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Understanding the impact of sustainable energy transition on risk acceptability and tolerability

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Abstract

Risk analysis helps to estimate the level of risk of a given situation, and to determine if the risk is acceptable, tolerable, or unacceptable. At this stage, the consideration of individual or societal factors becomes very important in the decision-making process regarding the acceptability or the tolerability of a risk. The energy transition is likely to affect the balance between risks and benefits, resultantly, it will create new risks as well as new benefits and therefore it is important to understand what society is likely to accept or tolerate, something that has not been fully investigated especially in countries with growth potential where it is very important to combine sustainability with need for growth Without public acceptability, tolerability and support for changes, a sustainable energy transition is unlikely to be viable. We argue that risk acceptability is often addressed too late and should be incorporated into the planning process from the start. Moreover, engineers, policy makers, and project developers tend to misjudge the complexity and causes of public resistance, trying to find the magic bullet to "solve" the lack of risk acceptability. The study is based on the positivism paradigm as this study aims to investigate the 'understanding impact of sustainable energy transition on risk acceptability and tolerability' objectively that can be observed and measured out in the general world. Quantitative research approach was used in line with positivism paradigm. The quantitative approach helps to study the cause and effect relationship. It also helps to collect systematic information to meet the objectives of research. Two Chinese power companies were selected for data collection. 1) China National Electric Engineering Company – CNEEC. 2) China power hub generation company (CPHGC). The rationale of selecting two energy companies as sample was due to Pandemic situation globally and due to inaccessibility of respondents. The total sample of 300 was selected for the data collection. It is summarized that the scale of risk acceptability and tolerability in context of Pakistan is moderate that encourages companies to work progressively and increase socio-cultural activities to make the society as partner of this new shift in energy transition that will increase the level of risk acceptability ultimately. Furthermore, addressing the main research question, the risk acceptability and tolerability level in context of Pakistan is moderate. As a society, people are not high-risk taker neither risk avoider due to limitation of income, uncertainty and political instability.

Keywords: Risk acceptability and tolerability, Sustainable energy transition, Risk management and energy system in Pakistan.

Contents

1. Introduction/background

The organizations that do not forecast the risk probability, cannot stay longer due to stiff competition in corporate world. Risk is undeniable factor in business operations but meanwhile is unignorable factor for organizational growth and development especially in energy transition. The omnipresent of risk is prevailing in almost every activity of human beings. To decide about whether the risk is unacceptable, tolerable, or acceptable, risk analysis is fundamental activity established for this precedent. Individual and societal factors become essential and pivotal for the decision-making process at this stage to judge about acceptability and tolerability of risk. The hazards potentially prevailing in societal activities associated with the risk management remains matter of sound public and technical interest. There is a considerable and continuous range of development in context of regulatory framework (Tchiehe & Gauthier, 2017). The establishment of many new frameworks of regulations is on its peak. Except the debate of public on risk assessment at general level is in dearth and need remarkable extensions for understanding of philosophical issues associated with tolerability and acceptability of risk especially related to sustainable energy transitions. Changing energy system is at heart of public acceptability of risk towards a production of more sustainable way of energy (Thao et al., 2014). Viability of sustainable energy transition without tolerability and acceptability of risk through public change is merely possible. The planning process should be incorporated with fundamental debate of risk acceptability and tolerability in order to avoid lateness and heavy losses in projects. Essentially, the policy makers, engineers and project managers should be profoundly knowledgeable of assessing the risks and its management (McComas et al., 2008). Additionally, by going this way will the policy makers and engineers will safeguard the projects from misjudge, complexities associated to public activities and solving the problems of risk acceptability. If the key concern of public interest around the energy project is fail, then such activities are counterproductive or even likely ineffective. One-size-fits-all solution is not prevailing: as risk acceptability is dynamic hence, context, projects specificity, and parties linked matters most. The standard of judging for risk acceptability criteria is based on decisions related to risk acceptance during risk analysis and risk evaluation. Certainly, comparing the results of risk analysis with criteria of risk as consequence of risk evaluation for the purpose to determine whether the level of risk is acceptable or tolerable or not. ALARP principle, absolute targets, GAME etc. are the different factors that

guide to distinction between acceptability and tolerability of risk. It also outlines the influencing factors for decision rules available to different industries especially to energy sector.

The original intended purpose is little beyond in once built projects. The truncations are often found but, the potential rewards can be excellent (Vlek & Stallen, 1980). On average it takes almost ten years to get good revenue but the trajectory in future is quite lucrative. The commitment of huge capitalization cost has to be carried out as a prior substantial upfront expenditure. The sponsorship from state may work to reduce the trajectory of risk and may enhance the possibilities of coming up with perpetual success. Another way to hedge the risk and to ensure the long-lasting success can be attained through restructuring of debt and ownership in order to save prior investments. Managing risk is a real issue that can be minimized in this way.

Energy transition is getting attention due to global climate change, health issues, poverty, and dynamic needs of economics. It geared up after united nations millennium goals of sustainability and prosperity. A growth in aging population, a change in labor markets, a change in shapes of human mobilization and urbanization, swift progress in technology and automation through information technology and extra societal movements, mega trends in technology and economy are shifting human job and life and business atmosphere by putting corporations under strong stress to variate radically, the way of their operations (Goštautaitė & Bučiūnienė, 2015; Kulik et al., 2014; Laplanche et al., 2015; Schönborn et al., 2019). Social performance of companies is growing parallelly (Schrempf-Stirling et al., 2016) point outs that there is no way to bear unsustainable human and social activities that cause exploitation of resources and to ignore inside and outside stakeholders of the organization (Pfeffer, 2010). Tolerability of risk (ToR) characterized by dynamicity that is pinned in process of decision making that help to gauge the societal and individual risk. The energy transition means changing the energy system from fossil fuel or any traditional mechanism to modern renewable sources that have sustainable impact over other. A wide range of changes in economic and social activities demands high attention to transform the energy production from ancient and inefficient systems to new and efficient system that can guarantee the minimum environmental depletion and maximum output. The energy transition is paramount important in current global energy system for the purpose to gain sustainable goals for organizations. The energy transition is defined in multiple ways. According to Hirsh and Jones (2014) “A change in fuels (e.g., from wood to coal or coal to oil) and their associated technologies

(e.g., from steam engines to internal combustion engines)". Smil (2016) explains energy transition as "The time that elapses between the introduction of a new primary energy source, or prime mover, and its rise to claiming a substantial share of the overall market".

The essence of sustainable energy transition is underpinned in renewable energy sources and is becoming the urge for future energy system especially wind and solar energy. So, we have to check the conditions on which people are willing to adopt renewable energy source. Meanwhile we have to educate the individuals to make their understanding better. Other than, enhancing the efficiency of renewable energy system, the companies also have to focus on improvisation of their production systems that can reduce the electricity consumption. Moreover, the individuals can work energy efficiency and can invest on solar energy source as easily available source. They also have to electrify the appliances that are energy efficient so that their energy demand can be reduced. They also have to change their daily behavior of using energy (Faber et al., 2001). Additionally, it is noteworthy to clarify that production of renewable energy is strongly correlated with environment condition and in many parts of world it is not readily available especially solar energy. Hence, the people have to balance their energy consumption and energy production to get rid of any inconvenience. It can be benefited through new technology on both side, consumption, and production. They have to use autonomous switches to shift and managing electricity burdens. In addition, its people can use storage technologies such as batteries and electric vehicles.

Hypothesis:

H_1: Potential positive effects of energy transition significantly influence risk acceptability

H_2: Effective measures of energy transitions significantly influences risk acceptability

H_3: Government support for energy transition significantly influences risk acceptability

H_4: Barriers to energy transition significantly influences risk acceptability

The figure is the pictorial view of research framework. It indicates that sustainable energy transition is a dependent variable. To measure the dependent variable the study incorporated four elements in order to measure it with maximum domain. Risk acceptability and tolerability is dependent variable and is measured in different domain. The domains of measuring risk

