic progress and advancement. It has transformed different countries in the world from agricultural-based to manufacturing nations. Through these transformations, there have been incredible advances in the wellbeing of the people as Roser (2019) observes that life expectancy in the world has risen notably in the developed world. The drivers for improvements in life expectancy included economic wellbeing, knowledge, science and technology, better living conditions, better housing, healthcare facilities, and a lot of it is due to improved energy consumption (Roser, 2019). Tariq, Huaping and Muhammad (2018) investigated the central role of energy that is not confined to the developed world only as a lot of developing nations like Pakistan, India, Bangladesh, and Sri Lanka are now entering rates of economic growth that are practically unprecedented (Tariq, Huaping and Muhammad, 2018). A lot of this economic growth in these countries has been due to energy consumption growth. Thus, energy is a central part of increasing standards

and wellbeing around the world. The United Nations has termed the year 2012 as "International Year of Sustainable Energy for All," due to the growing importance of energy. These initiatives at the global level have led to a superior position of international acknowledgment for conversion to a viable energy source supplies. There are still many nations faced with alarming energy demands and challenges of sustainability, affordability, insufficient access, and environment (Mahama, 2012; Colombo, Mattarolo and Mandelli, 2013; Vezzoli et al., 2014). The availability of energy and energy sources has always been a top priority of any country. Oil, for instance, remained a vital energy commodity for the world. As Yergin (1991), in his narrative, defined oil as the prime mover of the modern world and the creator of contemporary culture. His perception is well suited to all energy systems. Even in the agrarian community's perspective, energy access and governance entails great significance though with distinct types and procedures of extraction. With gradual development in the industrialized world, the need and demand for different sources of energy have increased. Due to the dominant position of "energy," in a nation's growth and its achievement of energy security, national and international policies classify it as a priority field. Field et al. (2018) examination of energy places it as a constituent of various disputes (Field et al., 2018). Most of the countries rely on importation energy sources to fulfill their specific energy needs. This surging demand for energy has certain risks like energy supply disruptions to which Yergin calls "geopolitics" of energy (Yergin, 2005). So, the survival of the modern economy rests on a sustainable supply of energy, which ultimately builds a link between energy and politics. As a result, every nation strives for the attainment of energy security, which results in global cooperation, ensuring mutually beneficial outcomes. The U.S. Department of energy (2017) report considers several determinants for energy security, including the advancement of global markets to boost energy into the international market, supporting private energy businesses inside the country and internationally as well as managing economical rates. The U.S. tried to achieve all such goals with the help of its massive economy, and a global understanding of its exceptional military capacities, which can support these targets.The idea of "energy security" was first coined as a response to the Oil Crisis (energy shocks) of 1973, since then the concept of "energy security" operated as a dedicated phrase for over two decades and started to get wider eminence only in the 2000s (Szulecki, 2018). Cherp and Jewell's (2014) assessment of "energy security" finds it as a significant component of national energy systems,

possibly employed for their low-vulnerability in a context (Cherp and Jewell, 2014). It is commonly used as a rhetorical term by policymakers, energy experts, academics, and many others to explain decisions, policy legitimization, and justification of specific actions in its name. Nations take specific actions in the name of "energy security," as they also do in the name of "the people interest" or "national interest," all these efforts are in reality an unceasing practice in creating energy security as a relational notion which develops in the context of a specific. It is commonplace to hear "the mantra" of "energy security," which is frequently used by politicians as an excuse for purposing large-scale energy projects in the less prosperous South Asian countries like Pakistan that are often unsuitable and needless for local development requirements at times.

Nevertheless, the energy-politics nexus is predominantly appropriate for developing nations as they want energy to further economic development. There is a gradual growth in the world population, and the developing world mainly observes this development. With increasing population and standards of living in developing countries, there will be more demand for energy. According to the estimates, over 70 percent of the energy demand growth originates from quickly developing nations like China and India. China and India next to each other make up around 36 percent of the global populace. They are responsible for even more than 1/4 of the globe's primary power demand (Kedia, 2016). In the Chinese case, there is rapid industrialization which requires access to more sustainable energy. China relies more on state-owned companies (SOEs) for domestic natural resource exploration and overseas energy acquisition as opposed to the U.S. who encourage private businesses in the energy sector (Lee, 2012; Bao and Houlden, 2013; Hongtu, 2015; Yao and Chang, 2015). Indian case as a developing country is like China, where vast amounts of energy consumption are taking place for sustainable economic growth. Both nations have an overwhelming population, whereas there is more poverty, lack of investment and infrastructure in India (Dubash, 2011; Sovacool and Vivoda, 2012). Unlike China, India's energy security is not well-researched and there is uncertainty in their approach to private energy businesses. The relationship between energy and politics is intricate in the Indian case.

In South Asia, there are several developing countries like India, Pakistan, Sri Lanka, Bhutan, Nepal, Afghanistan, and the Maldives. These nations are fronting rapid population growth in addition economic development which has increased the demand for energy. South Asian region is densely populated geographical territory in entire globe (Shukla et al, 2016). According to reports over 1.1 billion people globally have an inadequate connection to electricity; most of them exist in the developing nations of sub-Saharan Africa and Asia (IEA, 2017). Meanwhile, the fluctuation in fossil fuel rates has created its affordability as a profound challenge for the nations. Furthermore, due to the growing energy consumption, there is also an increase in the carbon emissions which has placed human life at risk from the effects of pollution, ecological hazards and climate change.

Pakistan is globally the sixth most populous country in the world and a fastest developing amongst South Asian nations (Kugelman, 2015). Unlike China and India, being the largest consumers of energy, energy security in Pakistan is not well explored beause of a variety of factors. The country faces several energy challenges. Though Pakistan's government has taken numerous initiatives to overcome the demand and supply gap in the country and to encourage private businesses to harness the power, there is still much work required to boost energy security. Following IEA (2017) report, 51 million people in Pakistan still have no access to electricity, thus making it the lowest compared to the neighboring countries. There are also energy shortfalls at over 25% of the total production capacity of the country, which makes the supply interrupted and unstable, even for the grid-connected population (IEA, 2017).

Attainment of energy security is a reliable driver for adopting Renewable energy (RE) policy in the national energy policies of many countries. RE's expansion is also driven by its climate change reduction potential and provision of energy access to the population through off-grid solutions (Hildingsson et al., 2012). The Government of Pakistan (GOP) has also been stressing on the inclusion of RE in its power policies promulgated over time (Irfan et al., 2019; Kamran et al., 2020). The national vision of Pakistan 2025 also stresses the utilization of indigenous, cheap, and environmentally friendly RE sources in the nation's overall energy mix to enhance energy security (Shakeel Takala and Shakeel, 2016; Lin and Raza, 2019; Ali, 2020).

This thesis aims to assess the role of renewable energy (RE) sources on Pakistan's energy security and its foreign and energy policies within the comprehensive framework of energy security. Also, evaluating the contemporary energy security needs of Pakistan in the national vision 2025 and securitization of energy resources. There are subsequent investigations into the suitability of the national vision 2025 for the country in terms of energy security. Thus, to provide some policy suggestions based on the idea's assessment. The research will make it evident that energy imports required for persistent development of the country stand as a volatile option, and for sustainable development along with the attainment of energy security, there is a need to further renewable indigenous energy sources because of availability, cost-effectiveness, and environment-friendly. To achieve this transition to green energy technologies, the role of politics will be even more crucial. As for the achievement of these goals, policymakers need to provide a comprehensive set of policies for greater energy security. There will be enormous challenges facing Pakistan in the twenty-first century and energy stands as the most significant driver of the country's overall development plan. So, to meet these daunting targets, the role of energy politics for enhancement of energy security stands as crucial.

Furthermore, there is no broadly accepted and globally recognized explanation of energy security. As "energy security," is an emerging field, so there have always been efforts done by different scholars to explain the phenomena. There is also a diversity of energy security descriptions according to relative conditions particular to countries or world regions. Moreover, in literature, increasing interest and stress can be observed on how to measure and evaluate energy security. This lead to the advancement and employment of energy security dimensions and its parameters in literature over time (Alhajji, 2008; Löschel et al., 2010; Martchamadol and Kumar, 2012; Månsson et al., 2014; Azzuni and Breyer, 2018). This thesis seeks to determine where Pakistan lies on this scope of energy security dimensions in the national vision 2025 as well as the energy security mentality of the nation.

Attainment and development of a "high level of energy security," should be the main objective of the nation-state along with maintenance of territorial integrity, strong defense capabilities, and promoting the precise foreign policies. For attaining greater security and independence, a nation requires to be free from energy imports and self-

reliant in power development as well as production (Yergin 2006; Chester, 2010). The approach of "energy independence" is still a desire in a lot of developing nations like Pakistan, where political communication is rampant with debates on nationalism and post-colonialism. There are several claims made by the successive governments in Pakistan to make the country as energy independent as propagated in (CPEC, 2019) that energy advancement plans under China Pakistan Economic Corridor will turn the country as an energy-independent nation. However, there is still a long way to go regardless of multiple efforts and initiatives at the domestic and international front by the government of Pakistan.

It is sporadic for a country to possess all-natural resources for ensuring energy security. Despite having energy sources potential, many countries in the world confront the challenge of exploiting those resources. Due to economic conditions, most of the countries at time lack the necessary finance and technological expertise to extract and utilize vast energy reserves (Yergin, 2006; Islam and Khan, 2017; George et al., 2018; Boute, 2019). Pakistan, as an example, has substantial coal reserves, and presently, they are obtaining them with the Chinese finance and expertise in the Thar region to meet overriding energy needs (Kousar et al., 2018; Kanwal, Chong and Pitafi, 2019). With these extractions, there are also public health and environmental concerns as coal is a highly polluting fossil fuel (Imran et al., 2014). Pakistan is a resource-rich country and blessed with an abundance of water, coal, wind, geothermal, biomass, solar, iron and other metals (Yasmin and Grundmann, 2019; Raza et al., 2020). The country posessess substaintial natural reserves of oil and gas as well as thorium (needed for nuclear power). The only problem remains there, and it is a lack of finance, expertise and appropriate technology to exploit this abundance of natural resources (Ion, 2012). Combing all these challenges, Pakistan has not been able to find sufficiently large quantities of oil and gas at the national level to address its ever-increasing energy needs. So, in the wake of all these issues, the question of Pakistan's energy security stands as paramount.

There is a vast Pakistani population without electricity access and also a growing economy with immense energy needs. The answer to this challenge lay in the development of the domestic energy sector with the utilization of indigenous renewable energy sources and the exploration of diverse global markets for resources

and required technology (Wakeel et al., 2016; Rafique and Rehman, 2017; Kamran, 2018; Valasai et al., 2017; Kazmi et al., 2019). As a result, energy security for Pakistan and other countries, in general, does not exist only in the attainment of absolute self-reliance, though increasing energy independence does entail its benefits.

Pakistan is also a natural disaster-prone country and faced a long war against terrorism. Like in October 2005, the deadliest earthquake struck the country's North-West Frontier Province (NWFP) and Azad Kashmir region, which caused substantial human and infrastructural losses. Energy, power, and fuel sector only suffered direct damages of 744 million rupees (Asian Development Bank and World Bank, 2005). Pakistan remained a leading nation in the global war on terror, which cost the economy $40 bn losses (Ali, 2010). Iqbal and Lodhi (2014) observe that Pakistani contribution to the war on terrorism led to the decline of economic activity in the country and the destruction of vital infrastructure, including energy (Iqbal and Lodhi, 2014).

Moreover, prompt restoration of energy supplies to people can reduce the impact felt. However, the costs involved in securing these supplies are tremendous and unbearable for the fragile economy of Pakistan. Sahir and Qureshi (2007) observe that besides a shortage of resources, the country faced the energy supply disruptions caused by terrorism and geopolitical wars being a front-line state in the fight against terror (Sahir and Qureshi, 2007). Terrorist attacks on energy infrastructure like on gas pipelines in the country have severe repercussions for the national progress and development (John and Daly, 2006). Due to the disastrous effects of terrorist activities, the country observed loss of the critical energy infrastructure, energy supply disruptions, shutting down of businesses, and services to consumers. Thus, causing much chaos for the economy and overall stability of the country.

The energy security of Pakistan is also associated with regional and international geopolitical intricacies because of its strategic location and partnership in the region as a significant geopolitical actor. Pakistan has indigenous resource potential and requires international help and assistance (Foreign direct investment and expertise) to meet its ever-growing energy needs. There are also economic growth trends in the country with mega economic and infrastructural projects like China Pakistan Economic Corridor (CPEC) with a $33 billion investment only in the energy sector of the country (Khurshid et al., 2018). Due to economic growth and logistic links with

the Gulf states, Central Asia through Gwadar and Karachi seaports natural gas and oil are likely to dominate the future energy mix of Pakistan, consequently increasing its import dependence. In order to reduce this overriding dependence on imported fossil fuels, the country can also further utilize its hydro and other renewable sources potential, along with rising shares of coal and nuclear energy in the national energy mix.

Furthermore, the encouragement in the policy and development of renewables may supplement the growing energy needs of the country. It is also a reality that a reliable technical backup from the developed world with substantial foreign investments will also be required to attain this goal. Therefore, the country needs an integrated planning approach and a conducive environment for implementation.

The government of Pakistan is working hard to accomplish its energy goals to provide energy access to everyone across the length and breadth of the country. Pakistan in its national Vision 2025, while accepting energy security as a challenge for the country, aims to achieve the United Nations (UN) Sustainable Development Goal 7 "Ensure access to affordable, reliable, sustainable and modern energy for all" by 2025 (Government of Pakistan, 2013). The government has laid great emphasis on the development of renewable and indigenous energy resources in this national policy. The reliance on imported thermal resources is an increasing phenomenon since the 1990s, and despite this expensive option, the country has faced the worst ever shortfall of electricity supply since the year 2007. It is an undeniable fact that the country's energy security is destabilized by the overriding share of imported fossil fuels in its energy mix mainly gas and oil. Pakistan needs an affordable energy supply for sustained economic growth, integrated planning and improved governance. According to a joint report by the Government of Pakistan (GOP) and International Renewable Energy Agency (IRENA), Pakistan has tremendous renewable energy potential. As a South Asian country with significant natural resources social and economic development could be attained through the effective use of these sources while improving energy access across the country (IRENA, 2018).

Besides, Pakistan's present energy mix, which profoundly depends on costly thermal sources, has remarkably raised the generation cost and CO2 emissions. The current energy mixture has a substantial economic problem on low-income households as well

as hazardous outcomes for the environment. The energy sector is one of the most significant contributors to air pollution and Greenhouse Gas (GHG) emissions in the country (USAID, 2016). It is indeed alarming and requires immediate attention and revision as policymakers in the country are still insisting on expensive and imported sources to fulfill the country's energy needs. Pakistan is on the fifth spot on the list of countries most vulnerable to climate change. Therefore, the climate indications of the country's current energy mix are high. The country's vulnerability to climate change and air pollution is a leading threat to public health, thus a looming threat to energy security (Sanchez et al., 2014: Chaudhry, 2017; Abubakar, 2019). Therefore, immediate policy interventions and necessary measures are needed to address the ever-growing needs and demands of Pakistan's developing economy for sustainable development.

The government of Pakistan has taken multiple initiatives to attain global sustainable development goals. Like it is pursuing low-carbon energy options as a signatory of the Paris Agreement in 2016 to mitigate climate change (Hassan et al. 2019). Moreover, there are domestic initiatives of utilizing the conventional RE sources in which hydroelectricity has been the most eminent, constituting almost a third of the country's electricity generation. Nevertheless, it is by developing the contribution of more renewable energy resources amongst its existing energy options for the country to secure social and economic advantages (Baloch et al. 2019). Presently, the nation suffers from a scarcity of electricity, resulting in load shedding for several hours each day due to the use of conventional and expensive energy resources. These sources have quantitative and environmental limitations that require an immediate shift to clean, cheap and indigenous sources of energy in the national energy system.

Therefore renewable energy sources turn out to be a viable option for Pakistan's energy sector as there are optimistic projections for the manipulation of various renewable energy sources in the country considering the geological setup, geographic setting, climatological cycles, industrial, agricultural and rapid urbanization. The country has immense potential of vast and macro/micro-hydropower, biogas, biomass, wind, solar, city, and other solid wastes, exploitation of low-head canal levels, sea wave/tidal and geothermal energies which can significantly help energy poverty mitigation in the country (Zaigham and Nayyer, 2005).

Pakistan, despite having great potential for renewable energy sources, the sector currently consists of only a 1% share of the energy portfolio (IEA, 2019). According to Baloch (2016), along with other issues, electricity access is an essential issue for a significant rural and urban population in the country where less than half of the rural population has no or very poor access to the grid. As noted earlier, the country depends on imported fossil fuels to meet the demand for energy. However, this expensively generated energy has limited access and more line losses due to old infrastructure. Energy production in the country also observes emissions which is a severe issue to the environment (Baloch, 2016). Sheikh (2010) has noted that about a 9% supply of energy in Pakistan is done through conventional energy supplies such as hydro, gas, and oil (Sheikh, 2010). The poor performance of the renewable energy sector entails certain factors such as the lack of the essential technology, an integrated regulatory framework, and institutional framework and proper policies and incentives. This thesis discusses both the potential for and the impediments to the growth of renewable energy projects in the country.

As an ultimate reality, the socio-economic progress of a country is significantly dependent upon the performance of the energy sector. The energy sector of any country is the primary driver of the engine of growth and development in all areas, including industry, agriculture, and defense. Moreover, it also has a significant impact on domestic users (Bergasse et al., 2013). Pakistan observes an increasing gap between the demand and supply of energy, which has brought economic progress of the country to a standstill. Over the years, several businesses have closed down in Pakistan due to this growing demand-supply disparity, which is anticipated to rise even further in the future (Kazmi et al., 2019). Balcilar et al. (2019) observe that due to electricity shortages in Pakistan, the country has faced severe economic and social impacts in recent years (Balcilar et al. 2019). According to the report (2019), damage to the economy due to the inefficiencies of the power sector of Pakistan was nearly $18 billion, which is 6.5% of the country's overall GDP (World Bank, 2019). As a result of power deficiencies, the industrial sector suffered a lot, which resulted in a decrease of industrial growth from 4.5% to 3.6% and loss of jobs in 2015 (Junejo and Khoso, 2018).

This research adds to the current literature on energy security discussion and the role of renewables in ensuring the energy security of Pakistan. It furnishes a concise examination of the energy policies and energy governance structure of the country. There are numeral factors that make Pakistan a new and exceptional case for such exploration in terms of energy security, such as historical, geographic and political aspects affecting the energy choices and heavy reliance on foreign energy supplies like oil from Saudi Arabia and LNG from Qatar despite having vast domestic potential. Mills (2012) observes that regardless of enormous domestic capability and significant geographical position as a promising energy passage between Central Asia and the Middle East, the country's energy sector remained unsuccessful in securing its energy needs (Mills, 2012). Pakistan is a country with an increasing demand for energy. At present, this demand cannot be met through indigenous resources only, and thus Pakistan has to find resource support elsewhere. Over time, Pakistan became over-dependent on Middle Eastern oil and gas supplies (Pakistan Energy Yearbook, 2012). Overdependence on Middle Eastern oil and gas is a severe concern for security; diversification of energy sources enhances security. It is somehow exceptional, along with many local efforts, there are international energy diplomacy and cooperation by Pakistan with global partners like China to diversify the energy generation through China Pakistan Economic Corridor (CPEC) energy projects.

Besides Chinese partnership, there are other global plans such as the construction of Iran Pakistan India (IPI), Turkmenistan-Afghanistan-Pakistan (TAPI) pipelines to balance against Middle Eastern dominance and to spread its influence in the region (Abbas, 2012). In pursuit of energy security, Pakistan developed warm ties with the other states in the world, while diversifying its sources of energy supply. Ali (2019) observes recent developments in the energy sector of Pakistan, like Saudi Arabia promised $ 20 billion investment in the country, mostly in the energy sector. Moreover, the first seven months of the financial year 2019 (FY19) power services attracted higher Foreign Direct Investment (FDI) in the oil and gas exploration sector. According to the estimates, the increase of FDI in gas and oil exploration reached $ 145.1 million and power sector services attracted $44.8 million in the country (Ali, 2019). Ahsen (2019), while tracing the history of imported fossil fuels in Pakistan like oil, remarks that Pakistan participated in the petroleum-fuelled thermal generation of electricity during the 1980s when the prices of oil were quite low. With price hike, the

rising cost of production, and many other financial problems, this option was replaced with the use of natural gas, and ultimately the government of Pakistan started looking over alternatives of power generation (Ahsen, 2019). Domestic and international politics, energy policies developed over time are at the crossroads of Pakistan's energy security concerns. The present research will, therefore, touch upon these aspects where ever required throughout the thesis. Empirical information gathered through semi-structured in-depth interviews and discussions with policymakers, officers, academics and professionals associated with the government of Pakistan, think tanks, educational and research institutes related to energy, the research endeavor hopes to bring up to date information, energy security mentality, conditions and salient challenges of the country's energy sectors at domestic and international level. Furthermore, this effort seeks to integrate the previously overlooked renewable energy sector of Pakistan in terms of energy security dimensions and parameters.

The Government of Pakistan has identified energy as one of the key pillars in the national vision of 2025, along with water and food (GoP, 2014). At the same time, while the government has embarked on a restructuring of the energy sector in consultation with various stakeholders, including the provincial governments, while the reality of the situation remains there that Pakistan has not achieved its targets so far (Khawaja, 2018). There are multiple reasons for this failure, including lack of political will and integrated energy policy, absence of cooperation between multiple stakeholders in the country, and necessary finance. The country's energy sector does not possess integrated planning. There are still multiple issues affecting the nation's energy sector, including the most vital of all, the lack of sufficient "transmission and distribution (T &D)" facilities. Due to this problem the current energy system is not capable to handle vast amounts of intermittent power produced by renewable like wind and solar (Ullah, 2013). Based on all these practical impedements faced by renewable and the significance of RE technologies for enhancement of the country's energy security this work has conducted an indepth analysis of the sector. Moreover, there are certain financial barriers to the advancement of green energy projects therefore it is suggested that through policy interventions and instruments private sector should be encouraged to finance RE schemes. This dissertation also provides a brief outline and discussion of the overall energy sector of the country. There are multiple restraints in the way of hydro, wind, solar, and distributed energy projects developement. Despite

promising energy developments and regulatory frameworks by the government of Pakistan. power availability is still an issue awaiting solution. In order to address the power shortages in the country the role of renewables can not be overlooked therefore some policy recommendations are presented to enhance the low share of RE in the prevailing energy mix of the nation.

The dissertation is organized into six chapters. Chapter 1 initiates presentation of the background of the study. It then illustrates the significance of energy security for Pakistan, Chapter 2 demonstrates a review of the relavant literature. It also reviews and deliberates the diverse nature of energy security as well as the development of notion in the contemporary international Relations (IR) discssions. While taking stock of the domestic and international dimension of Pakistan's energy security, the following analysis includes an in-depth analysis of energy security definitions in the literature along with its varied dimensions and their parameters necessary for the enhancement of energy security. Chapter 3 describes the research methodology of the study. It details the research design and research methods employed for the investigation. It also outlines the study's data collection, semi-structured indepth interviews, discourse analysis and case study methods. The investigation further leads to Chapter 4 presenting the illuminating issues in the energy policy of the country and scenarios of different energy sectors. brief analysis of the country's energy profile and policy formulation is done as well. Then chapter 5 deliberates Pakistan's Vision 2025 with the focus on its fourth pillar related to the enhancement of energy security. This section also touches upon China Pakistan Economic Corridor (CPEC) energy projects and their role in the development of renewable energy technologies in the country. Chapter 6 finally concludes the dissertation and reports the theoratical and practical implications of the study. It too present certain policy ready recommendations to further improve the performance of the renewable energy sector in Pakistan. All these details, issues and sectors have not been previously covered in any academic publication. Though these issues have been explored in technical papers and primary documents by the government of Pakistan and other research institutions, they have not been synthesized in a coherent form to offer an inclusive depiction of Pakistan's energy sector security based on multiple dimensions and parameters of energy security.

Most of the thesis content has assimilated the dimensions and parameters within the realms of energy security, and Pakistan's pursuits of energy security enhancement through policy development efforts, energy cooperation, and diplomacy. This effort will lead the analysis to the areas covered by other authors on the subject, though from a new outlook and rationalized for current developments. It will also discuss the energy profile and ongoing policies in the country as well as Pakistan’s bilateral relations with other countries for energy security enhancement while exploring countries and regions where needed. The research will further analyze energy cooperation according to energy security dimensions which will make the work even more distinctive as the contemporary energy security studies on Pakistan are deficient in this respect.

CHAPTER 2: LITERATURE REVIEW

This chapter is formulated in different sections. Part 2.1 discusses the varied nature of energy security. While 2.2 conceptualizes and reviews the evolution of the concept of Energy Security in contemporary International Relations (IR) debate. In 2.3 different dimensions of energy security and their parameters are assessed in the existing literature of energy security. Finally, it leads to research question development.

2.1. What is Energy Security?

The purpose of this chapter is to explore an explanation of the theoretical question: "How does the energy security concept evolve in the contemporary International Relations (IR) debate?" which paves way for understanding of the empirical question "What is the role of renewable energy in the contemporary energy security mentality of Pakistan?" followed by subsidiary questions such as, "Does the Vision 2025 address the need for contemporary energy security assessments?", "Is it the right vision for Pakistan?" and "What could be the policy recommendations based on the evaluation of the Vision 2025?" The study also aims to probe the energy security impact on Pakistan's energy and foreign policies developed over time. Moreover, analyzing the function of energy diplomacy in the advancement of RE sources in Pakistan. For an explanation of the investigation defining energy security stands as paramount.

Energy security is a comprehensive field, and therefore, the existing literature lacks a frequently agreed-upon explanation of energy security. Moreover, the notion is also highly context-dependent (Cherp and Jewell, 2014). By demonstrating the contested nature of energy security, this research endeavor provides an in-depth critical analysis of energy security constructions in literature and then leading this to the Pakistani context. This chapter deals with a review of the evolution of the energy security concept in the contemporary international relations discussion and how varied dimensions and their parameters deliberated in different studies conducted over time. This chapter reviews the associated scholarship in both streams and ultimately brings out the input of this research.

Attainment of energy security is one of the main targets of the energy policy of a country. Still, there exists no consensus on the commonly accepted definition of the term. Thus, making it hard to assess and challenging to stabilize against alternative

policy goals (Winzer, 2012). Therefore, a large group of energy security definitions is examined in the study to grasp a clear understanding of the concept. According to the International Energy Agency (IEA), energy security is "the uninterrupted availability of energy sources at an affordable price" (IEA, 2001). The perception of energy security entailed a stable supply of energy, primarily oil as it is the most significant energy source. The idea also calculated geopolitical tensions amongst states to attain energy supplies.

Energy security holds critical value for the national, global, and internal stability of a country. To cover diverse aspects of energy security identification of its relevant dimensions and indicators stand as paramount. Baumann (2008) has termed energy security as a multidimensional concept with "overlapping dimensions" (Baumann, 2008). Multiple energy scholars have attempted to outline energy security in their contexts while deliberating its varied elements. Cherp and Jewell (2014) consider energy security as the "low vulnerability of the vital energy systems" in a particular context. Energy security involves the safety of the overall energy system in a country as it may take in ensuring electricity security as well as oil consumed in transport. The vulnerability of vital energy sources in a country also covers the paradigm of energy security. Apprehensions regarding "energy security" have progressed with time. It started with sovereignty or independence perspective. Secondly, the concerns regarding the exhaustion of indigenous energy resources involve a robustness perspective. The third one relates to the resilience of the energy system, the recovery or response power of the system in case of any disruption (Cherp and Jewell, 2014). Kirchner and Berk (2010) in their outlook of energy security perspective, have focused on regional safety aspect which appeared as significant features in International Relations over a period (Kirchner and Berk, 2010). Whereas, energy security has also emerged as an international concern as well as it shapes regulations and policies. With practical strategies and guidelines, a higher level of energy security can be attained, and this ultimately results in a better life for the societies around the world (Ang, Choong and Ng, 2015). Hence interpreting energy security holds great significance for a better understanding of the phenomenon under consideration.

Scholars also find it critical to explain the idea of energy security clearly as it carries multiple meanings and interpretations. Additionally, it is a concept compared to a

policy that makes the task of explanation even more challenging (Lynne, 2010). Many investigators agree that the advancement of energy security is the main target of any society (Dunham and Schlosser, 2016; Franki and Višković, 2015; Sovacool, 2011; Vivoda, 2010; Eaves and Eaves, 2007; IEA, 2007). Energy security requires sustainable energy planning as it requires to accomplish basic human requirements (Andrews and Shabani, 2014). Maslow's hierarchy of needs also supports the attainment of one's autonomy of choice. To him, national and personal energy security should be adopted as ways, which ultimately permits advancement to actualization (Maslow, 1943). To make any nation energy secure all options should be exercised to its full. In pursuit of energy security, a country needs considerable attention to its domestic as well as international arenas of opportunities.

On the other hand, keeping in view the great significance of energy security for any nation at times, an overinvestment in energy security can be observed which ultimately results in nonoptimal use of resources that could be utilized otherwise. As a result, there rises a question concerned with the required level of security of energy. The answer lies in a vast range of justifications offered in different definitions and mentioned dimensions in their appraisal based on multiple assessment tools and approaches (Sovacool, 2013; Kanchana and Unesaki, 2014; Phdungsilp, 2015; Kumar, 2016). Studies argue that delineating energy security is linked with keeping into consideration various connections and considerations. It becomes evident with the discussion regarding the conception of energy security, which encompasses ample intricacy and overlap of basic proportions.

2.2. Conceptualizing Energy Security in International Relations debate

This thesis accesses energy through the approach of security studies, a broader International Relations (IR) subfield that observes the connection between energy and security. This section thus examines, from a critical point of view, the existent discussion in the IR literature on energy security and security studies. The understanding of energy security can be traced back to primitive times as an approach leading to crucial preparation for the attainment of required energy supplies. In order to comprehend the conceptualization of energy security in the present day world the evolutionary nature of the idea stand as paramount (Valentine, 2011). Energy security received specific position and significance since the energy shocks of the 1970s when

imbalances between the geographical distribution of energy resources were quite noticeable, which led to petroleum-dependent nations into oil shortages (Choucri and Ferraro, 1976). Consequently, the supply of oil became a subject of sensitivities between countries, either perceived or real. Since then, scholars turned to the study of the increasing rate of energy consumption and import dependency of many industrialized nations. Besides, political conflicts related to natural resources has been emphasised (Proops, 1988).Moreover, it is a common observation that countries strive to secure steady and sustainable inflows of required energy supplies at affordable prices. All these realities make it evident that energy security has a constant presence in global energy-related political discourse (Dudau and Nedelcu, 2016). Attainment of energy security is a simple strategic objective in energy policy practices around the world. It means different things for energy importing and exporting nations. As for the countries that import energy, it refers to the energy supply security through diversification of imports at an affordable price.

On the other hand, for the energy-exporting countries, energy security means the nation's capability to maintain and secure market share (Winzer, 2012; Belyi, 2016; Wang and Zhou, 2017; Shoram et al., 2018; Nicolli, and Vona, 2019). In either case, energy security entails an inherently political element, as international energy cooperation and reliance is a significant factor. This dependence leads the nations to indulge in international energy trade which ultimately puts energy-producing, transit, as well as consumer nations concerning mutual dependence which is not necessarily balanced and requires political interventions.

Therefore, due to the vitality of the concept of energy security for human civilization over time, the notion acquired widespread recognition not only in daily governmental systems but also in the epistemological structure of geopolitical affairs including International Relations (IR). It is an undeniable fact that energy is not only a decisive factor in relations between states but also performs an active part in creating ‘norms’ and these rules direct the international relation processes (Dubash, 2011).

To realize this globalization of energy, the role of International Relations stands as paramount as one of the main features of this global integration of energy politics is taking a view of theory that helps in understanding these relations (Viotti and Kauppi, 2013). A simple analogy of treating theories as a different colored lens through which

the world can be viewed according to the chosen colors. There are different theories to interpret world politics as a way of understanding the same issue from different perspectives. In that sense theories are not something different from the world. They tend to report on the world that is rather theories construct what we see. If one takes one theory, one may see one set of events and in the case of another theoretical position, a different set of events can be observed (Sterling-Folker, 2006). There are specific approaches to comprehend the philosophy of energy security in the IR discipline like realism, neo-realism, constructivism and neo-liberal institutionalism. These theories purpose in offering a conceptual framework upon which international relations can be investigated and studied adequately. Therefore, Belyi (2014) proposed four approaches of existing IR theories to evaluate and understand energy security including rational approach, institutionalist approach, the new economy of energy and international political economy (Belyi, 2014).

2.2.1. Realist approach

The first one is the traditional approach to security, which is deeply rooted in realism, or a realist approach that concentrates on power as a rational choice in global affairs. There are structural imbalances amongst energy consuming and producing nations. Therefore, energy supply faces certain perceived or real vulnerabilities (Dannreuther, 2018). In this approach, much investigation centers on the growth in energy consumption and energy dependency of various industrialized nations. Political conflicts over natural resources received particular attention in this process. Waltz (1979) while presenting realist conception opine that states struggle and act according to their respective structural power in an international system without any global authority. This struggle marks their power features that also determine relations between the nations including efforts for resources access (Waltz,1979). The realists view energy security as a part of national security and for them, the two are inseparable. In this case, energy is closely connected to power, and without energy security, the national security of a country will always remain volatile. Power is the main factor in a realist understanding of international politics as it helps in achieving security (Snyder, 2004). Therefore, the use of the military as a physical power is asserted to achieve energy security, as in hours of war or conflict, an adequate supply of energy can help a nation to utilize its military force effectively. In this approach,

states should strive for energy supply continuity for strengthening their position against threats. The realist does not disregard the significance of economic power as a part of the military, and they stress the need to join both for a stronger state. Bilateral cooperation is also given prominence for energy security enhancement along with the concepts source diversification and sustainable energy supply continuity in the realist paradigm (Waltz, 2010).

The neo-realist believe that the international system is anarchic where every actor is in a continuous struggle to ensure its security against others- this construction thus formulates the state behavior. In this conception, states act as primary and unitary actors performing rationally. The efforts for security and power maximization leads to conflicts (Smith, 2005). The realist approach has been criticized by many scholars' including the neo-realists like Gilpin for having a significant emphasis on the military force and physical power to ensure energy security. To him, the economic factor stands as a critical factor in defending the national security of a nation (Gilpin, 2016). Likewise, another scholar Susan strand directly addressed the problem by refuting the idea of military force being the decisive factor of the state power. State power is derived from four dimensions: military, production, ideas and finance. These other factors are not less significant than the military. Multinational corporations should also be included in IR analysis as they are crucial to global political understanding (Babic, Fichtner and Heemskerk, 2017). There are other vital factors in determining state power like the economy, culture, ideology as well as Nye (2017) confirms it with his notions of soft and hard power where culture and identity can be interpreted as the state's soft power (Nye, 2017).

2.2.2. Institutionalist approach

The Institutionalist approach serves as the second one based on the realization of institutions to resolve conflicts. These organizations arise from norms and practices which shape the security and stability of economic relations between states. This method tries to evaluate the effectiveness of global financial organizations on furthering security. As these economic institutions help in regulating and governing this cross-border energy trade so any misadventure sheds light on their effectiveness (de Buck and Hosli, 2020). The institutionalist approach comes within the framework of the liberalism theory of IR. Liberal understanding of energy security is the result of

their liking of economic issues and interdependence perspectives. Therefore, their interpretation of energy security has more focus on the economy as compared to the realists.

Neo-liberals, while focusing on institutions, believe in the option of stable and authentic cooperation within the global arena between actors. They incline to elucidate this by the practical implications of game theory in which cooperating selections of economic actors produce results concerning the preferences (Keohane, 1984). On the other side, they also present a non-zero-sum game perspective in international relations based on the friendship between democracies, the significance of interdependence, international institutions, free trade for free countries, and the value of community (Ikenberry, 1999).

Neo-liberals take stock of the illiberal practices and mechanism pursued by governments and provide liberal perceptions to overcome these challenges (Dannreuther, 2010). Therefore, institutions play an essential role in enhancing energy security at a global and national level in neo-liberal understanding. These institutions help explain various angles of energy policy strategy. There are specific norms, principles and rules that approach problems of resource management and any other such challenges (Jervis, 1999; Joseph, 2013). There are International information-based institutions like the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC). There are general rules of international economics law enforced through the World Trade Organisation (WTO), the law of the sea, international arbitration. There are sector-specific institutions such as the Energy Charter Treaty (ECT) and the Kyoto protocol. These institutions, laws and norms help in promoting expertise and data on energy and its related issues like GHG emissions, environment, health and other social issues. They are also instrumental in establishing general legal binding as institutions as they have emerged as a result of general multilateral agreements and conventions. These organizations and laws establish issue-specific treaties that directly involve the worldwide energy markets and precise dispute settlement mechanisms are adopted to resolve outstanding issues (Goldthau and Witte, 2010; De Jong, 2011; Keating et al., 2012).

2.2.3. New political economy of energy approach

There is the third approach, termed as the new political economy of energy. This method is also based on international energy interdependency, where global structures describe the capabilities of different nations. Andrews-Speed (1998) illuminates structural differences in states which lead to the adoption of a variety of energy security trends over time. The assessment is based on business and academic factors such as globalization, energy technology diversification, interdependency and foreign investments and tendencies following deregulation in the energy sector.

Moreover, the new era energy trade has emerged as a complex system, where political liabilities are based on the commodity price which shapes behaviors (Andrews-Speed, 1998). There are energy importing nations like the U.S., Japan and the majority of EU nations like (Germany, France, Belgium, Spain, Italy), but they also export finance and technology. There are also countries like the UK, Norway, Denmark and the Netherlands that export technology and finance as well as gas and oil. Whereas, there are hydrocarbon producing countries including Russia, OPEC countries and some central Asian nations that export gas and oil while importing finance and technology. The majority of the developing states of South-East and East Asia and EU applicant nations import both energies as well as finance and technology. So, their relative structural mechanisms determine their energy security approaches. Energy and economic system are co-related as the economic system of a country heavily rely on low and stable energy prices. Therefore, many states are adopting liberalization in the energy market to establish effective and efficient systems that ensure regular energy supply.

2.2.4. International political economy (IPE) approach

The international political economy is the fourth approach to energy security which criticizes the rationalist economic theories. It is also termed as a non-liberal approach towards energy security. Their focus is mainly on economic values such as nationalism and liberalism, which put a restraint on the rational approach of the governments. IPE scholars usually concentrate on matters where politics and economics interconnect, and observe a diversity of actors, counting states, individuals, and global organizations (Hancock and Vivoda, 2014). IPE has brought back politics into energy policy, where

earlier economic considerations were mainly focused (De Mesquita, 2005; Sovacool, 2014). Adherents of this approach laid their focus on the relationship between political and economic matters at the national and international levels. Besides this, the IPE scholars also focused on the role of states, interest groups, individuals, and sub-state actors, international governmental, and non-governmental organizations. Their various theoretical paradigms emphasize state power, cooperation, governance, ideas and identity to demonstrate the full range of issue areas to which the field can contribute.

The concept of energy security in international relations theories is linked to numeral coexistent and overlapping approaches. The hypothesis in these theories includes an arrangement of changes occurring over time, calculating the influence of economic structures and response of the political institution to these changes. Like the developing nature of energy security, the theories also evolved based on the efforts to define the ever-growing concept. To conceptualize the notion of energy security finding an answer to the fundamental questions like what does "security" means in general, whether it is a strategy to avoid a probable threat or a response to a real threat or a justification of concrete policy objectives. It all depends on the nature of the threat that one may try to explain and counter in the provided situation.