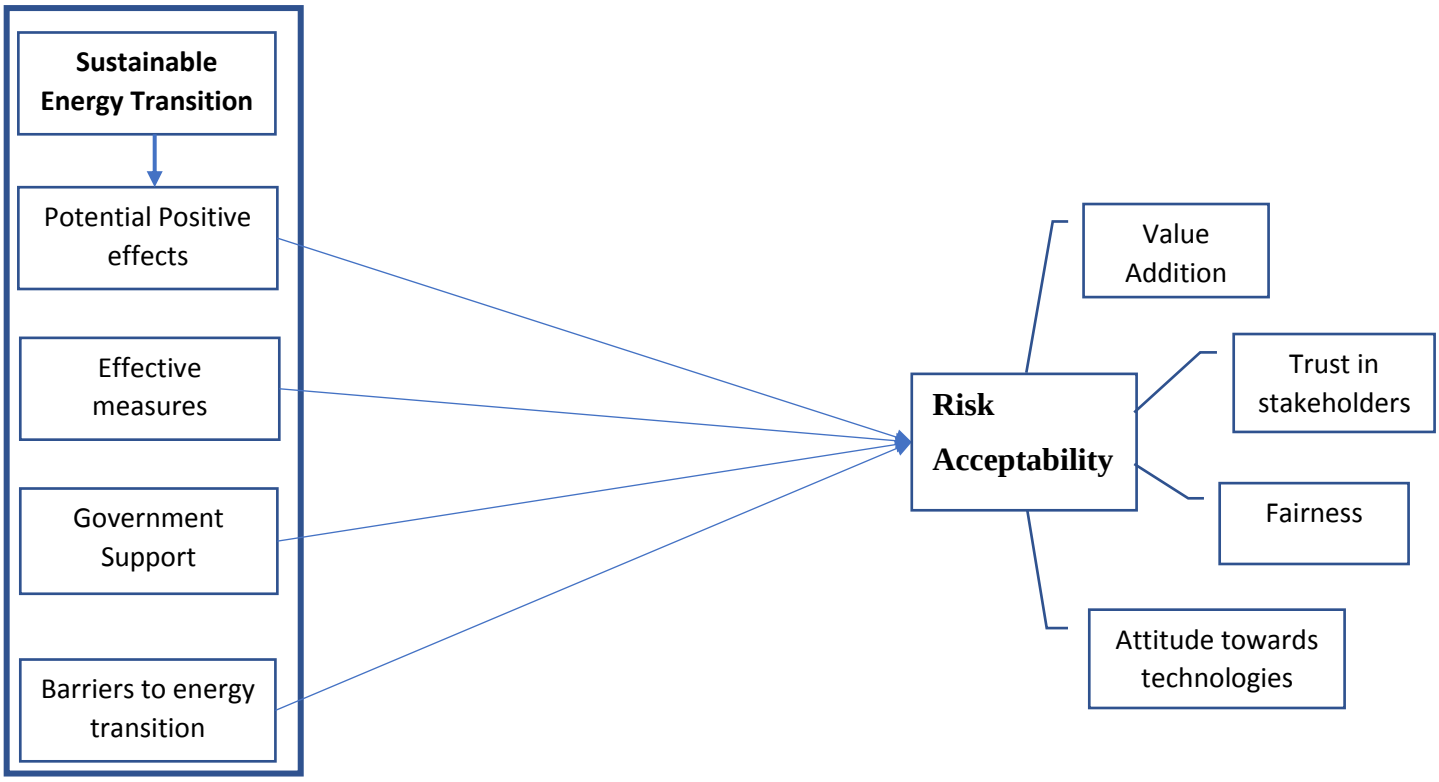


Figure 1: Research Framework

acceptability and tolerability are consisting of value addition, trust in stakeholders, fairness, and attitude towards technologies.

2. Literature review

The part of thesis narrates about the past studies conducted on this topic. It is evident that literature on sustainable energy transition and risk acceptability is in dearth but is getting attention of researchers and policy makers. Additionally, numerous studies have also showed that the topic is evolving and emerging. It is inevitable to conduct a comprehensive study on this topic. The chapter is schemed as; first part of the chapter discuses about literature on sustainable energy transition and its related topics while second part of the chapter elaborates about past studies done on risk acceptability and risk tolerability. The last part of the chapter presents a summary of whole studies and its integration with topic.

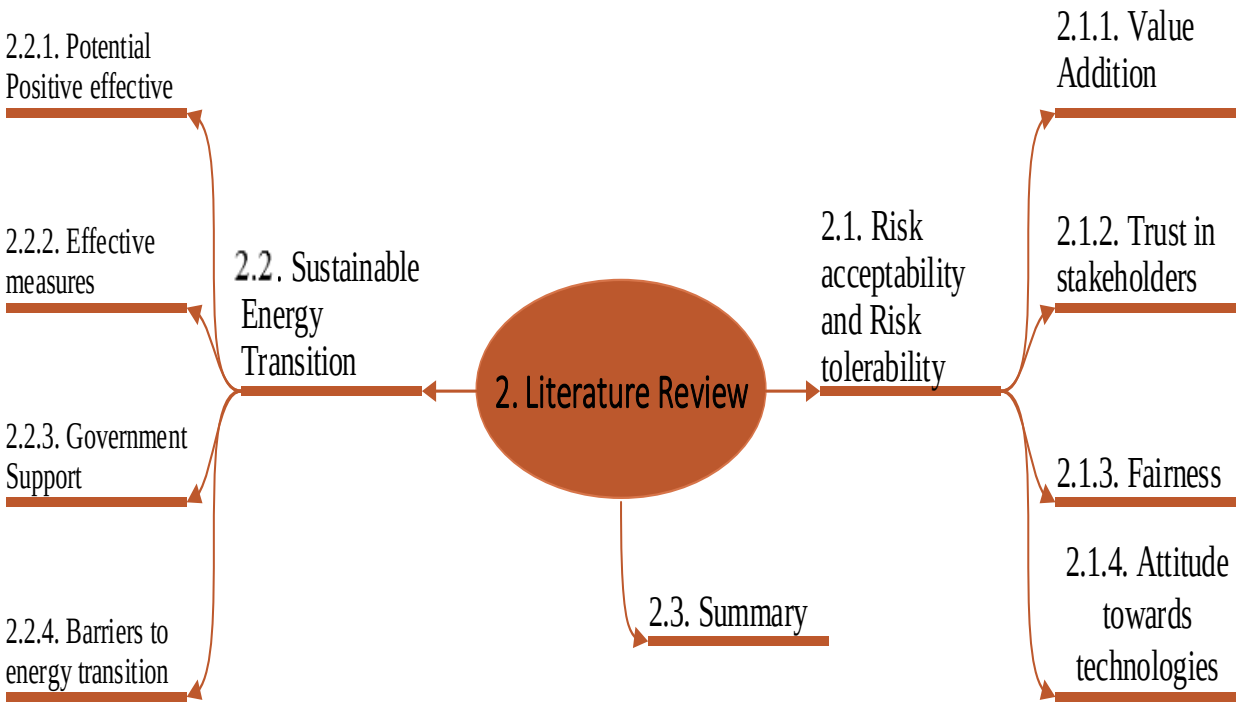


Figure 2: Literature flow diagram

2.1. Risk Acceptability and risk tolerability

The industrial risk management practices and policies' effectiveness is led by keener interest into increased level of political maturity, development issues, environmental awareness, and higher

education level to increase social benefits. The risky and unfriendly policies of hazardous industries have increased public interest to take risk towards environment protection. Despite this, `risk' is perceived poorly as a concept with confusion between probability, something involving both probability and consequences and something implying monetary or other loss. Vlek and Stallen (1980) provided different concepts of risk or riskiness by combining or mixing all or components of the two main component ideas. The traditional decision analysis estimates the consequences of chance estimates for better risk analysis. The standard deviation of each estimate has measure of uncertainty and social perception for better reflection of personal accuracy for risk acceptance and tolerance (Stewart et al., 2006). Regardless of all carefulness, there are chances of disagreement to prevail on exact definition of risk acceptability and tolerability, as many psychological and sociological terms appears in risk, depending on eventual outcome of one's stake and his point of view.

The level of risk acceptability or tolerability associated with any project or facility might depend on group, society or individual due to complexity of issues prevailing in certain context on which situation is being drawn. It is nearly impossible to deal the situation in one context with measures taken in other context with certain situation and limitations furthermore, Patterson et al. (1992) suggested some useful critiques and summary. As matter of fact, risk acceptability and tolerability are not necessarily same although it is interchangeable term in many common risk analysis terms. In some situation risk tolerability is referred as readiness to live with risk in order to protect certain benefits and interests in order to manage it in well mannered. On other hand, tolerance of risk means that we cannot ignore and neglect something rather it is something we need to keep it under review and try to minimize it till further level. Lower level of risk criterion is associated with concept of risk acceptability and additionally acceptability means more relaxed attitude towards risk. According to Layfield et al. (1987), the definition of 'acceptability' does not depict the disinclination that people that show hazardous activities in terms of nuclear power debate. The term acceptability and tolerability must be distinct because it is important to understand and implement. The term acceptability means getting consent or acceptance towards regularity authorities for risk situation. On other side the impact of the situation suggest that people have tolerability on the said situation as they have showed their consent.

In most human activities' risks are omnipresent and get attentions of researchers to conduct studies for the purpose to comprehend and assess the risks involved to the activities. In-fact, it is almost impossible to get rid of risks rather strategies can be driven to mitigate the risk(s) associated with project. There is plethora of studies conducted to generate a broad diversity of risks and concepts linked to the phenomena. In broader view, the notion of risk permits researchers' efforts to put their energy and utilize capacities to avert and safeguard organizations and human beings from harmful activities whether it damage financially or sometimes damages natural resources (Tchiehe & Gauthier, 2017). Furthermore, according to standard Thao et al. (2014) risk is uncertainty against loss of something that the organization aims to obtain and risk lies on the elements that are beyond the control or are not fully controllable. Although risk has some limits, but those limits are not well tacit, yet many methods and mechanisms of risk can help to analyze and access the quantum for decision making. These mechanisms and tools are effective to mitigate risk and to make it acceptable and tolerable (Thao et al., 2014). The term 'Risk acceptability' means the public or the organization is willing and has capacity to adhere the potential loss on account of certain benefits that the risk is worth taking and is being under control. The studies show that the risk, that is acceptable means it is tolerable (Schjølberg & Østdahl, 2008). Furthermore, they asserted that acceptable risk refers to tolerable risk as a subset. They asserted these concepts according to the contextual setting of society and value system of a community. According to Haridasan et al. (2015), the terms risk acceptability and risk tolerability are synonyms. On other hand, there are studies that showed adversary concepts that tolerable risk does not mean acceptable. Finlay et al. (1997), they distinguished that tolerated risk can be lived with but without being fundamentally accepted also. The difference between the result of event, their impact and diversified interaction may have difference than expectation is known as risk possibility. The risk is not only a described term but, more possibility is to calculate risk in statistical terms while risk uncertainty refers to situation in which causal force and potential outcomes are not fully understood. The term risk is multi-faceted and need to be unfold for clear understanding of driver, output and cause. Regardless, the impact depends on how they are integrated and interacted and avoided to certain level. Research-and-development projects present scientific challenges but face fewer social acceptability and market difficulties as they can be broken into smaller testable investments. There are wide range of risks associated to organizations that need conscious address such as Market risk, institutional risk, financial risk.