Consequently, the vast bulk of current research is strongly linked to the conventional security logic and then problematizes the notion. Shepherd and Weldes (2008) observe "academic and policy discourse are largely mutually constitutive" (Shepherd and Weldes, 2008, p.10). That exposes that mostly policy debate and discussion influences the academic conceptualization of energy security.

Policy discourses have presented different "logics" of security, and considering and understanding this approach is critical to this study and as well as the mainstream security literature. There is realist, liberal as well as other comprehensive logics of energy security propagated over time and developments.

Scholars from multiple approaches have viewed energy security as an evolutionary concept. Walt (1991), observes the emergence of traditional security studies as a separate sub-discipline of International Relations (IR) throughout the cold war time span, where the main emphasis continued with situation and "security studies," believe

that interstate conflict will always be a risk (Walt, 1991, p.212). Buzan et al. (1998) debated the evolution of security studies where there are two dominant schools of thought including traditionalists who confine the focus to politico-military matters; while there are those who go beyond that to the societal, economic, and environmental areas (Buzan et al., 1998).

For a more considerable time, the idea of "security" remained synonymous with protection from threats or potential dangers, usually of a geopolitical or military type. The state, as a referred object, is to be guarded against all such intimidations. This comprehension of "security" linked to a "realist" appreciation of "anarchy," constructing "self-help" as the foreign policy objective, as Mearsheimer (1990) believes that "each state must guarantee its own survival since no other will provide its security" (Mearsheimer, 1990, p.12). "Security" remains as the objective in the traditional studies on security where state existence is imperative in the face of outside threats. Shepherd and Weldes (2008) term it as "the object of security is the state and threats, and therefore insecurities, are objective, external, and fundamentally related to the use of power, and ultimately force" (Shepherd and Weldes, 2008, p.530). Due to the historic importance of the state in the discourse, the view of "security" has connected strictly to national security and state sovereignty (Walker, 1990, p.8).

In traditional scholarship, the "state" is described as "inside," which shall be guarded against "outside" threats, referring to the international system presented as "anarchic," including other factors. Based on this differentiation the discourses on security focused "state" as an essential element of "security" in addition the requirement to guard it against innumerable anarchic threats including other nations (Campbell, 1992). The prioritization of state in security discussions has somehow limited the security debate as Walker (1990) believes that in specifically on how "to think about more desirable alternatives," with the actual sense of security (Walker, 1990, p.7). In the same manner, classical studies on security also use "disciplining practices" (Krause, 1998, p.300) to explain and bound the outlook and discussion of research in security studies.

Furthermore, it is also observable that a division prevails between "realist" and "liberal" perception of the global system in the traditional security analysis.The neorealism and neoliberalism as their present more prominent methods, contribute to viewing the "international system" as an "anarchic world.". Besides, neorealists and

neoliberals practice common assumptions regarding “agents” whereby states are the central figures in the structure, also explaining “security” in their own “self-interested” conditions (Wendt 1992, p.392). These theories provide their grasp of security and the international system. The realist school of thought underscores the necessity of the state's strategic autonomy thus opposing interdependence. On the other hand, the liberal school of thought seeks economic and global institutional interdependence to attain national security. Therefore, it will not be wrong to say that liberalism has been more accepting of new developments.

Chourci and Ferraro (1976) view the energy challenges faced by countries as more political than economic. To them, energy security accomplished a specific position since the 1970s energy shocks, when oil shortages led to a price hike and decreased supply in the petroleum-dependent countries (Chourci and Ferraro, 1976). So, it is crucial to understand the underlying political differences to appreciate the effects of global interdependence for energy for which a more comprehensive construct is required.

2.2.5. The Copenhagen school of IR (Constructivism: Theory of Securitization)

In international relations, in addition to realism, the constructivist canvas is believed to be the main theoretical framework for reviewing the concept of security (Wendt, 1992). The Copenhagen School provides the most outstanding illustration of such work. The followers of this thought analyzed and provided a gradual shift to the approach to “security” from a limited, “state-centric” and “military” to an extensive one including the economic, environmental as well as adding multiple social features and regions. These varying levels of analysis have been done throughout and following the final years of the cold war (Wæver, 1993; Buzan et al., 1998). The conventional understanding of security to “desecuritization” both help in developing a good grasp of the developing and evolving concept of energy security.

Buzan (1998) emphasizes different sectors of security and these sectors are dynamic and interact with each other in his early works. He delineates five sectors of security, including “military, political, economic, societal and environmental” over a period in his writings (Buzan, 1998). The military sector is traditionally related to existential

and physical security concerns of a state. Secondly, the political sector entails threats focusing on ideology and sovereignty of the state. These threats arise from other actors or structural based reasons. The third sector relates to the economy which also forms the concrete base of a state-linked to ideology and institutional elements (Buzan, 1991). Later this sector observed the addition of existential economic threats that exist in every state which pose existential challenges to the population (Buzan et al., 1998). The economic security concept was evolved including the availability of finance, resources, and markets for state power and welfare of the people (Buzan and Hansen, 2009). Then the fourth sector accounts for the societal factors that can be associated with political security in multiple aspects like processes, actions that may threaten a state's collective characteristics including its language, traditions, religion, culture and other similar aspects (Buzan et al., 1998). The fifth sector relates to environmental concerns which refer to ecological security which provides necessary support to human existence (Buzan and Hansen, 2009). All these sectors require a joint security approach that moves away at times from state-centric approaches.

While keeping in view the dual nature of the "energy security" perception that remains outside the scope of most assessments of political science and energy studies as Cherp and Jewell (2011) note that "there is virtually no research" on the interaction between the "analysis of vulnerabilities of energy systems and policy narratives about risks and response capacities, at the same time, such narratives are often used in both setting the agenda of energy security research and interpreting the results" (Cherp and Jewell, 2011). Whereas Jewell and Brutschin (2019) research acknowledged "a gap between energy security rhetoric and action" in recent times, affirming the motives for using security positions in specific energy governance situations necessitate an additional detailed examination, and to them "there is far too little research which documents how actors use energy security to advance their own agendas at the national level" (Jewell and Brutschin, 2019). Therefore, the researchers presented the argument regarding "securitization" as a useful notion for all such investigations.

Buzan and Wæver being the advocates of the securitization concept within security studies define it as "the discursive process through which an intersubjective understanding is constructed within a political community to treat something as an existential threat […] and to enable a call for urgent and exceptional measures to deal

with the threat" (Buzan and Wæver, 2003). At the same time, majority researchers in energy policy (Özcan, 2013; Nyman, 2013; Bridge, 2015; Szulecki, 2016; Nyman and Zeng, 2016; Szulecki, 2016) while discussing "energy security" make loose references to securitization theory, concentrating mainly on provision of summaries of the key stakeholders and an apparent increase in references.

Very few energy policy studies to date have paid attention to propose particular actions that are beyond the ideas of securitization to mitigate threats to energy security. Most scholars focus on the identification of threats and a specific energy sector to be protected in their discourse on energy security. Whereas Szulecki (2017), while discussing the notion of "energy security," observes it not referring to any genuine threat in a specific context instead of functioning in a "desecuritized" background, thus challenging the proposition of energy becoming securitized in many countries (Szulecki, 2017). The Copenhagen School-theory of securitization tries to solve this problem in the debate by taking a discursive approach to understanding the construction of security in different contexts. It explains how issues become securitized, taken out of the usual political affairs into emergency politics and leads the policymakers to suggest extraordinary measures for mitigating threats. Looking at security doing more harm than good, this school of thought then prefers "desecuritization" which lacks the language of existential threats and emergency measures (Fako, 2012; Calcutt, 2014).

Energy policy researchers (Szulecki, 2016; Szulecki and Kusznir, 2018; Heinrich and Szulecki, 2018) feel that the study of energy securitization should move outside the repetitiveness of assertion of scholars regarding "security." Williams (2015) stresses the need for a socially performative feature of energy securitization, developing out of the acknowledgement of "existential threat" besides getting away from the rules of "normal politics" and "above all political" (Williams, 2015). He has posed questions regarding the functions of securitization. There is an increased interest in energy security debate in the literature, even if this does not always lead directly to revision of policy; it is still imperative from many perspectives. Due to the enormity of the scope of the notion of energy security, there are always many issues concerning the ways in which "energy security" rhetoric can empower, frame and distract individual

actors within any energy governance structure with straight political consequences. This stream has also continued to be unexplored up to now.

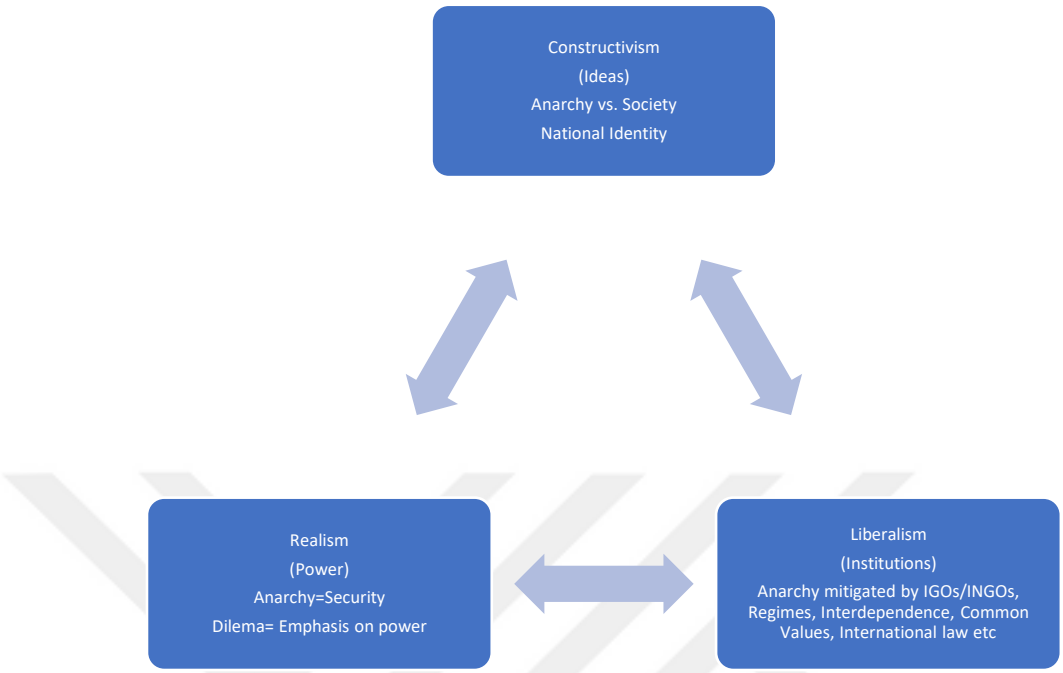


Figure 1-Relationship of Constructivism with other theories

(Source: Williams, 2015; Szulecki, 2016; Szulecki and Kusznir, 2018; Heinrich and Szulecki, 2018)

The reason for choosing constructivism and theory of securitization as a theoretical basis for the study is due to its varied and growing nature as well as owing to the close relationship of the constructivist approach with other theories. That makes it an inclusive framework of analysis. As debated earlier realism sets one of the bases of IR theory, discusses power as the primary determinant of state behavior, and claims that anarchy emphasizes power as an essential constituent. Whereas Liberalism claims that various types of institutions act as a significant determinant or driver of behavior and claims that anarchy is mitigated by international governmental organizations, international regimes, interdependence, shared values and international law. Then constructivist ideology claims that ideas not power or institutions alone can be the drivers of behavior. To them, ideas are the primary drivers of international politics and anarchy is treated as an artificial term not determinant but kind of secondary notion because it is produced by security. They immediately fundamentally transform behavior and relations in these fields.

Lack of an exact explanation of energy security turns it be an enveloping phrase for a lot of distinct policy objectives. In order to advance energy security, there is always a need to have a viable policy (Joskow, 2009; Winzer 2011). Attainment of Energy security is the predominant objective of energy policy. Regardless of the significance of energy security in policy, various researchers hold the view that the expression has not been described sufficiently (Checchi, Behrens and Egenhofer, 2009; Kruyt et al., 2009; Chester, 2010; Löschel et al., 2010; Mitchell, 2002). There is still not much consensus to explain energy security unilaterally. Many scholars, while talking about energy security, refer to Daniel Yergin who in his article (2006), discussed energy security in a modern world which is based on three things. First, reliable and affordable access to energy supplies by a country. He has once more emphasized not only on the security of energy but also affordability. Then turning to diversification, he has mentioned different types of diversification. Starting with technological diversification, ownership and structure diversification, space diversification: as an instance, he is not in favor of putting all oil refineries in one place (Yergin, 2006). To him, a more diversified system of energy is a better system in terms of resilience, accountability, and affordability. The third one is integration: no country can be an island in this globalized world, every country even Saudi Arabia imports equipment's for oil wells and needs capital from investment banks when they embark on any significant energy projects. Then finally, the governance and information flows are the fourth dimension. Price signals and tariffs cannot be ignored and having more aware consumers is also essential. Yergin wrote from the U.S. perspective thus being country or context-specific in his approach.

Winzer (2012) argues about the complexity of energy security in political conduct in different countries. As in the U.S., where leaders emphasize energy self-reliance, which ultimately encouraged renewable energy technologies for energy security. Alternatively, in the case of Brazil, there was a time when the legislators campaigned for developing the contribution of fossil fuels imports for energy security and demanded to lessen the input of renewable energy technologies (Winzer, 2012) whereas there are other scholars like Kemmler and Spreng (2007) who talk about energy security in India with an entirely different set of indicators including poverty, equity, energy access, environment. They have also presented a historical and projected assessment of India and all mentioned trends in the analysis are not positive,

such as resources are going down, poverty and pollution are increasing. It is also less equitable in India according to their calculation than it was ten or fifteen years ago because the gap between rich and poor is getting higher (Kemmler and Spreng, 2007). It is interesting to note that the objective of energy security for various scholars is diverse as for some, it is the safety of the poor and for others, it is the consistent delivery of different energies. Keeping into consideration the evolving nature of energy security Joskow (2009) notes that it has developed as an inclusive concept for the attainment of various policy objectives (Joskow, 2009).

This assessment between different scholars helps situate energy security with entirely different answers as to what its core constituent parts entail. Academic literature holds a different point of view regarding energy security dimensions like in an exciting investigation by Sovacool (2010) of more than ninety academic, peer-reviewed articles revealed four dimensions to energy security. The inquiry probes that 80% of the articles did focus on energy security as directly "availability" or "security of supply (SOS)." About half of the articles touched on "affordability," but only about third talking about "efficiency or innovation" and only about a quarter talk about sustainability issues like climate change, pollution, water, land-use change (Sovacool, 2010). There are specific problems within the existing literature on the subject as it does not explain energy security consistently. Many of them are very narrow in their focus as they concentrate on a sector or a single country like Russia or the U.S. In terms of technology, the scope is narrower as they talk about "nuclear security" or "oil security." There is also little attempt to look across energy security dimensions. There is also a limited attempt to collect data from experts or users, consumers or politicians or investors any type of stakeholder about what it was and there are very few attempts made to measure and track performance. Regardless of the bewilderment about the perception of energy security, some intellectuals reach an agreement that security is affected by certain liabilities. Various risks influence the supply of energy (Lieb-Dóczy et al., 2003; Wright, 2005; Keppler, 2007; Ölz et al., 2007; Rutherford et al., 2007; Gnansounou, 2008). The principle reasoning for dissimilarities in energy security impressions is due to the writer's selection of the subdivisions of these dangers considered for their study. Energy security analysis concentrate on multiple sources of risk and there is a diversity of dimensions to measure and assess energy security.

As Sovacool and Brown (2010) developed a straightforward energy security index focusing on OECD countries looking at the countries on a limited set of metrics across a few dimensions of energy security like dependence, diversification, consumption, prices, and pollution. The study evaluated energy security performance scores from 1970 to 2007 and provided scoring techniques from one to three. The results of the study show certain countries like Denmark, Belgium, the UK, Japan, Canada, Finland, France, Italy and Sweden who have shown improvement. Whereas, countries including Germany, Netherlands, New Zealand, Turkey, Australia, Norway, Austria, Ireland, the United States, Greece, Portugal, and Spain saw declining trends. (Sovacool and Brown, 2010). However, despite the strength of the inquiry, there were still few problems with the OECD Index as all the other dimensions such as equity, reliability, governance, water, competition, resilience, adaptive capacity, shocks, disasters, climate change were not included that could exist for energy security. There were no metrics where nuclear power, energy access for countries like India and China were accessed. There were only two data points and a limited number of metrics. The study was only covering 22 OECD countries in 1970 and a simple scoring technique with limited literature review.

There are varied proposals offered in works to regulate and assess energy security. Some studies have a compilation of energy security imperative dimensions and parameters (Sovacool, 2010; Ang at al., 2015; Azzuni and, 2018; Paravantis et al., 2019). On the other hand, there are studies using aspects to evaluate energy security (Johansson et al., 2012). Phdungsilp (2015) has critiqued the usage of several parameters for appraisal of energy security as it would make it limited, and the addition of more indexes does not ensure any exceptional judgment (Phdungsilp, 2015). Due to the enormity of challenges faced by countries to achieve energy security, there are investigators like Yergin (2006) and Sovacool (2011) who back the utilization of more aspects (Yergin, 2006; Sovacool, 2011). Narula and Reddy (2016) observe that the relevance and the extent to which every parameter is associated with energy security is distinct. So, in research one may find a great deal of inquiry-based on the index where investigators assigned a “numerical value” to “parameters” of energy security for appraisal of an energy structure in the face of numerous hazards (Narula and Reddy,2016).

In literature, the approaches to survey energy security are distinct as Ang, Choong and Ng. (2015) review diverse approaches to determine energy security based on the dimensions and writer's concern. Other factors include period and focus area including the significant dimensions. Indexes are constituted to encompass the required energy security dimensions. The process to compose "numerical indexes" differ according to the study (Ang, Choong and Ng, 2015). Besides the use of numerical indexes to evaluate energy security, semi-structured in-depth interviews can also be used as a design to evaluate energy security as Sovacool et al. (2011) embarked on the massive project to provide a comprehensive conceptual framework for energy security. For the study, 64 semi-structured research interviews have been conducted with presidents, vice presidents of utilities, chief economists at the BP, chief economists shell, secretary of energy U.S., to obtain data. The investigation also involved a survey with experts working in 15 countries at 35 institutions in Asia, Europe, and North. Results collected revealed that energy security for the participants consisted of five dimensions and these dimensions correlate with different components and metrics (Sovacool et al., 2011).

The dimensions included in the Sovacool et al. (2011) study has "availability" with its components like the security of supply, self-sufficiency, and diversification. Then "affordability" includes not just stability of prices but also access and equity issues as well as predictable prices. "Efficiency and innovation" were third that included aspects like research and energy intensity, safety and reliability (blackouts/accidents). "Environmental sustainability," as a dimension, was a comprehensive measurement including land use, water, pollution, climate change as energy security concerns. Finally, "Regulation and governance," served as the fifth dimension in which corruption, regulatory frameworks, the rule of law, exports and trades, subsidies, and information flows served as substantial components. The study took a year because obtaining data was hard. The scoring technique in the study was cross comparative and the results show very interestingly that no single country excels in all energy security areas. It suggests that sometimes energy security is a tricky business as elements in one direction are enhanced only by hurting elements in another dimension. The other thing the study argues is for a broad requirement of energy security as a discursive point; it is not just about supply and prices, which still dominates much literature. It is also about things like governance, pollution, water, innovation, and subsidies. All this matter could involve respondents list from an energy security perspective (Sovacool

et al., 2011). Correspondingly, Cox (2016) employed semi-structured in-depth interviews with the 25 UK energy sector professionals in his study of energy security. The selection of interviewees has been made on a purposive and snowball sampling basis as all the contributors know UK energy systems, energy security and the complexities of the energy system. Their selection is based on their distinctive role in policy processes (influence), through direct involvement or participation in research and consultations at various stages. Results expose that there are diversified and specific to context outlooks and understandings of energy security. So, the concept cannot be quantified in a small number of indexes (Cox, 2016).

Energy security is a tricky business, and there are multiple varying policy packages to accomplish this goal. Sovacool and Saunders (2014) while examining the energy security trade-offs, perceive proper operationalisation of some dimensions which need to be lined up and given more worth than the others. Investigators in the study have taken five energy security goals: self-sufficiency, affordability, universal access, mitigating climate change, and water. A water scenario has been exclusively included because energy systems are so intertwined with water. Shale gas, wind energy, solar require water while maintaining the proper functioning of these systems. The study observes the troubling aspect that the packages conflicted in terms of optimal approach as well as benefits and costs. An excellent example in this regard will be if the focus is put on self-sufficiency, which means using domestic resources which may be very expensive and unaffordable at times due to the cost to exploit them. Another one could be water and climate in which nuclear is a massive issue from a climate standpoint; it has minimal emissions across its life cycle compared to fossil fuels. From a water perspective, it is the most water-intensive source of electricity period. So the policy planners might see tough precarious tradeoffs that conflict and conflate energy security goals and the notion provided in this analysis is the trouble that no policy package achieves all dimensions of energy security and if one would like to find a country who possess all five energy security goals seems impossible with existing sources and technologies in the world (Sovacool and Saunders, 2014).

Brown et al. (2014) completed a principal component analysis and relation analysis of 22 industrialized countries for assessing forty years of energy security trends. Sovacool as a collaborator in this research employed the energy security index. The results of

the study exposed that the U.S. was low in terms of its energy security from 1970 to 2010. Outcomes also show from the least to most improved countries and would find the UK performing well, whereas countries like Turkey and Ireland were not performing very well. The countries have been clustered in this study with similar energy concerns so that they may band together towards addressing them. For example, the UK was put in the same cluster as Denmark and Norway, they have seen things like improved availability and efficiency but at the expense of affordability (Brown et al., 2014). There were specific gaps in these investigations as researchers were looking for the national energy security of different countries under observation but not technological energy security. Every energy system from a nuclear reactor to a smart meter has different energy security risks. There is nothing as such as risk-free or as environmentally benevolent sources of energy. Environmental risks are not only related to fossil fuels. It also exists for the low carbon sources like hydroelectric dams. There are also issues of emissions from reservoirs and forced the relocation of communities. There are risks of catastrophic failures that might risk human life. In Solar and wind, there are issues about toxicity with materials and mortality problems for wind turbines. Some issues need consideration such as excessive migration and backup, waste disposal, accidents, costs in terms of nuclear systems.

There is also a stream of literature focusing on discourses about energy security to find out its various dimensions, as Rafey and Sovacool (2011) found out while discussing energy security discourse not as an object but as a linguistic process in which framing and thinking shape the world view regarding energy security. They picked up a coal-fired project in South Africa that can be opposed or supported on energy security grounds. Energy security is such a malleable term; it is kind of whatever one wants it to be because the advocates who talk about the security of development and sustainability have added multiple aspects over time. As well as those who term it as an inequitable development and degradation both would use energy security frames. The socio-economic, cultural background of a person talking about the energy security issue has an impact on his description. Therefore, different voices are required to have an equitable point of view. Different narratives and representations of energy security circulate power or hegemony. Some people get marginalized and suffer losses. Even in low carbon transition, there are people around who become serious losers. Their voices count as evidence to obtain a holistic picture of the situation. It is fascinating to

note with this study of how energy security is constructed and deconstructed through different segments or groups of society (Rafey and Sovacool, 2011). So far in all these studies, diverse nations have been examined in terms of energy security. There is still a need for more work below the nation, the community like household security, fuel poverty, electricity access, clean cooking access, health issues, household air pollution. These factors still make energy security an interesting point of discussion in human life. Research on the subject proves energy security to be multidimensional as a topic. Supply and demand, import and export, security and insecurity, independence and interdependence, fossil and renewables all seem to be encapsulated in the notion of energy security. There is still a need for more dynamic as well as inclusive and holistic accounts of energy security elucidation.

A decade ago, much less was debated regarding energy and energy security. Current debates and analysis overdevelopment, global relations and internal security demand consideration to energy all treated energy security as a unique issue (Barton et al., 2004). Dannreuther (2010) points to the fact that energy security was treated as a limited subject as the discussions included the function of oil prices, the decision of OPEC, etc. Concepts like 'climate change,' 'gas weapon,' was voiced by radical groups like 'Green peace' and the Millennium Development Goals (MDGs) that did not address the concept of energy poverty. Further neglect of the energy security concept can be observed in literary works like 'International Security' journal, which is widely recognized and has merely printed eight articles over thirty years (Dannreuther, 2010). As discussed earlier that there is a lack of commonly accepted explanation of energy security and the special significance of energy in distinct contexts also affects the description of energy security, thus making it difficult to theorize (Sovacool, 2010). Florini and Sovacool (2009) while examining the idea of "global energy governance" point to the reason for significant change and development in the subject matter of energy and energy security opine that it is due to the development and finding of innovative energy encounters such as unstable prices, climate change, and energy poverty. This explanation of energy security led to a revival of investigation on energy policy and global energy governance as an innovative field in international policy studies (Florini and Sovacool, 2009). There are still limitations in global energy governance as a policy field as it does not entirely incorporate the study of global energy governance tiers. Secondly, it lacks

comprehension of international energy security concerns within the scope of the international relation's approach.

Energy and energy security, as an extraordinary policy field, is exceptional by its mere nature. As Goldthau and Sovacool (2012) in their discussion, signify Schumacher and Kirk (1977) who have termed energy as "the precondition of all commodities." They have termed energy as one of the "fundamental components of human existence" (Goldthau and Sovacool, 2012). As evident from the explanation energy interrelates with every single policy area, thus creating several factors and develops as the most complicated issue. A commodity-based approach will help comprehend the uniqueness of energy from an economic and a political approach as it is produced, traded and as well as consumed. Nonetheless, it is also a fundamental and strategic resource and provides a foundation for modern society, Politics, and institutions.

While analyzing energy from a political lens rather than economic, there appears to be a unique value of energy for all participants. Deficiency of the capability for appropriate energy use can prove to be lethal for a state, a company or an individual. Besides, sudden tariff fluctuations and stoppages in energy supply can lead to political and economic uncertainties which are like the fallouts of any armed clash. Primary and secondary forms of energy exporting countries rely on revenues for providing a level of public assistance like employment, health and also meeting their domestic demands of development, security, political stability (Friedman, 2006). Governments across the globe employ various tools to ensure the flow of oxygen (Energy) for their financial and public players. There are very high costs for the convenient operation of the energy market. Attainment of stable energy supply along with satisfying demand, is indeed a mammoth task.

The main trait of energy equated to other goods and services lies in its very character. As a commodity, private firms trade it on a regional and global market level based on the fuel type consumed by every sector and actor. This market suffers from many severe imbalances and fluctuations that require regulatory power. The intervention of the state crosses its limit which is required for the rectification of market failures owing to the strategic nature of energy. This involvement alters the process besides the formulation of market-based instruments and institutions. The significance of energy ultimately results in an intricate network of relations between private actors and states

mutually deciding domestic and international energy governance. Based on the structures, Lesage et al. (2010) submitted the explanation of "mega-issues" on energy, under which they comprehend the collaboration of multiple participants extending from the worldwide to an individual level. All contributors in this system have a substantial effect on the international energy system as a result of their way of life, finance choice and policies (Lesage et al., 2010).

Based on the discussion, state is presumed as the leading proponent of energy policy despite operating in the background and occasionally at the forefront. The threat of market failures in energy necessitates state intervention over energy policy issues, especially concerning security. The issue of energy also contains an evolutionary nature as it developed over some time with novel energy challenges. 21st Century witnessed several matters about energy. These encounters have evolved the landscape of energy considerably, enriching the significance of energy policy to an advanced level. Hoeven (2012) demarcated these contemporary demands and hazards counting monetary vagueness, climate change, access to energy, price hike, investments in the energy sector, excellent time of gas, power balance and global energy governance (Hoeven, 2012).

Energy security has its local as well as international dimensions. Therefore, energy producers and consumers encounter distinctive challenges. The demand side might meet more challenges as compared to the producers. Dubash and Florini (2011) have grouped these issues into three groups. The classification includes energy supply security, energy, and fuel poverty and environmental sustainability (Dubash and Florini, 2011). While going through various explanations of energy security, it becomes quite evident that it is highly context-dependent and dynamic. There is a growing emphasis on multiple dimensions in literature which has ultimately expanded the scope of energy security.

2.3. Different dimensions and their parameters to assess energy security

Energy security has been a vigorously considered field in current age. Established on sixty investigations, this dissertation presents thirteen different dimensions of energy security. These include aspects such as availability/affordability, location, technology and efficiency, military, environmental sustainability, literacy, diversity, policy,

cybersecurity, timeframe, reliance, health, culture, jobs, location, and their respective parameters. There have been developments in the energy security dimensions over time. Analysis of the studies reveal that the energy security notion has remained progressive as multiple new dimensions and their parameters emerged with the passage of time. Therefore, the energy security outlook has been broadened, with an observed and increasing significance on environmental, climate change and energy efficiency dimensions. As the concept is highly context dependent therefore, there is a considerable distinctness among energy security researchers in the way energy security indicators are constructed.

Based on the sixty studies, a particular state of art literature is listed in Table 1 below, revealing different dimensions and their parameters, the assessment endorses the belief that energy security is indeed a highly context-dependent concept.

Table 1- Literature Review of Energy Security Dimension

No	Authors	Availability	Diversity	Technology and efficiency	Location	Timeframe	Environment	Health	Culture	Literacy	Employment	Policy	Military	Cybersecurity
1.	Andrews (2005)	✓	✓	✓			✓	✓				✓	✓	
2.	Chalvatzis and Ioannidis (2017)	✓	✓									✓		
3.	Bazilian et al (2006)	✓	✓				✓				✓	✓		
4.	Kiriyama and Kajikawab (2014)	✓		✓	✓		✓	✓	✓		✓	✓	✓	
5.	Checchi, Behrens and Egenhofer (2009)	✓		✓			✓	✓				✓	✓	
6.	Wu (2014)	✓			✓		✓	✓				✓	✓	
7.	Shao et al (2017)	✓			✓	✓	✓					✓		
8.	Dadwal and Purushothaman (2017)	✓			✓	✓	✓				✓			
9.	Shaikh and Fan (2016)	✓	✓		✓			✓			✓	✓	✓	
10.	Leung (2011)	✓			✓		✓					✓	✓	
11.	Cao and Bluth (2013)	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	
12.	Baig (2017)	✓	✓	✓			✓		✓			✓	✓	✓
13.	Hussain et al (2014)	✓	✓	✓		✓	✓				✓	✓	✓	
14.	Zhang (2011)	✓			✓	✓						✓		
15.	Fang et al (2018)	✓					✓					✓		

16.	Li et al (2018)	✓	✓	✓	✓		✓	✓				✓	✓	

Table 1 (continued)

No	Authors	Availability	Diversity	Technology and efficiency	Location	Timeframe	Environment	Health	Culture	Literacy	Employment	Policy	Military	Cybersecurity
17.	Wu and Liu (2007)		✓	✓					✓			✓	✓	
18.	Grubb, Butler and Twomey (2006)	✓	✓	✓	✓	✓	✓					✓		
19.	Bahgat (2006)	✓	✓	✓		✓	✓		✓		✓	✓	✓	
20.	Intharak et al (2007)	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	
21.	Jamasb and Pollitt (2008)	✓	✓	✓	✓		✓					✓		
22.	Jansen and Seebregts (2010)	✓	✓			✓	✓				✓			
23.	Joode et al (2004)	✓	✓	✓		✓		✓	✓		✓	✓	✓	
24.	Joskow (2007)	✓	✓	✓	✓	✓	✓			✓		✓		
25.	Jun, Kim and Chang (2009)	✓	✓	✓		✓	✓				✓			
26.	Keppler (2007)	✓	✓	✓			✓		✓			✓	✓	
27.	Kruyt et al. (2009)	✓	✓	✓			✓							
28	Le Coq and Paltseva (2009)	✓	✓		✓	✓	✓		✓			✓		
29.	Lesbirel (2004)	✓	✓	✓		✓	✓	✓	✓			✓	✓	
30.	Lieb-Dóczy et al. (2003)	✓		✓		✓	✓		✓			✓		
31.	Mabro (2008).	✓	✓	✓	✓	✓		✓			✓		✓	
32.	McCarthy et al. (2007)	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓
33.	Mulder et al. (2007)	✓	✓	✓			✓		✓		✓	✓		
34.	Nuttall and Manz (2008)	✓	✓	✓		✓	✓		✓			✓	✓	
35.	Ölz et al (2007)	✓	✓	✓	✓		✓	✓	✓		✓	✓		
36.	Francés et al (2013)	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓
37.	Patterson (2008)	✓		✓		✓	✓		✓			✓		
38.	Rutherford et al (2007)	✓	✓	✓			✓		✓		✓	✓		
39.	Spanjer (2007)	✓	✓		✓	✓	✓				✓	✓		
40.	Turton (2006)	✓	✓	✓		✓	✓		✓			✓		
41.	Wright (2005)	✓	✓			✓	✓		✓		✓	✓		
42.	Chen et al (2015)	✓	✓	✓		✓	✓	✓	✓			✓		
43.	Chester (2010)	✓	✓	✓	✓	✓	✓				✓	✓		
44.	Lu et al (2014)	✓	✓	✓		✓	✓							

45.	Valentine (2011)	✓		✓		✓	✓	✓			✓	✓	✓	
46.	Augutis et al (2011)	✓	✓	✓		✓	✓							

Table 1 (continued)

No	Authors	Availability	Diversity	Technology and efficiency	Location	Timeframe	Environment	Health	Culture	Literacy	Employment	Policy	Military	Cybersecurity
47.	Narula (2014)	✓	✓	✓	✓	✓	✓	✓				✓		
48.	Zulfqar (2018)	✓	✓	✓		✓	✓		✓		✓	✓		
49.	Belyi (2003)	✓	✓	✓		✓	✓		✓			✓	✓	
50.	Ren and Sovacool (2014)	✓	✓	✓			✓				✓	✓	✓	
51.	Augutis et al., (2014)			✓		✓								
52.	Zeng et al (2017)	✓	✓	✓			✓				✓	✓		
53.	Baublys et al (2015)		✓	✓		✓	✓					✓	✓	
54.	Augutis et al (2017)	✓	✓	✓		✓	✓					✓		
55.	Valdés (2018)	✓	✓	✓		✓	✓					✓	✓	
56.	Kucharski and Unesaki (2015)		✓	✓	✓		✓	✓	✓			✓	✓	✓
57.	Månsson et al (2014)	✓	✓	✓		✓	✓							
58.	Bridge (2015)	✓	✓	✓		✓	✓	✓				✓	✓	✓
59.	Yao, Shi and Andrews-Speed (2018)	✓	✓	✓	✓	✓	✓		✓			✓	✓	
60.	Sovacool and Saunders (2014)	✓	✓	✓		✓	✓	✓				✓		

The widely held idea in the majority of studies relates to the security of supply/energy supply continuity or uninterrupted supply of energy. Apart from several vital ideas that are typically present, there is no widely accepted definition. Findings reveal that energy security is highly contextual and evolving. Moreover, energy security has also extended as a concept in its scope over the period. There are significant variances found among different studies in the way in which energy security dimensions are framed and constructed.

From the definitions discussed in these studies, the following thirteen major energy security themes or dimensions have been identified: availability, diversity, efficiency and technology, location, time, environment, health, culture, literacy, employment, policy, military, and cybersecurity. The treatment of these themes varies among

studies, and very few studies include all the thirteen dimensions. Overall, energy availability/affordability is recurrently discussed and examined in these investigations. In addition to this, energy security is also observed to be based on various circumstances and contexts. Some of the dimensions may be present with a few features or parameters in one study whereas the others may not consider it in their investigation.

These dimensions are based on multiple parameters like the presence of consumers, access to energy, and resources that constitute the dimension of availability. Availability is a crucial dimension of energy security. Many researchers (Andrews, 2005; Bazilian, O'Leary and Howley, 2006; Checchi, Behrens and Egenhofer, 2009; Zhang, 2011; Hussain et al.,2014; Shaikh and Fan, 2016; Dadwal and Purushothaman, 2017; Zulfqar, 2018) have included availability in their discussion of energy security as a noteworthy dimension. Availability mainly means the existence of resources. Therefore, availability is paramount to the enhancement of energy security. The parameters for energy include the availability of energy resources to meet the demand for energy. For the availability of more resources to meet the current needs, a diverse energy system is required as availability can help in the enhancement of energy security with the inclusion of renewable sources like wind, solar, biomass and hydropower which can turn the system more balanced and help in meeting the demands. The parameter of energy consumers (Public and industrial utilization of energy) entail the security of energy demand. It takes the perspective of producers of energy for whom energy security means ensuring existing as well as an exploration of potential markets. As the need and requirement of energy are growing over time at both the public and industrial level, consequently consumers require more energy. Then the parameter of energy resources existence (gas or oil) and the required resources for transformation into services for the public good (pipelines and other energy infrastructure) are also substantial for availability. For the development of any society, energy access has prime significance and with it, a country can develop further, therefore, enhancing energy security. Additionally, availability is also linked with diversity from geopolitical aspects like in case of destabilized governments, sudden wars that result in energy supply disruptions and for sustainable availability and supply of energy; therefore, diversification (supply sources) holds great importance to further national energy security.

For energy security enhancement the dimension of diversity has been repeatedly discussed in works (Belyi, 2003; Turton, 2006; Pascual and Elkind, 2010; Sovacool and Saunders, 2014; Bridge, 2015; Shaikh and Fan, 2016; Zeng et al., 2017; Azzuni and Breyer, 2018). Abdo and Kouhy's (2016) assessment exposes more diverse energy systems as additionally secure (Abdo and Kouhy, 2016). There are alternatives in a diverse energy arrangement that can replace it in case of any breakdown or failures. For example, an energy system with the inclusion of renewable energy technologies will make it more secure. As in the developing world, the issue of energy blackouts can be significantly reduced with the help of diversifying energy sources especially with the addition of renewables in the state energy mix. The parameters for diversity dimension include sources variety, utilization of different fuels, multiple technologies usage, advanced transportation systems and consumers.

The promotion of technology has a great connection with energy security development as it is a prerequisite for effective energy utilization in the modern world. Thus, many researchers (Dresselhaus and Thomas, 2001; Yergin, 2006; Cao and Bluth, 2013; Kiriyama and Kajikawab, 2014; Zhang et al., 2016; Zeng et al., 2017; Proskuryakova, 2018) advocate the employment of technology in the energy sector. With novel technological solutions, energy security can be affected in many ways, like better energy production, output and sustainability. Besides, technology enhances energy systems efficiency and productivity as well as lowering the cost. The utilization of smart technologies and energy saving devices can significantly help in energy conservation.

Moreover, technology helps in the transportation of energy by providing useful data regarding line losses (if any), and the introduction of smart grid technologies help in lowering the power supply costs. Technology also helps energy distribution through off-grid solutions and the provision of battery storage technologies to store additional energy. Consequently, the inclusion of new technological advancement helps in the provision of new sources of energy thus increasing energy security. Angheluţă, Badea and Gole. (2018) opine that technology has dramatically helped in the digitalization of energy systems around the globe which has intensely helped in the advancement of the productivity, accessibility, safety and sustainability (Angheluţă, Badea and Gole, 2018). In the developed world, the use of smart technology in-home energy systems

also increases the efficiency and also helps in responding to the climate change as well as providing reliable and affordable energy services (Darby, 2018). The technological dimension is also based on the parameters of the promotion of new technology through research and development.