Thus, locating a risk in the framework provides a guide as to what more, if anything, ought to be done as regards further risk control. It will inform the HSC or HSE's decision-making when considering risk regulation in general, but where it really bites is in informing HSE decision-making when it considers what duty-holders have done about particular risks. However, it appears largely to have been ignored in practice. Perhaps by default, the regulatory approach is the most common route in attempting to exert control over potentially hazardous activities. This trend is being followed in several countries as given in figure 3.

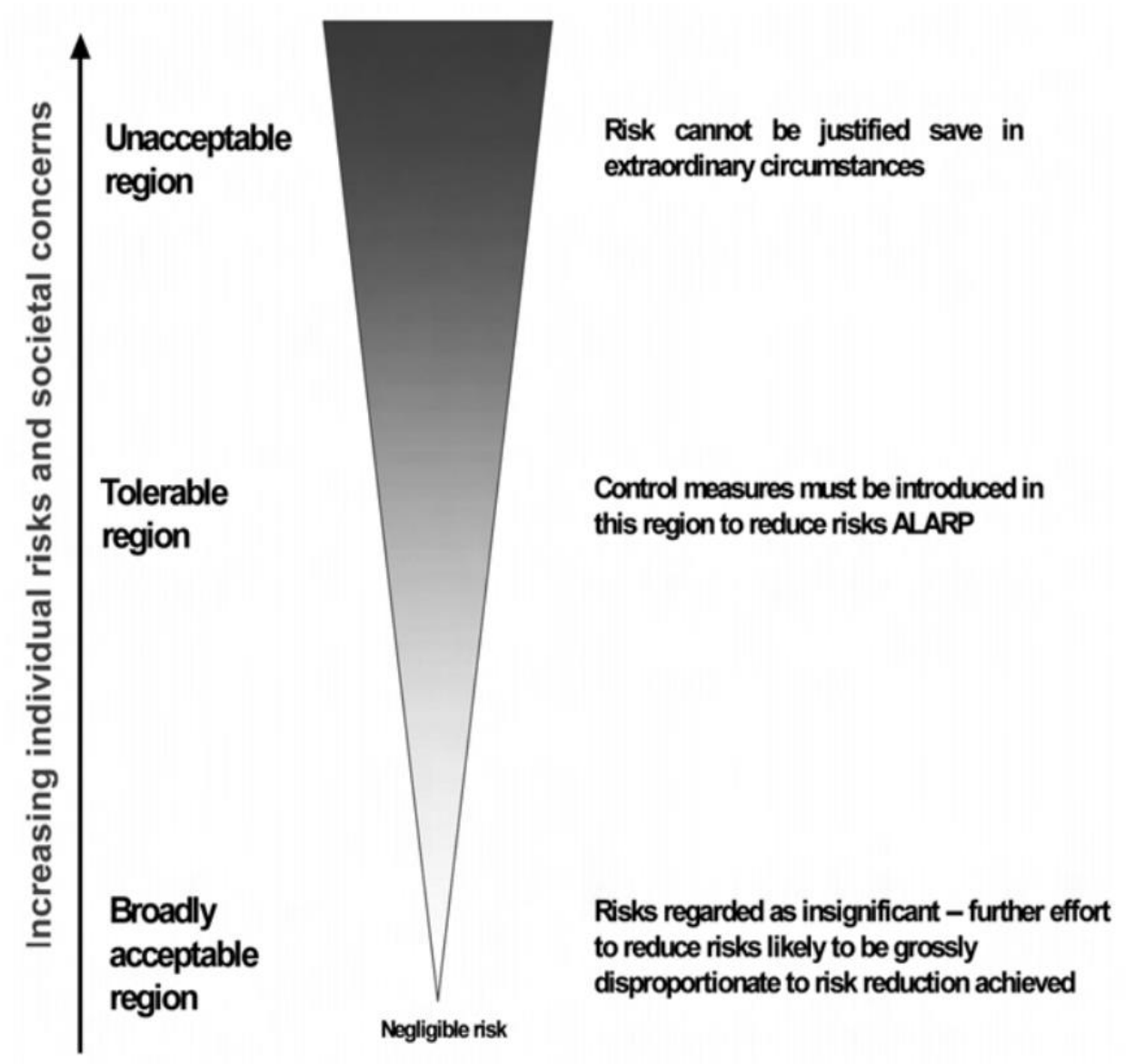


Figure 3: Concept diagram for Tolerability of risk (Bouder et al., 2007).

2.1.1. Value Addition

When perceived value of the project has something positive and renewable projects and efficiency of technology in energy projects such as electric vehicles are more acceptable the symbolic possibility of accepting risk is higher. Public commitment and toward sustainability energy transition become symbol of proud for them if they become part of renewable initiatives and the feel excitement. For instance, in Japan, the wind turbines are named with the people who contributed to the wind park and they feel privileged in the community. The impeded potentially signaling value of risk acceptability can be yielded by providing financial incentives and gives chances to earn money. At the heart of sustainable energy transition projects, there is opportunity to reduce the risk by providing more values as an alternate of their risk acceptability. Additionally, the strivings of people towards the generals goals is motivated by value additions Schwartz (1992) also shows what is pivotal to common people in different situations and across time. To certain extent, values are endorsed by the people across the world and they differently priorities the values. It is important to label the term 'value' that refers to individual characteristics of evaluating the projects and estimating the perceived benefits out of that project. Different implications are seen in different energy projects for people's values. Precisely, the characteristics of decision making process, the distribution of cost and benefits analysis, the nature and environment consequences, the possible hazards of health and safety, the quality and security of energy supply and type of technology used are all different characteristics of energy projects that have implications for people's value (Steg et al., 2014).

2.1.2. Trust in stakeholders

The several technology options are combined and facilitated in transformation of energy especially in wind, photovoltaic and grid technologies. In private investments, cost and flow of revenue for various stakeholders is the key issue to deal with because of large financial involvements. It is equally important to understand that physical characteristics of risk is detailed information of stake holders' questions and concerns. Moreover, apprehensions, fears, hopes and emotions of social consequences as well as likely the risk acceptance for economic and political responses and implication. The second component of risk appraisal – concern assessment – thus complements the results from risk assessment with insights from risk perception studies and interdisciplinary analyses of the risk's (secondary) social and economic implications. To underline the importance

of inclusion of public and stakeholders' group, the focus should be on governance rather than on administration or government for handling risk process and resultantly on stablishing public private partnership participatory partnership. As context of the framework the stakeholders are defined as socially organized group that will be influenced by output of the activity or event by the risk management options or risk originates to counter the real risk of the project. It is not enough to involve stakeholders only but related groups like non-organized observing public, the non-organized affected public, opinion leaders and culture elites and media, all have their significant role in risk governance. The quality of participation process is a resulting benefit from stakeholder and public involvement. It is merely not possible and sufficient to get all parties round the table and hope for the catharsis effect to come spontaneously. It is essentially important to consider other participating factors like time, effort and resources that need to handle the care and respect (Chess & Purcell, 1999). For the encouragement of various actors, the participation process should be designed in which stakeholders can contribute wherever, they have competency to improve the process and products' quality.

2.1.3. Fairness

The important factors that have influence on acceptance of decision are trust and fairness (McComas et al., 2008). Additionally, this study depicts that people consider a decision as fair when the trustworthiness of decisionmaker is being ensured. In this situation, risk management context is more likely to be accepted. Currently, however, a decision is threatens values if the fair procedure has limited values as suggested by Skitka et al. (2009). Hence, this research identifies that procedural fairness for important decisions, is important for acceptance decision in people's life. The environmental hazards can also be accepted by fairness as suggested by risk communication scholars. In fiduciary approach, the decision-making process is confined to a group of patrons who are obliged to make the 'common good' the guiding principle of their action. This approach also aligns involvement of the affected public and public scrutiny. For the patron, the public can provide suggestions as an input for the arguments that are allowed in policy formulation process and negotiation part. The faith in competence is part of system that rely on fairness involved in decision process for risk acceptability. According to personal affiliations and national prestige, advisers are selected.

2.1.4. Attitude towards technologies

Energy use has created numerous problems especially relate to environment and society that has spurred the growth of technologies in sustainable energy such as, hydrogen vehicles, carbon capture and storage and windmills. The successful introduction of these technologies in society is crucial due to resistance of public acceptance of these technologies (Huijts et al., 2012). Sustainable energy technologies are facing hinderance in implementation of these technologies due to public resistance (Zoellner et al., 2008), that hampers the achievement of societal and environmental important goals. It is pivotal for sustainable energy technologies to understand the main concepts of these terms that why individuals go for action in against or favor of these technologies. The way of adoption and implementation of these technologies should be communicated for better acceptance of these technologies and successful implication. The psychological factors of acceptance of these technologies is discussed in many studies but most of these studies emphasized more on limited psychological factors rather a complete framework that has key set of factors involving in acceptance of these technologies. Although, technology acceptance and influencing factors should be discussed and psychological factors' understanding and communication of citizens and application of the technology. Use of technology and support of technology reflects the acceptance behavior to enables or promote rather resistance of use of technology for better understanding. Because of the environmental benefits the proclaiming of technology is supported and expressed for usage and support of technology. The risk tolerance of technology due to certain behaviors and usage of technology depending on favors they get out of it. When people oppose technology but don't take action (tolerance) is known as connivance (Zoellner et al., 2008).

2.2. Sustainable Energy Transition

For the essential purpose to preserve the climate and natural resource, energy transition is inevitable. For the success of energy transition projects, public acceptance is fundamental and unavoidable. The current system of energy especially in developing world is unsustainable and cannot meet the requirement of environmental safety rather contributing to climate hazards. The ecological system is getting more tragedies due to unstable and unsustainable mechanisms of energy system (Smil, 2016). A socio-technical power system needs a profound transition mechanism to reduce the carbon emissions. Renewable energy is purely to meet the objective to

replace fossil energy. It is not an easy job to do rather a complex way of handling economic, social, and technological challenges to resolve it may have to handle structural problems that have serious concern in energy transition. A broad structural lock-ins has been developed with passage of time as, as identified in literature of the energy innovation (Markard et al., 2012). The incremental improvements are observed as an incentive of hard work of researchers and new approaches and technologies are replaced with conventional technologies (Geels, 2010). Co-evolutionary process is identified in transition of socio-technical between actors and social groups Geels (2012), yet understanding of public on energy transition is still under study. A long way of involving structural changes in production and distribution is known as energy transition. The greater prominence in niches and innovation at micro level for the purpose to gain greater prominence in form of niches at micro level. The determinant of novel innovation and understanding with institutionalized framework for existing practices to change the conventional regime of energy production. Beyond the direct influence of exogenous environment is because of socio-technological landscapes. It is consisting of mega conventions that have pressure on societies extensively, like global environment policy and regulations of market that more influence on awareness of environment and policy making for energy resources or availability of power resources. Moreover sustainable energy process is a long way to achieve through a systematic approach (Geels & Schot, 2007; Rafiq et al., 2020). The main challenges in socio-technological transitions are innovations in practices, the new ideas and emerging at niche level in order to realize the dream of sustainable power transition. The organizational innovation process is underpinned in niche-regime. Number of successful innovations normally challenge the dominant regime, in this way new dominant regime evolve and help energy transition projects (Spaargaren et al., 2013). For innovation in energy transition, the most important and key element is use of technology to get cleaner energy (Corner et al., 2012; Lin et al., 2018). The participation of social and citizens support is helpful for socio-technological transition that increases the understanding of public awareness and decrease level of risk. The study is eventually helpful because we take sample of participants from local community of Pakistan to know what their approach toward energy transition is and how is the look of future of energy transition. It is also important to mention that this study link energy transition with different approaches of risk taking to understand the phenomena of risk acceptability and tolerability. The reason of selecting Pakistan is due to expanding market and rapidly growing market due to which energy consumption demand is also rapidly growing. As

matter of fact, the decisions related to energy are influenced by national policies, consumption by companies and consumers. It also gets some influence from international market especially from Chinese market due to long lasting contracts with Chinese power corporations.

Over the past decade, renewable energy has grown with unprecedented pace and continuously surpassed expectations, with new growth milestones being nailed every year and it impressed new countries energy year who are committing their respective energy transition commitments. Due to effective policies much has been achieved in advance and coupled with ambitious targets. However, pace of energy transition has to increase as established goals in Paris Agreement, for this organizations and countries has to establish new policies for the purpose to increase new projects related to energy transitions. Globally power generation is being focused on renewable sources by policy support and an effort in cooling and heating and significantly the sector of transport is lagging. Fully integrated policies across the sector are required in future for policy framework and to take systematic approach for incorporating supporting infrastructure and measures for balancing supply and demand, taking advantage of synergies with energy efficiency, and harnessing distributed renewables for increased access to electricity and clean cooking. Other than this, it is fundamental to have all polices transparent and stable. In fact, number of discrepancies remain not least among them continued subsidies for fossil fuels, more cultured policies continue to rouse and provision the increasing uptake of renewable energy worldwide.

2.2.1. Potential Positive effects

From clean renewable source, the local governments can drastically minimize their footprints of carbon by dealing a contract of carbon emission trade. Lead by example by local governments through purchasing renewable energy, purchasing green power or by generating energy on-site. Where renewable resources vary in quality and availability there, governments can use combination of renewable energy options in some regions to meet the local requirements of energy. Renewable energy transformation has laid the foundations of sustainable energy form in electric power sector as a key measure to prevent the climate change and scarce resources depletion (Ari & Koksal, 2011; IPCC, 2007). Until 2050, the German federal government has plan to produce 80% of electricity from renewable sources in the country (BMWi, 2010). The fundamental structure of electricity system in the country will be affected and reshaped due to transition from fossil fuel. The sustainable energy system will fundamentally change the way how power is sold,

produced and transmitted to industries and households (Klose et al., 2012; Richter, 2013; Schleicher-Tappeser, 2012; Small & Frantzis, 2010). Electricity generation was exclusively considered as sphere of utilities, until some years ago. Due to expansion of renewable energies this trend has been dramatically changed. Until end of 2012, 23% of electricity was produced from renewable energy sources in Germany (BMWi, 2010). Moreover, twelve percent of German utilities are operated and owned by capacity of renewable energy source (Chang et al., 2013).

According to finding of different scholars, new core technology adoptions is required to industry incumbents with technological innovations for better performance and potential positive effects (Taylor & Helfat, 2009). Solar energy, biomass, and wind power have changed electricity generation source from fossil fuels and nuclear to renewable in order to mitigate the environmental threats. According to O'Reilly 3rd and Tushman (2004) define ambidexterity as a cerebral harmonizing act for administrators between upholding the present central commercial and emerging fundamentally new products and services for the future of the company. for new technologies and markets the senior administration should be ready in order to configure future success with solid assets, while without compromising the effects on established businesses and keep them going well. The ambidexterity theory of organization is to assist and understand the utilities challenges faced by renewable energies. This is named as renewable energy utilities business model. Number of current studies have raised the issues of renewable energy business model in recent studies (Duncan et al., 2010; Gupta et al., 2008; Klose et al., 2012). With an own underpinning business logic, two generic business models are pointed out in literature: renewable energy business model utility-side and customer-side renewable energy business models. A capacity of one and some hundred megawatts are discussed in large scale projects in renewable energy business model of utility-side. The main technologies of this application are large scale solar thermal energy, biogas plants and biomass, large scale photovoltaic systems, on and offshore wind energy and concentrated solar power. Bulk generation of electricity is the value proposition of this business model (Nimmons & Taylor, 2008). Conventional electricity value chain is utilized in the electricity is fed into the grid and delivered to the customer. It is further discussed that less generation capacity than nuclear power plants and conventional coal power plants are also characterized in this business model and customer interference in these power purchase agreements is very low.

2.2.2. Effective measures

The reason that is pushing world to switch on sustainable energy system is underpin the scarce petroleum supplies and facing global climate change. As matter of fact, that historical energy transition is not day mare rather occurred these shifts over a century or longer and motivated by scarcity of natural resources, innovation in technology, and increase in labor cost. More rapidness is needed in 21st century in energy transition. Sadly, acceleration of the energy transition is little known. Thus, this study is pivotal to review the past studies on energy transitions and elements along with factors and measures. The ups and downs in these studies are evident that much is done, and more is needed to be done. The study in Brazil on shifting transport from oil based to sugarcane ethanol got success and implemented with full support of local community. Moreover, the experiment of France for shifting electricity from oil to nuclear power was also successful while the US faced failure of mixing the foreign oil with domestic energy resources. Resultantly, all these factors have many lessons to learn in either case. The discussion on these lessons are important to take some measures. The identification of several instruments and policy recommendation was accelerated in energy transition although the overall global energy transition circumstances is very slow due to different social and economic factors. The yield of timely results and new treaties are need of given time to implement the programs in different countries with promotion of Smart Grids, a greater focus on energy efficiency, and with different political economies.