Location as another significant dimension of energy security deals with the geographical features of the power systems. As energy systems, according to its nature, are scattered around multiple geographical sites in the world, ranging from national to local (rural to urban) and from a single country to the international level. Accordingly, the dimension of location also entails multiple considerations for energy security development (Chester, 2010; Sovacool and Brown, 2010; Hossain et al., 2016). The distance of the energy location will affect cost and time factors. It has affected the energy security of many countries as they need to import energy resources from multiple locations like the Middle East, Russia, Venezuela.

Likewise, in terms of location density factors also have an impact on energy security. Denser (centralized) systems are believed to be more efficient as the energy is controlled from a central point whereas decentralized systems often suffer obstructions and disruptions as there is no central authority to control them. So, location of a centralized energy system certainly helps in the energy security enhancement. The parameter of land use is also significant in the current discussions related to the location of energy systems as they have impacts on environment, CO2 emissions, issues related to the extinction of the natural environment. Most nations rely on energy resource-rich countries to ensure their energy security. In today's globalized world, energy producers need to access consumers to guarantee continuous demand for their production. Consumers, therefore, are becoming even more challenging parameters as producers need to obtain access to that distributed group in different regions. The distance between energy sources and users intensifies liabilities for energy security. It is, therefore, the requirement to bridge this gap of demand and supply. For sustenance of energy security, energy-intense industries should be relocated to other countries as they are exposed to energy supply disruptions for being concentrated in one geographical region. Lastly, geography as a parameter of a location has influenced over energy security. China's CPEC project in Pakistan is an effort to diversify its energy supplies due to energy supply disruption threats and challenges that presently

pass through the Strait of Malacca. So, finding alternative routes of supply is crucial for the energy security of China.

Time is a crucial factor in deciding different policy options and decisions in an energy arrangement. It is an essential dimension for energy policymakers while planning and estimating short term or long-term goals related to energy security decisions (Martchamadol and Kumar, 2013; Balitskiy, Bilan and Strielkowski, 2014; Ang, Choong and Ng, 2015). Energy systems evolve, and decisions taken today related to energy will have future implications. Sovacool (2011) outlined three parameters for an energy system time frame including looking ahead, the time required by an occurance to create an effect and time of impact. The time frame also relates to the period required for the completion of an energy project. Length of an activity and its effects (overall impact) has multiple implications from financial to socio-political. There are timelines for energy projects and keeping track of development helps in better planning and forecast. Besides, the length of time also affects resources, cost and overall energy systems.

The environment plays a very important in any energy system. As most of the energy sources are extracted from the earth so this exploitation has severe consequences for the overall atmosphere. The environmental dimension of energy security has global implications; therefore, it is central to energy security understanding and enrichment (Vera and Langlois, 2007; Brown and Dworkin, 2010; Sovacool, 2010; Winzer, 2012; Yao et al., 2014; Valdés, 2018). Human energy ambitions can bring disasters to the ecological system thus affecting animals and plants as well as resulting in pollution through unclean methods of extraction. With the rapid exploration of energy resources, there are severe threats to food, water and climate security. The threats to the environment are diverse from human health to the life of different marine species. Pursuits of energy resources and efforts for ensuring energy security has affected not only the environment but also human health. Good health ensures healthy energy systems as the energy workers with better health can perform well and efficiently. Furthermore, the effects of good health will result in more productivity of the energy systems. Healthy consumers of energy utilize energy more effectively thus contributing to the energy security development (Broinowski, 2014).

Human concern for a better environment relates to human health. The pursuit of energy security also has severe consequences for people's health. Public health can also have disturbing effects on energy security. Therefore, the dimension of health is substantial in energy security improvement (Pachauri, 2010; Sovacool et al., 2011; Cherp and Jewell, 2014; Laldjebaev et al., 2018). There are effects on the health of people working in the energy exploration industry. Bad health of energy professionals will affect their performance thus reducing energy security. Moreover, the use of contaminated fuel has harmful emissions which may cause life-threating diseases. Human health issues at the national and international levels are mostly due to prevalent energy systems. As the nuclear disaster in Japan has risked millions of people and coal-based emissions result in diseases such as cancer. Energy systems have their relative effects on human life, natural habitat and animals (Ite and Ibok, 2013).

Many studies view culture as another significant aspect to ensure energy security. Energy security can also be enhanced with an overall conducive culture of people's participation. As an example, energy production and consumption can be controlled with an understanding and cultivating a culture of conservation which can save much power to be utilized by the other sectors (Intharak et al., 2007; Joon, Chandra and Bhattacharya, 2009; Kiriyama and Kajikawab, 2014; Matsumoto et al., 2018). The cultural dimension is related to public participation in energy systems. Uncertainty of an energy system has socio-cultural character; therefore, cultural effects of energy security can be observed at the production, transfer and consumption stages of an energy system. Production is necessitated due to the requirements of a society which may have negative impacts on the health or environment thus resulting in energy security reduction (Garmendia and Stagl, 2010).

As a dimension of energy security, literacy means attainment of knowledge and having access to information related to energy issues (Joskow, 2005; Intharak et al., 2007; McCarthy et al., 2007; Sovacool and Mukherjee, 2011). Out of concern for energy security, people should know their energy system so that they can play a decisive role in its development. Therefore, having access to information and knowledge (energy literacy) is an indispensable parameter of the "literacy" dimension to augment energy security. There is a considerable role provided to the quality of information as with a high quality of information regarding their energy system; public awareness will help

in the enhancement of energy security. Moreover, only information will not be enough; therefore, a collaboration of the public and private sectors can enhance the quality of information with the help of structured educational programs for necessary information and training which can positively impact masses (Brounen, Kok and Quigley, 2013; DeWaters and Powers, 2011; Lee et al., 2015).

Energy investment, technology advancement, energy efficiency, and provision of employment is receiving topmost priority for governments around the world (Sovacool, and Mukherjee, 2011). Therefore, employment and energy security has a two-way connection. Less secure energy systems observe higher rates of unemployment. Energy security declines with the rising energy prices thus resulting in a reduction in wages and unemployment (Löschel et al., 2010; Chester, 2010). Energy disruptions in many countries of Africa have led to the closure of industries thus raising the levels of unemployment (Mensah, 2018).

For enhanced energy security, a better policy always proves to be crucial. The energy security of a country is closely linked with the interest of its political elite (Lakić, 2013). Energy politics determines human survival as policy choices are taken under certain conditions, but the main objective of these policy outcomes remains in the attainment of energy security (Bang, 2010). Therefore, the policy has been considered as an integral dimension of energy security by numerous researchers (Hussain et al., 2014; Shaikh and Fan, 2016; Chalvatzis and Ioannidis, 2017; Yao, Shi and Andrews-Speed, 2018). The political system's stability or instability of the political system serves as a parameter of the dimension of policy. The political system (democracy or dictatorship) of a country determines how decisions are made. The political system of a country not only affects the energy security aspects at the local level but also at the international front through energy diplomacy. There are many facets of the policy dimension including regulations (liberalized and controlled markets), energy trade rules, subsidies (if any), overall governance structure, transparency and corruption. The policy dimension is inclusive in the sense that it takes stock of all aspects of the political spectrum of a country from domestic, regional to international relations.

The military is amongst one of the biggest consumers of energy. The military serves as an essential dimension of energy security from multiple angles. The need and role of the military is essential for safeguarding national energy systems and exercise of

power to attain particular objectives (Farrell et al., 2004). Energy and military have a crucial relationship which is based on multiple parameters. To protect a nation's energy system and increase its energy security a functional military is necessary and requires much energy. Therefore, many energy resources are utilized for military purposes as for powering tanks, use of fuel in air jets and nuclear weapons. Besides this due to heavy use of energy for military purposes, the issues of carbon footprints increase are also arising which is being tackled with multiple policy interventions to use alternative energy technologies. Energy can be used as a weapon in conflicts to attain specific objectives. The military also serves as an effective measure to counter terrorist activities against energy supplies and infrastructure. The use of military has extra costs and there are environmental concerns as well, but their role cannot be ignored in the geopolitical realities and global risks (Downs, 2004; Moran and Russel, 2009).

Cybersecurity is not a widely used dimension in the evaluated studies. Still, its significance can never be ignored in the present age of technological development. As a critical dimension of energy security, cybersecurity has been emphasized by research scholars (Francés et al., 2013; Bridge, 2015; Baig, 2017) in energy systems for the advancement of energy security. Onyeji, Bazilian and Bronk (2014) observe an increase in the number of sophisticated cyber-attacks on companies providing critical energy infrastructures and it carries serious security implications (Onyeji, Bazilian and Bronk, 2014). In order to attain efficiency, the energy systems across the globe rely on digital support. In the modern and technological world, energy digitization is essential for enrichment of energy security and it is incomplete without cybersecurity. As energy systems are based on a highly sophisticated type of structure that must be secure, the role of cybersecurity can never be ignored (Kagermann, 2015). Effective cybersecurity of a nation’s energy system has direct consequences for energy security. Through digital programs, all processes from production, provision of connections to consumptions can be effectively controlled. Ignoring the cyber dimension of energy security can result in huge economic losses. Through cybersecurity connectivity of energy systems across the country can be attained with the help of digital programming. It facilitates data collection. Attainment of information technology skills helps in proper maintenance as well as making the vital national energy systems secure against the cyber-attacks (Nussbaum et al., 2016).

After exploring these sixty studies, this proved to be an exploratory dive into the concept of energy security. This thesis followed the definition of energy security along with its multiple dimensions and parameters through a literature review as summarized in Table 1 above. While pursuing definitions and dimensions of energy security, there has been a recurrence of some definitions and their dimensions. Moreover, observation reveals that some new dimensions are added with time and development like cybersecurity. Nevertheless, the literature also led us to the point that there is still no commonly agreed definition of energy security. Therefore, this thesis will be an effort to adding to the discursive concept of Energy security with an in-depth analysis of Pakistan's energy sector which can be applied in future studies.

The survey of the literature shows the existence of significant variations among studies in the construction of energy security dimensions; this thesis proposes an energy security analysis framework based on the evaluation of multiple energy security dimensions extracted from literature. These dimensions are based on specific parameters extracted from sixty selected studies discussing energy security definitions and aspects. This framework will be useful for evaluating Pakistan's energy security in the context of its national vision 2025 as the parameters capture multiple dimensions of energy security including the economic, energy supply chain, and environment.

The fallouts show that energy security is a long context-dependent term and varies according to the context. Further analysis shows that energy security dimensions are also interrelated. The proposed framework allows quick identification of deficiencies within Pakistan's energy security mentality and its vision 2025. This framework is particularly suitable in the Pakistani case, where there is a marked gap in the area of energy security research with minimal available literature. Moreover, it will pave the way for having an in-depth understanding of the energy mentality at the policy level and present some policy recommendations for the country to improve its energy security which is eminently reliant on expensive energy imports to meet energy requirements. The framework of analysis for the study is shown below:

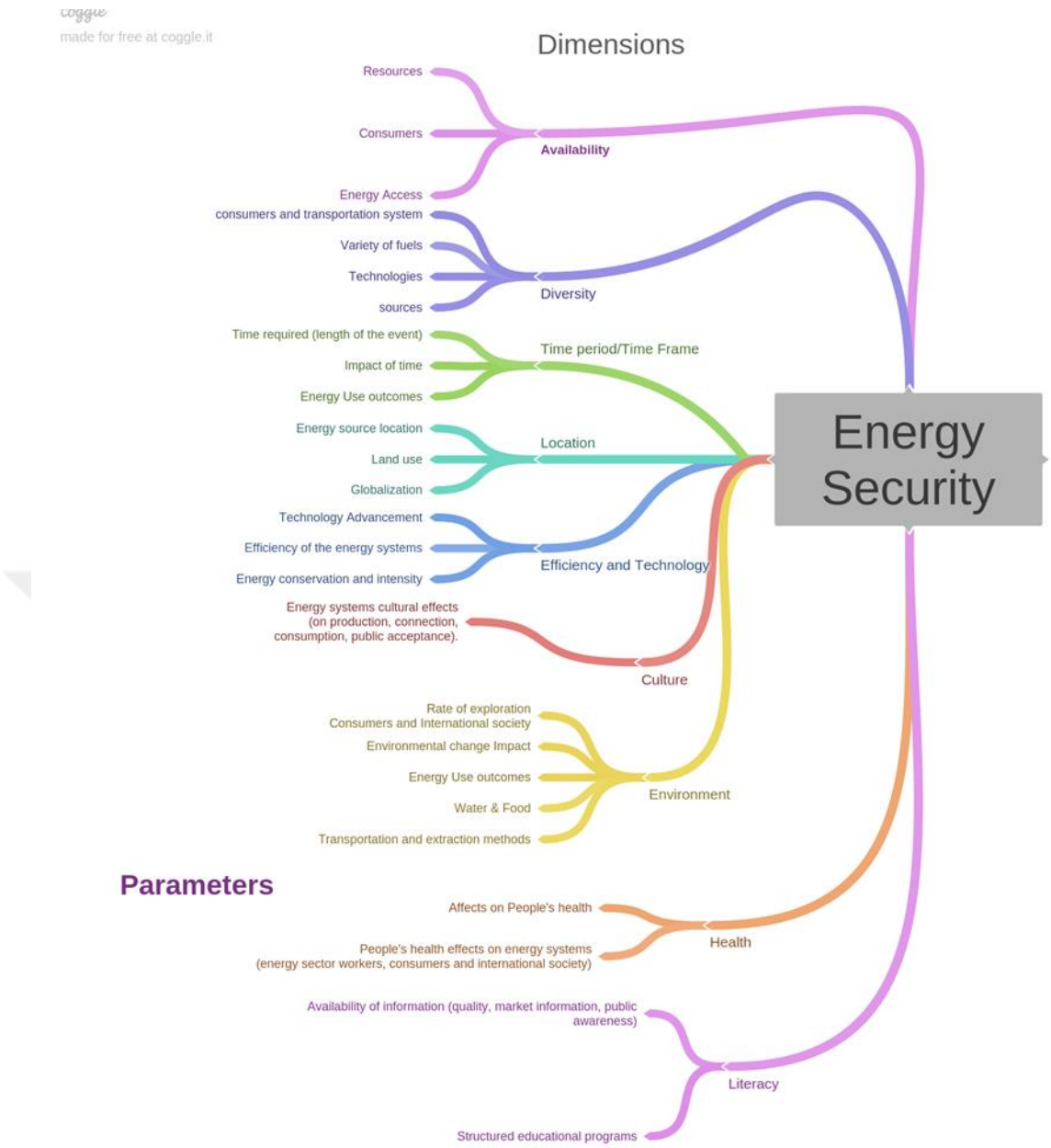


Figure 2-Framework of Analysis

Defining energy security seems to be a great challenge, as Chester (2010) approached energy security as 'polysemic' and 'slippery' based on its capability to encompass various dimensions concurrently (Chester, 2010). The historical discussion on energy security has demonstrated that it incorporates multiple dimensions. The same fact is pointed out by Kruyt et al. (2009) who perceives the majority of current literature on energy security investigating the concept with the help of dimensions (Kruyt et al., 2009). There are some scholars like Cherp and Jewell (2011) who criticize this classification based on dimensions for being non-transparent, methodically unjustified, and inconsistent (Cherp and Jewell, 2011). Phdungsilp (2015) while

assessing Thailand's energy security performance, thinks that energy security should not be too specific and additional indexes do not assure an improved evaluation thus disapproving the practice of utilizing many parameters (Phdungsilp, 2015).

However, Yergin (2006) approves the addition of either dimension and their parameters that incorporate any connection to energy security (Yergin, 2006). Classical energy security studies (Deese, 1979; Yergin, 1988) noticeably highlighted availability and affordability as two significant dimensions. The International Energy Agency (IEA) also acknowledges three elements in energy security, namely affordability and competing for supply, continuous and consistent supply, and supply accessibility. Additionally, physical availability, pipe-based import reliance, power system security, and market power, has been proposed by IEA as energy security measurement tools (Chester, 2010). Chester (2009) addressed four dimensions of energy security (accessibility, affordability adequacy, and sustainability) in her article while representing the idea of energy security as "multi-dimensional" and "slippery" (Chester, 2009)." Hughes (2012) proposed three indexes (availability, affordability, and acceptability) for analysis and description of energy security. Von Hippel et al. (2011) recommended six dimensions including military, social-cultural, environmental, economic, technological, and energy supply security (Von Hippel et al., 2011).

Costantini et al. (2007) discern dimensions such as economic, social, environmental, physical, also counting short and long-term aspects from the IEA explanation (Costantini et al., 2007). It is imperative to understand the notion of energy security which holds great significance to set a goal of enhanced energy security of a country. Current scholarship on the subject does not delineate the idea plainly with no mutual consensus (Bohi and Toman, 1993; Checchi, Behrens and Egenhofer, 2009; Krugt et al., 2009; Löschel et al., 2010; Narula and Reddy, 2015; Kucharski and Unesaki, 2015). Review of mainstream literature affirms that definitions are highly context-dependent and encompass multiple meaning (Nye, 1981; Sovacool, 2010; Dannreuther, 2010; L, 2010; Valentine, 2011; Augutis et al., 2011; D et al., 2011; Narula, 2014; Lu 2014; Jonsson, 2015; Chen, Chang and Sun, 2015). The subject matter in these definitions is accessed with multiple interpretations and from distinctive angles. Therefore, scholars have attempted to describe the term as vague,

abstract, ambiguous and obscure (A, 2009; A, 2010; L, 2010; Sovacool, 2011; K. and Reddy, 2016).

Historical investigation of energy security traceback the concept to "as old as fire." For protection, heating and cooking people had to attain a basis of fire like wood, which met individual requirements at that time (Karkanas et al., 2007). With the development of human civilization and growth of social system over time, new energy materials and novel methods of transportation were embraced thus making the issue of energy security more intricate. The requirement for energy security remained there from the very start of human civilization through recorded definitions of energy security is comparatively new (Valentine, 2011).

Majority of the analyzed studies entail the idea of 'security of supply,' or 'energy supply continuity,' or 'uninterrupted supply of energy,' (Bohi and Toman, 1993; Andrews, 2005; Grubb, Butler and Twomey, 2006; O'Leary et al., 2007; Hoogeveen and Perlot, 2007; Creti and Fabra, 2007; Checchi, Behrens and Egenhofer, 2009; Jansen and Seebregts, 2010; Findlater and Noël, 2010). Energy availability remains the most crucial factor in most definitions. Additionally, supply security stands as one part of the energy security perception. The approach to energy security is an emerging thought so new dimensions are also added with the passage of time and development.

The U.S. Chamber of Commerce study (2010) indicates four dimensions of energy security. These dimensions comprise the environment (carbon intensity of the system of energy), reliability (suitability and consistency of energy structure), and geopolitics (importing energy from fragile states). The study by Alhajji (2007) on energy security made a distinction amongst six dimensions (environment, social, foreign policy, economic, and technical security) (Alhajji, 2007). Sovacool and Mukherjee (2011) have deliberated five dimensions of energy security (availability, affordability, technology development, sustainability, and regulation) which are further divided into twenty elements (Sovacool and Mukherjee, 2011). Sovacool (2011) refers to twenty dimensions of energy security including governance, availability, literacy, dependency, diversification, access, decentralization, innovation, investment, trade, production, price stability, affordability, reliability, resilience, land use, water, pollution, efficiency, and greenhouse gas (GHG) emissions (Sovacool, 2011).

Winzer (2012) observes that the pursuit of explaining energy security has diversified with time owing to emerging challenges in the field of energy policy. Energy security will be defined differently in different contexts, following their energy situation setting and exposure to supply interruptions. Every country varies in its approach to energy security as well as in addressing energy security objectives and challenges (Winzer, 2012). Radovanović et al. (2017) uphold the idea further in their inquiry by indicating to the fact that while assessing the energy security, an exclusive methodology can not be developed owing to the distinctiveness of energy resources in different countries. Diverse energy resources in different countries vary in its climate conditions, demography, geopolitical positioning, economic growth, type and intensity at different points of development and other strategic priorities, which depend on the historical, social and socio-political circumstances (Radovanović et al., 2017). There are evolving and developing interpretations of energy security in the contemporary world according to upcoming developments. For a better understanding of energy security, multiple dimensions discussed by different scholars can help in developing a viable framework to understand and analyze the idea of energy security.

Over the years, many research centers and academics are actively occupied with expanding new dimensions of energy security. As an instance, the Asia Pacific Energy Research Centre (APERC) represented affordability, availability, accessibility and environmental acceptability as four dimensions of energy security (APERC, 2007). The research endeavor by APERC grew further with some more dimensions added by Von Hippel et al. (2011) counting military, socio-cultural, environment, technology, economy and energy supply security (Von Hippel et al., 2011). Sovacool and Marilyn (2010) represented energy concerning the environment, economic and energy efficiency, affordability and availability (Sovacool and Marilyn, 2010). Proceeding this study Sovacool and Mukherjee (2011) inserted technological advancement and efficiency, Social and environmental sustainability, governance, and regulations along with affordability and availability (Sovacool and Mukherjee, 2011).

The chapter has offered an inherently limited assessment of the theoretical literature on the concept of “security.” There has been selective focus on the useful literature for addressing the research questions of the study. Additionally, attention has also been paid to understand how energy security is instituted in a particular context, with an

evident focus on the character of "security" in this procedure. This inquiry has developed an understanding of "security" as a variable idea, both in terms of value and meaning, further asserting in appreciation of a "contextualized" and logical approach to comprehend my case in this study. In a way, this effort addresses the security scholarship proposal to move beyond generalized hypothesis and contemporary ideas regarding the notion of security to a more distinctive, based on reflexivity and context-based investigation of the ethics and politics of security.

This chapter also collects literature on current IR approaches to energy security and how they have evolved. It then involves "contextual analyses" of security constructions leading to "desecuritization" of the concept to include more dimensions over time and then developing an energy security evaluation mechanism with the help of multiple energy security dimensions and their parameters which can be applied in a particular context. As a contributor to the broader critical studies on security, this dissertation also explores how mainstream energy security studies rely on a very traditional security logic based on "military and use of force." This traditional handling of the notion of energy security suggests that this comprehension of the concept of "security" is not only inadequate and deficient according to the new developments but also responsible for creating a sense of insecurity for nations, people and their overall surroundings. Based on this debate, the concept of security is taken further to feature the challenged and variable nature of security and to practice more reassuring possibilities in the concept.

The literature review affairms energy security as an emerging concept in international relations debate and requires critical investigation to ascertain its meaning in different contexts. As an evolving notion the debates on the subject show greater emphasis laid on the environmental dimension which is even more highlighted. Moreover, with the extensive rise in the demand and use of energy the concerns for climate change are emerging which are quite visible in the discussions on energy security. Due to the extensive use of fossil fuels for power generation there are multiple risks to environment and climate change has emerged as an important issue. Concerns for environment and climate change has led the researchers on energy security to look for answers to mitigate these risks. Renewable energy is observed to be an answer to all such challenges. Renewable energies are obtained from inexhaustible natural sources

which are clean and helpful in generating clean electricity (power) without contributing to climate change and negative effects on the overall environment. The development of clean energy technologies is vital for coping climate change and environmental concerns. Based on these findings in literature it has led to the formulation of the empirical questions of the inquiry related to the position of renewable energy in the contemporary energy security mentality of Pakistan with its particular focus on the national Vision 2025. Other sub research questions include the exploration of the nation vision 2025 appropriateness for contemporary energy security assessments. As well as evaluating the vision's suitability for the country. Furthermore, presenting certain policy recommendations based on the evaluation of the vision 2025.

Formulation of these questions will help to understand the suitability of renewables for the context of Pakistan. As well as the appropriateness of RE technologies for the energy security enhancement of the country. The nation is observing transformation of the national energy system. There are multiple efforts done to develop political consensus in the country and integration of national energy policies to achieve the targets. The government of Pakistan has taken various initiatives to encourage foreign direct investment (FDI) in the energy sector of the country. Therefore, the study will systematically bring forth the national energy planning of the government. The following chapter will provide details of the implemented research design and methods used in this procedure of enquiry.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Research Design

This study relies on interpretive research design. In international relations, studies have been conducted utilizing interpretive methods as adopted in other similar disciplines like sociology, history, and anthropology. The goal of taking these methods is to comprehend social realms from the perspective of participants and to gain comprehensive information which is more descriptive (Reshetnikov and Kurowska, 2017). Interpretive research design helps in understanding individuals or people's experience of the world. It is more about in-depth knowledge. In that case, data tend to be more qualitative, not quantitative. While being orderly, this method does not pursue the hypothesis testing model that chases to find general outcomes as done in the scientific method. Instead, in an interpretive framework, it is occasionally denoted as an "interpretive perspective," which aims to recognize social worlds from the participant's perspective leading to in-depth facts (Schwartz-Shea and Yanow, 2013; Yanow and Schwartz-Shea, 2015). Therefore in interpretive research design, the researcher has no concern with hypothesis testing and empiricist causality.

The focus in the interpretive method is on "reflexivity, lucidity, and exposure," concerning options adopted throughout the research development (Salter and Mutlu, 2013). Reflexivity necessities the acknowledgment of the position of the investigator in the procedure of exploration as both "researcher and situational participant" while performing the interpretation of data (Salter and Mutlu, 2013). The primary aim of reflexivity is to have a full understanding of the researcher, the researched and the research context as the position(ality) of the researcher affects unquestioned assumptions, access, and how others correlate with the phenomenality (Rose, 1997).

The necessity for this research endeavor is to examine the conception of energy security and its application in a specific analytical situation. Evaluation of the current works problematizes the concept of energy security by accepting its significance and meaning. It fails to question energy security as an issue and the definition of "security" in written and spoken language in the context of energy. The focus of this study is on finding the depiction of energy security and the way it is implemented, briefly the

manner in which it is created, and its performance in this procedure. Succeeding these goals, the main research question of my study is:

(1) How does the energy security concept evolve in contemporary IR debate? (Theoretical)
(2) What is the role of renewable energy in the contemporary energy security mentality of Pakistan? (Empirical)

The focus on the link between energy and security has driven the quest for the preceding sub-questions:

(2. a) Does vision 2025 clearly address the need for contemporary energy security assessments?

(2. b) Is it the right vision for Pakistan? (2.c) What could be the policy recommendations based on the evaluation of the vision 2025?

The empirical focus on a single country, the Islamic Republic of Pakistan contributes to a case study-based research design. The case study can combine any number of qualitative and quantitative traditions and techniques to meet the specific needs of the research. Case studies are perhaps the most flexible methodology able to burn/merge the influential culture into research design (Abbott, 1992). Research design based on a case study analysis best suited this research project as it seeks to appraise the energy security mentality and role of renewable energy for energy security enhancement in Pakistan, as it will enable the investigation into an understanding of energy security construction in a certain case as well as to develop an in-depth and analytically rich investigation, which has not been explored and analyzed in this manner. As well as to validate or disprove specific debate regarding Pakistan's energy sector and foreign policy. Due to the enormity of the area, an interpretive approach is adopted that facilitates the exploration of the phenomenon under consideration. Case studies will also provide a short descriptive pattern of a specific case.

Consequently, it is amongst the most frequently used research methodologies, particularly for applied research. Qualitative data is typically obtained from sources such as interviews, focus groups, observation of real-life settings, and existing documents. One study may include one, several, or all of these sources. For example,

a researcher studying an energy use behavior might observe the users' daily routines as they wake up, go to the workplace and so on. A researcher to understand the phenomena might interview the energy users individually or as a part of a small group about what they were thinking and feeling while manifesting a particular behavior. The researcher may also examine documents such as yearly energy consumption reports to paint a holistic picture of the overall energy consumption behavior.

The procedure of research purposed in this inquiry incorporates discursive analysis of primary and secondary records to accomplish understanding in the field of energy security. There is a varied scholarship on the concept of energy security in different contexts. To provide an additional measure to this research, and to add in some existing knowledge and understanding, fifteen in-depth semi-structured interviews were conducted to obtain maximum awareness and understanding of Pakistan's energy security mentality from a cross-section of the society including leading experts in the area of Pakistan energy, foreign policy, and energy security.

The curiosity in this project is based on analyzing constructions of energy as a security issue and how this concept has evolved in the contemporary debate into different dimensions and their parameters. Besides this effort has been done to explain the meaning of security for energy, which led to the empirical inquiry on the Islamic Republic of Pakistan, as the fifth most populous country in the world and amongst one of the top energy consumers in the South Asian region (Abbas et al., 2018). The country is also amongst the significant gas and oil-importing countries globally (EIA, 2017), making it a particular case of energy (in) security concerns.

In research, design selections are made for choosing the discourses to be analyzed or for discursive analysis (Hansen, 2013). Therefore, for this research endeavor, specific contextual and historical details were indispensable to create an understanding of the discourse and policy, thus becoming the starting point. This included a brief overview of the energy scenario of the country as well as the history of energy consumption and production and energy policy-making. In terms of primary material for the study, the starting focus was official discourse, as it has the most impact on policy choices. However, official discourse is produced in several places in the particular case of the study, where different governmental organizations are working on multiple aspects of energy policy and security. Therefore, the main focus remained on power policies

developed by different administrations in the country and the national vision 2025, where the primary target was energy security.

The following section will present the qualitative research methods employed in the thesis: Discourse analysis, case study, and in-depth interviews.

3.2. Research Methods

3.2.1. Data Collection

There are different types of data collection, like interviews, focus groups, observation, document review, audio, and visual materials. Following the development of a clear research design which enabled me to prepare for my data collection. The main data collection techniques employed in this research study included literature reviews discussing the evolutionary nature and definitions of energy security. Moreover, fifteen semi-structured in-depth interview from multiple stakeholders of the Pakistan's energy sector. As majority of the participants were from the leading energy sector governmental organization in Pakistan, therefore I have also observed them and their surroundings during the interviews. I have also conducted some group discussions which helped me to have better grasp of the country's energy system and governance structures.Furthermore, a number of options were considered while collecting data. A starting point and clear instructions were provided for the investigation. The following section first describes the choices made for examining the required sources for the study. Additionally, there is a concise review of the cultural differences and contexts that affected the data collection process of the study. It then outlines the procedure of data collection in primary, and secondary sources.

For the thesis, primary, and secondary sources have been utilized. For primary sources, I have read some notes of the people who served in certain policy making processess in the main energy player organizations like the Ministry of energy, Planning commission, WAPDA, NTDC, and AEDB. As secondary source I have reviewed the relevant literature to the topic of study in which sixty studies have been identified. Through which thirteen dimensions of energy security based on their parameters have been selected. These selected dimensions are then applied to the Pakistani case to understand the existing energy security mentality of the country. For obtaining an in-depth insight into the energy security of Pakistan multiple virtual sources

(websites/webpages) have been searched to obtain relevant information such as power policy documents, and Pakistan's national Vision 2025 official document draft. The web pages of Pakistan Water and Power Development Authority (WAPDA), Ministry of Energy, power division (MoE), Pakistan Council of Renewable Energy Technologies (PCRET), Alternative Energy Development Board (AEDB), China-Pakistan Economic Corridor (CPEC), energy update Pakistan, BP data, World Bank, International Energy Agency (IEA) and Pakistan Atomic Energy Commission (PAEC) were instrumental during the research.

The secondary sources helped to identify major players in integrating and enforcing Pakistani energy policy. These sources were also helpful to comprehend elements constituting the country's energy mix, energy institutional framework, and policies. All these data sources were helpful to obtain a comprehensive insight into the significant practices and formation of Pakistan's energy policy. A considerable section of the study also deals with the energy story of Pakistan. It entails the evolution of the energy sector and strategies over the period and the country's energy diplomacy initiatives with other countries, and how this affects Pakistan's quest for energy security. This approach is termed as historicism and can be summed up in the ideas of origin and a particular context.

Keeping in view the evolutionary nature of energy security as a field of study and availability of short writings to date on Pakistan, the study will adopt analytical interpretation by connecting Pakistani energy security landscape with regional as well as international scenarios. Where required, an appropriate inductive analysis will also be applied, for instance, while interpreting the Pakistani foreign and energy policy. The examination usually practiced in this research study is deductive, and it is employed to evaluate relevant papers, data and other publications on the issue. There are still restraints and vitality of the applied thoughts at work. I have tried to utilize appropriate logic at a suitable argument keeping in view the limits implicitly related to the type of idea.

3.2.1.1. In-depth Interviews

As a qualitative research method, an in-depth interview (IDI) is an extended discussion with one or more people. Sovacool (2012) has justified the use of semi-structured interviews as a suitable tool as they empower the investigator with direct

communication with the participant as compared to other sources for the required facts. Typically it is open-ended, and it allows the interviewer to be flexible and adapt to what people tell and the questions can be changed in order to get more information from people as the conversation evolves (Sovacool, 2012). Usually, the investigators utilize in-depth interviews for exploratory questions. They want to understand something there for which there are not any theoretical explanations. So, in this case, an "explanatory question" is a question to get general information about the issue under investigation. It can be explanatory and the researcher may do some survey research, some analysis that may give a clue about the process that is going on in a particular situation but in-depth interviews, more information is provided about the questions that one wants an answer for.

For in-depth interviews, it is important to be very clear about what is the total sample? What is the total population you need to sample from? And then select interviewees on characteristics that need to be representative. It could be gender, race, and educational level or age, any of the various criteria that one would do for sampling for a survey. This can be a part of in-depth interviews. At the same time, in-depth interviews can be instrumental and do not need to be representative of the population. This might be an exploratory study that one is not sure of which criteria is important so, therefore, the first round of inquiry for the research is to do in-depth interviews to get an idea for instance, what this population of interest looks like in a case. So it can be an actual goal of the research and the IDIs can do so to achieve it. While representation could be a consideration for the research, it is not the necessary component of the research and does not make it less valid and reliable. If the consideration is for representation, then it does not apply.

An IDI that is repeated with, for instance, student attitude, one might do it with one group of the population. The protocol will be the times of questions asked, would be asked to the same question with each person. So that extensively, the interview information that one gets from each individual is treated in the same manner. One, student another student, then the next one. There is another type of in-depth interview where one is less concerned about representation and it is called a "key informant interview." So in the same kind of research agenda in terms of achievements instead of doing a correctly represented sampling, one may get students of various educational

levels, socio-economic backgrounds, racial and gender identities this kind of a thing. One might think instead of doing interviews with a particular group, choose individual faculty members, administrators, people who have view of student achievement, who might have been there for ten-fifteen years, who might have an idea of what is happening at the structural level and to this extent the content of this interview can be weighed equally with that of one student or even necessarily with one faculty member. The perspectives may differ from the roles that one might have in the organization. A key informant interview is conducted with individuals who have qualitatively different levels of understanding and position concerning the research question. So, they might have power with respect to the question. They might longer view concerning the research question. The researcher need not be necessarily concerned with research questions about how many key informants are required. The key informant by definition is one person who has a personal understanding of the research question.

In order to implement In-depth (IDI) well, it is required to have most of the conservation adequately. The first thing is to prepare extensively, to write down the questions, make sure the timing and order, make sense such that the respondents get comfortable before starting to get to the need of the questions to be asked. At the same time, there should be a balance between the questions like whether and how their family is doing and how their health is? Open-ended questions to let the respondents feel comfortable. Running out of time can also be a problem and one can not get what is expected to be a response. There should be a balance between the order and timing of the questions and how one could get to the questions that matter the most in the research. If the research is not regarding personal things, one gets faster to the point. This will also depend on the agenda of the research. So, the interviewer needs to prepare in the manner that one should not be reading while interviewing. The best interview is that draws off one's topic and on a piece of paper with a checklist along with a series of questions. Many questions with bullet points can distract the conversation because at the end of the day, the content of the interview becomes the data to be analyzed. Recording devices can be useful as they enable one not to write anything while having a conversation as it becomes very distracting.

The in-depth interviews (IDIs) in the ongoing investigation aim to examine Pakistan’s potential of achieving its vision 2025 goals in terms of energy security. The interviews

were carefully prepared and organized with fourteen questions to obtain detailed information from the participants. The questions posed in these in-depth interviews try to understand the perception of managers/policy-makers/officers/individuals related to ten goals identified concerning guaranteeing uninterrupted access to affordable and clean energy for all sections of the Pakistani population in vision 2025. It was a mammoth task to obtain access to senior-level and mid-career officers and policymakers at the Ministry of Planning, development and Reforms, Ministry of water and power, Pakistan Water and power development authority (WAPDA), Alternative Energy Development Board (AEDB) as I have to travel to different cities to meet them at the available hours. In the academic circle, academics from PAK-US Center for energy and public policy institutes at COMSATS and Riphah International University Islamabad have been engaged for the research interviews. A federal government female Social Activist, female renewable energy expert, and mentor at WIRE-women in renewable energy and head of the business desk in a big media group in Pakistan were also among the participants. Accordingly, the outcome of these interviews has provided me with comprehensive information, data which helped me to draw policy ready recommendations about the successful implementation of vision 2025 goals in terms of energy security.

I moved to different locations to conduct these meetings at the participant's convenience and available time. The in-depth interviews had a semi-structured format that took between one to two hours from the participants and this time often extended with a few participants in an informal discussion to gain more comprehensive knowledge and understanding of the energy system and governance structure. Participation in this research was entirely voluntary. The interviewees were assured that their information will not be shared with anyone outside. The information collected from this research will be kept private. Any information about the respondent will have some number or any other identifier on it instead of their name or true identity. In order to conduct this in-depth interview activity in Pakistan, proper permission was sought out from the Research Ethics Committee of the Izmir University of Economics. After which the researcher proceeded with the interview procedure. All participants were provided with the information sheet regarding the activity and they all were supposed to sign a consent form with their details to which

they were assured of complete confidentiality. They all signed the consent forms and after that, they were interviewed by the researcher.

This research work took place over six months as I had to travel to Islamabad, Rawalpindi, Peshawar, Ghazi Brotha Hydel Power project, Tarbela Dam project (T-4 extension) to access different people for their interviews and inputs. The respondent's experience as managers/policymakers/officers/individuals contributed to the understanding and knowledge related to Pakistan's vision 2025 goals in terms of energy security and their likelihood of being successfully achieved. The in-depth-Interviews were later transcribed and then the energy security dimensional analysis was carried out to understand energy security conceptualization in terms of national vision 2025.

3.2.2. Discourse Analysis

Discourse analysis is a qualitative and interpretive method of analyzing texts in contrast to content analysis where interpretations are based on both the details of the material itself and on contextual knowledge (Shanthi et al., 2017). Discourse analysis facilitates the analysis of how discursive realities are formed within a particular discourse (Fairclough, 1992). Discourses contribute to the creation of social positions, as well as relations between people and, of specific relevance to this study, of International Relations debate and beliefs across the world. Thus discourses do not just represent mere reality, but also indicate the real world.

Critical Discourse Analysis (CDA) stands as a political approach to discourse analysis. CDA asserts the practices that generate meaning in different contexts. Moreover, it is a field that is involved with learning and examining both written and spoken texts to unveil the discursive sources of dominance, inequality, bias and power (Wodak and Meyer, 2015). This approach also evaluates the reproduction of these discursive sources within specific social, political and historical contexts and their maintenance. Particularly, Critical Discourse Analysis (CDA) as recommended by Fairclough (1992), facilitates the examination of language as necessary in the formation of discursive reality (Fairclough,1992). The purpose of CDA is to make clear the relations between discourse and social practices, social structures, and making the linkages that might be unclear to the ordinary person.

The role of language, ideas, and power is often examined with discursive methodologies in different disciplines and social sciences stand as no exception to it (Feindt and Oels, 2005). Many researchers in energy policy are adopting discursive approaches to analyze and make sense of evolving energy systems and the related discourses through which change is given meaning (Scrase and Ockwell, 2010). This shift can also be observed in the current research on energy policy and transition, where discursive methods are increasingly applied. As through these methods the existing and future policy constructions can easily be identified and emphasized, they are quite helpful in the investigation of politics, institutional change and perceptions of technologies in different contexts (Späth, 2012; Genus, 2014; Åberg, Höffken and Lidström, 2018; Isoaho and Karhunmaa, 2019).

For this research, sixty studies over different periods underwent critical discourse analysis to observe the discursive construction of the concept of energy security and how the concept evolved to include multiple dimensions and parameters to assess the notion. Evaluation of both manifest contents, besides latent content in the studies, helped in getting the dimensions. After doing so, these dimensions are tabulated based on their relative parameters such as the dimension "Availability" with its settings of resources in a particular context, consumers who would utilize the energy, means of transport (access) to import it for the use also includes the cost incurred on it to transport it. The dimension of "Diversity" has the parameters of the diversity of sources, fuel types also including energy carriers, also means that includes technologies and transportation to explore and take it to the required destination and consumers leading from household to commercial users. Then the dimension of technology and efficiency entails the promotion of new technology advancement, as well as energy system efficiency, energy intensity, literacy, and awareness regarding energy conservation practices. Location as an essential aspect of energy security which included energy systems boundaries, location of energy sources, density factor (centralized/decentralized), land use, globalization, population settlement and distribution (in case of energy projects like hydro projects or others require resettlement of people), geography (difficulties of terrain), and industrial intensity as its potent parameters. The timeframe of energy projects is also a significant area of energy security which covers the timeline of the plans because it affects multiple things from cost to resources.

The length of the event has effects on the overall energy system of a country for which there are definite struggles and the impacts have socio-economic outcomes. The environment as a dimension of energy security has gained great popularity in the academic debates on energy security. The exploration rate in a country has impacts on the resources as well as on the overall environment and cost. Location can have severe consequences for the environment as for energy projects like hydro there are serious climate issues as well as the issue of scarcity of water which is plaguing the South Asian region, there are parameters related to the methods of extraction and transportation as well as outcomes from energy use. The impact resulting from environmental change has a substantial cost for the whole world and its relationship to water can not be ignored for human existence. Then cultural effect on the energy system on its production, connection, consumption, cultural acceptance of a particular energy system. Energy conditions are shaping the cultural aspects of a country. In terms of the policy, there are concerns for the political system prevalent in a country (democracy/dictatorship). Nature, the stability of a political system includes the issues of citizen's will and the internal and external relationship of the country (energy diplomacy). There are Regulations (liberalized and controlled market, rules, and subsidies). It also counts the governance structure of the country (whether people are following the rules (transparency) or some countries follow the rules selectively or not following the rules (corruption).

Then these explored dimensions, along with their relevant parameters, were applied to the in-depth interview conducted from a cross-section of Pakistani society to understand their perceptions of energy security following the national vision 2025 of Pakistan. The fifteen semi-structured in-depth interviews were fully transcribed, constitute the primary sources of empirical data used in this thesis. Through the lens of CDA, these interviews have been examined and other documentary evidence (mainly government policy documents from 1994 onwards) to understand the discursive construction of energy security and understanding the similarities and differences in the theoretical and empirical assessments of energy security. The sample chosen for the study includes fifteen people from different walks of life, ranging from relevant ministries, energy institutions, academia as well as journalists.

3.2.3. Case Study Method

Investigation of particular energy sectors in the country was also done as a component of focusing on some of the research questions. This endeavor reveals various requirements encountered by the state, counting transparency, revising the industry, and dubious policies. All these dilemmas have a political aspect and addressing them will implicate some very ambitious choices. A compelling and appropriate instrument that has integrated an in-depth examination of the accessible papers and comprehensive interviewing relevant people involves the case study method.

Case studies delineate "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence" (Robson, 1993). This explanation contains terms like "particular contemporary phenomenon," mainly refering to one often, but it is not the case; it might be several units, matters in a case study. It is not always one case study; sometimes, it is one but can be several. The contemporary phenomenon, that significantly contains the idea of an event, which is a general term that means something is going on, and that phenomenon can be a person and often is a person, but it can be a lot of other things too, lots of other social aspects, like organizations or events or places. So, some elements, something happening or somebody undertaking something or some group of people doing something and of course it is contemporary, it is happening now, one is studying it currently. It is not a historical approach. Real-life context is another crucial point about case studies is the contextualized aspect of it. The researchers are doing in their context. The most prominent contrast there is with experiments where you tend to do tests in the lab. One tends to bring the people in, one's research institution, university tend to bring people in for the inspection in the office or some similar room to work on him/her. In the case of case studies, it is very much a case of going out to wherever the phenomenon is, wherever the people are, wherever the event is happening, wherever the institution is. The researcher has to go out there and study it in the context. In its context also entails to bring into account the contextual factors the facts that they use people or operating in the broader world with things going on, something happening, they are affecting other items and so on. So, all these relationships are part of the context. A case study uses multiple sources of evidence for interpretation and explanation of a specific phenomenon. It is most

common in the qualitative field approaches such as interviews, particular observations, ethnography, and it can be other sources too. The major one used in the case study includes documents so if you are going into an organization, you will typically talk to people, observe them, doing things and collect the materials they are keeping about the activities in the organization. So, work in commercial organizations like a factory, or an office is a typical case study approach one may choose on-site to accomplish the task. In the case study method, information is gathered by talking to the employees and collecting the data about their activities, minutes of meetings and other guidance documents that they use and of course, to observe them while they are working.

A case study can either be descriptive, explanatory, or explanatory. Most research strategies can center around like surveys: they tend to be illustrative, but they can exploratory and can be explaining. The same is true of case studies; they are probably most well known for an exploratory approach in which one is exploring an area. The reason for choosing a case study or any other kind of such a technique is to know about a particular area of research in detail. A questionnaire can not be designed unless it is not known what questions are supposed to be asked. In the case studies, one can go in almost knowing nothing about what is going on in a specific example, ask questions, and observe. So, it is a very open technique; it an explorative approach to collect data. It can also be descriptive, as one writes about what he/she sees there describing the situation. It can be explanatory, in the sense that one begins to understand why things are happening and therefore can explain them. It might not be as powerful as an experiment, as they are probably the most potent way of making judgments about causation and giving explanations for things but certain case studies can do that as well. Case studies can help one understand why people do certain things? What motivates them? How do they explain what they are doing? What type of preceding activities they do in terms of ideas and therefore, one may tell what is going on in a particular situation.

The current study employed a case study method on Pakistan's Energy Sector. The country was among the first countries to endorse the global Sustainable Development Goals 2030 agenda, and in 2016, the parliament approved them as a national development agenda. The adoption of SDGs by the government of Pakistan also connected the country with the United Nations Framework Convention on Climate

Change (UNFCCC). Pakistan participated in the Conference of Parties (COP-21), Paris, France, where Intended Nationally Determined Contributions (INDCs) for curtailing fossil-fuel carbon emissions from the economic processes were submitted by each country (Climate change, 2015). These all realities make the country as a great case study for the development of renewable energy (RET) technologies in the south Asian region.

The Government of Pakistan developed a National Action Plan (NAP) on Sustainable Development Goal 12 (SDG12), which is Sustainable Consumption and Production (SCP). Sustainable consumption and production (SCP) aim at the promotion of resource and energy efficiency, sustainable infrastructure, and providing access to essential services, green and decent jobs and a better quality of life across the country. SDG targets are closely aligned with the SCP goals as it also focuses on the increase in the share of Renewable energy in the energy mix (GoP, 2017).

The Government of Pakistan is actively pursuing the use of Renewable Energy Technologies in its energy policies to enhance energy security (PES, 2016-17). After independence in 1947, Pakistan became a fast-developing economy, and the need and requirement for energy have increased, It is now the sixth most populous (197 million) country in the world, as well as the fastest-urbanizing South Asian nation (Kugelman, 2015). Along with its rapid population growth, Pakistan's energy consumption has also increasingly risen to a level of 80.9 Mtoe in 2017 (BP, 2017). Production of overall electricity in Pakistan was 108408(GWh) till 2016-17 (PES, 2016-17). The percentage of energy sharing resources by fossil fuel and renewable energy technologies is as follows: Pakistan mainly depends on gas and oil for power generation. (BP, 2018). According to a survey by the government of Pakistan, the role of fossil fuel remains the highest to produce electricity from 2003 to 2017 in the form of oil and gas i.e., 64% resource consumption. The share hydropower plants for power production are 30% and nuclear power plants contribute only 6% (PES, 2016-17).

So brief case studies of the country's Hydro Power, Solar Photo Voltaic (PV), Biomass, Wind power plants, and Geothermal Energy in Pakistan, along with the small discussion on energy poverty in the country.

As with all research projects, this study also has many limitations. Owing to the time considerations, resource limits, as well as social and political impediments, the research has more observable emphasis on official discourse over the broader energy policy debate in the country. Due to multiple stake holders in the energy system of the country there are at a time certain differences over the connotations of energy security, though less so over the solutions of the problem.

In order to fix the complexity of the situation in the country some marginal political discourses have been selected to show the contestation of dominant constructions of energy security. The analysis of marginalized discourses has helped in taking a start, being a representative argumentation rather than the whole of contentious discourses around the issue of energy. This study has separated energy from other traditional notions of security, including economic and foreign policy issues, of which it is a substantial factor. The current investigation lays its focus on prevailing understanding of energy security in the relevant scholarship and based on the findings a framework of analysis is developed to assess the energy security mentality of Pakistan in the framework of the national vision 2025. Semi-structured in-depth interviews have been used for the assessment of the prevailing common sense and understanding of energy security in the country. The preceding chapter will concentrate on the energy policy of the country.

CHAPTER 4: ENERGY POLICY OF PAKISTAN

This chapter discusses energy policy in Pakistan. Section 4.1 offers an overview of the energy policymaking and national energy policy documents implemented from time to time. Section 4.2 discusses the energy profile of the country, followed by 4.3 delineating brief policy analysis of the power policies in force. The section on 4.4 and 4.5 debate energy poverty and energy justice, respectively.

4.1. Energy Policymaking in Pakistan

Energy policy is characterized as guidelines and set of ideas proposed for the regulation of the energy sector of a country (Kassim and Menon, 1996). There are specific objectives set in a country's energy policy. These goals entail a variety of aspirations, such as regulation of the energy sector, oversee the current and future energy balance, steps to ensure an undisrupted supply of energy, and propose ideal sources for power generation. Energy policies typically manifest goals, visions, and plans required to accomplish specified ideas (Trutnevyte et al., 2011; Trutnevyte, 2014; Strengers and Nicholls, 2017; Longhurst and Chilvers, 2019). There are numeral aspects that may impact the energy policy direction of a country, future visions, energy security concerns, resource availability, environmental considerations, international agreements and matters related to approved sustainability designs (Chapman and Itaoka, 2018). There are several factors for the policy choices adopted in energy policy. Enhancement of energy security is the foremost and a significant aspect in the creation of energy policies for every nation (Kiriyama and Kajikawa, 2014). As an instance in a country like Pakistan with a richness of hydro resources, the central idea of the nation's energy policy could be to produce energy from cheap hydro sources to enhance energy security. As it will be visible in the subsequent discussion on the different power policies in the country. Whereas, in a nation's energy mix which is heavily influenced by conventional hydrocarbons as in the Pakistani case, the aim may be to decrease dependence on imported and expensive hydrocarbons thus most of the power policies focus is on the development of locally available and cheap renewables, nuclear power or other suitable substitutes. Moreover, there are challenges regarding adoption of nuclear power due to the sensitively of the Public and its potential adverse effects may result in phasing it out with other available alternatives.

As previously discussed, “energy security” is not itself a “policy” but rather a term denoting a wider set of policy goals. These policy targets are often manifested in policy papers, declarations as well as speeches of different leaders. However, for the current investigation, ‘energy security policy’ will be employed for explaining the policies aimed at energy security advancement.

Like other nations, Pakistan is also a member of international treaties such as the “United Nation Framework Convention on Climate Change (UNFCC),” and the “COP21 Paris agreement” which obliges her to formulate national energy policies in line with these global parameters (Salik, 2017; Khalil et al., 2019; Gadiwala and Burke, 2019). There are certain institutional and political factors involved in the energy policy-making procedure of the country which often complicates the process due to the inclusion of multiple stakeholders. This will be discussed in more detail later in this section.

Since its independence in 1947, Pakistan has witnessed several developments in its policy formulation process at different levels. In the present setup, the federal government, along with provisional governments and other institutional units, are in charge of devising feasible policies in the country. According to Bashir (2013) there are political institutions, judicial institutions, civil and military bureaucracy, international monetary organizations and foreign regimes who are considered to be the most significant players in the public policymaking process in the country (Bashir, 2013). Like all policies in the country, the advancement of an energy policy also necessitates appropriate legislation, strategies for energy conservation, global energy agreements, incentives and subsidies to the potential investors.

For a developing nation like Pakistan, an effective energy policy is fundamental to inclusive development. For an extended period, there was not a single energy policy document in the country; there were somewhat different energy subject wise separate sub-policies. The country witnessed its first energy policy in 1994. There are also various policy documents at a time, including environmental policy, Renewable energy policy, energy conservation and efficiency policy, and power policy (Ali, 2012). The following Table 1 shows the details of different national energy policy documents implemented across sectors and jurisdictions in Pakistan from time to time.

Table 2- National energy security policies documents implemented across sectors and jurisdictions in Pakistan (Source: International Energy Agency (IEA) Policies database, 2019).

Name of the policy	Year	Status
Pakistan net metering policy for solar PV and wind projects	2015	In Force
Minimum Energy Performance Standard (MEPS) For Window Type & Split Air Conditioners With Cooling Capacity under: 14000 W (12000 - 48000 BTU/hr)	2014	In Force
Pakistan feed-in tariff for solar power	2014	In Force
Upfront Generation Tariff for Solar PV Power Plants	2014	In Force
Framework for Power Cogeneration 2013 Bagasse and Biomass	2013	In Force
Alternative and Renewable Energy Policy, 2011 (Medium term policy)	2011	In Force
Building Code of Pakistan Energy Provisions (2011)	2011	In Force
Scheme for Financing Renewable Projects - soft loans	2009	In Force
Policy Recommendations for Use of Biodiesel as an Alternative Fuel	2008	In Force
Alternative and Renewable Energy Policy, 2006 (Short term policy)	2006	Ended
Alternative Energy Development Board	2003	In Force
Building Energy Code of Pakistan (1990)	1990	In Force

Pakistan's energy sector power planning has implications for almost all sectors of the economy. The policy-makers have been remarkably skillful in pronouncing the overall objectives for energy policies within a national development context. The problem is not what the policy objectives are but how they can be realised. There is a need to integrate all these policies into a single policy document, and the deliberation on the issue is ongoing. Presently, there is no single energy policy document due to a lack of coordination between different stakeholders in the country. Pakistan neither has a shortage of policies nor structure of energy sector organizations that embrace several units each with their distinct but linked functions and area of supervision, as shown in Table 2 above and Table 3 below.

Table 3- Main energy sector players in Pakistan (Source: Institute for Energy Economics and Financial Analysis, 2018)

Energy Sector Organizations	**Operation area/function**
• Planning Commission (Energy Wing) • Ministry of Water & Power (Power Division) + Ministry of Petroleum and Natural Resources = on 4 August 2017 renamed as **Ministry of Energy (Power Division)** • Ministry of Water & Power presently renamed as **Ministry of Water Resources** • National Electric Power Regulatory Authority (NEPRA) • Oil and Gas Regulatory Authority (OGRA) • Pakistan Nuclear Regulatory Authority (PNRA)	Coordination on Policy Formulation, legislation, and regulations, Policy formulation and Implementation, Development of natural resources of energy and minerals, regulations
• Oil and Gas Regulatory Authority (OGRA) • Oil and Gas Development Company Limited (OGDCL) • Pakistan Petroleum Limited (PPL) • Pakistan State Oil (PSO) • Private multinationals	Production and Distribution of Oil & Gas
• Water and Power Development Authority (WAPDA) • Pakistan Electric Power Company (PEPCO) • Generation Companies (GENCOS) • Pakistan Atomic Energy Commission (PAEC) • National Transmission and Distribution Company (NTDC) • Distribution Companies (DISCOS)	Production, transmission and Distribution of Electricity
• National Energy Conservation Centre (ENERCON) • Various Academic Institutes • Alternative Energy Development Board (AEDB) • Pakistan Council for Renewable Energy Technologies (PCRET)	Research & Development (R&D)

As a federal-state, Pakistan has a constitutional arrangement between the federation and provinces to resolve all matters including energy under the 18th constitutional amendment. In the present legal and governance structure, the responsibility of policy formulation is delegated to the provincial governments under the 18th amendment and fiscal decentralization through National Finance Commission (NFC) award (Jabeen et al., 2016). Now the federation and provinces develop consensus through the Council of Common Interest (CCI). The Council works under the Ministry of Inter-Provincial Coordination and reports to both houses of Parliament, the Senate and the National Assembly (NA). In the present arrangement, the center is a facilitator as far as energy

ventures between the federation and provinces. Ministry of Energy also provides a suitable mechanism for the energy initiatives of the regions. CCI is the consultative forum for any outstanding issues between the center and provinces (IPC, 2012). As per the constitution, CCI should meet after 90 days but in practice, it does not frequently hold meetings. This lack of frequency of meetings has caused misperceptions and misunderstanding among the stakeholders. CCI functions on the principle of consensus; therefore, there is a need to have a more frequent and regular meeting for the vital cause of energy.

Pakistan is an energy deficient country trying to come out of the energy crisis. The energy issues facing the country entail multiple challenges such as dearth of integrated energy planning and demand forecasting seriously worsening the gap between energy supply and demand (Mirjat et al., 2017; Zafar et al., 2018; Rehman et al., 2019). More recently, after the 18th Constitutional Amendment and fiscal decentralization through National Finance Commission (NFC) award, the responsibility of policy formulation has been delegated to the provincial governments who work in coordination with the federal government to make decisions. Specific problems are emerging in this mechanism as being new such as issues of circular debt, amount of cash shortfall within Central Power Purchasing Agency (CPPA) that it is unable to pay to power supply companies. Moreover, there is a severe issue of imbalanced energy mix at the national level, and with heavy dependence on gas, oil (72% imported) has become a considerable burden on the economy (WWEA, 2017). There is also a massive task ahead for the energy planners to utilize enormous locally available sources of Thar coal, solar, wind, and hydro. Alongside these problems, there are also heavy losses to transmission /distribution networks, theft and inadequate revenue collection by the distribution companies (DISCOs).

The story of energy sector in the country is interesting as the country after its independence faced numerous challenges, and energy remained one of the important ones. Till the growth of the transport and industrial sectors in the country, the energy sector has been led by the electricity system and it was the energy sector mainly. The Pakistan Water and Power Development Authority (WAPDA) was established in 1958 as an autonomous and statutory body mainly for the supervision of the country's water resources as the economy agricultural-based at that time. Since its inception, the

authority strived to make many small to large dams and other reservoir projects along with electricity generation (Kessides, 2013). On the other side due to low prices in the past, fossil fuels mainly oil was utilized for electricity generation whereas most of the energy policy plans and documents in the country have recognized the benefits of utilizing renewable sources like water/hydro for electricity generation, but minimal substantive actions have been taken for their effective utilization in the energy mix (Farooq and Kumar, 2013).

Due to all these factors, there was no concept of integrated energy planning in the country until the rapid growth of other sectors of the economy due to the rapid urbanization in the 1980s. Pakistan Water and Power Development Authority (WAPDA) remained the largest autonomous organization in the country until the 1990s reforms. WAPDA received a considerable amount of international support in the technical capacity building and financing of the various mega projects like Tarbela and Mangla Dams. Various studies on power system planning were conducted to supplement the regular five years of plans by different governments during this period (Solangi et al., 2019). Until 1994, no energy policy was formally announced by any government in Pakistan. The power and energy policies announced at that time were deficient, inconsistent, faced implementation challenges and lacked an integrated energy planning approach utilizing energy modeling tools.

4.2. Energy Profile of Pakistan

A federal parliamentary republic in South Asia, Pakistan consists of four provinces, the Islamabad Capital Territory (ICT), the disputed Kashmir region-Azad Jammu Kashmir (AJK), along with a group of federally and provincially administered tribal regions (Badshah and Timoshenko, 2019). Under the mainstreaming policy, the tribal areas have been merged into Khyber Pakhtunkhwa (KP) province (Shah and Areas, 2018). The country is ethnically and linguistically diverse with 201 Million people and ranks as the sixth most populous nation globally. Out of entire people, 39.5 percent of the Pakistani population resides in urban areas. The over-all area of the country is 796,096 km2 (World Bank 2010-14). As compared to the population growth of the country, energy consumption has also significantly increased to a level of 80.9 Million Tonnes of Oil Equivalent (Mtoe) in 2017 to 85.0 Mtoe in 2018. Pakistan is heavily dependent on imported natural gas (44%) and oil (28%) (BP, 2018). This import levies

huge burdens to its already crumbling economy, which is currently facing the dual challenge of an increasing annual fuel import bill and climate change. According to reports the oil import bill for 2017–18 was $13 billion (Hussain, 2018).

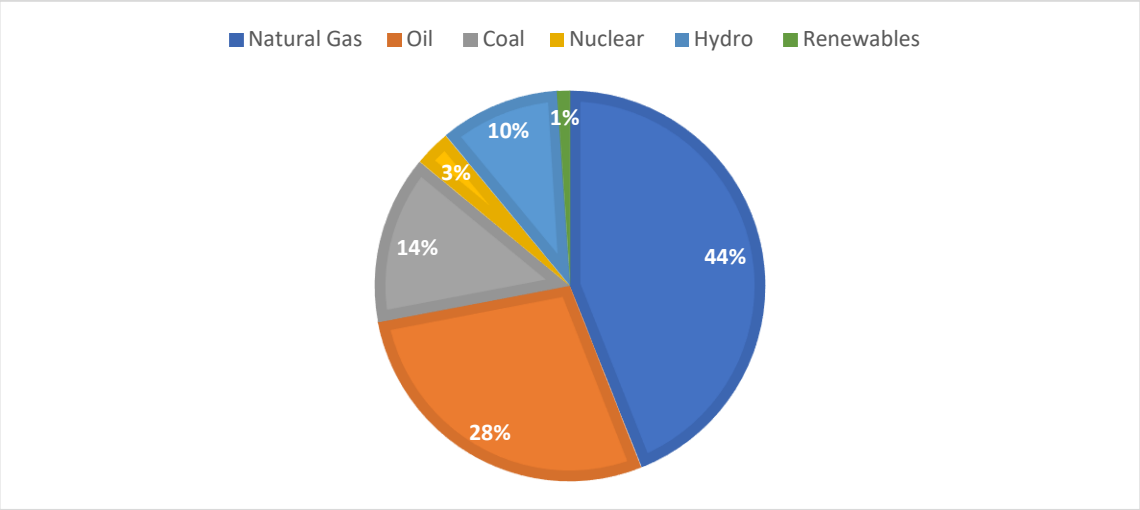


Figure 3-Primary energy consumption of Pakistan 2018

(Source: BP, 2019)

The primary energy consumption in the national energy mix of the country is heavily focused on fossil fuels. Based on data. Natural gas accounts for 44%, oil 28%, coal 14%, hydro 10%, nuclear 3% and renewables 1% of the primary energy consumption of the country's energy mix (BP, 2019). It is evident from the statistics that despite abundant renewable reserves in the country, its overall share in the total primary energy mix is remarkably low.

Source wise installed generation capacity in the existing power system of Pakistan is estimated to be around 61% of the national electricity is generated with thermal sources. Whereas, as shown in the figure 4 below, the share of hydro 29% and wind, solar, bagasse, and nuclear input is 3%, 1%, 1% and 4% respectively in the power system (NTDC, 2019). China Pakistan Economic Corridor (CPEC) energy projects have also contributed to the power sector development of Pakistan by launching numerous energy projects across the country. These projects will help the country to uplift its generation capacity, improvement of transmission and distribution infrastructure, and provision of finance for new energy projects (Zubedi et al., 2018).

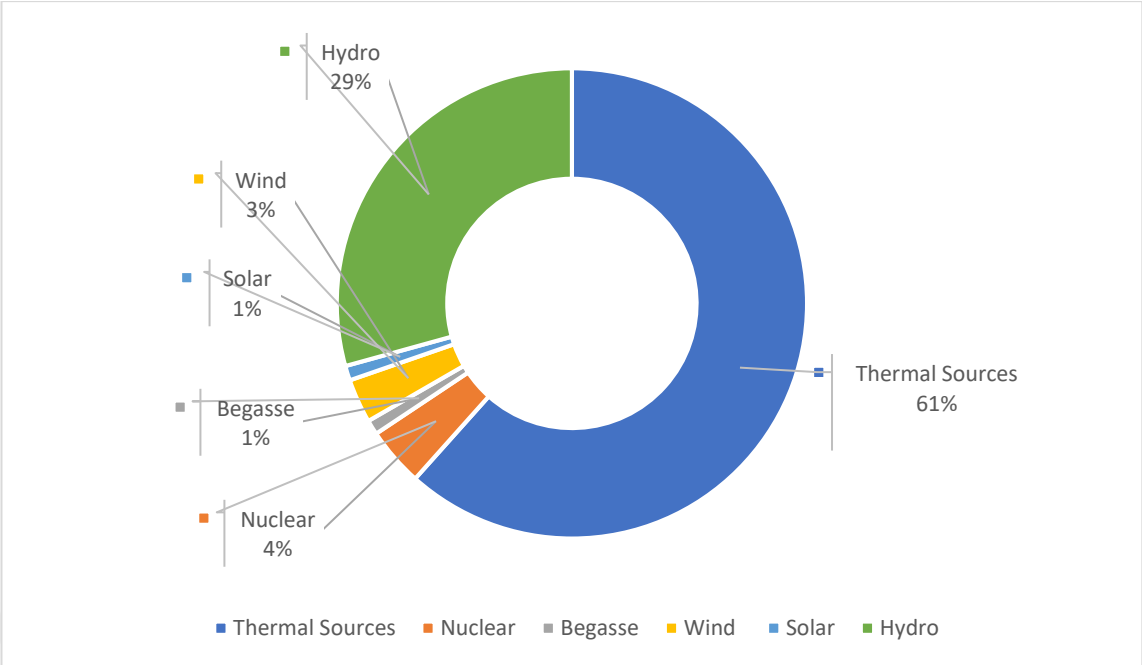


Figure 4-Source wise installed capacity percentage share in the existing power capacity of Pakistan (Source: NEPRA, 2019)

Moreover, the country also faces serious challenges to use existing energy resources efficiently and productively (Wakeel et al., 2016). National measures are imperative to ensure the implementation of a coherent energy planning and conservation program together with the improvement of infrastructure, systematic lacunas and all other related issues as well as discrepancies arising from the 18th Amendment to the constitution. The government's efforts to attract investment in power generation could get unfulfilled if some of these problems are not addressed adequately.

4.3. Pakistan Energy Subsectors

The core energy consumption sectors of Pakistan comprise commercial, domestic, thermal power generation, industrial, agricultural, transport, and additional government facilities.

4.3.1. Pakistan's Installed Power generation capacity

According to available data, the country's installed capacity has risen phenomenally and the government has been partially successful in reducing load-shedding with increased production of electricity, there are still challenges of price and energy access in the country. As Rehman (2019) opines that though Pakistan's electricity generation

has increased over time, the country is still unable to solve the issue of uninterrupted power supply. Breakdowns, power tripping and load shedding, are still observed across the country. The transmission and distribution network of electricity in Pakistan is weak and old which leads to a deficit of energy in the country (Rehman, 2019).

The National Transmission and Dispatch Company (NTDC) delineates the installed capacity (in MW) for FY 2017-18 as in different sectors such as hydro, Hydro Independent Power Producers (IPPs), Thermal Public, Thermal IPPs, Nuclear IPPs), Wind IPPs, Solar IPPs, and Bagasse IPPs. Table 8 demonstrates the installed capacity in Mega Watt (MW) for FY 2017-18. Whereas for the FY 2017-18 energy generation by fuel type in Gigawatt hours (GWh) is hydro Public, Thermal Public, Hydro IPPs, Thermal IPPs, Solar IPPs, Wind IPPs, Nuclear IPPs, Bagasse IPPs, Import from KE. Table 9 shows the energy generation in GWh for FY 2017-18.

Table 4-Installed Capacity in Mega Watt (MW) for FY 2017-18 (Source: NTDC, 2019).

Sr. No	Sources	Installed Capacity (MW)
1.	Hydro	8341 MW
2.	Hydro Independent Power Producers (IPPs)	348MW
3.	Thermal Public	5662 MW
4.	Thermal IPPs	15138 MW
5.	Nuclear IPPs	1345 MW
6.	Wind IPPs	985MW
7.	Solar IPPs	400MW
8.	Bagasse IPPs	306 MW

Table 5-Energy generation in Gigawatt hours (GWh) for FY 2017-18 (Source: NTDC, 2019).

Sr.No	Sources	Generation in Gigawatt hours (GWh)
1.	Hydro Public	27425 GWh
2.	Thermal Public	17086 GWh

Table 5 (continued)

Sr.No	Sources	Generation in Gigawatt hours (GWh)
3.	Hydro IPPs	1137 GWh
4.	Thermal IPPs	62485 GWh
5.	Solar IPPs	664 GWh
6.	Wind IPPs	2118 GWh
7.	Nuclear IPPs	8800 GWh
8.	Bagasse IPPs	1039 GWh
9.	Import from KE	31 GWh

According to studies, Pakistan was in the severe energy crisis of 4000 MW in 2008 and it was expected that energy shortage would increase to 8000 MW till 2010 and this energy shortage continuously grow at the usual yearly pace of 5.67%. In 2015 Pakistan faced an energy deficit of 5201 MW and daily, there was load-shedding of 14-18 hours across the country continuing from 2011. According to the present government prediction, it is expected that the energy crisis in Pakistan will finish in 2019 and the country will produce the surplus energy of 2732 MW. According to this study, Pakistan was generating 553.3 MW of electricity through modern renewable energy technologies in 2015-16 which is added to the national grid (Kamran, 2018). Still, Pakistani energy scenario heavily depends on oil to produce electricity until 2013-14; a shift from oil to gas has been witnessed in the power sector to produce energy for industrial, household, commercial and transport sector consumption. As compared to 2008, the fossil fuel cost increased in 2009 resulting in a 0.6% decrease in the total energy supplies which severely affected the economy of the country. The contribution of fossil fuel remains the highest in the form of oil and gas i.e., 64% resource utilization in order to generate electricity. Despite all these efforts, Pakistan is unable to fulfill the demands of energy requirements. This situation mainly affected the industrial sector resulting in the export minimization and resulting in adverse effects on the economic growth of the country. The total installed capacity in terms of fossil fuel, hydropower and nuclear power plant to generate electricity in Pakistan up to July 2017 reach 25100 MW and with a generation of 108408 GWh (Pakistan, 2009).

As discussed above, Pakistan is an energy lacking nation confronting an energy crisis of electricity and natural gas shortage which has led to an administrative policy of

forced load shedding (Aized et al., 2017). Apart from the persistent energy deficit and the electricity supply outages that have gradually become larger in the last decade, load shedding ranged from 8 to 12 hours per day in the urban areas and up to 18 hours in the rural parts of the country. The growing gap between the demand and supply is due to the failure of the existing energy system, reducing energy resources and financial limitations (Valasai et al., 2017). Moreover, the country also faces serious challenges to use existing energy resources efficiently and productively (Wakeel et al., 2015). National measures are imperative to ensure the implementation of a coherent energy conservation program together with the improvement of infrastructure, systematic lacunas and all other related issues as well as discrepancies arising from the 18th Amendment to the constitution. The government's efforts to attract investment in power generation could get frustrated if some of these problems are not addressed adequately.

In order to meet the energy requirements, gas and oil imports cost the country a lot of financial burdens. Pakistan needs to shift to the contribution of other energy resources to the total energy mix. Cooperation has already been very strong in the nuclear energy sector, to a lesser extent in the hydroelectric sector between China and Pakistan. Pakistan is looking to China for much-required technology, expertise and investment to develop the use of renewable energy technologies like wind and sun (Mehmood Hussain, 2017). The acute energy crisis faced by Pakistan is causing a massive loss to the economy and is a significant obstacle in the overall development of the country. The industrial sector has been severely affected, curtailing the export potential of Pakistan.

Additionally, it has emerged as a catalyst factor in social unrest and disaffection. Overcoming the energy crisis is therefore, a top priority of the government. In the government of Pakistan, Vision 2025, energy (along with water and food security) has been identified as one of the seven pillars of the vision. The government has pledged to "double power generation to 45000 MW and vows to provide uninterrupted, affordable and clean energy for all." The government plans to enhance electricity access from 67% to 100% (GOP, 2014).

4.3.2. Renewable Energy (RE) Landscape of Pakistan (A Brief Overview)

Renewable energy is vital for Pakistan as the country is facing the massive challenge of power availability, access, climate change, and many other such challenges (Raza et al., 2020.). The energy sector is the most carbon-intensive sector in the whole world and Pakistan is no exception to this reality (Rasool, Zaidi and Zafar, 2019). Pakistan's energy sector also possesses an overriding share of fossil fuels in the national energy mix. Pakistan needs to deploy renewable energy on a massive scale to address the power needs in different sectors of the country. The country shares very less part of renewable energy in its present energy mix; on the other side, it is a fact that the country possesses immense potential for renewable energy. There are some practical challenges to the effective utilization of RE technologies in the country ranging from lack of political will, necessary finance, skill, technology and required policy interventions. Presently, Pakistan ranks 97th/115 as an emerging country striving for transition with an imbalanced energy system (Energy Transition Index, 2019).

The government of Pakistan has taken numerous initiatives to adopt RE technologies in the country. Pakistan was among the first countries to endorse the global Sustainable Development Goals 2030 agenda, and in 2016, the parliament approved them as a national development agenda. The adoption of SDGs by the government of Pakistan also connected the country with the United Nations Framework Convention on Climate Change (UNFCCC)'s. Pakistan participated in the Conference of Parties (COP-21), Paris, France, where Intended Nationally Determined Contributions (INDCs) for curtailing fossil-fuel carbon emissions from the economic processes were submitted by each country (Climate change, 2015). The effective use of RETs in the nation's energy mix can easily pave the way for a clean environment and affordable energy prices for households and industries.

Moreover, the Government of Pakistan developed a National Action Plan (NAP) on Sustainable Development Goal 12 (SDG12), which is Sustainable Consumption and Production (SCP). Sustainable consumption and production (SCP) aim at the promotion of resource and energy efficiency, sustainable infrastructure and providing access to essential services, green and decent jobs and a better quality of life all across the country. SDG targets are closely aligned with the SCP goals as it also focuses on

the increase in the share of Renewable energy in the energy mix (GoP, 2017). Development of NAP was a voluntary effort by the government of Pakistan to show its commitment to the SDG targets. Furthermore, it was an effort to garner political support for SDG's and making them a part of the country's development agenda (APP, 2016). There are still many targets that await accomplishment in the NAP.

At the institutional level, the GOP has set up two subdivisions; Pakistan Council of Renewable Energy Technologies (PCRET) and Alternate Energy Development Board (AEDB) for alternative energy technologies deployment, particularly in the power area for the furtherance and development of RETs across the country (Irfan et al., 2020). The PCRET assists in the research and development initiatives. AEDB, on the other hand, helps in the development of renewable energy policy and supply support for the employment of renewable energy technologies across Pakistan. According to a long-term plan of AEDB, 10% of power will be produced through renewable energy technologies within the five years duration. AEDB also plans to produce 9700 MW of energy through renewable energy technologies supplying 7874MW off-grid energy to distant rural communities (AEDB, 2010). PCRET alternatively, commenced and implemented small-scale projects to display its practicability and effectiveness across the country (PCRET, 2010). Most of the pilot projects of renewable energy technologies that are expertly installed by the PCRET include wind turbines, solar desalination systems, biomass plants and solar water heater projects across the country. According to the report by the Government of Pakistan (2015-16), 438 MW of renewable power plants have been installed in different regions of the country, adding 802 GWh electricity during the year 2014-15. Brief details of these renewable energy projects are as follows: FFC Energy Ltd. Sindh (50 MW, 139 GWh), Zorlu Energy Sindh (56 MW, 156 GWh), TGF Wind Farm Pvt. Ltd. Sindh (50 MW, 80GWh), Foundation Wind Energy–I Sindh (50 MW, 56GWh), Foundation Wind Energy-II Sindh (50 MW, 26GWh). Through Biomass energy technology i.e., Bagasse Co-generation, Jamaldin Wali (JDW)-II Punjab (26MW, 163GWh), Jamaldin Wali (JDW)-III Sindh (26MW, 124 GWh) and Rahim Yar Khan (RYK) Mills Ltd. Punjab (30 MW, 32 GWh) added electricity to the national grid during the year 2014-2015 (GoP, 2015-16).

Following section summarizes the renewable energy technologies in Pakistan:

Hydro Power

Through Hydel power plant 24544 GWh electricity generation gets added to the national grid according to the GOP economic survey (GoP, 2015-16). The total established power of hydro plant is 7027 MW which is connected to the national grid till 2016-17. Information in (AEDB, 2012) discloses that the established power capacity is inadequate as compared to the national power demand. A study by Mirza et al., (2008) recommends the potential areas of Pakistan especially the northern areas where 41,722 MW of energy is expected to generate (Mirza et al., 2008). AKRSP (Agha Khan Rural Support Program) in collaboration with AEDB is installing 103 micro hydro power plants in the Northern areas of Pakistan, including the Chitral and Gilgit region (AEDB, 2012). Pakistan Council of Renewable Energy Technologies (PCRET) has installed 228 'river type hydel plant' recently in the northwestern region of the country with the dimensions of 3 MW each (PCRET, 2008). The Ministry of Power has reviewed many other mini hydropower plant projects of 187 MW and feasibility reports of these projects are under consideration (Sheikh, 2010). In addition, the provincial government of KPK is working on 6 micro hydel projects with the capacity of 118 MW and that is expected to be accomplished in 2018. The provincial government of Punjab is working on 4 micro hydro projects of 20 MW capacity which are likely to be completed in the start of 2018 (Kamran, 2018).

Solar Photo Voltaic (PV)

Sun shine remains 8-9 hours in Pakistan especially in the province of Baluchistan which is the most favorable and appropriate place for solar energy technology deployment to overcome the current shortage of electricity (Nasir and Raza, 1993).

Pakistan installed the solar power grid in the capital Islamabad with the support of Japan International Cooperation Agency to produce 356.16 KW of power through photo voltaic solar system and excess power will be put up for sale to Islamabad Electric Supply Company (IESCO) (PEC, 2011). AEDB installed solar PV system to 601 houses in 2004-2005, at multiple localities of the country by go beyond its goal of 400 residences (HDI, 2005). An additional landmark in this regard is the deployment of a photovoltaic system with a capacity of 2 MW on the national assembly of Pakistan (NA) building (NA, 2016) which is accomplishing its own

power prerequisites and transmit the surplus electricity to the grid [14]. At present, a 1000 MW solar PV power plant is under erection phase in Bahawalpur, Pakistan under Quaid-e-Azam Solar Power (Pvt.) Limited (Kamran, 2018).