Although the world is confronting an extraordinary urgency for a rapid energy transition to renewable and sustainable sources of energy, it is unlikely to happen in decades. In-fact, critical energy transition is possible through stronger government commitments and for policy makers it is important to understand and realize the current energy policies and existing energy efficiency in technologies that are rapidly needed to implement and address the institutional barriers to recognize. Moreover, it is important to address and overcome the barriers for better measures (Chandler & Brown, 2008). The implementation and measure of renewable energy's efficiency is rapid due to the existence of technologies and its cost effectiveness. The more energy can be saved in electric power sector due to effective measures to minimize greenhouse gasses emission than conservation technology in buildings and electric vehicles using hybrid electric gasoline. The recovery at larger quantities of waste heat is possible in growing electric power sector due to electric power measures (Warr & Ayres, 2010).

To reduce the impacts of environmental vulnerability, it is important to improve operating efficiency, enable latest technology, digitalize smart grid and improve and utilize latest electric system that can overlay information and technologies in communication for evolving global future vision of energy transition measures. Low power energy sensor technologies, the electric meters with two-way communication features and software to manage energy (Coll-Mayor et al., 2007). The definition and usage of smart grid is still at early stage of development and need broader consensus more specifically in definition and scope. Measures like energy service model will increase customer satisfaction and will integrated energy efficiency technologies (Coll-Mayor et al., 2007). In the US 5% power grid efficiency increase will save equivalent energy and will help to eliminate the greenhouse gasses of 53 million cars (Solomon & Krishna, 2011).

2.2.3. Government Support

Government is a key stakeholder in energy transition that can affect the performance of energy companies in either way. The decision about the public support is taken by the government to offer clean energy. The policies are defined in light of public support that deploy clean energy and give incentives to companies and individuals. In industrialized countries energy transition has become prominent political question for sustainable energy due to rising concerns about energy security and environmental sustainability. Past studies have suggested that external shocks for understanding transitions are central and positive reinforcement (Jacobsson & Lauber, 2006). National politics is effected in variegated ways due to international pressure as revealed in domestic literature of energy transition (Ikenberry, 1986). Impede sustainable energy transition and political strategies are in dearth in these theories and do not offer insights into related concepts. In the study, with support of quantitative evidence, I have tried to bridge the gap and presented formal theory of sustainable energy transition. Global decarbonization is required in order to mitigate climate change but without improvement of technology the cost of achieving emission reduction is high (Barrett et al., 2013). Without intervenes of government a sustainable energy transition is nearly impossible in a community as, government helps to impose binding constraints on emissions of carbon either through using price instrument or direct regulation (Fischer & Newell, 2008). Hence, fundamentally political factors are seen in sustainable energy transition. Strategically exogenous shocks in terms of oil price shocks are motives to get governments react. Extant literature suggests about political constraints and constituency pressure (Hovi et al., 2009; Michaelowa & Jotzo, 2005), this is theoretically untreated. Although due to international pressure,

strategic interactions are significantly in sighted on domestic responses (Gourevitch, 1978; Ikenberry, 1986; Katzenstein, 1985). In fiscal management, some strategic considerations and political economists have been explored (Alesina & Tabellini, 1990), but clean energy policy extent is questionable in these findings. Positive reinforcement is an important confounding factor: previous policy choices improve the economic keenness of clean energy and generate new electorates, such as renewables producers, who demand additional public support for clean energy (Kline et al., 2004; Laird & Stefes, 2009; Torvanger & Meadowcroft, 2011).

2.2.4. Barriers to energy transition

The embeddedness of energy system is fortified in earth system, social system, and economic system. It is absolute that energy- economy or energy transition cannot exist standalone. The far more complexities in the system are prevailing that are not allowing the industry to progress according to the demand of market due to which the potential is not being optimized (Sovacool, 2014).

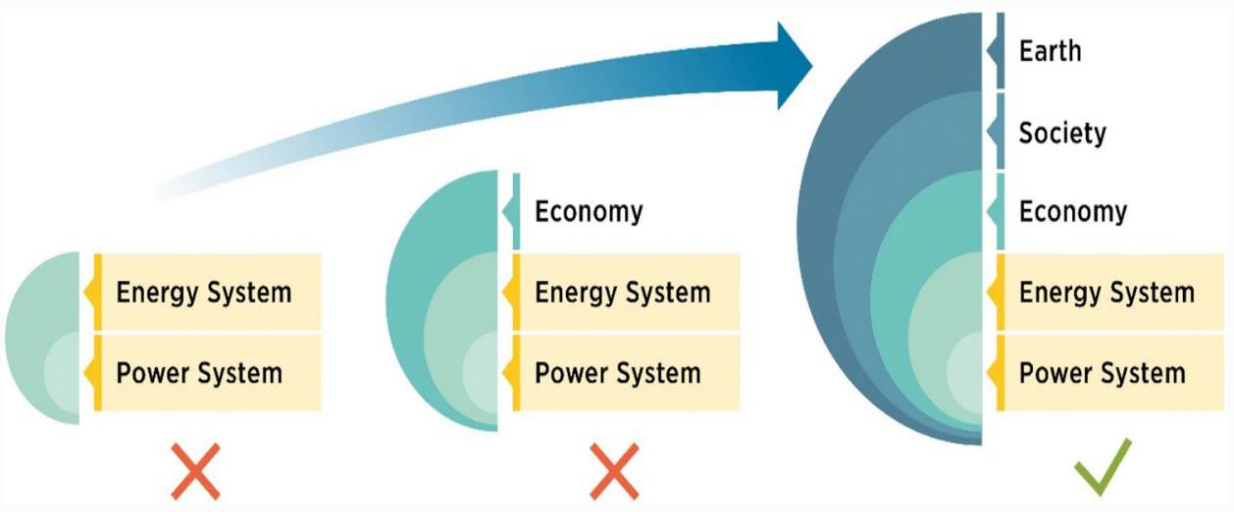


Figure 4: Embeddedness of energy system (IRENA, 2019).

The economic and social systems are becoming the real complexities in setting up the modeling paramount in energy transition roadmap to gauge the proper assessment for implementation (Mercure et al., 2016). The change in climate is becoming the reason of these shifts in energy system because it has deeper impact on community and the economy that is dependent on this system of energy transition. A set of opportunities and challenges are risen as trigger of this

response. By studying the enabler structural and environmental organisms this system will assist to increase the potential paybacks and eventually will lead to more information and reduction in barriers and will help the adjustments that are needed by along the way.

Technical issues are another barrier to this system that got attention of many researcher is since the beginning of 21st century. Since the start of this revolutionary century, renewable energy has got significant support by researchers and scientists (Kariuki, 2018). The process to bring people from non-renewable sources to renewable sources is quite slow despite of the fat that scientists are coming up with convincing and practical technologies on renewable energy sources, this problem is much deeper in developing countries and is uncertain to some extent. Hence, this study is important to investigate the barriers especially related to technologies and behavior of people towards the adoption of this factor. The use of energy is unarguable in rural and urban areas while production of this energy on coal is being discouraged in major part of the world (Alshehry & Belloumi, 2015). Despite of the fact, still energy is being produce with mix fossil fuels that are causing a severe damage to atmosphere (Eleftheriadis & Anagnostopoulou, 2015).

2.3. Study scope and limitation

The main objective of the study is to explain the impact of sustainable energy transition on risk acceptability and tolerability in contextual setting of Pakistan. Risk science and energy transition field in Pakistan is relatively new and is gearing up. Although, it is worthwhile to mention that lot of work is done in context of Europe and other progressed world, but it is important to conduct this type of study in developing context. As matter of fact, the concept of risk acceptability is multifaceted and multidimensional and needs specialized study to address each branch and dimension of risk. The risk acceptability and tolerability with perspective to energy transition is not been discussed before, hence, it is novel combination to address the challenge of risk management and energy transition especially in context of progressing world.

As theme is novel so few resources were available to gather data. The socio-cultural dimensions of risk are not discussed due to limitation of time. Due to pandemic situation the data is gathered from limited companies that need to be gathered from maximum companies in order to meet the requirement of generalizability. The response companies were only Chinese, so it is suggested for future research to take point of view of different companies from different countries.

2.4. Main research questions

What is the perception/understanding of acceptable and tolerable risk in the context of the energy transition in Pakistan?

Sub-research questions

How energy transition can create efficiency by mitigating risk?

What is role of government in hedging risk?

3. Research Methodology

Following table is a comprehensive view of the research methodology used for this research.

Table 1: research methodology for this study

Research Paradigm	**Positivism**
Research Approach	Quantitative
Research Design	Cross-sectional
Sampling technique	Probability sampling
Data collection instrument	Close ended questionnaire
Data collection method	Survey from employees of companies

3.1. Research Paradigms used for this study

This research study used positivism research paradigm to rightly answer the research questions. It is suggested that when the research problem is of empirical nature then it is appropriate to use positivism research paradigm.

Table 2: comparison of paradigms

	Positivism	Constructivism	Pragmatism
Ontology	Naïve Realism	Relativism	Accept external reality, choose explanations that produce best desired results
Epistemology	Objective	Subjective	Objective + Subjective
Logic	Deductive	Inductive	Deductive + Inductive
Methods	Quantitative	Qualitative	Both (Quantitative + qualitative)

Source: Adopted from Prouska (2006:143)

3.2. Research Approach used for this study

To determine the impact of sustainable energy transition on risk acceptability and tolerability, quantitative research approach was used in line with positivism paradigm. The formal way of inquiry to achieve objective oriented and systematic information is possible through quantitative research approach that trials the realities quantitatively to determine the cause and effect link grounded upon assumptions of determination (Bell et al., 2018).

3.3. Research Design used for this study

The study incorporated cross sectional design to collect data within specific time period from different respondents in one go. The choice is rationale according to the quantitative research approach beside its measuring limitation in phenomenon (Bell et al., 2018).

3.4. Population and Sampling

The universe unit considered for research is known as population of the research (Bell et al., 2018).

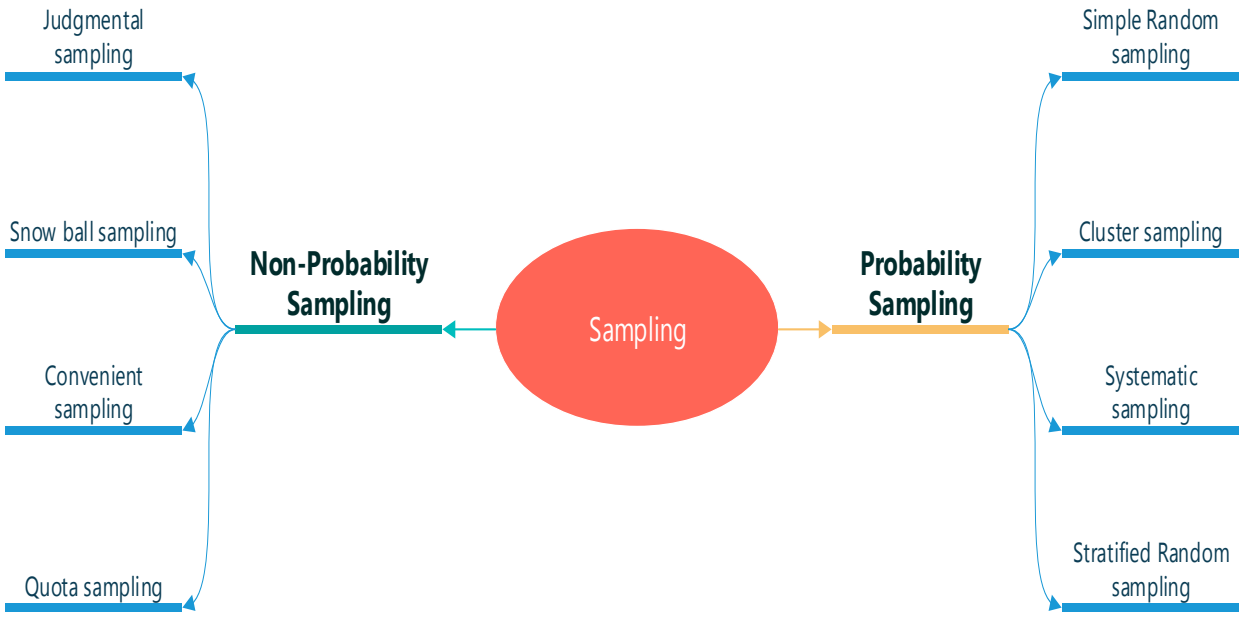


Figure 5: Sampling techniques

Probability sampling techniques is used when data is collected through survey method adopted by quantitative research method (Bell et al., 2018). Two Chinese power companies were selected as

case study while making sure their active participation in energy transition. 1) China National Electric Engineering Company - CNEEC Pakistan, that company is actively working in Pakistan since 2012 on solar and wind forms of energy. 2) China power hub generation company (CPHGC). The rationale of selecting two energy companies as sample is underpinned the reason of Pandemic situation round the globe and due to inaccessibility of respondents. The sample size is calculated through Rao-soft software which suggests the sufficiency of respondents as the following rule;

$$x = z\left({}^{c}/_{100}\right)2_{r}(100 - r) \qquad 1$$

$$n = {}^{Nx}\Big/\left((N-1)E^{2} + x\right) \qquad 2$$

$$E = Sqrt\left[{}^{(N-n)x}\Big/_{n(N-1)}\right] \qquad 3$$

According to this formula the desired sample size is 300 respondents was selected for investigation to conduct study. The data collection from whole census was expensive, time demanding and human resource intensive as well. This decision of collecting data from selected sample is rationalized from different scholars and statisticians without compromising on efficiency of results while being cost and time efficient rather to approach whole population.

3.5. Data instruments used for the study:

Five Likert scale questionnaire was adopted from (Gölz & Wedderhoff, 2018). The questionnaire has three major parts; first part was consisting of basic information of respondents, like, age gender, experience etc. The second part was related to energy transition and last part was comprised of risk acceptability and tolerability. The main variables were further categorized into different constructs in order to dig deeper into the research problem. For the investigation purposes the data used primary source for its collection because primary data source meets reliability and validity issues of data. The underlying associations can be grounded in quantitative nature of data for exploring the reality objectively. In this nature of data, the researchers test existing variables for generalizability of theories to check associations among variables-that meet the objectives of this research. Aligned to the justification of data collection, the study is in accordance with

positivism paradigm that focuses on scale development to minimize the biases elements prevails highly in qualitative approach. Bell et al. (2018) narrated the survey method is best approach to avoid biasness and to generate results on larger scale with maximum possibility of accuracy.

3.6. Instrument reliability and validity

Apart from numerous benefits associated with survey strategy, there are certain reliability and validity issues that are mandatory to be addressed while data collection and assessment. The solution to these concerns enhances the acceptability of research and make it quality oriented. It is worthy to mention here that the instrument is adapted from previous studies, as discussed above, that enhances the confidence on data instrument. Moreover, a pilot study of fifty respondents were carried to contextualize the instrument and to remove the possible reliability and validity issues. The experts' opinions and literature support were done to check the content and face validity of instrument. Additionally, Cronbach's alpha helped to check the inter-item reliability and all items' values were found reliable with minimum acceptable value greater than 0.70 (Davis, 1992).

3.7. Energy debate in Pakistan and motivation to select the topic

Energy resource development is fundamental debate in context of Pakistan as, economy of Pakistan is growing fast, and it will high need sustainable energy sources. There are three major features that must be considered while discussion on energy sector. 1) to meet the different needs of energy demands there is complex range of energy resources available. 2) due to inadequate production, weak transmission and distribution, the gap between demand and supply is widening. 3) environmental hazard is another burning topic in energy field of Pakistan and is threatening social welfare and development prospects. Hence, all research and policy making is revolving around these concerns.

As matter of fact, the research in contextual setting that can address the issue of risk taking and energy transition is insufficient to help practitioners in decision making. In this perspective the current study is pivotal to bridge the gap of these discrepancies. Additionally, the study is helpful to recommend some suggestions for gauging the risk acceptability especially for foreign companies.

4. Results and Data Analysis

This chapter describes about results and data analysis. To draw the results descriptive and inferential statistics were applied. The descriptive analysis helped to summarize the demographics of the respondents while inferential statistics helped to analyze the relationship between variables. The assumptions of regressions were analyzed through factor analysis in order to reduce the factors and eliminate the unloading factors. The reliability and validity of data was checked by Cronbach's Alpha and discriminant validity. The respondents who were did not answer the questions or did not participated are summarized in following table.

Table 3: participation facts

Sr#	Items	Missing values or who did not attempt the question(s) (%)
1	Gender	6
2	Age	5
3	Experience	8
4	Position	10
5	Idea to put number on Risk	5
6	Ready to take financial risk	7
7	Potential effects of energy transition	12
8	Effective measures	14
9	Government support	6
10	Barriers to energy transitions	10
11	Risk acceptability and tolerability	4

This study investigates about the understanding of impact of sustainable energy transition on risk acceptability and tolerability. In this perspective the study investigated the energies companies working in Pakistan that are using sustainable energy transition model in order to measure the risk acceptability and tolerability. Additionally, the study took help of Chinese power corporations operating in Pakistan under China-Pakistan Economic corridor (CPEC) one of the major projects of Belt and Road Initiative (BRI) of China. To observe the relationship between independent and

dependent variable data is collected from 300 respondents. The data is analyzed in Smart-PLS, the latest software to analyses the quantitative data and to test the hypothesis. Mainly descriptive and inferential statistical analysis are used to draw the results.