Biomass

62% of people in Pakistan reside in rural areas which comprise the largest portion of the country's residents with scarce/no-energy resources. The study by Chaudhry et al., (2009) also emphasizes the biomass power as a way out to the energy deficiency in Pakistan (Chaudhry et al., 2009). Mirza et al., (2008) argues that an average biomass user data per annum required for house hold activities is equal to 2325 kg of wood or 1480 kg of animal droppings or 1160 kg of agricultural produce remains that are essential for cooking, heating, and other household purposes (Mirza et al., 2008). According to another study by GOP (2006), Pakistan possesses 62 million animals with the annual increase rate of 8% and the on a daily basis dung of an animal is approximately 10 kg/animal that would become 620 million kg dung drop every day (GoP, 2006). One kg of animal dung at 15+ degree centigrade produces 0.19m3 of bio-gas which makes it double at 27 degree centigrade (Mirza et al., 2008). This denotes that at a yearly mean temperature of Pakistan (25.8 degree centigrade), 1 m3 gas/day can be produced through 20 Kg wet dung (Ghaffar, 1995). Through animal waste, approximately 23.25 million m3/day of bio-gas production is possible under these calculations. According to the Research conducted by Meena (1984) for lightening of 100 candle-power lamp, 0.127 m3 of gas is mandatory, whereas, in order to power 1KW generator, 0.57 m3/hr of gas is required (Meena, 1984).

Agricultural remains are another biggest chance for agriculturally wealthy Pakistan to generate electricity through biomass energy source (Asif, 2009) i.e., rice straw or bagasse of sugar cane. With the existence of around 80 sugar mills in the country and 3000MW energy production capacity, only 700MW of production is done so far. Director general of Renewable resources (DGN-RER) (AEDB, 2004) installed 4137 biogas units throughout the country until 1987, which got improved with the passage of time. Observation by Khan (2006) shows, presently 5357 biogas units installed all over the country with the capability to generate 3-15 m3 of bio-gas daily (Khan, 2006).

In Karachi (Sindh province) at Landhi cattle colony, AEDB is working on a 30 MW bio-gas project, whereas, in Punjab province at Shakarganj mill (Jhang), 8.25 MW biogas plant production project is also under developmental stage (Bhutto, Bazmi and Zahedi, 2011). AEDB with the cooperation of M/s Eco-Friendly Fuels Pvt. Ltd is trying to set-up a pioneer commercial 18000 tons of biodiesel per year production plant at Karachi (AEDB, 2012). Pakistan Amraas International Pvt. Ltd. with A-Power Energy generation system Ltd. and Shenyang power group (World Biomass Markets, 2010) is working to build up two biomass power plants of 25 MW capacity to meet its own energy needs since 2011.

Wind power plants

Research by Nasir and Raza (1993) discusses the monthly average speed of wind in the four provincial capitals of Pakistan, advocating that the least and highest speed of wind in Karachi (Sindh province) is 2.75m/s to 6.7m/s chased by Quetta (Baluchistan province) 2.5m/s to 4.4m/s, thus declaring both the perfect site for wind energy plant employment (Nasir and Raza (1993)). The first wind power plant of five wind turbines was established in Jhimpir (Sindh province) to generate 6 MW clean energy with the help of a Turkish company (Zorlu Enerji) in 2008 (AEDB, 2012). The Zorlu Enerji is anticipated to provide more wind turbines in order to generate 200 MW until the end of 2018 (Shakir et al., 2014). As reported in Pakistan energy Year book (2005) 100 micro wind turbines have been installed to provide electricity to 467 houses across Pakistan. AEDB has also installed 40 wind turbines in Karachi (Sindh province) with 10 MW power. Research and development on 500 Watt wind energy generation turbines by AEDB in various universities of Baluchistan province is as well under progress (Pakistan energy Year book, 2005). PCRET on the other side has set up 26 micro-units of 500 Watt wind power plant at ‘Gul Muhammad’ Village of Sindh province (Sheikh, 2010). Fauji Fertilizer Company (FFC) Energy Ltd. installed 50 MW wind power plants in 2013 and 14. Other wind power projects of 663 MW in Jhimpir and Gharo regions of Sindh province are at different stages of growth and anticipated to be ready in 2018-19 (Kamran, 2018).

Geothermal Energy

Pakistan has a great probability to generate 100,000 Mega Watts of energy through Geothermal power resources (Tariq, 2012). The sun shines almost all year around in Pakistan, and with the utilization of geothermal technology, heat from the sun which is available on the earth's surface can help in the absorption of minerals and resources can conveniently be extracted (PRES, 2012). The investigation by Shuja (1986) evaluated the tectonic and geologic facial appearance with the outside symptoms of geothermal movement in Pakistan to clarify the inherent qualities of the region for study and progress of geothermal force (Shuja, 1986). Likewise, Bakht (2000) gives an overview of the potential geothermal areas of Pakistan and argues by providing details of the Himalayan collision zone, counting Murtazabad (Gilgit Baltistan-GB), Karachi and Dadu (Sindh province) being the most suitable ones (Bakht, 2000). According to research done in Murtazabad (GB) area by Ahmad et al., (2001) where the surface temperature was noted as 40 to 94 degree centigrade. Moreover, water samples were also collected and after the isotopes analysis, it was accomplished that the thermal water is meteoric water and the circulation time of thermal water towards the surface is more than 50 years. This remains as a proof that the region is most suitable for the geothermal power resource (Ahmad et al., 2001). Amraas Pvt. Ltd. and Shenyang Power Group (SPG) have only been reported working jointly on the geothermal project in Pakistan to supply power by exploiting geothermal power resources (Bhutto, Bazmi and Zahedi, 2011).

The energy crisis of Pakistan can be seen from multiple dimensions. There are imported fossil fuels and regulatory challenges in the country. Thermal power generation on expensive and imported fuels has been a source of controversy with the interlinked questions of regulatory authorities as well as terms and conditions of investment on which Independent Power Producers (IPPs) operate in Pakistan. There are also debates on the role of the public sector involving government structures like WAPDA and Ministry of Power in the context of IPPs and the 18th Amendment to the constitution of Pakistan. All this vast system of multiple stake holders in the energy system of the country has raised the issues of jurisdiction, price fixation, regulatory mechanism, distribution mechanisms and sharing of revenues amongst the federating units.

Furthermore, Pakistan is at an opportune moment in its history, where prospects for regional connectivity could unlock vast potentials for the country. One essential feature of this regional connectivity relates to the energy sector with oil and gas pipelines and transmission lines including China Pakistan Economic Corridor (CPEC), CASA-1000, Iran Pakistan Pipeline (IP) and Turkmenistan Afghanistan Pakistan India (TAPI). Hence it is imperative to streamline certain issues identified for sustainable energy flows in the country.

4.4. Pakistan Energy Policy Analysis

To address the research question, it is also critical to analyze the energy policy of Pakistan. Pakistan is an energy deficient country. The energy issues facing the country entail multiple challenges, such as deficiency of an integrated energy planning and forecasting of demand which is seriously worsening the gap between energy supply and demand. There are also issues of circular debt, the amount of cash shortfall within the Central Power Purchasing Agency (CPPA) that is unable to pay to power supply companies. Having a good and effective Energy policy is essential for the socio-economic development of any country because energy is at the core of economic and social activity. Hussain et al. (2013) observe that energy planning received proper consideration after the oil crisis of the 1970s in the world. During that time, the approaches related to the planning of energy mainly stressed the efficient supply choices. With the gradual development, the planning also advanced with minimum cost solutions that could address the demands.

Additionally, the other standards included environmental apprehensions and the supply reliability based on monetary values including the cost criteria thus taken as restraints (Hussain et al., 2013). There are various energy policies implemented from time to time in the country; however, the thesis shall be focusing only on significant power sector policies listed in Table 6. There are certain leading players in Pakistani power sector shown in the Figure 5. Every government in office works on restructuring in the roles and responsibilities of these organizations according to the needs and requirements.

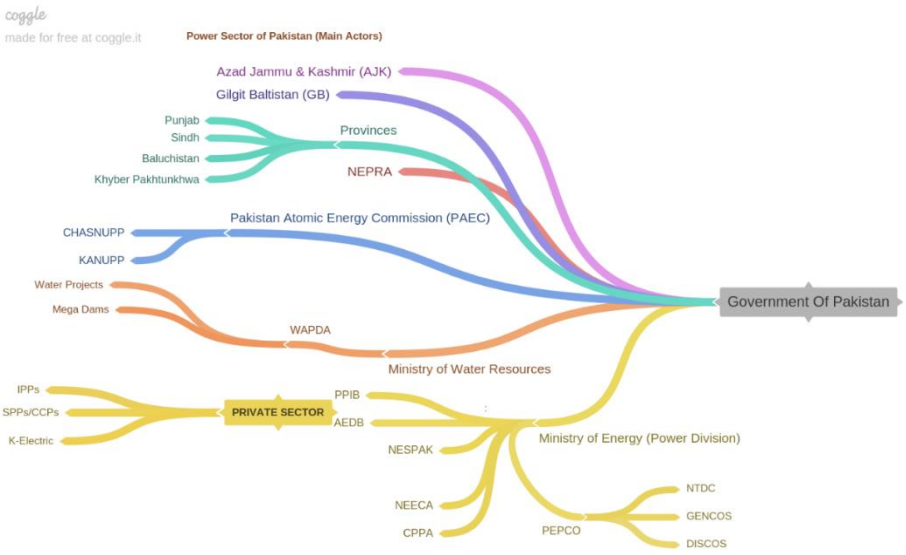


Figure 5-Main Actors of Pakistani Power Sector

(Source: Data from Private Power and Infrastructure Board (PPIB), 2019).

Power division of the Ministry of Energy with backing and coordination of Planning Commission (PC), formulates and implement the energy policies for the power sector of Pakistan. An integrated power sector planning approach is adopted to effectively accomplish balance in the country's energy triangle. This approach necessities inclusion of accurate forecasting of demand, improving transmission and distribution systems, addition of generation capacity, taking costs down and guaranteeing sustainability. The government of Pakistan since 1994 has targeted on the energy and power policy making, still, most of the publicised policies to date concentrate on either on low cost solutions or readily accessible primary energy sources. Hussain et al. (2015) observes that there are no integrated energy modeling exercises undertaken for rational policy making in the process of policy formulation (Hussain et al., 2015). There is one study found in the existing literature (International Resource Group, 2010) presenting an energy modeling exercise of an Integrated Energy Model for Pakistan. This exercise does not have any suggestions for the policy formulation process. The fallout of these investigations and policies is negligible due to the issues of implementation; thus the country has not observed any significant development and economic activity across numerous sectors as per laid goals.

Integrated and inclusive energy policy is critical to the development and nourishment of a developing country's economy, such as Pakistan. It is noteworthy that the GOP

enacted various energy policies over time, and they entail different targets as illustrated in Table 10. These policies have mostly failed to address the energy crisis in the country, which nation has faced over the last couple of years. The absence of long term and integrated energy policies has led to these energy crises.

Table 6-Area of focus for varied energy policies in Pakistan

Energy Policy	Focal Point
1994	Bringing Independent Power Producers (IPPs) to increase access to power for people
1995	Hydel power utilization
1998	Creation of competitive market
2002	Organizational restructuring
2006	Less dependence on imported energy and incentives for renewables
2008	Power co-generation by sugar industry
2010	Energy conservation and RPPS
2011	Promotion of Alternative and Renewable energy technologies
2012	Cheaper fuels
2013	To minimize supply-demand gap and encourage energy conservation
2015	To encourage investment in clean and cheap fuels mainly hydro

Until 1994, no energy policy was formally announced by any government in Pakistan. The power and energy policies announced at that time were deficient and suffered the issues of inconsistency, implementation challenges. There is also a lack of an integrated energy planning approach utilizing energy modeling tools in the following energy policies of the country. The following section presents a brief discussion on the power policies implemented from time to time.

4.4.1. 1994 Power Policy

Pakistan announced its first national power policy in 1994 mainly focusing on enhancement of electricity generation to 13,000MW with the help of Independent Power Producers (IPPs) and conservation of energy. For ease of business Private Power and Infrastructure Board (PPIB) provided one-window operation (providing all services at one place without any delays) (Fraser, 2005). Moreover, irrespective of IPPs electricity generation the policy guaranteed fixed payment along with exemption from surcharges and taxes like custom duties, sales tax and income tax for facilitating IPPs imports. Fuel supply and power purchase agreements were introduced for the first time. As an attractive policy for IPPs, foreign exchange risk insurance was administered in the 1994 policy (GoP, 1994). The 1994 energy policy initiatives resulted in direct foreign investment of $4 billion, mainly in thermal power plants (Ali and Beg, 2007; Mirza et al., 2008). The desired outcomes from the policy entailed

1,300-Megawatt (MW) generation whereas actual outcomes resulted in 4,500 MW from sixteen IPPs. This shows that the policy outcomes were effective in terms of generation (Bacon, 2019). Whereas there were certain issues related to efficiency, ethical considerations and evaluation of alternatives in this policy.

4.4.2. 1995 Power Policy

The 1995 power policy is also termed as hydropower policy as it focused on power generation grounded on indigenous hydropower resources as opposed to the 1994 power policy, which utilised thermal resources for power generation by the IPPs. This policy also received all the fiscal privileges provided in 1994 power policy. It is the first policy specifically for private sector hydropower development for investors to participate fully in the development of hydropower projects across the country. Whereas, the policy also required that after the completion of twenty-five years of the hydropower project, the investors will transfer the ownership of the hydro projects to Government of Pakistan (NEPRA, 1995).

Development of power generation capacity was the main aim of both 1994 and 1995 power policies. These policies also aimed involving “private sector” and attracting “foreign direct investment (FDI)” in the power sector. However, the 1995 policy efforts to balance thermal-hydro mix faced certain challenges as the thermal power generation received more investments as compared to hydropower development.

4.4.3. 1998 Power Policy

With the revision of the 1994 power policy, a new 1998 power policy was adopted as a more rationalized version of policy redesigned to suit new private independent power projects. An independent regulatory authority with the name of National Electric Regulatory Authority (NEPRA) was established in 1997 and this new policy in 1998 adopted tariffs constructed on open bids in Pakistani rupees. The policy worked towards seeking finance for hydro and coal powered generation plants and privatization of power distribution companies (DISCO’s). Alike the past polices this policy also granted protection against specific risk and exemption from certain taxes and duties for investors. Meanwhile, IPPs were also allowed to raise finance in local and foreign currencies (GOP, 1998).

4.4.4. 2002 Power Policy

Power Policy 2002 is also known as policy for power generation projects in Pakistan which targeted advancement of private, public-private and public sector power generation projects. Through introduction of competitive bidding and tariffs based on Energy Purchase Price (EPP) the policy aimed at encouraging foreign investors to have joint ventures with local Industry for power development to attain 20,000MW by the year 2015 (PPIB, 2002). Though the output of the policy remained successful in adding a generation capacity of around 3300MW to the national grid, there remained issues of highly unaffordable fuel mix based generation (Mirza et al., 2009).

4.4.5. 2006 Power Policy

This policy is known as a devoted policy for the promotion and development of Renewable Energy (RE) power in the country. The policy was developed to encourage electricity generation plants such as small hydro, wind, solar, and bio-fuel based technologies. The policy also provides tax and duties exemptions for investors in Renewable Energy Technologies for importing machinery to attract more investment in the sector (AEDB, 2006). The policy witnessed some implementation and enforcement issues as only one Renewable Energy plant based on Wind power generation was installed in Jhimpir in the year 2009 (Yazdanie and Rutherford, 2010; Zafar et al., 2018). The reasons for failure also included a lack of intense political and financial commitments that are essential to achieve the green future for the country. The successive governments in Pakistan largely remained more tilted towards thermal power generation to overcome the enormous electricity demand-supply gap in the country.

4.4.6. 2008 Power Policy

The power policy of 2008 is based on the idea of power cogeneration by the sugar industry in Pakistan. The government wanted to encourage the power cogeneration by bagasse produced in the sugar plants across the country for which the "Levelized tariff" for 30 years for 60MW capacity plants or above was introduced in the policy (PPIB, 2008). It is also considered as an extension of the 2002 power policy as it also focused on targeting the advancement of private, public-private and public sector power generation projects. This policy resulted in the problems of circular debt and

there was an exceptional surge in oil prices and the government has to provide subsidies from its resources.

4.4.7. 2010-12 Power Policy

In 2010 the energy policymakers shifted their focus on the a vital issue of energy conservation. There was a short term as well as long-term plan for electricity generation through rental power plants. This policy also envisioned rehabilitation of existing public sector power plants and investments by Independent Power Producer (IPPs). The outcomes of the policy resulted in massive corruption in Rental Power Plants (RPPs) and massive mishandling of the energy sector (Zafar et al., 2018). Then the following year in 2011, another policy with the name of Alternative and Renewable Energy (ARE) emerged which entailed the core objectives of attaining an ambitious target of attaining at least 5% of total commercial energy supplies through ARE sources by 2030 and to promote alternative and renewable energy technologies (AEDB, 2011). Policy for the development of renewables was framed in 2006 which aimed to supply sustainable energy to all consumers including those households which have not been supplied electricity and natural gas in rural and far-flung areas. The policy was extended for implementation in 2011 and is still in use.

ARE Policy 2011 intention is to complement ARE-related efforts of various governmental bodies as well as to grow ARE deployment, present incentives to attract investment, enhance the effect of ARE deployment in underdeveloped areas through income generation, and other socio-economic benefits. It also aims to raise ARE relevant institutional and technical dimensions. Furthermore, the promotion of research and development, as well as the development of local, ARE manufacturing base is on the agenda of this policy. ARE 2011 resulted in expensive generation due to imports as AEDB Solar Projects (Aized et al., 2018; Zafar et al., 2018). In the year 2012, the government under the public pressure due to lack of electric power in the country nationalized the energy sector, and energy corporations were tasked to perform power generation functions in the country (Alahdad, 2012).

4.4.8. 2013 National Power Policy

The core purposes of National Power Policy (NPP) 2013 are to overcome the shortfall by 2017, to decrease the crucial issue of supply and demand gap, attaining efficiency

and sustainability. The Ministry of Energy in Pakistan is responsible for the Power Policy development and provides assessment for the current and future energy requirements (PPIB, 2013). This policy of 2013 also purposes to resolve the critical challenges of the Pakistani power sector and strives for the provision of relief to the ordinary citizens.

NPP 2013 entail nine targets to achieve the long-term vision of the power sector and overcome its challenges in the country. These include building a power generation capacity that can meet the country's energy needs sustainably — creating a culture of energy conservation and responsibility in the country — ensuring the generation of inexpensive and affordable electricity for domestic, commercial, and industrial use by using indigenous resources such as coal (Thar coal) and hydel-power. Minimization of the losses and adulteration in fuel supply. The promotion of a world-class efficiency in power generation and the creation of a "cutting-edge transmission network" across the country. Finally, it focuses on the minimization of the inefficiencies in the distribution system and financial losses across the system (PPIB, 2013). This policy was also an effort to align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators.

There were specific targets of this policy set for the year 2017-18, including efforts for eliminating load-shedding. Further, decreasing the cost of generation from 12c/unit to 10c/unit and transmission losses from 25% to 16%. Moreover, improvement of the collection of bills to 95% (Khan, 2020).

4.4.8.1. Power Generation Policy (PGP) 2015

The core objectives of the 2015 Power Generation Policy (PGP) include a renewed focus on the available indigenous resources. Thus suggesting a remarkable production of power and environmental protection. The policy was declared to present more significant incentives and secure processing for the projects so that the local and international investors feel encouraged to participate in the development of power projects in the country (PPIB, 2015).

The fundamental purposes of the Policy include the provision of enough power generation capacity at the least cost as well as encouragement for the exploitation of indigenous resources. It also focuses on the aspect of proper care for all stakeholders

in the energy sector. This policy follows an inclusive paradigm by focusing on the economic, military environmental, and social security aspects. Through this policy, the national security paradigm has become more inclusive with energy. Therefore, this policy is inclined toward the availability of energy because the policy planners believed that the energy security of a country depends on uninterrupted and affordable availability of energy (Hassan et al., 2019).

It is an established reality that there is no dearth of energy policies in Pakistan. After a brief overview of the power policies in the country, there seems to be a crucial requirement for policy innovations and integration for the resolution of widening energy crises in the country. The challenge of energy in Pakistan requires proper identification of the confronted problems, which requires immediate support from Research and Development organizations or institutes. There is also a need for the evaluation of local, social and political context as there are multiple stakeholders in the country who can play an effective role if provided with better representation and voice. The country requires better communication with the public before the policy formulation process, as most of the policies in the country are made without public involvement.

Energy and Power policies in practice lack timely review of policies including review of targets, review strategies, review of implementation, review of funding sources, review of regulations. All policies including Renewable Energy policy 2006, Power Policy 2015 require an integrated energy policy and the Ministry of Energy (Power Division) should take up this matter and establish a national commission or a committee such as National Energy Experts Commission/Committee (NEEC) to review the existing policies. This proposed NEEC should design and develop one integrated energy policy, keeping in view the Energy Situation, Energy sources, Energy regulations, Energy targets, Energy incentives, Energy Financing and most importantly implementation of existing laws and regulations.

Different organizations in the country suffer from the implementation of laws as Pakistan Engineering Council (PEC) has developed the Building Code of Pakistan 2011 which has specific provisions related to energy. These provisions lays down minimum requirements for construction and energy-efficient design of buildings across the country (IEA, 2017). In the same manner, the Pakistan engineering council

(PEC) has launched "PETSAC (Pakistan Electric and Telecommunication safety code of Pakistan 2014)" to protect human lives and to reduce the material loss from electrocution and associated risks (PEC, 2014). NEECA-National Energy Efficiency and Conservation Authority of Pakistan has issued the "National Energy Efficiency and Conservation Act 2016," which provides the required governance framework that can facilitate the wide-scale implementation of sound energy-efficient practices throughout all sectors of the Pakistani economy (ENERCON, 2016). The energy and power policies, laws, codes lack an integrated energy planning approach; therefore, the implementation of all these policies and regulations is weak and inconsistent. There is a great need to set up an Implementation Unit (IU) at federal and provincial levels to ensure implementation of these policies, laws and acts or each department, ministry and authority should set up its implementation units for effective employment of existing policies, regulations and acts (Mirjat et al., 2017).

Due to the inherent flaws of implementation and inconsistency in the national power policies for the promotion of RET in the national energy system, natural gas and oil are utilized for power generation. (Mirjat et al., 2018; Lin and Raza, 2019). With the extensive use of thermal sources for Power generation and consumption, the country's environment suffers significantly. They are thus resulting in extensive CO2 emissions, depletion of fossil fuels, contamination and utilization of natural resources. Each factor causes environmental degradation, ultimately leading to climate change, which consequently causes natural disasters. The Power sector of the country alone contributes to 50% of the Carbon dioxide (CO2) emissions (Fatima, Hassan and Ghias, 2018).

Pakistani government is actively pursuing the goal of familiarizing Renewable Energy Technologies (RETs) in its national energy policies (PES, 2016-17). The country faces a shortfall of 19777.988 (KOE) which is a great obstacle in its development. This shortfall may aggravate in future if the relevant quarters in the government will not opt for rational policy decisions. They need to make prudent use of available and clean energy resources in the country. The country's present energy supply mix is highly imbalanced and overwhelmingly comprised of imported gas and oil. There is a small share of hydro, and nuclear. Imported natural gas constitutes 49.5 percent. A part of the share of natural gas has been supplied from the country's own resources for its

usages in power generation, domestic, commercial, industry and CNG-fitted transport in the country. The natural gas proven reserves of of the country at the end of 2012 are estimated to be 22.7 trillion cubic feet with reserve to production ratio is 15.5 (R/P ratio) (BP, 2019). There is a need to have a multi-pronged strategy in the country to tackle the energy crisis. A diversity of options can be adopted as there is no single solution to solve the energy shortfall. Natural resources in the country and globally are prone to deplete and natural gas is a strategic commodity. Therefore, immediate measures should be taken as due to the rapid usage of the available reserves, the current stock would last soon. Therefore, the national policies necessitates an immediate shift to the renewables in order to address the growing energy needs.

The political will is paramount in this regard as in the previous government's case; they have prioritized coal and RLNG fired power projects. So, unless there is a political will, Pakistan would not be able to deploy renewable energy on a rapid scale effectively. In the recent past, there has been a lot of investment coming in the coal-powered plants, especially CPEC energy projects investments, which are fossil-based and a great threat to the environment (Kouser and Subhan, 2019).

Most of the energy policies emphasize on diversifying the energy mix to address the issue of the "base load" due to which coal is still utilized in the energy system of the country for power generation despite health and environmental concerns. Coal is considered as cheap and local (control on the supply and price), concerns of circular debt and rising energy demand. Moreover, renewable energy is thought to be intermittent by the advocates of coal power in the country (Ebrahim, 2019). Pakistan is amongst the countries which started developing/harnessing its renewable energy resources earlier than developing coal fired projects, so, which is quite incredible on the one hand. But the fact of point is that Pakistan started developing renewable energy projects and then it shifted towards the coal technology which is quite strange. There is no doubt that the country has its energy needs and they are to be addressed.

Energy is a prerequisite for the economic growth but there is also need to look at other aspects as well such as climate change, as the country is among the most vulnerable countries in terms of climate change impact. So, the issue of base load which basically means the generation of cheap electricity using those resources which provide the electricity on a lower operational cost and meet energy demand round the clock in a

country but now that argument is failing because when it comes to cost, renewables are much cost competitive as compared to coal or even RLNG right now.

Moreover, Pakistan has a severe problem with access to grid as 51 million people in the country are still believed to have no access to the electricity/grid (Khan et al., 2018). The managing grid has always been managing uncertainty. The country has shifted from oil to gas, coal, RLNG in its energy policies over time and due to the recent developments in the prices and availability of renewables globally. The system can adopt this change as well as the energy system has been changing ever since. It has always been managing uncertainty and renewables have proved to be a better options for countries like Pakistan which has immense potential for harnessing RE technologies. No country can afford to have a rigid system based on the notion of base load. Pakistan has already crossed that threshold, now the country requires resources that can generate electricity on lower cost and can compete economically as well as addressing climate concerns (Shah and Solangi, 2019).

Besides energy access and baseload challenges there are rising energy prices in the country. Pakistan should focus on technologies that can provide cheaper electricity because electricity prices are already becoming quite an issue in Pakistan. So, renewables can be one of the solutions for that. Base load is an economic concept and technical concept instead of indulging in the technicalities Pakistan should follow the suite of many countries who have found ways to integrate renewable energy on massive scales (Abbas, 2015). There are certain developing countries as well which have around 95 to 98% shares of renewables in their energy mix. Costa Rica is an example, also Morocco for that matter, they are also shifting towards it (Grover and Alfarra, 2019). Now the way forward for Pakistan is as the country has potential, there is an issue of political will as discussed, but there are capacity issues as well. Presently, for the development of renewables, NEPRA has announced tariffs for wind and solar; they are already cheapest forms of electricity in Pakistan. If the projects that have been awarded tariff, they are given go ahead to develop their projects. So the wind tariff that has been announced recently is between 4.1 US cents to 4.4 US cents and for solar, it is the tariff announced between the range of 5.2 US cents per kilowatt hour to 5.6. So, if it is compared with coal that falls in the range & to 8 US cents, RLNG falls between

6.06 to 6.7 US cents. So, it is becoming cost-effective with technological advancement; it is becoming more efficient, accessible and affordable.

Renewable energy is the need of the hour and the community without electricity access, especially for rural electrification, as the majority of the Pakistani populations reside in the rural areas. Therefore these rural communities lack access to power due to terrain (location) challenges and away from the national grid. Off-grid solutions are empowering the communities globally So, right now, the national power policies of Pakistan need to have a clear cut policy, long term policy on renewables and it should not focus on coal or any other fossil fuel any more because the world is phasing out coal. Pakistan needs to have a stable policy framework and regarding rural electrification, the country still has around 27% of the population without having access to electricity. So renewable resources today have become an excellent and optimal instrument of electrifying communities which are not connected to the national grid or regional grids because expanding the grid and transmission cost would far exceed developing a home-based system (off-grid) in a rural community or developing a microgrid or other solutions distributed generation.

4.5. Energy Poverty in Pakistan

Pakistan became a rapidly developing economy after obtaining independence in 1947 from British rule. It is also the sixth most populous country in the world, as well as the fastest-urbanizing South Asian nation (Kugleman, 2015). The need and demand for energy are increasing day by day around the world and Pakistan remains no exception. It is a fact that all human actions necessitate energy for proper operations. Pakistan as a developing country is still struggling with a massive energy crisis, which not only obstructing the progress of the country but also affecting daily life. All major sectors of Pakistan including industry, transport, agriculture and domestic sector, require a continuous supply of energy. Due to this continuous demand for energy in Pakistan, the demand and supply gap has increased in the country (Javed, 2016).

An enormous supply and demand gap exists in the country despite the completion of the recent energy project. In the last few years, the supply and demand gap has been increased many times. As per estimates of the National Power Regulatory Authority (NEPRA), 5298 MW gap was observed at the end of 2016. According to evaluations,

almost 1.3 billion people are living without having access to electricity and it is believed that 66 percent of the people suffering from energy poverty live in ten countries that include Pakistan as well (UN, 2013).

Since the creation of Pakistan in 1947, energy poverty has plagued Pakistan, this national problem got consideration presently. It is argued in the literature that from 1947 to 1980s domestic resources could meet only two-thirds of the required energy (PIDE, 2012). With the drastic increase in population in the 1980s, annual growth rates of more than 3%, the country was struggling with the growing demand for energy and its limited supply. In Pakistan, the energy consumption per capita also advanced with 193kWh in 1985 to 256 kWh in the year 1989 thus increasing the gap between demand and supply of energy (World Bank, 2019).

A federal parliamentary republic in South Asia, Pakistan consists of four provinces, the Islamabad Capital Territory (ICT), the disputed Kashmir region-Azad Jammu Kashmir (AJK), along with a group of federally and provincially administered tribal regions (Mirza et al., 2003; Wynbrandt, 2009). Pakistan is ethnically and linguistically diverse, with 201 Million people ranks as the sixth most populous country in the world. Out of entire people, 39.5 percent of the Pakistani population resides in urban areas. The over-all area of the country is 796,096 km2 (World Bank 2010-14). As compared to the population growth of the country, energy consumption has also significantly increased to a level of 80.9 Mtoe. Pakistan is heavily dependent on imported natural gas and oil (BP, 2018). This import levies huge burdens to its already crumbling economy which is currently facing the dual challenge of an increasing annual fuel import bill and climate change. According to reports, the oil import bill for 2017–18 was $13 billion (Hussain, 2018).

As per the World Bank's (2017) data, the GDP per capita of Pakistan stands at $5539.107. The gross domestic product (GDP) of Pakistan reached 300 billion US dollars with an annual growth rate of 5.8%. Services and facilities in a developing country like Pakistan are insufficient to address the increasing demands of energy by economy and population, resultant in an increase of pressure on scarce available energy resources. According to experts, the annual GDP growth rate is expected to decline from 5.8 to 5.4% in 2020, resulting in high poverty and a low standard of living in the country (World Bank, 2017). Despite the efforts of the Government of Pakistan

(GOP) for poverty reduction, a large population in the country is still living below the poverty line and passes their lives on less than 2 USD per day. Pakistan ranks 3rd in the South Asian countries, where 59% of its population is living below $2 per day, while there are poorer cases who live in India and Bangladesh. Figure 6 shows the comparison of the South Asian countries' population living below $2 per day (Sharma, 2014).

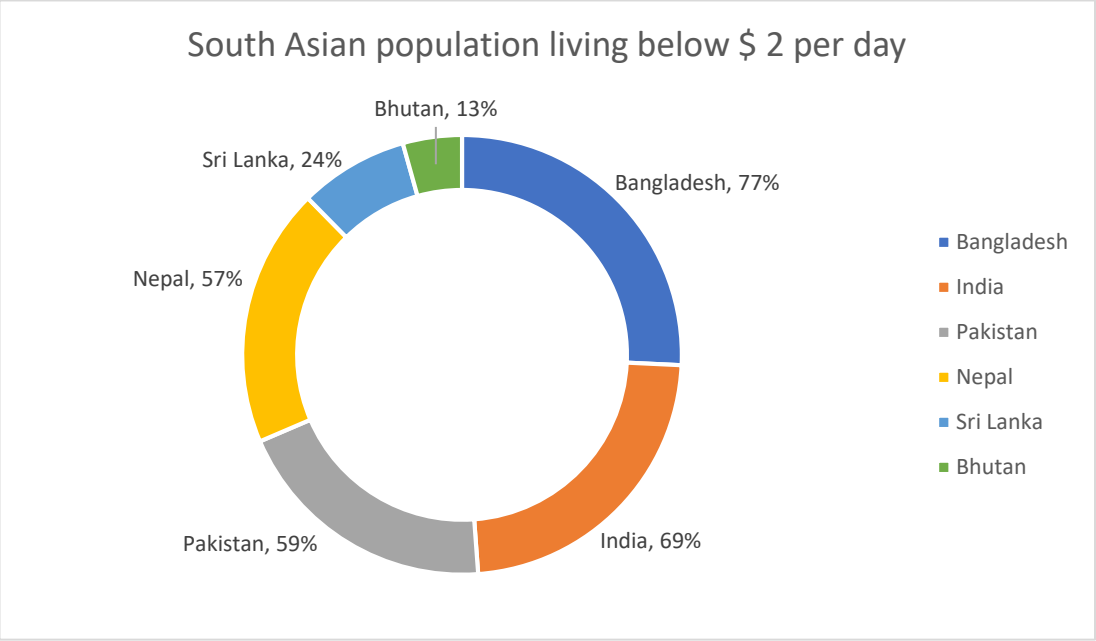


Figure 6-South Asian population living below $2 per day

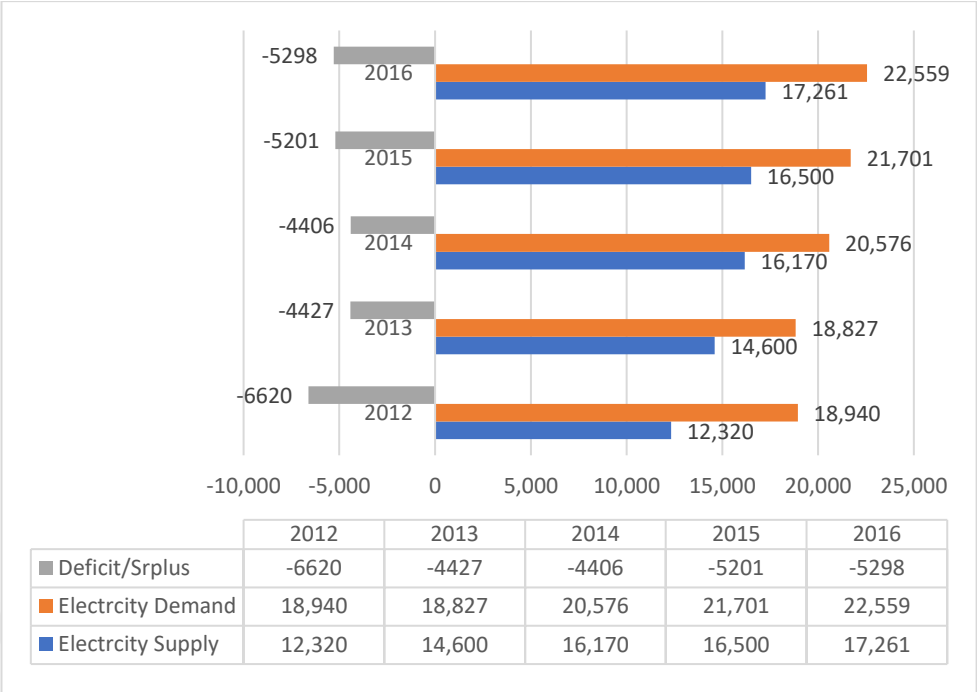
(Source: Sharma, 2014).

The Demand for energy has surged globally since the turn of the last century and Pakistan remains no exception. For the effective functioning of all human activities, energy is a prerequisite. Pakistan has suffered a considerable energy crisis during the last decade, which not only hindered the progress and development of the country but also adversely affected the daily life of the public. Like all countries, major sectors of Pakistan including industry, agriculture, transport and domestic needs, require an uninterrupted and continuous supply of energy. The gap between supply and demand has increased due to the unceasing demand of energy thus resulting in the depletion of energy resources (Javed et al., 2016). Following Table 4 demonstrates the data extracted from the National Electric Power Regulatory Authority (NEPRA) from 2012 to 2016 of the electricity installed capacity Megawatts (MW) from different sources in the country (NEPRA, 2016).

Table 7-Pakistan's electricity installed capacity (MW) 2012-2016 (Source: NEPRA, 2016).

Source Category	**Year 2012**	**Year 2013**	**Year 2014**	**Year 2015**	**Year 2016**
Thermal Sources	15969	15941	15693	16619	16619
Hydro Sources	6730	6947	7116	7116	7116
Renewable Sources	1	50	106	439	852
Nuclear Sources	787	787	787	787	787
Total (MW)	23487	23725	23702	24961	25374

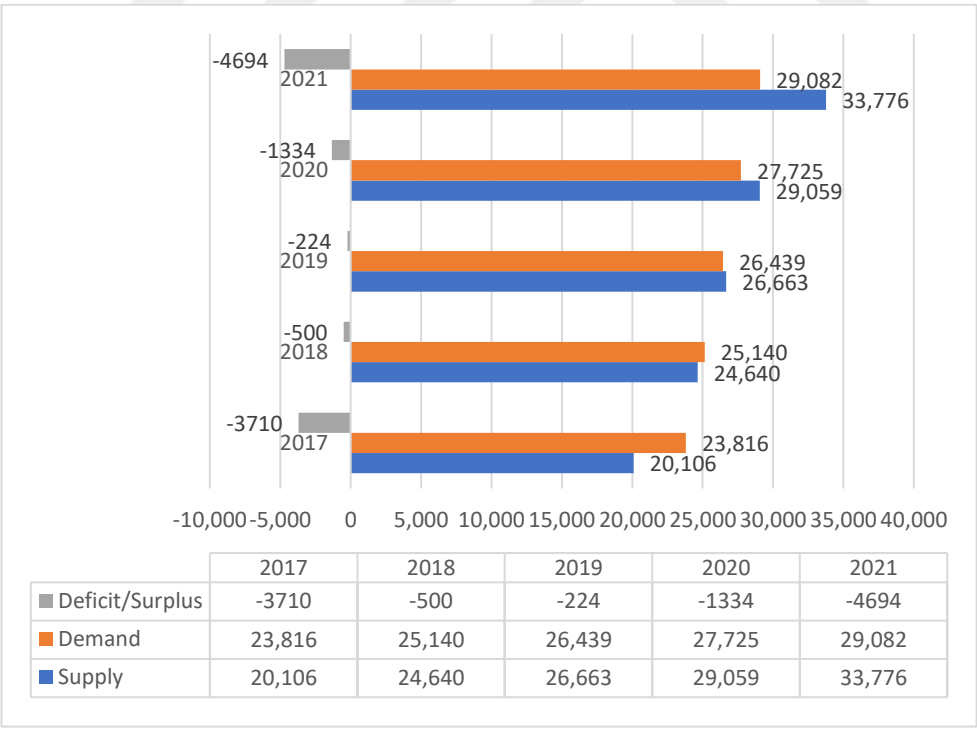
With the commissioning of current energy projects in the country the total power generation capacity has touched 25, 374 MW. There is still an enormous electricity supply and demand gap in Pakistan. Data from Table 7 reveal the widening of this gap in the last few years. NEPRA (2016) reports the electricity supply and demand gap from 2012 to 2016 which is revealed in the following figure 7. Whereas Figure 8 anticipates a continuation of the trend till 2018 (NEPRA, 2016). In the meantime, electricity prices have increased drastically making it difficult for industrial as well as domestic consumers to afford (Malik, 2012).