Proposed Hypothesis:

H_1: Potential positive effects of energy transition significantly influence risk acceptability

H_2: Effective measures of energy transitions significantly influences risk acceptability

H_3: Government support for energy transition significantly influences risk acceptability

H_4: Barriers to energy transition significantly influences risk acceptability

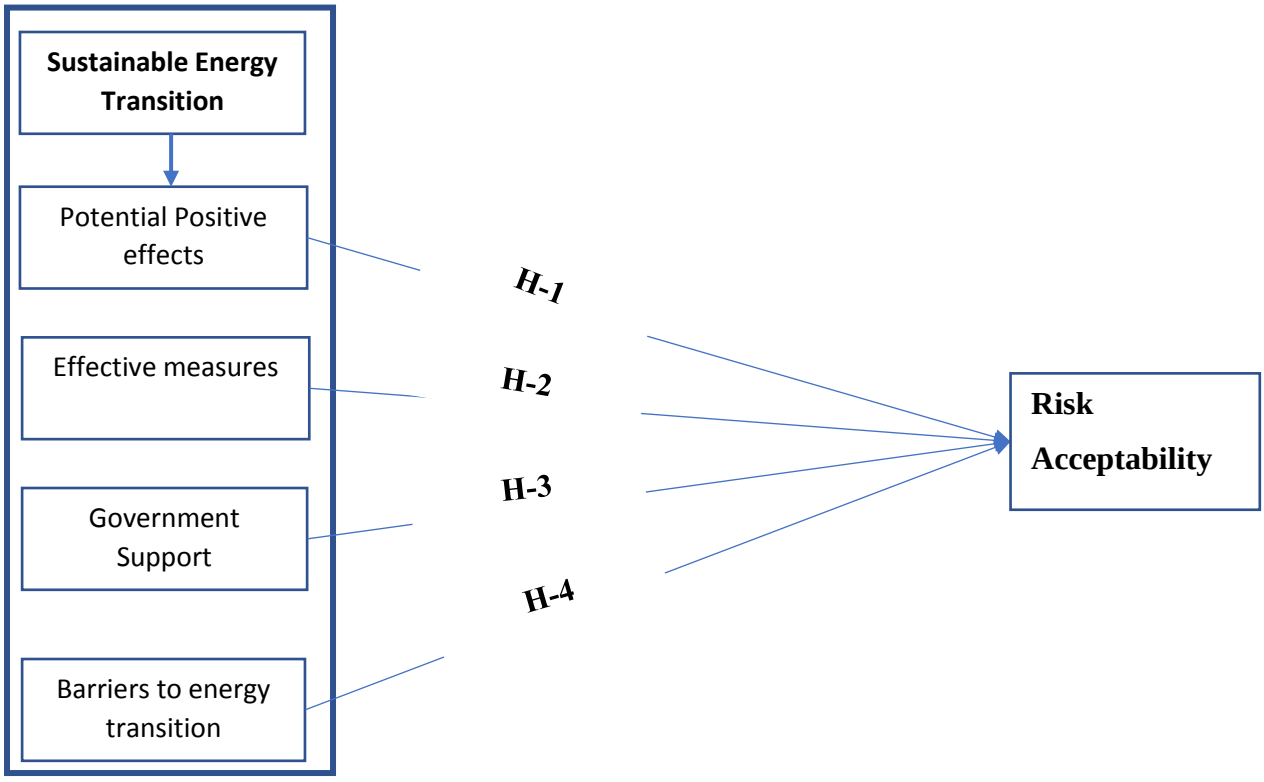
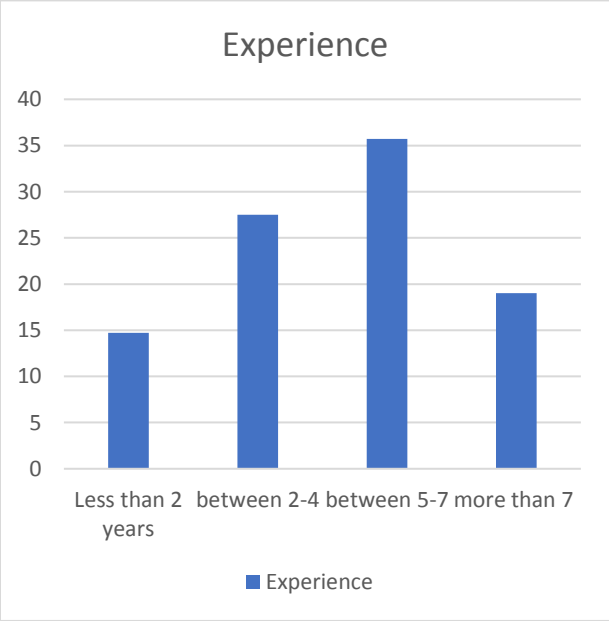


Figure 1: Research Model

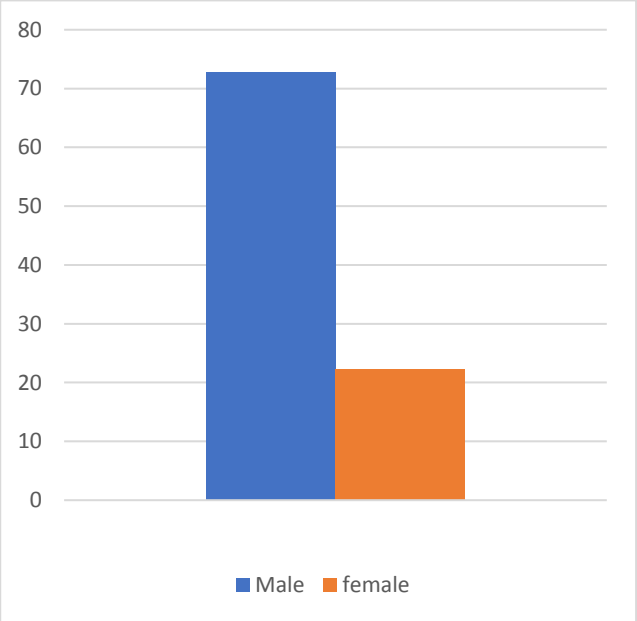
4.1. Demographic Analysis

Demographical data is important that help researchers to draw results about demographics of respondents. Eventually it is meaningful for understanding the gist of sample used for the study. The following table indicates the major demographics used for the research. It shows that the

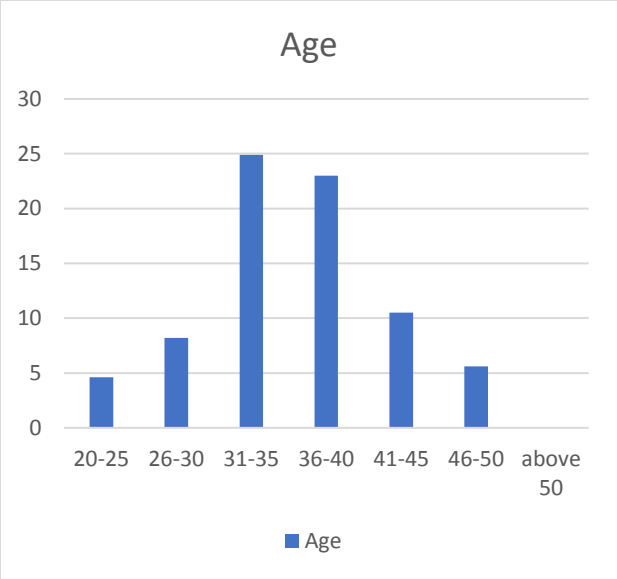
contribution of male participants was dominant with percentage of 72.8 followed by female respondents with 22.3%. Age is another important demographical item showed in table. The data of table depicts that 24.9% of contributors in research were 31-35 years bracket. It indicates that most of the respondents were youngsters who contributed to the study. The next highest age bracket was from 36-40 with 23%. The lowest percentage of respondents with the youngest age were from 20-25. Moreover, designation of the respondents was important to measure, in order to know about decision making ability of the respondents. The results indicate that majority of the respondents were from middle level of management which is important layer in management hierarchy to bridge the gap between higher and lower management. The last item in demographic was experience. The percentages in the table tells that majority of the respondents were with 5-7 years' experience with accumulative 37.5% percentage. The lowest percentage in experience brace was 14%. The detail is attached in appendix table-6. Following is the graphical representation of demographical findings of the study. The graphs are the representation of above table.



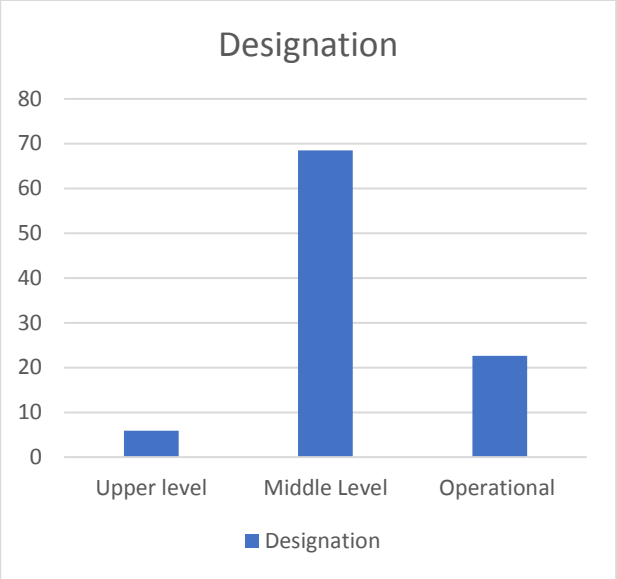
Graph 1: experience



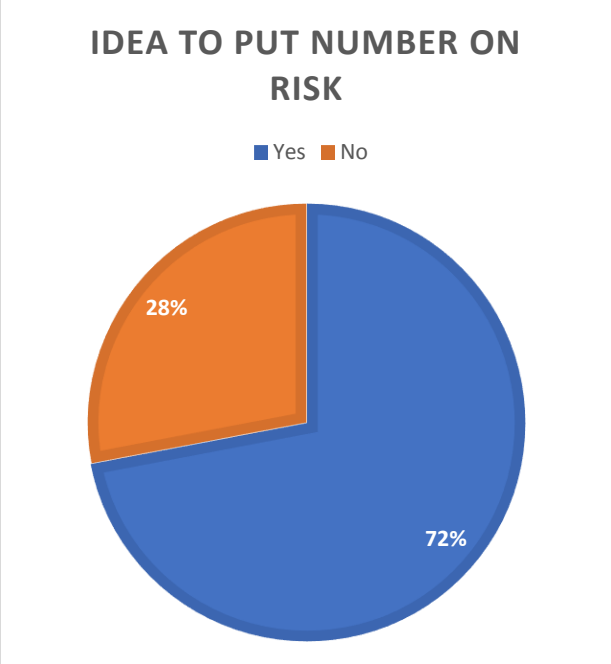
Graph 2: Gender



Graph 3: Age



Graph 4: Position



Graph 5: Risk taking

Graph 6: put on number

The above given pie chart graphs depicts about the questions asked related to idea of putting number for risk evaluation and either they are willing to bear finacial risk for energy transition. The graph-5 explains that 72% people encourage the idea to evaluate and measure the risk through number while 28% people unlike. The reasons to go different may call attention towards other

factors that are important for risk measurement like emotions, norms etc. The graph-6 inidcates that 84% respodents tick the option yes which supports the argument that they are ready to take financial risk for energy transition while 16% people said that they are not ready to take financial risk for energy transition. It is evident from statistics that majority of the respoendents are in favor of forgo financial incentives for sustainable energy transition.