	2012	2013	2014	2015	2016
Deficit/Srplus	-6620	-4427	-4406	-5201	-5298
Electrcity Demand	18,940	18,827	20,576	21,701	22,559
Electrcity Supply	12,320	14,600	16,170	16,500	17,261

Figure 7-Electricity supply-demand gap 2012-2016

(Source: NEPRA, 2016)



	2017	2018	2019	2020	2021
Deficit/Surplus	-3710	-500	-224	-1334	-4694
Demand	23,816	25,140	26,439	27,725	29,082
Supply	20,106	24,640	26,663	29,059	33,776

Figure 8-Anticipated electricity supply-demand gap 2017-2021

(Source: NEPRA, 2016).

The main cause for energy crisis and power deficiency is the overall energy mix of the country which is highly dependent on natural gas, oil and LPG which makes 78.8% of the overall 70.3 million tonnes of oil equivalent (MTOE). As shown in figure 9 the proportion of the other primary energy supplies include hydroelectricity 11%, Coal 7%, Nuclear 2%, Imported Electricity 0.15%, LNG imported 0.67% and renewable energy resources 0.27% (NEPRA, 2016).

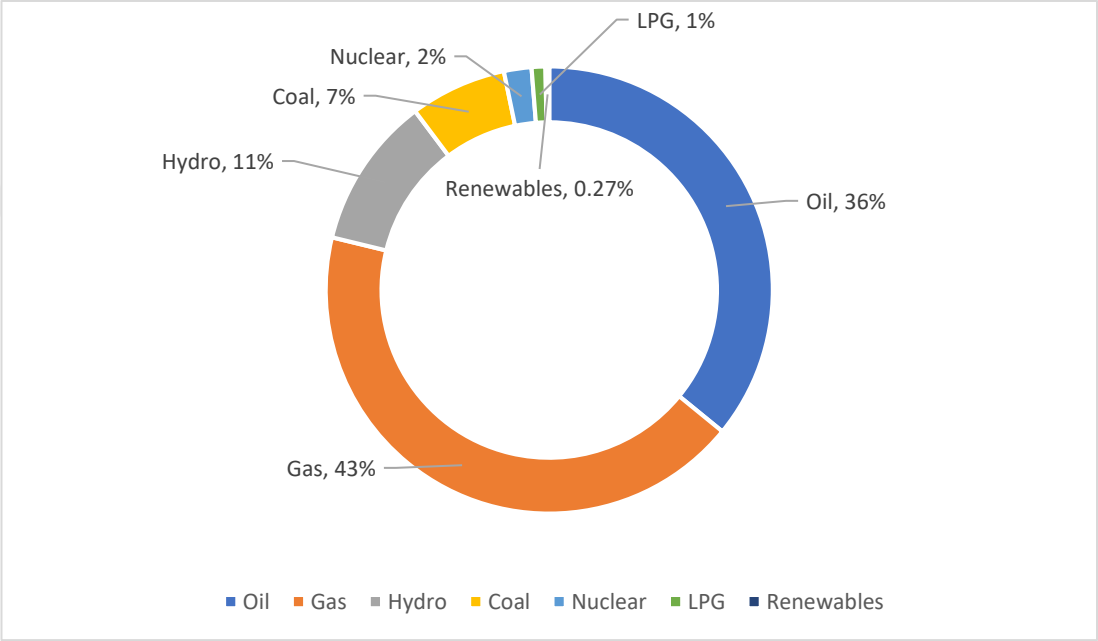


Figure 9-Primary energy supplies by source type in the energy mix

(Source: NEPRA, 2016).

Zakaria and Bibi (2019) in their investigation opine that high economic growth rates are enjoyed by all South Asian countries including Pakistan. As per World Bank data (2015), India has the highest economic growth rate with 7.57% (GDP growth rate) in the region followed by Bangladesh (6.55%) and Pakistan (5.54%). The high economic growth rate has ultimately led to increased energy consumption and CO2 emissions in the region. India is the highest energy consumption and carbon emitting nation in South Asia while the lowest include Pakistan, Sri Lanka, Afghanistan, Nepal and Bangladesh. Over the years with increasing energy consumption in South Asian region pollution has also emerged as a significant challenge as 2.4 million people are estimated to die due to air pollution in the South Asian countries. The energy consumption in Pakistan declined due to energy shortage in the last few years (Zakaria

and Bibi, 2019). At present many South Asian countries have higher per capita energy consumption as compared to Pakistan as demonstrated in the Table 8 (IEA, 2018).

Table 8-Comparison of South Asian countries per capita energy consumption (Source: IEA, 2018).

Official Name of the Country	Electricity Consumption/Pop (kWh/per capita)
Republic of India	920
Democratic Socialist Republic of Sri Lanka	630
Islamic Republic of Pakistan	500
People's Republic of Bangladesh	350
Federal Democratic Republic of Nepal	170
The Islamic State of Afghanistan	119.8

Based on International Energy Agency Report (2017) 51 million people in Pakistan are estimated to have no access to electricity. Pakistan's electrification rate remained 74% with (90% urban and 63% rural population) in 2016. Following Table 3 presents the comparison of electricity access in the main South Asian countries (IEA, 2017).

Table 9-South Asian Countries Electricity Access in 2016 (Source: IEA, 2017).

Official Name of the Country	**Electrification Rate in Percentage (%)**	**Urban Electrification rate in Percentage (%)**	**Rural Electrification in Percentage (%)**	**Population without access to electricity in Millions**
Republic of India	82	97	74	239
Islamic Republic of Pakistan	74	90	63	51
People's Republic of Bangladesh	75	90	67	41
Federal Democratic Republic of Nepal	77	97	72	7
Democratic Socialist Republic of Sri Lanka	100	100	100	0

According to the World Bank estimates South Asia is believed to have accommodated one-fourth population (24.89%) of the world. India is foremost with 1.342 billion people, followed by Pakistan with 0.196 billion and Bangladesh with 0.164 billion (WB, 2019). The South Asian region has a collective $2.6 trillion Gross Domestic Product (GDP). It is also observed that the South Asian region will observe increase in population by 0.4–1.9% over time (WB; Gouranga, 2014). This rapid population growth will have 7.4–7.6% annual increase in the energy demand (Sankar, 2005; Parikh et al., 2013).

According to studies a large number of South Asian population has no access to electricity as revealed in Figure 10 (Anoop et al., 2013). Asian Development Bank estimates more than 700 million people in Asia and Pacific live without access to electricity (ADB, 2019). In South Asia those with access to electricity confront with electric supply issues. Due to the poor quality of electric supply lines there are 5-8 hours per day power outages in both rural and urban areas. These consistent power shutdowns in this region has serious repercussions for the economy. Economic losses suffered as a result of power closures in different parts of South Asia (Anoop et al., 2013).

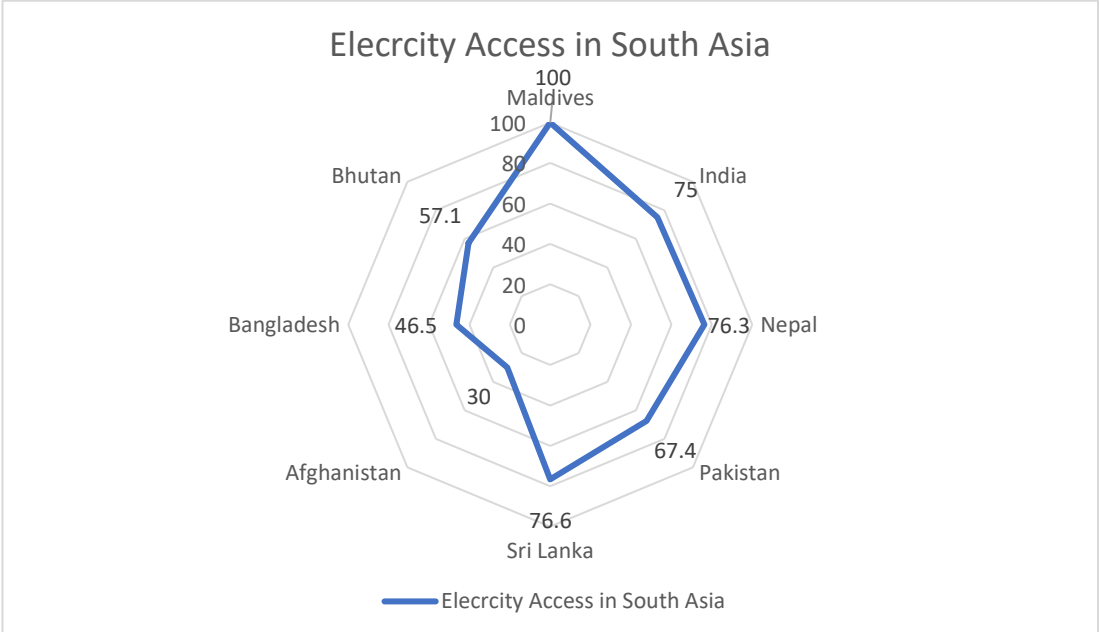


Figure 10-Electricity access in South Asian countries

(Source: Anoop et al., 2013)

Table 10-Economic Damages as a result of Power Shutdowns in various South Asian Countries

Sr. No	Country Name	Economic Damage (%)
1.	Nepal	26.95
2.	Bangladesh	10.56
3.	Pakistan	09.16
4.	India	06.62
5.	Afghanistan	06.49
6.	Bhutan	04.33
7.	Sri Lanka	03.00
8.	Maldives	00.00

Parikh et al., (2013) have stated the factors that become an obstacle in the efforts to improve availability and access of electricity in South Asian countries including deficiency of investment in generation, fuel accessibility problems for power plants, grid extension and worse financial condition of the energy sector (Parikh et al., 2013). Moreover, Saeed et al., (2016) refer to security concerns (internal and external), old power systems, inadequate fuel resources, deficiency of capital investment, deteriorating economy, circular debt and administrative flaws as reasons influencing the power industry in the South Asian region (Saeed et al., 2016). Mahmood et al., (2015) and Mahmood et al., (2016) have pointed out soaring energy prices, low affordability of energy wastage and losses, deficiency in institutional frame work and bad policy, along with random demand and consumption patterns as some of the key factors affecting advancement of energy in South Asia (Mahmood et al., 2015 and Mahmood et al., 2016).

Continuous and uninterrupted electricity supply remains the foremost aspect, due to which the developed nations attained socio-economic growth. South Asian countries are energy resource rich to encounter their energy demands. Still, due to the several issues discussed earlier, an uninterrupted and continuous power supply in the South Asian countries is till now a dream awaiting reality. In the South Asian states, there are concentrated efforts made by the respective countries to realize this goal to uplift their socio-economic profile.

Pakistan's industry has suffered a lot due to interrupted power supplies which has led to huge economic sufferings in the country in the last decade. As in 2008, another disappointment faced by the industrial consumers who were already facing a shortage of electricity to run their businesses when the government of Pakistan announced a 75% increase in the commercial tariff from 5 to 7 rupees per kWh to 14 kWh for the industrial sector. There was also an increase in the tariff for domestic users from 5 to 7 rupees per kWh to 8-10 rupees per kWh. This led to a devastating financial crisis and helplessness to supply electricity using furnace oil by K-Electric (Karachi Electric Supply Company), who was the key electricity provider to twenty million people of the biggest city of Pakistan-Karachi. The study further observes the issue of load shedding in 2011-12, from 8 to 10 hours daily in the metropolitan areas whereas 20 hours in the rural areas thus significantly affecting the economic growth of the country (Subhani et al., 2012).

According to PIDE (2012), there was a total shortfall of more than 6000 MW which led to limited industrial production activities in the country. Predominantly, energy exhaustive industries suffered the most due to this situation. These industries include Petroleum, Steel and Iron, all engineering industries. This also led to 0.2 percent decrease in GDP growth during the fiscal years 2010-11 and 2011-12 (PIDE, 2012). With the decrease in the total output of the energy-intensive industries in the country due to shortage of power, overall progress and development of the country got affected adversely (Kessides, 1993). In 2014 the price of crude oil fell down from 11,298 rupees per barrel (December 2013) to 6, 112 rupees per barrel (December 2014), almost half of its previous price (Indexmundi, 2014). Similarly, the 2012 country statistics for Pakistan disclose that the country had an annual electricity consumption of an insufficient 74 billion kWh and consumption per capita remained 456.64 kWh which was lowest in the world at that time (Indexmundi, 2012).

According to the State Bank of Pakistan (SBP) report (2013-14), Pakistan has failed to achieve its energy demand by utilizing conventional fuels and still counted among the ten most energy-deficient countries in the world. There are certain internal flaws in the distribution network of the country which is not capable of transmitting more than 15,000 MW. The study reveals that at present, the main obstacle is distribution not generation. The country does not possess an effective distribution network to

dispense power across the country (SBP, 2014). Therefore, the total installed capacity in the country is larger than the actual generated energy whereas the actual generated power is less than the demand by different sectors (IAEA, 2018). The acute energy crisis faced by Pakistan is causing a massive loss to the economy and is a significant obstacle in the overall development of the country. The industrial sector has been severely affected, curtailing the export potential of Pakistan. Additionally, it has emerged as a catalyst factor in social unrest and disaffection.

Overcoming the energy crisis is therefore, a top priority of the government. In the government of Pakistan, Vision 2025, energy (along with water and food security) has been identified as a vital factor for socio-economic development of the country. The government has pledged to double power generation to 45000 MW and vows to provide uninterrupted, affordable and clean energy for all. The government plans to enhance electricity access from 67% to 100% (GOP, 2014).

4.6. Energy Justice

Sovacool et al., (2017) explained energy justice as "a global energy system that fairly distributes both the benefits and burdens of energy services and one that contributes to more representative and inclusive energy decision-making" (Sovacool et al., 2017). Hernández (2015) has argued utilising four fundamental rights to ensure energy justice which stands as crucial. These four essential rights include the availability of best energy infrastructure, affordable energy, healthy and sustainable energy production, and uninterrupted energy service. (Hernández, 2015).

Energy justice is an evolving and highly context-dependent concept. As a concept, energy justice assesses the emergence of injustices in different sections of society, which are ignored and affected. It also evaluates the processes in practice for remedial purposes in order to expose and reduce such injustices (Jenkins et al., 2016). In order to understand energy justice, different dimensions are considered, including ethics, morality, and justice.

Energy systems around the world have developed as more complex with highly centralised, fossil fuels-based power plants along with the recently emerging social and moral frameworks added to manage them. Every dimension of an energy system is observing a change in terms of the utilization of energy sources, types of grids,

energy governance structures. With all these rapid changes, there are prospects for social well-being, economic advancement, and environmental sustainability. Therefore, there is a need for a "justice-aware" energy policy. (Sovacool et al., 2017). In usual policymaking practices, the planners mostly depend on technology and economic considerations for the provision of solutions. Most of the resolutions lie deeper in socio-political and cultural problems faced by the individuals.

A justice approach to energy in this sense will be that the energy systems in a country are typically the mechanisms of resource extraction that exhaust resources (fossil fuels) available for the future generations and use them for the present ones. There are positive attributes of energy system related to useful consumption for societal good, but there are specific segregating points that are related to some negative externalities of the energy production where those people are excluded through the unfair decision making through policies (Jenkins, 2016). Consequently, energy justice applies the principles of "justice" to energy policy, production, consumption, systems, activism, climate change, and energy security.

After thoroughly reviewing the energy policies developed in Pakistan, Mirjat et al. (2017) believed that they are prepared with more economic and technical dimensions, moderately outlining human and social aspects (Mirjat et al., 2017). Environmental aspects are also ignored at times resulting in environmental degradation in the country, which ultimately fails in the development and achievement of Sustainable Development Goals (SDGs). Many scholars (Guruswamy, 2010; Hassan et al., 2018; Asif and Saleh, 2019; Siddiqi, 2019) in their assessments have pointed to the "injustices" in the energy systems, structure and policymaking of Pakistan.

The energy justice approach places the 'just approach' in a society (Sovacool, 2014). Energy policies in Pakistan seem to be aligned with the social and behavioural dimensions to energy use as they relate to sustainable development goal no 7, affordable and clean energy for all. They have well-written objectives to ensure access to affordable, reliable, sustainable, and modern energy for all. Whereas there is an observed inadequate and unstable energy access through unbalanced energy supply, which has serious implications for overall development and growth. Though the country's energy system has observed noteworthy expansion in current years still 51 million people, have no access to the grid (IEA, 2017). The country is also behind

many South Asian countries in terms of urban and rural electrification. Bangladesh (Urban-90% and Rural 67%) and India (Urban-97% and Rural 74%) in the South Asian region have attained an impressive electrification rate (IEA, 2018).

Access to clean cooking facilities (fuels) is considered as another facilitator of community development in a country. Lowering of expenditures and the inconvenience of utilizing polluting fuels for cooking purposes can be attained through access to clean fuels. Nearly 130 million people in Pakistan are clean cooking fuels deficient. Subsequently, resorting to environmentally polluting and unclean fuels such as coal, biomass and kerosene. There are annually 2.8 million premature deaths due to the usage of dirty fuel (biomass and coal) (IEA, 2017). This huge reliance on biomass and coal is a considerable concern for the policymakers as these polluting fuels have improved "household air pollution (HAP)" in the country due which respiratory problems and the rate of mortality in children has significantly increased (Naz et al., 2017). Besides the affordability issues of the clean cooking facilities in the country, there are challenges of energy infrastructure. According to the World Energy Outlook Report (2017), a 20% population above the poverty line in the country has no access to electricity (IEA, 2017). Electricity access for the entire community is a prerequisite for development, well-being as well as for attaining energy justice (Islar et al., 2017). In its absence, other targets does not seem realistic, like security and quality of energy.

Pakistan's power sector has suffered from common vulnerabilities like power cuts and interruptions. There is a persistent demand-supply gap in the energy system of the country. During peak hours, frequent power cuts and interruption resulted in 8000MW electricity shortfall and 6-14 hours load-shedding across the country. Based on these stark realities, Pakistan is ranked 115 amongst 137 countries in terms of the consistency and reliability of the electricity supply (Schwab, 2018). There is an increased generation capacity in the power sector of the country due to multiple energy projects in the country and power shortfall in the urban parts has been recovered to a more considerable extent. It is still a daunting problem for the rural parts of the country where most of the population resides. According to the news report (2019), the total production remained 9800MW, and the demand was more than 12500MW (Daily Times, 2019).

There have been concentrated efforts by the successive governments in Pakistan to increase the generation capacity to address the demand-supply gap. This generation capacity addition does not make the power sector as resilient in the wake of multiple other challenges like the transmission and distribution (T&D) losses. The country's T&D system is old and unable to transmit more than 19,000MW of voltage (Ebinger and Hasnie, 2010). There are several other problems in the energy system of the country, including an overdue dependence on imported (expensive) fossil fuels, a highly centralised energy network (national grid), a high share of technical losses and problems of circular debt.

There are social and environmental costs of the GOP policies to shift to cheaper fuels like coal and LNG sources in order to address power shortfalls. Most of the LNG will be imported, thus having heavy costs for the already fragile economy. Coal share in the power production is predictable to rise to 25% which will be helpful in the reduction of the cost of electricity generation (IEA, 2019). On the other side, there are environmental and health impacts of the energy system transformations as the CO2 intensity of coal is the highest (52 kg CO2/kWh). Therefore dangers of effects on air quality are quite evident as the GHG emissions are expected to rise in the country to "260.13 and 338.92 Mt" with the gradual increase in the coal-based production (Ur Rehman, 2020).

Energy availability is not the only concern for human well-being; therefore, energy justice debates also take affordability of available energy as another significant area of concern (Moore, 2012; Middlemiss, 2016). Following the heavy reliance of Pakistan on expensive fossil fuels, instability of fossil fuels prices globally together with issues of transmission and distribution network losses there are distinct challenges to the efficiency of the prevailing energy system in the country. The energy mix of the country is heavily dependent on expensive thermal fuels like natural gas and oil, leading to 81% of the total supply of energy in the country (NEPRA, 2019). According to a study by Fatima and Nasim (2019), total thermal based power generation of Pakistan was "67.4%" of which natural gas-based generation was "54%" and oil-based generation remained at "46%." The GOP initially absorbed the cost of thermal production in the form of power subsidies and later passed on to the consumer in higher electricity prices (Fatima and Nasim, 2019). Pakistan's most of the oil, natural gas and

LPG requirements are met through imported fossil fuels which are very expensive (GOP, 2017). This situation unfavourably disturbs the obtainment of energy for the public as the cost becomes very high which is also against the rules of justice and equality in society. Due to the price hike, the energy services are becoming expensive in the country thus making the "household's fuel poor" in Pakistan. As the current average income in Pakistan is Pakistani Rupees (PKR), 15,000 and the expenditures exceed the 10% threshold in terms of energy services despite governmental subsidies on gas and power (Zhang, 2018). This evaluation is based on Boardman's Ten Percent Rule (TPR) (1991) on energy sources affordability which considers households as "fuel poor" if they spend 10% or more on the disposable income on energy services (Boardman, 991).

In addition to the problem of high rates of energy and expensive production costs, there are other such issues of power losses of electricity and gas due to technical problems, theft and transmission and distribution (T&D) losses which ultimately results in the higher cost of energy. Due to technical losses and energy theft, around 20% of electricity is lost in the energy network of the country (Bhatti et al., 2015; Zhang, 2018). These losses to the existing energy network of the country have led the country to the problem of circular debt (Zameer and Wang, 2018). The GOP pays to the power companies for the provision of subsidies to consumers which becomes problematic for the government. The ultimately leads to late payments which affect the entire supply chain of the energy system in the country, thus leading to the disrupted power supply, load-shedding and many other associated problems.

A fossil fuel dominated energy system like Pakistan is prone to environmental problems like climate change and its associated risks. According to USAID (2016), Pakistan's energy sector is considered as one of the most significant contributors to Green House Gas (GHG) emissions. GHG emissions increased by 123% during the years 1994-2015 in the country (USAID, 2016). Moreover, the country is also amongst the top 10 vulnerable nations to climate change and its associated effects (Chaudhry, 2017). The country is the fifth most vulnerable to climate change effects during the last two decades. Pakistan lost 9,989 lives, grieved over economic losses worth $3.8 billion and observed 152 extreme weather events from 1999 to 2018 (Eckstein, 2020).

Irrespective of the prevailing environmental situation in the country, CPEC energy projects 70% additional capacity will mostly come from the coal-powered generation plants thus increasing the share to more than 30% by 2025 (GOP, 2017). All these developments in the power sector and other sectors will raise the emissions further. There are a plethora of challenges faced by the people of Pakistan as their fundamental rights to have best energy structures, affordable energy, healthy and sustainable production of energy are often overlooked in particular policies (Coal) and energy structures which lead to multiple energy injustices like lack of clean cooking facilities (Fuels), uninterrupted energy services. Different segments of society suffer due to these injustices, like women and children health issues are emerging due to unclean fuel practices in rural areas. Further research and development interventions, plausible policies and energy literacy programs can help towards energy injustices mitigation.

The following chapter will provide an in-depth analysis of an aspirational vision for the country with its focus on energy security as envisioned in this plan. The national vision 2025 of Pakistan is an integrated plan of action to achieve national goals and aspirations through effective strategy and road map.

CHAPTER 5: PAKISTAN'S VISION 2025: ONE NATION-ONE VISION

"Vision 2025: One Nation-One Vision" –is an ambitious outlook for Pakistan and the dream project of the government of Pakistan. It is a national vision that provides certainty about a shared vision of the future for the country. It has numerous advantages for the citizens, as a single policy document that could help in connecting various projects, past and present, to bring Pakistan to a universal platform of progress and prosperity. It will help in moving with the universal trends of sustainable development and create a positive impact in the lives of all sections of Pakistani people - rural and urban, young and old. This chapter will discuss key features, implications, and challenges of Pakistan's national "vision 2025," for the achievement of energy security. Followed by an analysis of the CPEC energy initiatives in this regard and an analysis of the semi-structured In-depth interviews.

5.1. Introduction

The Government of Pakistan (GoP) launched the Vision 2025 in 2014. Pakistan has been facing several challenges since there existed no roadmap for long-term development in the past. Therefore, the national vision 2025 aims at a collective vision for the nation. It notes political stability, continuousness of strategies, peace and security, the rule of law, and social justice as a critical catalyst of national development. There are long-term aspirational targets, frameworks, and priorities, as well as challenges and prospects in the national vision 2025 of Pakistan. The concept represents an aspirational destination for Pakistan. It will serve as a crucial guideline for the development of an effective strategy and direction to reach national goals and aspirations. Vision 2025 carries a roadmap for 2025 and beyond. It aims at realizing the first of the three development phases: Starting with 2014-25: in which the focus is on reviving growth, strengthening Pakistan's developmental foundation to become a top 25 global economy. In the second stage 2025-35: purposes attaining regional and global leadership in key target sectors leading to upper-middle-income country status. While at the third stage 2035-47: the target is of becoming the top ten global economy and a fully developed economy.

5.1.1. Seven Pillars of Vision 2025

The vision 2025 is a 12-year plan, which has identified seven pillars of development. It has set quantitative targets against each component. The concept envisages putting people first through human development and social capital; achieving continuous domestic and comprehensive progress; improving governance structures through restructuring of institutions and transformation of the public sector; water, food, and energy security; investment in private sector & promotion of entrepreneurship activities; establishing a viable knowledge-based economy and updating infrastructure for transportation and more enhanced regional connectedness (Hassan et al., 2016; Zafar and Shakir, 2016; Khawaja, 2018). Figure 11 below demonstrates the seven pillars and their aims.

The process of the vision is built upon the largely successful pursuit of the global declaration and partnership of committed nations to reduce extreme poverty, and with a deadline of 2015, eight time-bound targets were set identified as Millenium Development Goals (MDGs) (Planning Commission, 21014). These MDGs were a launching pad for The twelve-year strategy, having seven pillars, was prepared and presented by the Pakistan Muslim League (Nawaz)-PML-N government in early 2014 and had four and a half years to work on achieving its targets. This plan groups several quantitative targets under each pillar. Khawaja (2018) further observes that "over a third of the goals should have been met by the end of the PML-N's tenure in May 2018." (Khawaja, 2018). Therefore, the next government in power Pakistan Tehreek-e-Insaaf (PTI) is responsible for taking the vision further to its realization, which has met certain targets.

Figure 11-Pakistan's national vision 2025 pillars

(Source: Planning Commission, 2017).

The first area of focus of the vision involves seeking investments in health, education and social development, opening new avenues for youth and creating jobs. The first pillar caters to a considerable increase in education level and its quality. There are international study scholarships proposed for human resource development (HRD) to meet the objectives. The second pillar of the vision emphasizes the revival of

sustainable growth through investment, keeping in view equity and environmental considerations. The ambition is the provision of better living conditions to all Pakistani citizens regardless of their caste, color, creed, domicile, religious and political association. The third sector concentrates on the institutional strength of parliament, judiciary, police and the civil service for ensuring good governance. The purpose is to have a transparent and efficient government operating under the rule of law, administering the people's security (Planning Commission, 2017).

Water, food, and energy serve as the fourth pillar of the Vison which believes in the adequate, dependable, clean and cost-effective availability of these vital sources. Food, water and energy security indispensable for sustainable economic growth and development. Then the fifth pillar aims at entrepreneurship and private sector-led growth. This purpose is turning the country as a highly attractive place for private sector investment through the development of small and medium-sized enterprises (SME). Next in the row is the development of a knowledge economy through contributions in the factors of national competition in skill development, information and communication technologies and indulging in global market activities. Industry-academia relationships will be enhanced to lay the basis for a knowledge-based economy. Significant for growth and development, though mentioned at the end, the establishment of the modern system of transportation and achieving more regional connectivity holds great significance for Pakistan as it has a tremendous geographical setting for being at the link of four most active world regions including China, Central and South Asia and the Middle East. An integrated and efficient transportation system is essential for the progress and prosperity of Pakistan as well as for regional dynamism (GOP, 2014).

Pakistan’s 2025 policy framework covers several extraordinary targets and aims. The vision provides an evident direction to the people of Pakistan in their struggle to become a developed nation. Awareness and acceptance of the vision by the people of Pakistan can lead the nation towards the realization of the goals set in the document (Afzal Humayon et al., 2018). However, in the current situation, the country is far from achieving all the targets enshrined in the vision. Few sectors received foreign Direct Investment (FDI) through CPEC $45million investments in energy and other

infrastructural development (Abid and Ashfaq, 2015; Markey and West, 2016; Ali et al., 2018).

5.1.2. Vision 2025: Food, Energy and Water Security (An Opportunity Towards Sustainability)

The agenda of the Vision 2025 engages the nation in seven priority areas accomplishment termed as "Pillars" and "Water, Energy and Food Security" serves as the fourth pillar. It primarily focusses on the sustainable growth of agriculture and food sectors along with allied subsectors. Pakistan has demonstrated commitment to sustainable economic growth and development through clean, cost-effective, reliable, and adequate availability of energy, water, and food through the vision. In past years, these sectors suffered a lot in the country due to the lack of integrated policy and execution. There are different problems faced by agriculture, which has been complicated by climate change, and the same goes for water and energy accordingly. Therefore, the government is committed to meet these gaps through new investment, national consensus, and appreciation of public and private partnerships in conservation and efficiency of energy and water (GoP, 2014). It is an acknowledged fact that cheaper and sustainable supply of energy not only bring success for the nation at larger but also support in eradication of poverty through various direct and indirect networks.

Pakistan's national vision 2025, accepts energy security as a nationwide challenge, purposes to accomplish the United Nations "Sustainable Development Goal 7," "Ensure access to affordable, reliable, sustainable, and modern energy for all" by 2025. The seventeen Sustainable Development Goals (SDGs) by the United Nations 2016-2030 associated to each other as the accomplishment of one rest on others. Each of the United Nations' (UN), SDG has its relative significance for developing country like Pakistan as it provides a particular direction for development (Mallick, 2017; Cho et al., 2018). Access to "affordable, reliable, and sustainable energy" is crucial to reaching most of the Sustainable Development Goals–from "poverty eradication" through developments in education, water supply, health and industrialization to climate change mitigation efforts. The cumulative effect of all these could be the attainment of global values of Justice, Peace, stable Institutions, national and international partnerships (Islar et al., 2017). Cho et al. (2018), while discussing the the SDG development in Pakistan, opines that the country is performing comparatively

fine concerning Sustainable Development Goal-7 on “affordable and clean energy” and Sustainable Development Goal-13 on “climate action,” compared to other lower-middle-income countries. It equates with the upper-middle-income countries according to the available data. Moreover, Sustainable Development Goal 17 on “partnerships for the Goals,” and Sustainable Development Goal 15 on “life on land,” it can be associated with the lower-middle-income countries (Cho et al., 2018). Whereas, there is still a great need and the requirement to do more for attaining sustainable development goals (SDGs) in Pakistan.

Pakistan was among the first countries to endorse the Sustainable Development Goals 2030 agenda, and in 2016, the parliament approved them as a national development agenda (SDGs, 2019). The adoption of SDGs by the government of Pakistan also connected the country with the United Nations Framework Convention on Climate Change (UNFCCC)’s. Pakistan participated in the Conference of Parties (COP-21), Paris, France, where Intended Nationally Determined Contributions (INDCs) for curtailing fossil-fuel carbon emissions from the economic processes were submitted by each country (Conference, 2019). The Government of Pakistan developed a National Action Plan (NAP) on Sustainable Development Goal 12 (SDG12), which is Sustainable Consumption and Production (SCP). Sustainable consumption and production (SCP) aim at the promotion of resource and energy efficiency, sustainable infrastructure, and providing access to essential services, green and decent jobs and a better quality of life all across the country. SDG targets are closely aligned with the SCP goals as it also focuses on the increase in the share of Renewable energy in the energy mix (GOP, 2017).

Pakistan faced the worst ever shortfall of electricity supply across the country since the year 2007, whereas the increasing dependence on expensive imported thermal resources is an increasing phenomenon since the 1990s. These changing trends have led the country into various problem like slow economic growth and rising climate change concerns but the policy planners still insist on expensive and imported fossil fuels to meet the energy requirements (Amer and Daim, 2011). Increasing the requirement of hydrocarbons cannot address the goals set in the national vision 2025 and subsequent RE policies enforced from time to time in the country. Pakistan, with its growing population, requires an abundance of energy for its sustainable

development and growth. However, the government efforts of producing power from renewable sources that are sufficiently available need to be ameliorated as the country is presently among the top ten countries facing a severe energy crisis.

The UN sustainable development goal No. 7 focuses on affordable and clean energy. According to the International Energy Agency (IEA), 2017 analysis, 1.1 billion people across the globe do not have access to electricity, let alone affordable or clean (IEA, 2019). According to the World Health Organization (WHO), about "3 billion," lives depend on wood, coal, charcoal, and animal waste to make food and heat (WHO, 2018). Also, electricity and energy are the most significant patterns of climate change and they are responsible for about fifty percent of the worldwide green gas discharge (Akpan and Akpan, 2012). By the year 2030, the United Nations (UN) would like to double the universal rate of energy efficiency and secure world-wide access to affordable, dependable and modern energy services. Their mandate also includes the expansion of infrastructure and upgrade technology for supplying new energy services everywhere (SDG, 2019). In order to attain energy security and accessibility, the supply of power is significant for the viability of the contemporary world. Unceasing exploitation of conventional fossil fuels is set to provoke multiple threats: decrease of conventional fuel resources, ecological issues, geopolitical, global warming, armed clashes, and sustained as well as vital fuel cost increase. An alternative power policy is a resolution to the soaring power demands. Alternative energy technologies (AETs), including hydro, wind, solar, biomass, and wave/tidal energy, are abundant, unlimited and eco-friendly (Asif and Muneer, 2007). Kyoto protocol deals with climate change since 1990 and advocates the reduction of CO2 production on a secure level (K. Protocol, 1997), which is a quite severe concern for the South Asian region confronted with climatic change and rising greenhouse gasses challenges.

Pakistan heavily relies on importing fossil fuels to meet its energy needs like many other nations in the world. The country's energy landscape disregard a balanced approach to evolving tasks of a protected, reliable and sustainable access to energy with its obvious essential limits in the development of energy supply and policy-making process (Asif and Saleh, 2019). Presently, several projects related to the wind power plant and solar PV technologies are operational and under the developmental stage in the country to reduce energy challenges (Yousuf et al., 2014.). Available

details reveal that the geothermal energy resources have been continuously neglected by the (Power Division) Ministry of Energy (Zaigham et al., 2009). The study also reveals that there is minimal production of electricity from geothermal energy technologies in Pakistan despite having massive potential. Pakistan's energy policy focuses on the implementation of a vast number of wind energy, biomass, and solar photovoltaic projects in urban and rural areas of the country. There is still a need to take more rigorous initiatives towards the development of renewables in the country. The renewable energy policies, if appropriately implemented, can adequately support the decentralization of the energy to the rural areas as well as supply to the national grid of Pakistan. The GOP is moving in the right direction by focusing on utilizing renewable energy resources in its current electricity infrastructure to address the energy shortage. There have been some success stories in this regard so far, like Pakistan in new hydropower installed capacity ranks third in the world with only 535 megawatts (MW) addition in 2018 (IHA, 2019).

The transformation of the energy system in Pakistan is at the core of resolution to global warming problems, as well as air pollution and energy security perspectives hold equal significance as these arguments will define how this transition will take place. The effective use of RE technologies can help to improve the economy, global climate change, and air pollution issues. The rigorous implementation of RE technologies in Pakistan will pave the way for the effective implementation of SDGs. Energy security is a crucial issue which has been ignored by subsequent leaderships in Pakistan (Baloch et al., 2019). This research and effort is to assess the use of renewable energy technologies for all across the country.

Along with the discussion on renewable energy technologies utilization in Pakistan, the study also recommends the policies for the adoption of lacking resources like ocean/tidal and geothermal resources for electricity production. Renewable energy technologies adoption in energy policies that will ensure energy security, job creation, reduction of global warming, protection of environment and development. With a rigorous RE policy, Pakistan's dependence on fossil fuels can be reduced through the effective use of RE technologies in the national energy system.

The power crisis in Pakistan is anticipated by the government to finish in the coming years based on the present government energy policies of ongoing renewable energy

projects. With these projects, there are emerging hopes of 2732 MW surplus power generation by 2019 (NEPRA, 2019). Today there is an observable turmoil in the whole world due to their energy needs, and energy security has become an essential security issue these days. To acquire energy from one thing that is the whole thing going on and developing countries like Pakistan have particular needs and these needs are much higher than the indigenous production potential. So the country's dependence on outside sources is very high (Anwar, 2016). Although Pakistan is located within the oil hub in the sense that all the oil exporters are around Pakistan. The country has not been prosperous in finding that quantity of the oil that could make it self-sufficient (Zahidi, 2010). While going through the energy potential of Pakistan, the country does not just have one source; it has a lot of mineral resources such as coal, oil, gas, water, wind solar, geothermal, tidal wave, and biogas. Although there is news that there is a sufficient quantity of resources and for one reason or the other (no enough financial resources, lack of technology, expertise, political will) they are not exploited to a sufficient level (Bhutto, Bazmi and Zahedi, 2011).

There is a dire requirement for international cooperation and support to uplift the prevailing energy system and infrastructure of the country. Therefore, Pakistan needs global energy collaboration through diversification of energy trade and diplomacy. The vision 2025 also anticipates the increasing demand for energy due to population growth, rapid urbanization and economic growth in the following years. So, there is again a focus on private sector investments for improving the multiple sectors including the energy (Planning Commission 2014). Therefore the Pakistani government has intensified efforts to obtain Foreign Direct Investment (FDI) from various nations around the globe in different sectors, including China, the United States, Japan, Norway, the United Kingdom, Hong Kong, Saudi Arabia, and Switzerland. Among the other targeted sectors power and energy sector is considered as the most important one, and the others include construction, transport, financial business, trade, and textile. According to the reports of the government a higher amount of FDI is received by the power and energy sector of Pakistan (PESP) being one of the major sectors for investors (GOP, 2018). Recently, the Government of Pakistan (GOP) has announced a new power policy and offered different incentives for encouraging domestic and foreign investors to invest in the power and energy sectors (Latief. and Lefen, 2019).

In this regard, a significant foreign direct investment (FDI) in the energy sector and as well as in the RE sector in the country is made by the leading plan of Chinese Belt and Road Initiative (BRI), China Pakistan Economic Corridor (CPEC) which has also generated economic development in the country (Khurshid et al., 2018). Moreover, the national vision 2025 also projects rapid urbanization in the country around 50–60% and a high GDP growth rate ranging to 8% by 2025 (Planning Commission, 2014). Therefore, this anticipated boost in the country's economic activity and resultantly rapid urbanization will derive more demand for fuel and energy at an exponential rate. Thus such projects are considered in line with the vision plans and aspirations.

Hali et al., (2015) in their work deliberate that CPEC's main objective is to link the deepwater port of Gwadar (Baluchistan), on the southwest coast of Pakistan, to Xinjiang in the west of China, through a series of energy infrastructure, transport routes, and communication networks (Hali et al., 2015). The entire project of CPEC is envisaged to cost $57 billion (The cost may go up with gradual development), with the considerable amount being financed by the Exim Bank of China and China Development Bank in shape of heavily subsidized concessionary loans (Hussain, 2018). Many studies delineate the significance of CPEC for both China and Pakistan due to multiple reasons. Presently, more than 70% of trade by China (mostly 70-85% of its energy supplies) is done using the Indian Ocean. This Indian Ocean route passes from pirate-swarmed "Strait of Malacca (Malacca Dilemma)." The Indian and U.S. navies watch the route. In case of any conflict, the energy supply to China can easily be cut off (Makhdoom et al., 2017; Ibrar et al., 2018).

Gwadar port lies at the convergence of three regions, namely the Middle East, Central Asia and South Asia. This geographic location suits Chinese interests. The time, cost and security of the Chinese energy supplies can easily be ensured. At present, the port is being transformed into one of the world's most extensive transit and transshipment cargo facilities. Gwadar port's significance is determined out of its proximity to a strategically cardinal "Strait of Hormuz" as well, which is a mostly Maritime route to oil-rich countries. Its connection with the Chinese city of Kashgar is established through Pakistan via the Karakorum highway route that manifests almost 2000 km of distance. China is heavily dependent on Gulf oil that provides her approximately 60% of the energy needs, which will be transported through this CPEC route as a shorter,

safe and economical route (Grieger., 2016; Shaikh., 2016; Ahmad, 2017; Garlick., 2018; Li., 2018). The CPEC project significantly reduces the trading route for China by more than 10,000 kilometers, thus lowering shipping costs. China can deliver and receive its products in just ten days compared to the current transit time of forty-five days through this alternative short route. The project as well allows China to avoid any potentially contested channels near Indonesia, India, Taiwan, Vietnam, and the Philippines (Bhattacharjee., 2015; Chowdhary, 2015; Ahmad and Malik., 2017; Ali, 2018). Following Map 1 exposes a long route of energy supply for China through which it transports 54.8% Oil. As an alternative supply route, CPEC would reduce the distance, time and cost of the oil imported from the Persian Gulf and East Africa to a considerable level (Mushtaq, 2018).

Pakistan has a geopolitically significant location at the crossroads of South Asia, the Middle East, and Central Asia. It has borders with Iran and Afghanistan on the west, India on the east, China in the north, and the Arabian Sea on the south side (McCartney and Zaidi., 2019). Map 2 refers to the Proposed China-Pakistan Economic Corridor. The economic corridor like CPEC holds excellent worth in an age of transnational interdependence and cooperation. They are a critical instrument of regional cooperation, development and partnership. These corridors stimulate economic activities with the creation of economic opportunities for all, energy infrastructure (pipelines), telecommunication structure, tourism activities and many other mutually agreed partnerships (Zargar, 2017).

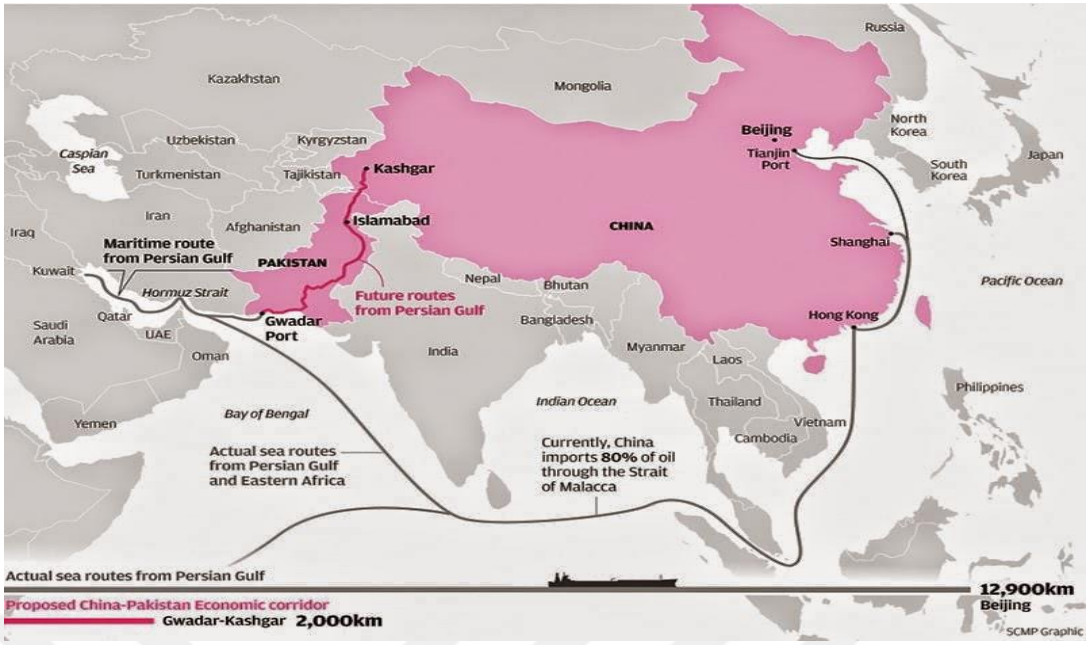


Figure 12- Map 1:The CPEC route versus the Strait of Mallaca

(Source: Mushtaq, 2018).

The energy cooperation between Pakistan and China is at the heart of the CPEC. This collaboration between the two countries is carried through the Joint Cooperation Committee (JCC), which is the framework for supporting the China-Pakistan Economic Corridor (CPEC). Under the CPEC framework, there is an energy group. From the Pakistani side, it is the Ministry of Water and Power, now Ministry of Energy (Power Division) and on the Chinese side is Energy Administration. So, the two countries have a mechanism for the ETCC-ETCC, is a ministerial-level and Energy Group is a Vice ministerial level, so, before JCC, energy group meets and then the proposals and recommendations are sent to JCC for discussion and subsequentially for approval. The joint-JCC plans for energy cooperation and so far, twelve programs have been identified that are also known as early harvest programs (CPEC, 2020). The following section will provide an overview of the CPEC energy projects which are a successful example of energy diplomacy efforts in the entire region.

Figure 13-Map 2:Proposed China-Pakistan Economic Corridor

(Source: Zargar, 2017).

5.2. An overview of CPEC Energy Projects

China-Pakistan Economic Corridor (CPEC) is also termed as the "Pakistan-China Energy and Economic Corridor (PCEEC)". Pakistan is facing an energy crisis and the CPEC carries a notable contribution in the energy sector by putting $35 billion in energy projects out of a total of $45 billion (Shaikh, 2016). CPEC is playing an essential role in all fields like Foreign Direct Investment in multiple sectors like Transportation, Infrastructure Development, Regional Integration, Employment Opportunities, Industrial Parks, exchange of cultures, Tourism. Energy being the leading sector in this cooperation, carries great significance for both China and Pakistan.

According to reports under the CPEC energy initiatives, 6910 Mega Watt capacity power projects have been installed, which have added 3240 Mega Watt of energy to the national grid of Pakistan (CPEC, 2019). Following Table 3 provides details of EPEC Energy projects with their updates.

Table 11- Details of CPEC Energy Projects along with their updates (Source: GoP, 2019)

Project Name and Progress achieved so far
1- Coal-Fired (2×660MW) power plant, Port Qasim, Karachi • Civil works started in May 2015 • Jetty completed, Energization begin in October 2017 and inaugurated in November 2017 • The second unit started commercial operation from 25th April 2018
2- Suki Kinari Hydropower Station, Naran, Khyber Pakhtunkhwa • Land acquisition awarded on 17th Nov 2016 and Financial Close granted on 31st December 2016. • Construction is in the process, Expected to start commercial operation by December 2022.
3-Coal-Fired (2×660MW) power plant, Sahiwal, Punjab • Financial Closed (FC) granted in December 2015 and project completed and connected to the national grid in 28th October 2017
4-Mine Mouth Lignite Coal-Fired (Engro Thar Block II 2×330MW, Thal Nova 1×330MW and TEL 1×330MW) power plants, Sindh, Pakistan • Financial closed awarded in April 2016. • Currently construction in process and expected to complete June 2019.
5-Surface mine (block-II) Thar Coal field • Financial close achieved in April 2016 and IA/EA signed • Mining work starred with an annual capacity of 3.8 MTPA • Expected completion date December 2018
6-Dawood wind power project, Gharo, Thatta • Financing achieved on March 27, 2015 and commercial operations started in April 2017
7-Imported Coal Based (300MW) Power Project, Gwadar • Initially, LOI was issued in May 2017 then extension in validity was made up to November 2018. • The site has been finalized by CCCC and NEPRA's tariff determination is in process
8-Quaid-e-Azam (1000MW) Solar Park, Bahawalpur • Commercial production of 3x 100 MW started in August 2016
9- Jhimpir (UEP) wind farm, Thatta • Financial Closed (FC) achieved on March 30, 2015 and Commercial production started in 16th June 2017
10- Jhimpir (Sachal) wind farm, Thatta • Financial Closed (FC) achieved on December 18, 2015 and Commercial production started in 11 April 2017
11-SSRL (I 6.8 MTPA) Coal Block &SEC Mine Mouth (2×660MW) Power Plant, Thar • Financial Close of Plant and Mine second quarter of 2017. • Mine Commercial production is expected by 2019. • Plant Expected Commercial Operation Date (COD) 2018/2019.
12-Karot Hydropower Station • Land acquisition award did. • Financial Close attained in February 2017 and land was acquired. • Construction (41% civil works completed) in process. • Expected Commercial Operation Date (COD) December 2021.
13-Three Gorges (2nd & 3rd) wind power Project • Financial Close attained in March 2017 and commercial production started in June and July 2018.
14-CPHGC Coal-fired (1,320MW) power plant, Hub, Balochistan • Power Purchase Agreement Signed on 25th January 2017 • Expected Commercial Operation Date (COD) 660 MW Dec 2018, 660 MW Aug 2019
15-Matiari to Lahore (±660kV) HVDC Transmission Line Project • IA initialed in December 2016, land acquisition completed • Agreement signed between PPIB and State Grid of China on May 2018 and expected to complete in March 2021
16-Matiari to Faisalabad Transmission Line Project

• A feasibility study completed and commercial operationalization expected in 2018 / 2019

Table 11 (continued)

Project Name and Progress achieved so far
17- Mine Mouth Oracle (1320MW surface mine) power plant, Thar • Feasibility stage tariff obtained for coal. • Shareholding agreement on new equity partners in the process.

China Pakistan Economic Corridor (CPEC) is a leading project of the Chinese Belt & Road Initiative (BRI), projected by the government of Pakistan as a game-changer for the country's emerging economy (Dadwal and Purushothaman., 2017). CPEC was made known in July 2013 during the Prime Minister of Pakistan's visit to Peoples Republic of China (PRC). CPEC is a long term initiative having a time frame of 2014–2030 (Malik, 2018). There are five main constituents of CPEC. The first one is Gwadar that includes the socio-economic development of Gwadar city as well as the region including the port. Second and the most significant one is Energy (hydro, coal, solar, wind, LNG). The third one includes Transportation Infrastructure (Rail, Road, and Air). The fourth one is Industrial and Investment Cooperation (Free zone in Gwadar and industrial parks). Lastly, any other areas of mutually agreed interest by the partnering countries (Javaid, 2016).

The China-Pakistan Economic Corridor (CPEC) in general and its energy projects, in particular, bring enormous benefits for both Pakistan and China. As in the case of China, in the past foreign businesses were set up in the trade-friendly coastline cities in the eastern sea-front of the country thus leaving the western provinces of China underdeveloped. It is believed that CPEC would help in the development of connectivity of Chinese provinces such as Xinjiang by attracting local and foreign investment through companies setting up their operations in the region as a part of the Belt and Road Initiative (BRI). Likewise, Pakistan will serve as a transit route to connect the western provinces of China to the Indian Ocean and central Asian markets thus reaping collective economic benefits (Grieger, 2016).

The Chinese economy is the second-largest economy in the world. China has emerged as a global leader through innovation and technological advancement in global key technologies like green energy, robots, electric cars and semiconductors. China also has a considerable share of world foreign direct investment (FDI) across the globe. China is observed to be facing the problem of market saturation at home like many

other developed capitalist economies in the world. The domestic need of Steel, Coal, Cement and many other industrial goods have lessened and the Chinese manufacturing giants are overproducing. Chinese "Going Out" strategy responds to their need for accumulation and growth (Harris, 2018). There are so many objections leveled against this grand Chinese scheme of BRI. Regardless of the Chinese motives behind this mega project, observation reveals that China has already financed $300 billion in the BRI partner countries in terms of loan and trade financing (Casarini, 2016).

Besides, as discussed earlier, CPEC carries the excellent potential to make its energy interests secure as China is the world's second-largest importer of oil (EIA, 2018). China imports oil through a very long route of energy supply. It is believed that this initiative of CPEC would reduce the distance, time and cost of the oil imported from the Persian Gulf and East Africa to a considerable level via Pakistan (Zhang, 2011). China and Pakistan relish a cordial relationship from the very start in 1951. CPEC is believed to benefit Pakistan significantly to overcome its various challenges including energy crisis. Cooperation is made under the umbrella of CPEC in four main areas i.e. security and energy concerns, geostrategic interests, shared Economic interest and cooperation (Ali et al., 2017). Pakistan and China relations demonstrate remarkable stability and retain their strategic quality. Both countries share common concerns concerning many issues including their energy security challenges. For the last few years, the country is passing through an intense crisis of energy. The GOP pays 60% of its reserves on importing the fossil fuel that lays an immense load on its economy (Sheikh, 2010).

Through the China-Pakistan Economic Corridor, Pakistan is benefitting from the Peoples Republic of China's (PRCs) financial and technological cooperation in the energy sector. It is indeed an opportunity for Pakistan to diversify its energy resources (Tiezzi, 2016). Hussain et al., (2017) points to the current energy mix of Pakistan, which entails imported Gas (50%) and Oil (30%) of the total energy requirements. This massive energy export cost the country a lot of financial burdens. While understanding the prevailing energy scenario of Pakistan, the country urgently needs to shift to the contribution of other energy resources to the total energy mix. Pakistan and China have robust collaboration in the nuclear energy sector, to a lesser extent, in the hydroelectric sector. Through CPEC, Pakistan is looking for much-required

technology from China as well as the transfer of expertise to develop its overall energy sector (Hussain et al., 2017). CPEC energy projects are based on the development of Coal, hydro, wind and solar. These projects help mitigate the menace of load-shedding and power crisis in the country. Moreover, these projects will also achieve GOP objectives of improving the energy mix of the country by concentrating on indigenous coal, hydro and renewable energy sources (GOP, 2014).

5.3. CPEC role in the development of RE technologies

Power production under the CPEC energy projects has improved the lives of Pakistanis by helping in overcoming the severe electricity shortage, reduction of load shedding, provision of energy sector jobs and infrastructural development (Zhang and Shi, 2016; Hussain and Hussain, 2017). According to CPEC (2019) official information, the projects under the plan have achieved substantial achievements in different areas such as in the energy sector, 5320 MW of electricity has been added to the grid while progress on seven 4170 MW power projects is approaching completion. Moreover, there are additional 2844 MW projects under the planning stage (CPEC, 2019). Kugelman (2017) believe that CPEC "could conceivably zero out the country's energy shortfall, which ranges from 5,000 to 7,000 megawatts (MW)" and provide cheaper energy mix to a highly populated country (Kugelman, 2017). As discussed in the vision 2025, capitalizing on the "indigenous energy resources." (GOP, 2014) will help the country to lessen overall dependence on expensive and imported fossil fuels (mainly gas and oil) which levies high costs to the national exchequer.

The detailed list of the energy projects in Table 11 reveals that there is a mix of coal, hydel, solar and wind energy projects across the country, whereas the majority of the projects are coal-based. Due to this, CPEC projects are often criticized for the development of unclean fuel-powered plants like coal. According to CPEC authorities, these claims are baseless as these power plants provide clean electricity, green environment to Pakistan. As an example, 1,320 MW of electricity is generated through Sahiwal coal-powered plants, two units, fulfilling the energy requirement of 4 million people in the country. Proponents of the coal-powered generation in the country term these plants as technologically advanced and very environmentally friendly (uses bituminous coal), contrasting the general observation that coal-fired power plants are risky to environment and health. Based on the reports of independent monitoring

agencies in the country and meeting international standards of environment after checking the quality of air, water, and soil in the area, the Sahiwal coal power plant has recently won the Annual Environment Excellence Award 2019 by the National Forum of Environment and Health Pakistan for environmental protection (Malik, 2019).

There are three hydro projects in the plan with a total capacity of 2700 MW and several other renewable energy projects like wind power and solar. Three wind power projects (Jhimpir, Gharo and Three Gorges) are operational. The solar power project "Quaid-e-Azam Solar Park" in Punjab province has a capacity of 1000 MW. In comparison to renewable energy projects, there are several coal-based projects with an estimated capacity of 8880 MW (CEPEC, 2018). Although coal is the local and cheap energy source for power production in Pakistan, there are serious environmental implications of these coal-based plants. Many scholars have asserted that the reason for environmental hazards in China is mostly due to coal-based energy production. China is also the largest coal producer in the world and consumes nearly half of it to meets the energy requirements. Coal is also the most significant contributor to carbon emissions which resulted in polluting cities around the world and ten Chinese cities are amongst the ten most polluted cities in the world. China is facing problems with bad air quality and water pollution and due to bad air quality and pollution, nearly 300,000 people die prematurely (Zhao, 2005; Gallagher et al., 2006; Economy, 2011). Coal-based power production and its other uses are mainly accountable for air quality degradation and overall environmental hazards across the country. The imbalance of renewable energy projects in the CPEC power projects has an environmental dimension. Though these coal-powered projects will help in the demand-supply gap reduction in Pakistan, there are anticipated environmental hazards.

There are claims in the official documents and policy of the GOP regarding ensuring the fact that the CPEC remains environmentally sustainable in all its economic and infrastructural projects inside Pakistan (Zubedi et al., 2018). Both Pakistani and Chinese officials stress in public regarding their commitment to adopt modern and clean coal combustion technologies meeting international standards. During my interaction with Director of CPEC at the Planning Commission, Ministry of Planning, Development Pakistan and Reform (PDR) Pakistan on the question of environmental

concerns concerning the coal-powered generation he was of the view that the Government of Pakistan is sensitive to the anticipated environmental concerns of coal-based energy projects and there are efforts and hard work proceeding to curtail the cost to the environment (if any) by utilizing the latest expertise and technological help as per the global standards for coal power plants to reduce carbon dioxide and other gas emissions. (personal communication 29 January 2019). However, while interacting with different other people for my semi-structured in-depth interviews genuine concerns were raised about coal-based power plants in the CPEC projects having severe environmental implications for the country. Most of them expressed these feelings in inform sessions as a majority of them were government servants so they were reluctant to express these concerns openly against the governments stated policy. Accordingly, CPEC substantial energy investments bring optimism on one hand of the energy sector development, the shift to coal-powered plants, on the other hand, carry grave environmental implications for the country already vulnerable to climate change (Zaman, 2016; Saleem 2017). Pakistan is amongst the ten most climate change affected countries in the world where due to extreme weather, human deaths and economic losses are recorded (Kreft, Eckstein and Melchior, 2017).

The government of Pakistan needs to revise its policy of coal-based power plants as they carry environmental hazards. The country should focus more on clean local alternatives as enshrined in its national vision 2025. The country has enough potential to produce clean and green energy. Pakistan possesses a renewable energy potential of around 167.7 GW, that can easily fulfill the electricity demand of country (Rafique and Rehman, 2017). The GOP should make applicable policies and create required energy infrastructure to exploit the maximum renewable energy potential of the country with the help of modern technology. The global trends are changing towards more renewable energy investments as $241.6 billion have been invested in renewables in 2016 excluding hydro power energy. Findings further reveal that in 2016 a total of 138.5 GW energy has been added to the global power (McCrone et al., 2017). As opposed to these international moving trends towards harnessing more renewable energy, Pakistan's energy mix contain very meager percentage of renewables (1%) (BP, 2019). Pakistan should follow the global trends for renewable energy for environmental safety and a secure future.

Coal can be taken as a short-term option and its exploitation should be done with the utilization of clean and latest technologies. Furthermore, the GOP should formulate very rigorous energy policies to minimize the negative implications of environment. China and Pakistan can work together to address this issue of environmental degradation through joint efforts. A proper planning, monitoring and management of environmental risks can help in the minimization of the CPEC projects ecological costs (Nabi et al., 2018; Kanwal, Chong and Pitafi, 2019). Additionally, tree plantation should be encouraged across the country as it plays a considerable role in countering the adverse repercussions of environment and public should be sensitized through structured literacy programs regarding the protection of their environment. In the present age of technology, the information and communication technology tools play a vital role in literacy development and creating awareness amongst the masses regarding any social, political as well as ecological issue. Such technological innovations and interventions through governmental institutions, civil society organizations, educational institutes can help in fighting the menace of climate change and environmental degradation in the country. Pakistan can overcome these problems through adopting and realizing sustainable development policies that encourage green technologies for environment. While there are challenges of energy access and availability in the country, coal could prove as local and cheap source of energy, the environmental cost of this option should be carefully tackled through taking certain policy measures with its very strict implementation at different levels across the country. The provincial governments as well as other multiple stake holders sin the national energy system should be taken on board to implement a single policy framework in this regard.

5.4. Analysis of the In-depth interviews

Table 12 below presents the dimensions considered in the in-depth interviews by different interviewees. The check marks in the table below show the consideration of energy security dimensions by the particpaints during their interviews and discussions on Pakistan's energy security 14 semi structured in-depth interview questions. Out of 13 dimensions the interviewees mentioned 12 of them with varying frequency and parameters which have been marked accordingly in the table. Cyber security dimension was not stated by the interviewees. Whereas military was cited by three

participants with an indirect reference to the "dominant forces" in the country who influence the power structures in the country.

Table 12- Semi-structured in-depth interviews covering energy security dimensions

Sr. No	Interviewee details	Different Dimensions of Energy Security	Availability	Diversity	Technology and efficiency	Location	Timeframe	Environment	Health	Culture	Literacy	Employment	Policy	Military	Cybersecurity
1.	Ex-Chief Engineer WAPDA		✓	✓	✓	✓		✓		✓	✓		✓		
2.	Additional Chief Engineer WAPDA		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3.	Senior Engineer WAPDA		✓	✓	✓	✓	✓			✓	✓		✓		
4.	Resident Engineer WAPDA		✓	✓		✓	✓	✓		✓	✓	✓			
5.	Assistant Professor (Energy) PAK-US center for energy		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
6.	Assistant Professor (Policy Studies)		✓	✓		✓			✓		✓		✓	✓	
7.	Assistant Professor (Policy Studies)		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
8.	Professor (Public Policy)		✓	✓	✓		✓	✓		✓	✓		✓		
9.	Female Energy Expert		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
10.	Head of Business Desk		✓	✓	✓	✓	✓	✓		✓			✓		
11.	Senior Management Professional-CPEC		✓	✓	✓	✓	✓	✓		✓	✓		✓		
12.	Female Member of National Assembly (MNA)		✓		✓	✓	✓	✓		✓	✓	✓	✓		
13.	Senior Officer (Policy Sector) AEDB		✓	✓	✓	✓	✓	✓		✓	✓		✓		
14.	Female Social Activist		✓	✓	✓	✓		✓		✓	✓		✓		

15.	Senior Officer (fuel Sector) Ministry of Planning			✓	✓	✓		✓		✓			✓		

Out of 13 dimensions of energy security the respondents have frequently discussed 08 of them including availability, diversity, technology and efficiency, location, time frame, environment, literacy, and policy. Whereas, remaining five dimensions including health, culture, employment, military and cyber security were less significant, at times some of them were interchangeably used and in the case of cyber security none of the respondents pointed to it. The dimension of health for example was interchangeable discussed with environmental dimension and culture with literacy.

In order to assess the main research questions of the study the theoretical question related to the evolution of the energy security concept in the current IR argumentation led to energy security varied dimensions and parameters developed over time. Which have also been analyzed and assessed on fifteen semi-structured in-depth interviews conducted across Pakistan from different stakeholders affecting the energy sector of the country directly or indirectly. These interviewees are instrumental to assess the contemporary energy security mentality of the country, as well as the role of renewable energy and its potential to achieve the goals set in the national vision 2025. To evaluate all this an in-depth semi-structured interviewee based on 14 questions was prepared after thoroughly reading and consulting the official document of the Pakistan National Vision 2025. While shaping interview questions all thirteen energy security dimensions extracted from the analysis of relevant studies were also considered. Moreover, a range of energy policy documents, including the major power policies in place were carefully assessed according to the primary focus of my study related to energy security.

These in-depth interviews semi-structured interviews are central to the study as majority of the participants have some role in the energy policy development process in their respective organizational role. The sample selection for the interviews is not randomly done it was based on the purposeful sampling. Purposeful sampling is also done in qualitative studies such as (Sovacool and Mukherjee, 2011; Thiengkamol,

2011; Wattanasaroch et al., 2012; Blum, 2015; Cox, 2016; Saad et al., 2017; Mola et al., 2018; Elahi, 2019). These fifteen interviews are helpful to understand the perception of multiple stakeholders to ten goals identified with respect to guaranteeing continuous access to inexpensive and clean energy for all segments of the people of Pakistan as enshrined in the vision 2025. Assessment of energy security dimensions on these in-depth interviews will help in the formulation of a viable understanding of the energy security mentality and overall energy situation of Pakistan as well in formulating some useful policy recommendations.

All these thirteen dimensions contribute to our conceptualization of energy security in this thesis, which argues that in order to assess energy security of any nation these dimensions and their relative parameters should be explored including availability, diversity, technology, location, timeframe, environment, health, culture, literacy, employment, policy, military and cybersecurity. All these dimensions of energy security are helpful in energy security enhancement and understanding.

The awareness of energy security initiated mainly on attaining access to oil and other non-renewable resources. With diversified emerging energy markets in the world and gradual transformation in energy systems along with increasing use of energy, the conventional energy security hypothesis which was merely concentrated specifically on oil and natural accessibility has become barely noticeable (Vivoda, 2009). As well as, to the transition of energy security explanation with the passage of time and advancement, numerous additional and unique dimensions of energy security have started to surface. Various aspects like climate change, pollution, soaring energy prices and price variations, energy import security issues, etc have transformed the dimensions of energy security over time (Chalvatzis and Hooper, 2009; Umbach, 2010). For the attainment of a comprehensive outlook of energy security, an all-inclusive set of energy security dimensions is required. This type of workable and comprehensive framework of energy security is imperative for a comprehensive understanding of energy sector of a country (Vivoda, 2009).

Availability

Every consumer of energy search for the availability of the most indispensable goods and services. Energy security is also about access and availability to energy and

making sure that its approachability at a cost to the economy that allows the economy to function. The majority of the analyzed studies refer to the same fact of availability as the most significant measurement for the energy security of a country. In crux, availability of energy symbolizes the physical existence of resources as well as presence of people for its effective utilization, and measures for its effective transportation (Ren and Sovacool, 2014; Cherp and Jewell, 2014; Brown et al., 2014; Kruyt et al., 2009; IEA, 2014; Yergin, 2006).

The same was expressed by the interviewees while answering the questions posed in the in-depth semi-structured interviews. As for instance, the following respondent who is an ex-chief engineer and presently working as an Advisor to WAPDA on a hydro project expressed his concerns related to availability in terms of lack of funds to support high-cost projects in order to achieve the target of eliminating electricity supply and demand gap in the country:

"The main reason is the financial crunch. We don't have our own money. We depend on the donor agencies and again the policies of the donor agencies like world bank, ADB and all those."

Ex-Chief Engineer and Advisor (Hydro sector) WAPDA

Similarly, a serving chief engineer at WAPDA debates the physical availability of natural resources in the country which lacks proper management and these ample sources are not properly governed to obtain maximum benefits. As he states:

"If we start from the northern part, starting from the Kalam and Swat area with the natural water flow, turbines of small capacity should have been installed for producing electricity and that could have been, for that no dams are required, for that no large investments are required for those projects no special arrangements are required and the government could have done this so easily, so cheaply and facilitate the people with electrical energy." He further goes on while saying "Yes, as far as hydel generation is concerned, we have great potential by the grace of Allah."

Chief Engineer WAPDA

A professor of public policy in Islamabad views the availability of energy form a physical existence perspective. Pakistan is mainly dependent on hydropower projects for power production. Water sector problems in the country are pointed as follows:

"Particularly with the water sector which is very critical form Pakistan's context because there is a serious challenge of water security since per capita availability of water has decreased about five times since Pakistan came into being so, the data has become quite alarming with respect, because the security of water is related with the energy security as well as the food security."

Professor of Public Policy (Islamabad)

While speaking about supply and demand gap in the country a female energy professional at Reenergia-Enhar and mentor, WIRE-Women in Renewable Energy Pakistan tackles the aspect of availability from the aspect of financing deficiency for new energy projects and infrastructural issues in these arguments:

"As things are going, probably not, definitely not, like I have told you all the reasons why we cannot do that because we cannot invest that much amount of money and you know in the grid infrastructure and there are so many areas in Pakistan and population in Pakistan that it's not even possible to invest to bring the grid there."

Female Energy Expert (Islamabad)

Diversity

Diversification of energy sources for mitigation of security risk has been argued in different works over time. Yunsa and N.C. (2016) detects globally the recent fluctuations in energy prices, dangers of supply disruptions and unpredictability of global fuel market value attention on a multiplicity of resources and fuel supply has gained more consideration (Yunusa and N. C., 2016). Diversity entails reliance on a variety of resources to address the energy needs of a country. The effectiveness of energy security rests on a viable policy of diversification employed in the energy governance structure of a country (Yergin, 2006). Hughes (2009) outlined several views of diversification such as multiple suppliers for the same type of energy, pointing to substituting the insecure supply source with more reliable ones. Moreover, he further goes on to discuss the option of alternative energy sources as a

diversification strategy thereby replacing the prevalent sources like fossil fuels to renewable energy sources (Hughes, 2009). Stirling (2010) pronounces diversity in terms of diverse socioeconomic, cultural, and technological contexts. He believes in the variety of energy supplies by multiple suppliers and considers it as a crucial factor of energy security (Stirling, 2010).

A female Social Activist at work in the capital city of Pakistan while debating the diversity and mix of energy in the country views diversity as a necessary component for energy generation in Pakistan. According to her understanding:

"We can generate electricity by using all these sources which you have mentioned (like oil, gas, coal, water, wind, solar, nuclear, etc.) but I think on the part of government or on, they are unable to utilize these resources. They are particularly emphasizing like to produce electricity by using water, like hydro, atomic energy and all these things but not like oil I think."

Female Social Activist (Islamabad)

On the other hand, an energy policy professional at the Alternative Energy Development Board (AEDB) points towards the adoption of diversification policy for energy generation through nonrenewable and renewable energy options in the country.

"There has been a drive within the governments and the past governments and the government before that they, to diversify the energy generation and that was the reason that the coal power projects were initiated and the LNG power base power generation was also introduced in last 5 years and now the Renewables have become so cheap that the government is also very consciously taking, in the process of assigning specific targets for Renewables as well in the energy mix. So, there are I think efforts being made to diversify the energy mix specifically with, within the context of ensuring energy security that the reliance on imported fuels is reduced, the addition of nuclear power plants and the use of Thar coal is an example & recently the government has also decided that no more project based on imported coal & imported LNG or any other imported fuel will be developed."

Senior Officer (Policy Sector)-AEDB

A senior management professional at China Pakistan Economic Corridor (CPEC) refers to this mega project of Chinese grand Belt and Road Initiative (BRI) in Pakistan as a hallmark to diversify the country's energy production through different available options:

"Basically, through CPEC the best thing we have done is the bouquet if I can call it of energy has been diversified and as a responsible nation we started off with Wind & Solar, we had about 400MW of Solar & that's going to be in Bahawalpur & that's going to be around 1000MW."

[…] "we did was around 400MW on wind & because, we have this beautiful wind corridor in Jihmpir in Sindh So, we are going to as per the government's policy in next phase, we will only encourage projects based on indigenous sources of energy, Thar coal, hydel, wind, solar. We will discourage on part of the government, we will discourage imported coal projects. So, I think this as a good…, This ensures our energy security when we use our indigenous sources of energy."

Senior Management professional-CPEC

Technology and Efficiency

Another very significant dimension mentioned by researchers relates to the adaptation of new technology advancement for overall energy system efficiency, intensity, and conservation. Umbach (2018) in his study observes multiple challenges faced by energy systems globally. The world is witnessing energy sources transition from conventional fossil fuel options to more renewable technologies which require the employment of new technologies for decarbonization, decentralization, and digitization (Umbach, 2018). According to IEA (2017) report on digitalization and energy, the use of technology is the energy sector was among the first ones to adopt digital technologies for the exploration and production of oil and gas. They were also used for the operation and management of the grid. Advancement of technology is making the energy systems around the globe more interconnected, well-organized, sustainable and consistent (IEA, 2017). Miao et al. (2018) observe positive impact of technological revolution on the energy consumption of main businesses in their research. The findings suggest that modernization in technology will help in energy maximization (Miao et al., 2018). Allen and Marquart-Pyatt's (2018) survey findings

expose respondents backing for less use of energy through the involvement of technology and renewable energy technologies (Allen and Marquart-Pyatt, 2018).

Technology can help in achieving efficiency with the potential use of RE technologies in Pakistan discourses a female energy professional as the cost of these types of machinery is reducing with the passage of time and gradual advancement:

"Because when it comes to let's say solar panels or wind turbines, they are cheaper to invest in and everything because the technology is getting better and better and cheaper and cheaper with every passing day."

Female Energy Expert (Islamabad)

While the same view was shared by a university professor heading a public policy faculty at a school in the federal capital city of Islamabad with an added opinion of indigenous production of these technologies:

"For solar like we have to go for more cost-effective technologies and those technologies must be locally manufactured technologies."

Professor of Public Policy (Islamabad)

Head of Business Desk at a media group in Pakistan while conversing about the energy mix in the country advocates inclusion of the private sector for the desired technology advancement as it requires investment and latest knowledge and expertise transfer from other countries:

" […] for the development of renewable energy, technologies like hydro, solar, wind, biomass, the inclusion of private companies in this sector is very important".

"[…] For the renewable energy sector to develop NEPRA has to ensure availability of cheap electricity at the lowest cost while traditionally hydro generation is the cheapest, followed by gas but now as you see the focus is shifting towards renewable energy technologies like solar and wind."

Head of Business Desk

CEO of an energy company and an academic researcher points to the lack of technology development over time in the country which led to the electricity supply and demand gap. The country is still dependent on outdated technology for her energy sector.

"These projects of Warsak, Mangla, and Tarbela entailed interconnected grids with the state-of-the-art telecommunication control system at that time from Warsak all the way to Karachi. The dire situation of demand and supply or electricity storage, sorry I mean shortage as you name it that Pakistan finds itself in today is because of the lack of power sector development during the last four decades."

CEO energy company

Location

The location of the energy source holds a very critical position in the energy security of any country. The location of its own energy sources and the external sources on which the country heavily depends on its energy remains as a central point of the geopolitics of energy. The geographic location of the consumers and producers of energy holds great significance in international affairs (Austvik, 2018). Location performs a critical role in determining the energy geopolitics of a country. The location and size of a country's own resources regulate its cost, transportation mechanisms and ways, market and political choices, and also sets procedures for the number of imports of energy. Each and every factor of energy requirement depends on the resource location of energy that affects the internal as well as external energy policies of a country (Austvik and Lembo, 2017).

A retired chief engineer and advisor to WAPDA on hydro projects while speaking about the impediments in the way of mega hydro projects like Diamer Bhasha Dam construction in the country articulate the issue of geographical dispute (the geopolitics of energy) between India and Pakistan on Kashmir region. Furthermore, he refers to the suitability of different geographical locations in the country for harnessing renewable energy options. He also considers finance as a serious concern to carry out these developments:

"[…] Diamer Bhasha you see, Diamer Basha there are two major problems again one thing is that we don't have our own money and the donor agencies, the international donor agencies do not like to participate in that and the main reason for that is that they call it to be in a disputed territory and basically the all this game in the background is being played by Indian government you see."

"Yes, on this Indus river you can only see that there are several sites like Pattan, Thakot this Diamer Basha, Poonji is also on this Indus river but you see these are all in papers but we cannot in a position to implement all those projects."

"Northern areas you see in a hydel power station the problem is that these sites are away from load center and you have to make special arrangements for transmitting the powers from those centers so a lot of work is being done but again the problem is that we are always short of money."

Retired Chief Engineer & Advisor (Hydro Projects)-WAPDA

Moreover, Additional Chief Engineer WAPDA indicates the run of water projects which can be built on naturally suitable geographical locations in the country for the production of cheap electricity. These projects are feasible in the present economic conditions of the country as they do not require very heavy financing:

"Yes, the Kalabagh dam, of course, and to be more precise small projects of producing electricity. If we start from the northern part, starting from the Kalam and Swat area with the natural water flow, turbines of small capacity should have been installed for producing electricity and that could have been, for that no dams are required, for that no large investments are required for those projects no special arrangements are required and the government could have done this so easily, so cheaply and facilitate the people with electrical energy."

Additional Chief Engineer-WAPDA

A female energy expert remarks the difficulty of terrain in some parts of the country as Pakistan is geographically diverse. This territorial diversity makes it difficult to install energy infrastructure in such locations and connect the energy infrastructure with the national grid so off-grid solutions stand as best options in such cases:

"[…] there are so many areas in Pakistan and population in Pakistan that it's not even possible to invest to bring the grid there so, we have to start thinking about off-grid and unfortunately right now Pakistan does not have any regulations or rules or you know the policy for distributed generation."

Female energy expert (Islamabad)

A female member of National Assembly of Pakistan and a member of the ruling party in Pakistan points to a miscalculation by the previous government in choosing a coal-based project location in the country:

"Do you know about the Sahiwal projects, yes I do, projects or the equipment installed in the Sahiwal was not the right decision and not the right location because world knows that such projects should be close to the ports."

Female, Member of National Assembly (MNA)-Pakistan

Timeframe

Energy security being a progressive idea also hinges on the proper analyzation of the timeframe. As von Hippel et al. (2011) spot those investigators who study extended timeframes are more likely to give preference to strength over cost-effectiveness (von Hippel et al., 2011). Adherence to a proper timeframe or timeline holds great implications for understanding the energy security of a country as it is an evolving concept. A differentiation between the security of supply or demand and the energy governance structure of a country that fulfills that requirement based on political or economic factors over time is very crucial while observing energy security. Consequently, the attention and focus of energy security studies rest on multiple factors at play at different periods of time from timely execution of energy supplies and length of the event that helps the supply security or length of the effect (struggle or impact) that results in insecurity of energy supplies (Johansson, 2013). For the attainment of energy security timely execution of projects also embraces great consequences as some scholars sight that Renewable energy production facilities can be raised in a short timeframe so their value has increased in recent years to meet energy needs of many countries around the globe (Warner and Jones, 2017; Hache, 2018).

Additional Chief Engineer WAPDA counts timeframe as a crucial factor while talking about the demand-supply gap in Pakistan. According to his experience the time period specified for a project or timeframe allocated to any energy project is not duly followed in Pakistan due to certain political challenges:

"For example, and many projects are being politically, politically refused to be achieved, for example, the Mohmand dam which is going to be inaugurated in the very nearest future, they should have been done earlier."

Additional Chief Engineer-WAPDA

Construction of hydro energy projects at large scale takes more time so immediate solutions like coal have become even more viable for the country says an Assistant professor working at Pak-US energy center in the following words:

"[…] Pakistan is moving towards the coal-based projects, but you must have noticed globally the trend is changing. The whole world is giving up coal-like America, Germany, France, and even China. It is understandable in the case of Pakistan that an immediate solution can be found in coal, as current energy situation does not allow much time for hydro projects to come up very early, they are time-taking as you know especially the big ones otherwise, I think Pakistan's medium- and long-term goal should have been hydel power for both energy security and food security."

Assistant Professor at the Pak-US center for energy

Resident Engineer at a hydro project refers to that particular period of time when financing for the large dams was not possible in Pakistan due to a global ban on mega projects:

"There would have been no problem with this if we started sincerely aah…., during Musharraf period in 2001, he tried to start the dams but at that time the international company for the large dam did not support the construction of large dams because there is a ban on large dams internationally."

Resident Engineer (Hydro Project)

Environment

New dimensions to the definition of energy security were added with the passage of time including environment as done by the UNDP (2004) assessment report and Müller-Kraenner (2008) (Goldemberg and Johansson, 2004; Müller-Kraenner, 2008). Environmental concerns involve exploration rate and resource location of energy. These apprehensions emanate from initiatives for energy exploration. Moreover, extraction and transportation methods also come under consideration in the environment as energy pursuits might require natural imbalances thus causing a disturbance in the atmosphere. Outcomes from energy usage that contaminates the overall ecosystem like industrial and vehicle pollution. Impact resulting from environmental change and its relationship to water also come under deliberation in environmental alarms (Brown and Dworkin, 2010). Environmental issues have rapidly become significant for human development and survival along with rapid economic growth which has also led to resource depletion over time (Xu et al., 2016). Keeping in view the environmental and climate change challenges Chen, Cheng and Urpelainen (2015) witnesses world-leading consumers of fossil fuels like China rapidly shifting to the advancement and exploitation of renewables technology options (Chen, Cheng and Urpelainen, 2015). As stated by Narula (2014) sustainable energy security is defined as a favorable arrangement of energy supply in a reasonably priced, environmentally suitable, efficient and just manner (Narula, 2014). Sustainable energy security embraces diversity, compatibility, and viability along with efforts of socio-economic and environmental growth.

On the question of considering environmental impact while designing an energy project in the country a senior officer at the energy wing, the Ministry of Planning believes that it is taken into consideration while planning an energy project. While another senior officer working on policy sector at Alternate Energy Board (AEDB) bring forth the absence of environmental contemplation in politically designed energy projects:

"Yes, of course, definitely environmental impact and as well all these aspects…, economic feasibility, scalability, indigenousness, you know, & risk assessment and all these things. All these things because being project coordinator implementation we also look into the all these things almost all. Environmental control, GHG

control is very, very limited in Pakistan so far. You know but in advance countries they have done their job as well in advance and now we are imposed to control your pollution and like this. We are already a neat and clean country, we don't need… Ha ha-ha..., we have enough space to dispose this GHG emission like this."

Senior Officer (energy wing), Ministry of Planning

"Mostly the procedures set out for development of power projects in Pakistan does cater for all these items such as economic viability, sustainability, financial viability, and environmental concerns, so, there are checks and balances but at times certain decisions especially the, you can say the so-called political decisions, for going towards one technology or one source of generation. In the broader sense we might see some you know bypassing these major contents but mostly when individual projects are being developed these things are taken into consideration."

Senior Officer (policy sector), Alternate Energy Board (AEDB)

While discussing the indigenous Thar coal project in Pakistan, a female Social Activist tell her concerns about its environmental impacts. Whereas a university professor at the Pak-US center for energy believes that if clean technologies for energy production are utilized coal appears to be a viable option for the country for being indigenous and in abundance. He also supports the use of renewables for mitigating climate change and environmental degradation in the country. He does not support energy imports (fossil fuels) for being expensive, causes environmental hazards and levies a huge burden on the national economy which is already fragile. Regarding the failure of Quaid-e-Azam solar park he believes that proper environmental risk assessment was not done that led the project failure:

"Yes, pollution will be added to like it will spoil our environment and environmental pollution, they will face this problem. Yeah by using this."

Female Social Activist (Islamabad)

"Well, if we address environmental issues somehow Pakistan's has a great potential for coal. As total coal resource is reported as some 185 billion tonnes.

The bulk of this coal around 99% of it is in Pakistan's huge coal resource, notably, that lies in the Thar coal field, which is located in the province of Sindh. It is reported that the coal reserves of Pakistan are high in Sulphur and ash contents. According to the expert opinion the moisture presence is also high in Sindh coal, especially in the Thar coal. But with some treatment measures it can be used and it can turn out to be a good cheap indigenous resource for the future energy mix of Pakistan whereas the Gaddani project, as far as I know, is planned on the imported coal which is obviously not a good option for a struggling economy like ours."

"[…] Turning to renewables, it carries many benefits as it will reduce greenhouse gas emissions, which are the main cause of rapid global warming as well as climate change in the country."

"[…] Moreover, there are many draw backs of this imported fossil fuels including, being expensive, risky for the country's energy security perspective, not environment friendly, etc."

"For the development of sustainable energy projects all these factors are very important to be kept in mind and as far as I know every project is designed while keeping in mind these things because if these things will not be kept in mind we might not get the desired outcomes as the case in point can be quoted here the Quaid-e-azam solar park project where the desired approximately 1000 MW of electricity could not be obtained and it was also planned that in the first phase 100 MW will be generated whereas only 18 MW was generated. According to sources in the field the problem has been created due to solar plates used in this project, which were of low quality. Proper risk assessment and environmental impact were not checked while designing this project I believe that is why the desired outcomes did not work out. So, all these factors at times get ignored as well due to many reasons like in the projects that are donor funded, financed by international agencies."

Assistant Professor at the Pak-US center for energy

Literacy

Sovacool (2016) surveys the concept of energy security among different nations. It is inferred from the study that the notion of energy security varies across different cultures. Cultural effects on the energy system necessitate ones understating of the production process, connection, consumption, and cultural acceptance. There are energy conditions that also shape the cultural aspects of a country (Sovacool, 2016). There are diverse energy cultures around the globe that change from one region to another. Different scholars have viewed this phenomenon in multiple ways. Allum et al. (2008) view the variances in geographic cultures at the national level. Every nation possesses distinct cultures prevalent in different parts of the country which also shapes its distinct geographical culture to understand energy (Allum et al., 2008). There are economic cultures as well, when we talk about energy, they change according to reasonable access and energy services affordability in a particular context (Ailawadi and Bhattacharyya, 2006). Every society has a particular political culture as well from a developed democracy to an authoritarian government that affects individual attitudes as well (C. Flanagan and Lee, 2003). There are skill and knowledge-based cultures that also include professions in diverse organizations (Schein, 1996). Multiple cultural understanding help in understanding the overall energy security culture of a country.

Hydroelectricity expert working with WAPDA in an advisory role observes the domestic sector is the largest consumer of energy in Pakistan due to lack of awareness and proper planning. It is observed that the country also lacks latest technology and required literacy regarding conservation techniques. He stressed the need for structured educational programs to raise energy conservation literacy in the country.

"Basically, you see our problem is that the growth in power consumption is mostly in domestic sector not in industrial sector so again you see there is contradiction between different policies and on one hand we can not cope up with the requirement and demand of the energy and other hand we are providing free market for air conditioners, fridges and all those appliances which basically require electricity."

"[…] we at least consume 10MW energy on keeping the charges on you see this is our cultural problem and we don't switch off the charger after the mobile phone is charged so we just don't bother to switch off the charger and if we keep on the charger then the entire charger being used at the moment at least use 10MW energy. The other thing is the energy conservation you see still we are using these tube lights and ordinary lamps which consume about 100% more energy than the newly introduced LED lamps and all those things. You see in the, I had a chance to visit Germany about 10 years back and I was astonished to know that German government is not going to build any future power houses to increase their energy but they were working on conservation of the energy like introducing very efficient appliances and what they were telling to me is we can say 90% energy by introducing new appliances whereas in Pakistan you see the people are not educated, their social awareness is not up to that mark, you don't bother to save energy so, this is another problem you see. This is the main factor if we develop ourselves in a manner to save the energy than all the losses being pointed out at the moment can be to my opinion reduced to 50%."

"This is very important this is very very important, and we should I mean pay attention to it and this is the tendency all over the world. Instead of going to I mean built new power stations, dams & other energy infrastructure and all those things the people are I mean now trying to divert themselves towards the conservation of energy and this I am sure that if we go for this energy conservation so we can I mean this reduce or diminish all the losses being faced at the moment."

Advisor, Hydro-electricity WAPDA

An Islamabad based female energy expert while discussing the issue of raising social awareness through education and training regarding peak and off-peak hours provides an example of the practical step taken to create a culture of energy conservation among women which yielded good results and she even stresses the role of female participation to further this culture of energy conservation:

"[…] we started this company called the one "Paidaar Tawanai," (sustainable energy) you know get an idea. So, as part of that specially when it comes to social mobilization & everything, we have recognized women to be more effective than

men when it comes to energy conservation and awareness and management and everything else."

"When you talk about energy conservation so, you have to talk, you have to include the women because that is where it is going to create the impact and everything so, yes just because most of mostly when it comes to residential segment, women are the ones who actually who can actually choose when it comes to energy conservation and using the electricity responsibility or not."

Female Energy Expert

The country lacks the culture of conservation and people do not use energy-efficient appliances as observed by a federal government female Social Activist who also lived in Japan. The same views are shared by a senior officer at AEDB.

"Yes, appliance are energy efficient and they don't abuse or like misuse energy like in case of Pakistan we misuse it, we keep the lights on all the time and geyser on all night, overnight & we leave it and all the lights are left unchecked and not being monitored by us so we use gas heaters all the day, we turn on the geysers and gas heaters and we don't turn it off and we don't check it."

Female Social Activist (Islamabad)

"Ahh… very less significance was given to demand management and especially conservation and energy efficiency measures in the last few decades but now it has been realized that these are two major areas and especially demand management plays an important role in meeting the overall energy demands and there are some initiatives that the government has taken towards ensuring energy efficiency and proper demand management because this is one way by virtue of which we can shift our reliance from imported fuels as well as we can better manage our own demand even with in the constraint situations."

Senior Officer at AEDB

Policy

Attainment of energy security is one of the main goals of any country's energy policy. The energy policy of a country determines energy options and preferences. Yao and Chang's (2014) deliberate the notion of policy as an important dimension to determine energy security while examining the Chinese case. China is the major energy importer in the world and the strength of its energy policy impacts national and global energy security (Yao and Chang, 2014). Prontera (2009) while scrutinizing the energy policy he refers to it as governmental outcomes to address energy challenge and the supply reliability. Energy policies also incorporate governmental measures to deal with energy supply disorders and endeavors for its conservation and subsequently economic development (Prontera, 2009). As Chapman, McLellan and Tezuka (2016) outlook on energy policy formulation incorporates multiplicity of aspects encompassing political system (democracy or dictatorship), rules and regulations (liberalized, controlled market, provision of subsidies), nature of the administration (level of stability, citizen's will, and internal and external relationships, transparency). All these factors determine a workable and inclusive energy policy (Chapman, McLellan and Tezuka, 2016).

There is no dearth of policies in Pakistan declares a Professor of Public Policy in Islamabad, the only issue remains in their effective implementation. Moreover, he stresses a balanced energy transfer and allocation which is imperative for the sustained economic growth of any society. He implies the same for the transportation policy of the country that will be helpful in fuel conservation and shift towards other clean options.

"I mean, the, I think as per this is always a great concern for…., as far as institutional regulatory frameworks is concerned in terms of transparency and transparency with respect to improve the efficiency of the system is concerned, this is, still Pakistan is lacking in that framework. It is not the issue of the availability of the framework, the framework is available various policy instruments are available the issue is the effective implementation of those frameworks that is a serious challenge and we have to develop some kind of a mechanism that how to implement those various instruments to improve that delivery framework, to improve the efficiency of the delivering of the energy system."

"[…] I think in last couple of years a lot of infrastructure development initiative has been taken by the government however we need an effective transportation policy in this country so that particularly after the, after the CPEC (China Pakistan Economic Corridor) it's a huge all types of dynamics are changing after the start of the CPEC and the new dynamics are emerging so, this the whole dynamics of the transportation network systems is changing and this is very much critical and both aspects has to be particularly transportation sector must be addressed."

Professor of Public Policy (Islamabad)

Assistant professor (Policy studies) working at a federal university describes policy paradoxes in the country where some dominant groups backed by military and other forces manipulate the energy policy formulation process for their own vested interests.

"Yeah, this is another very problematic question for example the policy makers who are involved in energy production or energy creation they are designing such type of plans, they are more suitable to their own interest, they are not focusing on those projects that can facilitate the interest of the common people so, many energy policies, energy problems, energy plans and energy planning's in Pakistani society. For example, Pakistan is energy deficient country and Pakistan is a country where you can see so many policy paradoxes & these policy paradoxes are due to our suffering, due to the influence of dominant forces into the affairs of the, in the affairs of the country for example in Pakistan many energy projects are captured by those companies who are backed by military forces who are backed by dominant forces in political affairs so, they are largely focusing to protect their interest on the name of energy. So, the planning, the policies related to energy in Pakistan they have different interest they are not focusing on the interest of the common people. They are covering, they are targeting the interest of the most dominant people in Pakistan so, I think every policy and particularly energy policy is a most vital tool to protect the interest of the bigger elite in Pakistan."

Assistant Professor (Policy Studies)

A female Member of Parliament and parliamentary secretary of a significant ministry responsible for policy formulation in Pakistan when asked about the

government policy for energy conservation had no details regarding this vital issue whereas she expressed her own views on the subject.

"you know water is also a part of energy, conserving energy is one aspect I think we should take media on board, we should take the journalists on board, we need to take civil society on board, to you know educate our people, to sensitize our people then through media and other mediums we should be focusing on it. Till date I think we are trying, the 12th year plan, the annual plan there are some measures which have been discussed but still I have to go through what are the policies as a government policy, what framework we are working on as government on energy because for me water conservation is one subject which is very close to my heart and I think making new dam is a long term project but conserving existing water is a short term measure which we can start right now."

Female Member of National Assembly (MNA)

There are multiple dimensions of energy security discussed by scholars in literature. The in-depth semi-structured interviews from the Pakistani respondent also consider the most debated dimensions while considering energy security enhancement in their mind. Most of the respondents agreed that availability as a vital dimension of energy security along with diversity, location, timeframe, culture, diversity, literacy, environment, and policy. Debating energy security is an extensive effort as energy security studies tend to be an interdisciplinary field studied in many branches of knowledge beyond International Relations. Therefore, these interviewees provide a useful insight into Energy Security practices along with focus on Energy Security construction in Pakistan's national policy document thus trying to empirically testify the things proposed. To support this analysis energy data has been collected from different energy relevant departments of the government of Pakistan like WAPDA, NTDC, Ministry of energy (power division), Planning Commission of Pakistan (Ministry of Planning), NEECA, AEDB and many others together with the IEA and the Energy Information Administration (EIA) online databases.

While there was documentary analysis provided in the dissertation where necessary or required. The interviewees complimented the analysis of the

empirical question. Before the start of the interview the participants were informed regarding the background and framing of the research through an information sheet (Appendix B). As the participation in the research was entirely on voluntarily basis and they were ensured of their anonymity which was ensured in the document. All the participants signed the certificate of consent with their name and designation (Appendix C). They were also requested to contribute directly to particular parts of the analysis for which relevant e-mail addresses were provided to which a few responded with their valuable inputs.

Apart from their formal discussion, the respondents in their personal off-the-record discussions revealed their concerns for the country's acute level of insecurity in the form of energy poverty, energy justice, lack of access to the national grid and public access to the advanced (Clean) energy resources. Most of the respondents touched upon the demand and supply gap due to transmission and distribution losses, thefts and systematic governance issues in the energy sector governance. They were also concerned about the rising prices of energy in the country. Moreover, energy sector challenges were also pointed out including the limited diversification in supply of sources thus having more focus on oil and natural gas. There is declining reliability of the energy structure as it is old and require immediate technological interventions for sustainability and efficiency. There are rising cost of procurement of energy supplies and no or very low local manufacturing that often creates hurdles in the effective implementation of renewable energy technologies across the country as imports cost more. Energy production through thermal sources and coal have negative externalities and consumption of these sources have economical and environmental cost respectively. Most of the respondents agreed that although national energy policies take grasp of the most of the challenges faced by the Pakistani energy sector, they are deficient in taking a holistic approach to resolve all these confronting problems. Environmental and ecological considerations seems to be missing in the subsequent energy policies.

It is perceived by the majority of the interviewees that in practice environmental protection in Pakistan appears to be the least prioritized area when it come to national energy policies. Pakistan lags behind China and India in the South Asian

region in terms of its part in the global warming whereas it can play an effective role while devising its future plans for energy bringing in more green transition to its energy system. The GOP has 20% GHG reduction targets till 2030, it seems difficult to achieve these goals where there is an inclination towards using thermal and coal based technologies in the system. This situation will further increase carbon intensity and reliance on imported fossil fuels.

There was a unanimity of the view by all the respondents on the governments initiatives that should be implemented with immediate effect to work on the provision of energy supplies taking into account the social and environmental cost, without them, long term energy security of the country can have serious repercussions. Moreover, the female and a few male respondents were concerned about the cost and effects of unsustainable energy projects in the country on the vulnerable sections of the society especially women (in rural areas) who have serious health risks due to the excessive use of pollutant fuels and children who suffer with premature deaths due to bad air quality and pollution. It is therefore critical to reformulate the policy to fix national energy mix of Pakistan by growing the share of clean and indigenous fuels based supplies and work towards effective implementation of the international environmental treaties such as Paris Agreement. This shift in the supply chain of energy system is very significant due to the huge external cost paid by the government every year to obtain expensive fossil fuels. The following chapter will discuss the fallouts of the study and present some policy ready recommendations for the development of RET's in the energy system.

CHAPTER 6: CONCLUSION AND POLICY RECOMMENDATIONS

This chapter concisely demonstrate a discussion on results, theoretical contributions, practical implications, limitations of the study and avenues for future research.

6.1. Discussion

The aim of this doctoral dissertation is a comprehensive analysis of the Pakistan National Vision-2025 concentrating on the fourth pillar-Energy and the present energy sector of Pakistan. The main research questions on theoretical level is "How does the energy security concept evolve in the contemporary International Relations debate?" and empirical one entails "What is the role of renewable energy in the contemporary energy security mentality of Pakistan?" There are sub-research questions such as "Does Vision 2025 clearly address the need for contemporary energy security assessments?" and on the suitability of the vision for the country as well as some policy ready recommendations based on the evaluation of the vision 2025.

Firstly, this dissertation seeks to explore the concept of energy security in the international relations (IR) debate which has emerged as one of the most debated and significant issue. To answer the theoretical part of the study around sixty relevant articles have been examined to find out different dimensions and parameters of energy security. The results reveal that the debates in energy security studies are done in many disciplines beyond IR. As energy security is an interdisciplinary field therefore theorizing the notion is a mammoth task: whereas in the current times various efforts have been done to broaden the meaning. As Ang, Choong and Ng. (2015) refer to Sovacool who finds as many as forty-five different definitions in the existing literature (Ang, Choong and Ng, 2015). There are multiple investigations offering and debating several energy security competing definitions as the notion is widely used. Kruyt et al. (2009) observes that this effort to broaden the meaning of energy security is much more common in energy policy/technology and environmental studies than security or IR studies. The emphasis in these investigations has largely remained on security of supply and stable prices of fossil fuels (oil and gas) (Kruyt et al., 2009).

In International Relations, the debate on energy security remained mostly influenced by a realist-strategic approach and a liberal market approach. These methods are observable in the academic and policy thoughts about Chinese and American cases. The realist-strategic approach emphasize competition, state survival and national security and represent energy security as a "zero-sum game". This paradigm views avoidance of dependence on others for energy needs, whereas struggle for resources is realised as inevitable and natural in a global view of rising demand and insufficiency (Andrews-Speed, Liao and Dannreuther, 2014; Nyman and Zeng, 2016; Chalvatzis and Ioannidis, 2017; Nyman, 2018;). On the other hand, liberal-market based approaches concentrate on ensuring stability and economic security with the aid of global energy markets. Unlike realist scholars for them energy is not a "zero-sum game". The proponents of this approach stress on developing linkages, integration and liberalization of energy market. Through which economic competition between the states leads to access global fossil fuels markets for sustainable supply (Bielecki, J., 2002; Youngs, 2009; Vivoda, 2010; Sovacool and Mukherjee, 2011; Dannreuther, 2017; Wilson, 2018). Nyman (2018) has referred to certain efforts in literature by some researchers (Jaffe and Lewis, 2002; Tunsjø, 2010) to hold the middle ground by joining approaches to endorse diversely comprehensive approaches (Nyman, 2018). Nevertheless, all these viewpoints and their different alternatives have a state-centric consideration of energy security taking it as national security, stressing the requirement of fossil fuels uninterrupted supply.

The conception of "security" has been taken further by the Copenhagen school of security studies. "Security," is no more considered in the traditional terms of a "threat" instead as the outcome of the political explanation and understanding of the threat through a procedure termed as "securitization." The proponents of this school of thought construct a conceptualization of "security," more specific than an old idea of a "threat" (Buzan et al., 1998). Through globalization of energy and diversification of energy sources the concept is no more limited to the supply of oil only. The assessments of energy security have extended with time entailing multiple ideas related to environmental concerns, economy, and social security issues. The energy security condition and standing of different countries differs due to available energy reserves, consumption patterns and required energy. Therefore multidimensional characteristics of energy security are evaluated in literature.

Environmental dimension is more emphasized than before in the contemporary debates in international relations. Moreover impact of climate change and its hazards such as the issue of climate refugees is recurrent in the discussions. Due to all these emerging concerns for environmental degradation due to polluting fuels and climate change, transfer to more greener options is repeatedly suggested. Therefore, renewable energy technologies are seen as an answer to the challenges where energy security and access to energy is a very big and emerging concern in the world. With all these subsequent developments the concept of energy security is embracing new dimensions away from economical and technical concern to more social and human considerations and emerging as one of the most debated fields in the International Relations.

The question regarding renewables meeting entire energy needs of Pakistan by 2050 is answered in recently published energy roadmaps study by Stanford University (2019) for 143 countries to address climate crisis. The study suggests that it is possible for Pakistan to transit to 100% clean & renewable energy using Wind, Water and Solar (WWS) by 2050. The study does not just mention the electricity but entire energy supply chain, including the heating, cooling, industries, transportation and agriculture. The possibility of attaining the target lies in the countries need to convert all their end-use energy to electricity. That means to abandon the use of natural gas stoves, and no need of burning coal, gas and oil for industry and transport. And, by doing so, Pakistan could improve energy efficiency by 31%, because of more efficient use of electricity versus combustion. The study projects that by 2050, Pakistan can meet its total end-use energy demand of 103.2 GW using 100% renewables (WWS) as opposed to 206 GW in business-as-usual (BAU) case. While it will cost us around 6.8 US$ cents/kWh to generate 100% clean energy versus 10.4 cents/kWh in BAU (Jacobson et al., 2019).

The current study investigated the role of renewable energy in the contemporary energy security mentality of Pakistan? and empirical question “Does vision 2025 clearly addresses the need for contemporary energy security evaluations?” The study also surveyed the secondary questions related to the suitability of the vision 2025 as being the right vision for Pakistan keeping in view different challenges faced by the nation. Based on this extensive evaluation of the energy sector of Pakistan certain policy recommendations are given in the chapter.

The thesis also probed the energy security impact on the domestic energy policies also considering the foreign policies developed over time. There is also an analysis of the role of energy diplomacy in the advancement of RE resources in the country considering the developments made so far along with some future. Defining energy security is very important in this type of investigation therefore a stock of contemporary literature in the field is taken out of which recurrent dimensions and parameters are drawn and then implemented in the Pakistani case to see whether the contemporary energy security mentality in the country considers the global parameters of energy security while devising the country energy policy.

After reviewing the current status and accomplishments received so far in accordance with the vision 2025 the utilization of renewable energy resources in the country as well as comparison of energy generation can be done effectively. It can be determined that in Pakistan there are a variety of projects related to modern renewable energy technologies under implementation stage as well a few of those that are in the commissioning, expected to be operational till the end of 2018-19. It is assumed that these renewable energy technology projects will facilitate the country to address its dire energy requirements. It is also believed that there will be great benefits to the economy of Pakistan with the gradual employment of these RE schemes. In addition, with the adoption of a rigorous policy of renewable energy technologies, the country is believed to minimize its dependence on importing the fossil fuels which are already a huge burden and a gradual threat to Pakistani economy. There are a few policy recommendations outlined in this section for improvement in the Renewable energy sector of Pakistan.

The transformation of the energy system in Pakistan is at the core of resolution to global warming problems, as well as air pollution and energy security perspectives hold equal significance as these arguments will define how this transition will take place. This thesis is an effort to assess the use of renewable energy technologies for energy security of Pakistan and its accessibility for all, across the country. Along with discussion on renewable energy technologies utilization in Pakistan, the thesis also recommends the policies for adoption of lacking resources like ocean/tidal and geothermal resources for electricity production. Renewable energy technologies adoption in energy policies will ensure energy security, job creation, reduction of

global warming, protection of environment and development. With the discussion in this thesis it is concluded that with a rigorous energy security policy based on the use of renewable energy resources the country's dependence on fossil fuels can be reduced. Power crisis in Pakistan is anticipated to finish in the coming years based on the present government energy policies of ongoing renewable energy projects. With these projects, there are emerging hopes of 2732 MW surplus power generation by 2019. The effective use of RE technologies can help to improve the economy, global climate change and air pollution issues. The rigorous implementation of RE technologies in Pakistan will surely pave the way for effective implementation of Sustainable Development Goals.

The demand for energy is increasing in Pakistan due to raise in population and industrial growth. The country still relies on the expensive, imported and polluting fossil fuels to meet most of its energy needs. In the meantime, fossil fuel prices have increased most recently in the world. It will have direct consequences for the country like Pakistan, being net importer of gas and oil to meet its energy needs. There is very low share of renewables in the country's energy mix therefore there is no other means to produce energy, resulting in energy short-falls across the country. Policy architects around the globe are looking for alternate ways of energy to resolve energy shortage problems. Following the same evolving trend Pakistan is also exploring different sources of alternate and renewable energy. In the research work I have compared different renewable energy sources in Pakistan i.e., Hydropower, solar, biomass, geothermal and wind, based on price, average life span, emission of hazardous gases, consumption of fuel, operation and maintenance costs.

It is also concluded that with the use of renewable energy technologies the pressure on the national budget can be lessened which is being used for importing expensive fossil fuels, especially gas and oil. The use of solar energy is only limited to solar PV, solar water heaters, solar geysers, solar cookers and solar pumps in Pakistan. But until now, renewable energy share in the total energy mix of Pakistan is negligible. Pakistan's topography and climatic conditions are ideal for the utilization of different renewable energy sources at its maximum level. Finally, I have provided some policy implications to address the barriers in the way of renewable energy technology use in Pakistan, to make people aware about the current energy problems of the country, by

supporting and promoting renewable energy technology practices and attract local and foreign investors to invest in renewable energy projects across Pakistan. To conclude, renewable energy has the potential to solve Pakistan's energy crises in a short time period.

Pakistan should follow the Swedish case where the country went from dependence on cheap foreign oil to being a world leader in renewable energy. Almost fifty years ago Sweden was dependent on imported oil to power the country like Pakistan but the policy makers there realized the fact after the oil crisis of 1970s transformed everything. The oil prices also raised due to 1973 crisis. Like many countries, Sweden was hit even introducing rationing on petrol as it had few fossil fuel reserves of its own. Based on these stark realities the Swedish government realized things would have to modified. It invested heavily in nuclear energy as well in wind, and hydroelectric power. Swedish government gave multiple incentives and started providing energy literacy programs in an effort to change the attitudes of Swedes towards energy, hiring 'energy advisors,' to explain the benefits of green energy to ordinary people. Over the years this approach transformed Sweden's energy sector. In the year 1991 Sweden's renewable energy consumption was 34% now its over 50% the highest renewable energy share. The country ranks 1st on the Energy Transition Index (ETI) with a well balanced energy system, a diverse range of energy sources and affordable energy prices for households and industries. Sweden is the most prepared country in the world for energy transition but it's still ambitious it aims to produce total energy with RE sources by 2040 and wants to eliminate greenhouse gas emissions by 2045. Pakistan should learn from the Swedish case to get maximum benefits from its available indigenous renewables energy sources to avoid foreign debt on expensive oil and gas as well as mitigating climate change.

In the same manner in South Asia the example of India's quest for renewables stands as a glaring case. According to reports for the first time, India is investing more in Solar energy than coal. As the world's second most populous country wakes up to the power of renewables India is the world's third highest producer of greenhouse gases after the US and China, India relies heavily on fossil fuels, Coal generates almost three quarters of its electricity supply and usage is still rising as demand increases but at the same time India's renewable energy capacity is growing much faster. It has doubled

in less than 3 years. It has built one of the world's largest Solar plants. Presently India's energy demand per person is comparatively low which is changing fast due to population growth and rapid economic development which could double its share of global energy demand by 2040. India remains on track to meet its obligations under the Paris climate agreement and it stands as a good example for other countries in South Asia to invest more in renewables to reduce carbon emissions and limit global warming.

Therefore it is a challenge for the government and people of Pakistan to move towards a more sustainable energy pathway. The country requires an energy framework and system that recognizes and considers human welfare as a fundamental part. It has become critically important to have structural and policy reforms in the country's energy sector to improve reduction of imported supplies, energy mix, transmission and distribution loss, and endorsing modern energy conservation and management practices. Reduction of environmental impact on the energy sector should be a priority area of all such reforms efforts. The country also needs to exploit its massive local RE sources effectively. There is also a great requirement to rationalize the energy price for the consumers to ensure optimal profits for the nations economy.

6.2. Energy Policy Recommendations

After reviewing the current status of renewable energy resources utilization in Pakistan and comparison of energy generation. It can be determined that in Pakistan there are a variety of projects related to modern renewable energy technologies under execution stage as well a few those that are in the commissioning, expected to be operational till the end of 2018-19. It is assumed that these RE technology projects will facilitate the country to address its dire energy requirements. It is also believed that there will be great benefits to the economy of Pakistan with the gradual implementation of these renewable energy projects. In addition, with the adoption of a rigorous policy of renewable energy technologies, the country is believed to minimize its dependence on importing the fossil fuels which are already a huge burden and a gradual threat to Pakistani economy. There are a few policy recommendations for improvement in the RE energy sector of Pakistan.

1. Encouragement of investment in renewable energy technologies

The GOP should provide subsidies and incentives to the foreign investors to actively invest in the RE sector of Pakistan. The China-Pakistan Economic Corridor (CPEC) is a good example in this regard in which most of the projects are related to energy including RE technologies projects. There is need to do more in this regard so that others may also invest in the RE projects. Friendly countries may also contribute more in the development of renewables in Pakistan through friendly policies of the Government of Pakistan.

2. Energy Education and RE awareness

It is very critical to teach the youth regarding the significance of energy conservation at school, college and university level. Energy education and specially the knowledge regarding the RE technologies is a must in the today's rapidly developing century. Energy education should be made a part of national curriculum in order to equip the youth with the best practices in the field. Regular seminars, workshops and training sessions should be conducted for the national awareness regarding the best practices in the field of energy.

3. T &D Losses reduction in the energy sector

Currently, the line losses of electricity in Pakistan stand at 22% which is due to the poor quality of power/distribution infrastructure. The transmission and distribution feeders are quite old. Old transmission and distribution infrastructure (T & D) should be replaced with the new one to reduce power losses. Energy policies should provide more incentives to investors to encourage investment in this very vital sector of the energy system of the country.

4. Net Metering and energy generation through PV Installation

For every building, the building owner should generate its own electricity by installing the photovoltaic panels (PVs) on the rooftop, and building glass in order to generate maximum power. This decentralized electricity mechanism is quite helpful as it is also beneficial to reduce the line losses which are caused due to old long supply lines

connected to the national grid. Moreover, there are areas in the country where laying down the transmission and distribution network is very difficult due to the difficulty of the terrain. This decentralized/off grid solution can easily power those remote areas of the country. Wide spread commercial Net Metering should be encouraged across the country so that more and more indigenous investment can be generated in the RE sector.

5. Geothermal energy and Tidal energy.

Pakistan has enormous potential for geothermal energy which is not exploited properly. The government should seek investment and expertise from the developed countries to tap the potential effectively. This can prove to an easy and accessible resource and Pakistan can produce electricity on commercial scale by utilizing the geothermal energy resources. Moreover, innovative ways should be explored to get benefit from the ocean tidal energy to generate maximum power.

6. Biogas Plant.

Presently, Pakistan is utilizing a very limited amount of biogas. Pakistan can generate energy through biogas plant and also encourage commercial level energy production from it. It is cost effective and a readily available resource. Biogas plant should be developed and installed at a high density population area. It can be used there to utilize the waste and produce the appropriate gas required. Biogas can also be used to run the gas engine in order to produce electricity thus fulfilling the energy demand in the area.

7. Energy conferences/Seminars/Exhibitions for FDI in RET

For potential investors, Pakistan is indeed a green paradise to invest in its energy sector. The government of Pakistan through its relevant quarters should propagate this massive opportunity for any potential investors around the globe. In order to attract more energy investments, regular energy related conferences/seminar/exhibitions should be held in Pakistan. The investors should be informed about the investor friendly policies in the Pakistani RE market through media campaigns and advertisements.

8. Implementation of storage technologies

Like many other countries Pakistan should adopt energy storage policy. It should be integrated within the framework of RE technologies as it increases the reliability of sustainable energy generation. The cost of energy storage technology is decreasing continuously, and it is the right time to invest in it for sustainable generation and supply of electricity.

9. International Collaboration and R&D

There is a need to open more national energy incubation centers across the country for further research & development in the energy sector of the country. The centers should be able to deploy new RET's through innovative business ideas. Moreover, they should forge international cooperations through mutual research and development in the RE technologies.

Global energy mix is shifting towards more renewable energy technologies in order to counter the challenges of environment and climate change. Renewable energy market is new in Pakistan and faced with several challenges. There is need to strengthen and integrate the energy institutional governance, fast track processing of the novel energy technologies proposals, encouragement of more FDI and private sector investment and attractive renewable energy policies with proper inclusion of all stakeholders. The government of Pakistan is also observed to be moving in the direction of global trends of energy transition. Based on the policy recommendations the country can move faster in the RE transition through encouragement of local manufacturing of these technologies. Moreover, the future energy policies in the country should take into account the guiding principles of affordability, sustainability, responsibility and availability for their effective implementation.

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APPENDICES

Appendix A: Semi-Structured In-depth Interviews Questions

1. What do you believe are the reasons for Pakistan being unable to achieve the target of eliminating the electricity supply-demand gap by 2018?
2. Do you think it will be possible to meet growing future demand by 2025?
3. What do you think about the diversity and mix of energy generation in Pakistan (i.e. the use of oil, gas, hydro, coal, nuclear, solar, wind and bio- mass in energy generation?
4. Do you think factors such as indigenousness, economic feasibility, scalability, risk assessment and environmental impact are taken into account sufficiently? Why/Why not?
5. Do you have information about the status of the two major hydroelectric projects: Diamer Bhasha and Dasu dams? If yes, what do you think are the reasons that prevented these from being completed?
6. What do you think about the prospective role Thar coal in the energy mix of Pakistan? How important is the 6600 MW Gaddani Energy Park project in this respect?
7. Can you elaborate on your perspective regarding the potential use of renewable energy in Pakistan? What are the enablers and barriers regarding the increase in the share of renewables in Pakistan?
8. What do you think about the policy of using Nuclear energy in Pakistan? How successful do you think is the government policy in this field?
9. How do you think the distribution and transmission losses can be minimized?
10. What is the situation of the transmission and distribution infrastructure and effective enforcement of controls in Pakistan? Which do you think is more crucial?
11. What is the significance of the organizational infrastructure and the availability of human capital for the energy sector of Pakistan? What do you think about the current situation in this respect? How can it be improved?
12. 12. How important do you think are demand management and conservation in terms of energy for Pakistan?
13. How can increasing awareness, regulations, and incentives be employed to achieve better balance between peak and off-peak hours

14. How do you perceive the institutional regulatory frameworks regarding the energy sector in terms of transparency and efficiency? What are the reasons for the current situation? How can they be improved?

Appendix B: Information Sheet

Introduction: I am Athar Rashid from Izmir University of Economics. I am conducting a study on the Pakistan's Vision 2025 Goals related to energy security. I am going to give you information about and invite you to be part of this research.

Purpose of the Project: The main aim of this project is to examine Pakistan's potential of achieving its Vision 2025 goals in terms of energy security. We would like to understand the perception of managers/policymakers/officers/individuals related to 10 goals identified with respect to ensuring uninterrupted access to affordable and clean energy for all sections of the population of Pakistan in Vision 2025. Accordingly, we would like to provide policy makers with comprehensive information, data, and policy ready recommendations about the successful implementation of Vision 2025 goals in terms of energy security.

Type of Research Intervention: This research will involve your participation in a semi-structured in-depth interview that will take between one to two hours. Participant Selection: You are being invited to take part in this research because we feel that your experience as a manager/policy maker/officer/individual etc. can contribute much to our understanding and knowledge related to Pakistan's Vision 2025 goals in terms of energy security and their likelihood of being successful achieved.

Voluntary Participation: Your participation in this research is entirely voluntary. It is your choice whether to participate or not.

Procedures: We are asking you to help us learn more about Pakistan's Vision 2025 goals related to energy security. We are inviting you to take part in this research project. If you accept, you will be asked to participate in an interview with myself.

Duration: The research takes place over 6 months in total.

Risks: The research does not entail any risk to you as a participant.

Benefits: There will be no direct benefit to you, but your participation is likely to help us find out more on our research subject.

Confidentiality: We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number or another identifier on it instead of your name.

Sharing the Results: Nothing that you tell us today will be shared with anybody outside the research team, and nothing will be attributed to you by name and/or your position.

Right to Refuse or Withdraw: You do not have to take part in this research if you do not wish to do so. You may stop participating in the interview or focus group at any time that you wish.

Who to Contact: If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact me via: athar.gs@gmail.com and/or Mehmet Efe Biresselioglu, PhD, Izmir University of Economics, Head of Sustainable Energy Division efe.biresselioglu@ieu.edu.tr and Muhittin Hakan Demir, PhD, Business School, Izmir University of Economics, Head of the Department of Logistics Management muhittin.demir@ieu.edu.tr .

This proposal has been reviewed and approved by Izmir University's Ethics Committee, which is a committee whose task it is to make sure that research participants are protected from harm. If you do have any further questions about the Committee, please get in contact with Prof. Filiz Baskan Canyaş via filiz.baskan@ieu.edu.tr

Appendix C: Certificate of Consent

I have been invited to participate in research titled as "understanding Pakistan's Vision 2025 goals related to Energy Security: A qualitative Inquiry". I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions and any questions I have been asked and have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Name of participant

Signature of participant

Date

Statement by the researcher

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the details of the research. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Name of Researcher

Signature of Researcher

Date

CURRICULUM VITAE

Mr. Athar RASHID was born on 1st January 1983 in Mansehra, Pakistan. He received his Bachelor's in Modern Languages and MA English (Linguistics & Literature) degree from National University of Modern Languages, Pakistan. He also completed his M.Phil (American Studies) from Quaid-i-Azam University Islamabad, Pakistan. In 2005, he was employed at the National University of Modern Languages Islamabad Pakistan as a Lecturer and then got promoted to the position of Assistant Professor in 2012. During his Ph.D. studies, he also served as research assistant to Prof. Mehmet Efe BİRESSELİOĞLU and aided in different research and teaching assignments. He won Higher Education Pakistan Funding for his doctoral degree under faculty development program from National University of Modern Languages, Islamabad Pakistan. His research interests are Energy policy, Energy security, Energy politics, and Discourse analysis. He participated in a number of international conferences where he presented research papers, (some of them are already published, others are in the publication process).