4.2. Reliability Analysis

It is pivotal for scientific research to critically address the issues of reliability and validity of data. Hence, the study also has rigorous approach to address this challenge. The following table indicates few valid tests suggested by different researchers to approve the reliability and validity measures of the data and instrument of the study. Cronbach's Alpha is considered among most used test to check the reliability of data. According to Tavakol and Dennick (2011) the values of each variable should be above 0.70 to consider it reliable. So, it is obvious from the statistical analysis that all values of variables are above the minimum recommended value. 'potential effects of energy transition' has highest values of Cronbach's Alpha while, 'Barriers to energy transition' is with lowest value 0.770 which is eventually greater than the accepted value. Composite reliability (CR) is another analysis that validates the reliability concerns of the data. The minimum accepted value of CR is 0.70. so, all the values in this study are greater than 0.70. the maximum value of CR in this study is 0.924 and minimum value is 0.843. According to Alarcón et al. (2015) the minimum accepted value of Average Variance Extracted (AVE) is 0.50. if the values of AVE are less than 0.50 it shows that data is not reliable. Hence, all the values of this study are above the accepted value range of AVE. the maximum value of AVE of this study is 0.673 and minimum value is 0.574. The details are attached in appendix table-7.

4.3. Discriminant validity

Primarily, cross loading examination and Fornel-larcker criterion were applied to measure the discriminant validity (Henseler et al., 2015). The discriminant validity, conversely, cannot effectively be measured through Fornel-Larcker method. Therefore, multitrait-multimethod matrix was also used alternatively in order to measure discriminant validity for this research. The study also used Heterotrait-monotrait correlation ration to get the desired results. According to Henseler et al. (2015) claim the value of heterotrait-monotrait ratio must be less than 0.85 to ensure the discriminant validity. The following table reports no issue of discriminant reliability as all values are under accepted values range. All values in this table are below 0.85. it is helpful calculate and

access measurement error. It is used to correct the attenuation which helps to determine whether the concepts are related or unrelated. The detail is attached in Appendix table-8.

4.4. Factor Loadings

Factor loading is important to test the research model. The purpose of factor loading is to condense many latent variables into smaller ones. The minimum accepted value in factor loading must be greater than or equal to 0.50. If the values are less than the accepted value, the researchers eliminate those items. Twenty percent of total items can be deleted or skipped according to suggestions of (Henseler et al., 2015). After a careful process of factors examination two items were deleted as those values were less than the recommended values. Pte1 and rat6 items were eliminated according to the principle. The following figure shows a pictorial view of factor loading according to research model. The detail is attached is appendix table-9.

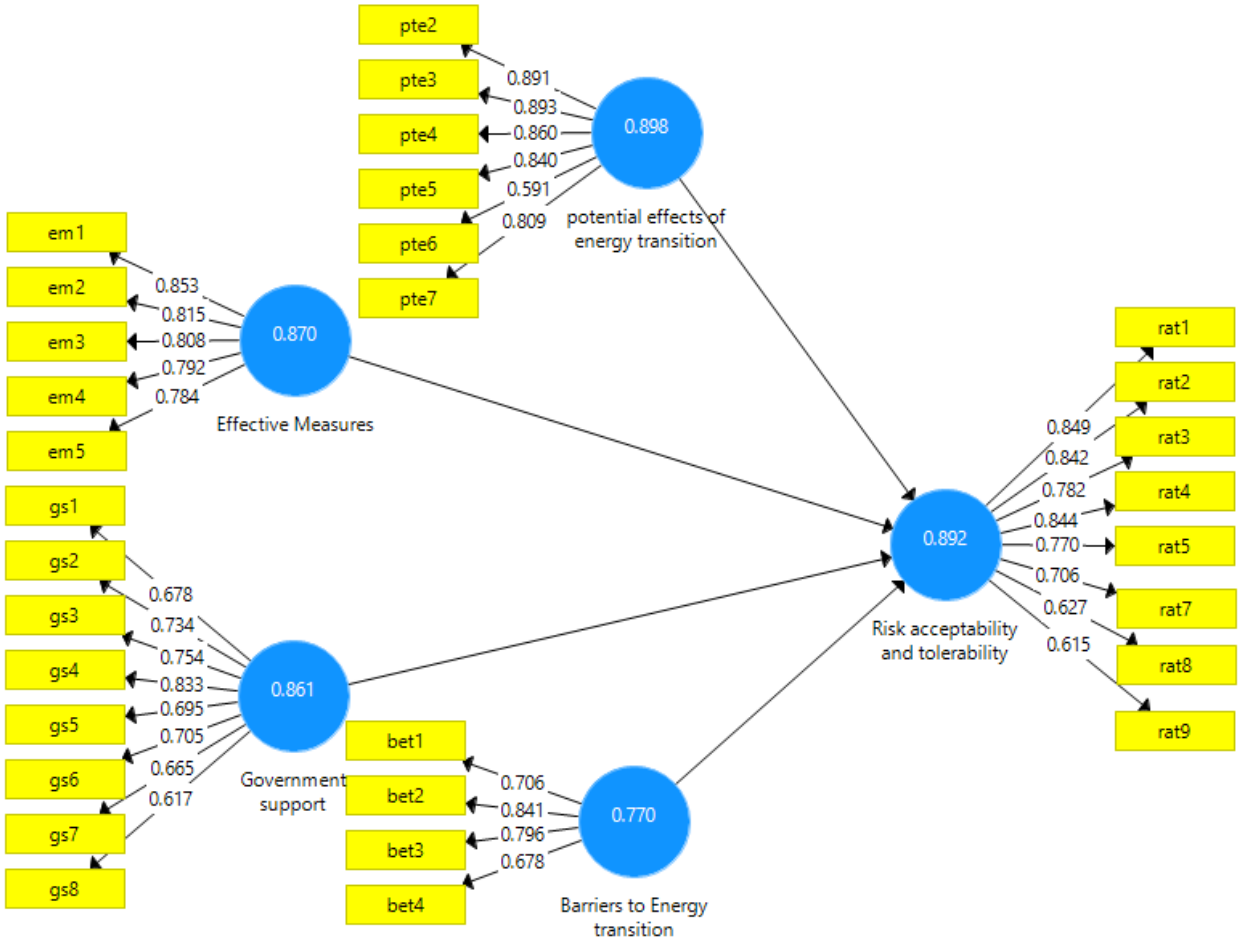


Figure 2: Factor Loadings

4.4. Regression Analysis

Regression analysis is used to predict about the assumptions. It tells us about an impact of independent variable on dependent variable. R^2 is the value that shows the change in percentage due to independent variable in dependent variable. The increase in value of R^2 means increase in effect of dependent variable. Sig/p-values indicates whether the relationship between variables exists or not. The study used multiple regression that is being used only when there are two or more than two independent variables.

Table 4: Regression Table

Hypothesis	Relationship	f-square	R-square	T-values	Sig/p-values
H-1	Barriers to Energy transition -> Risk acceptability and tolerability	0.050	0.238	3.611	0.000
H-2	Effective Measures -> Risk acceptability and tolerability	0.001	0.126	0.504	0.614
H-3	Government support -> Risk acceptability and tolerability	0.115	0.269	5.823	0.000
H-4	potential effects of energy transition -> Risk acceptability and tolerability	0.178	0.351	6.870	0.000

Regression is calculated through the following formula:

$$\boldsymbol{yi = \beta 0 + \beta 1 xi1 + \beta 2 xi2 + \cdots .. + \beta p xip + \epsilon} \qquad \mathbf{1}$$

where $_i$= η observations

y_i =Dependent variable

x_i = descriptive variables

β_o = constant term

β_ρ = descriptive variable's slope coefficients.

ϵ = residual (error term)

The R^2 values in above table-4 indicates that the most effect is transferred in risk acceptability and tolerability through potential effects of energy transition with highest value of 0.351 while lowest effect is transferred through effective measure with 0.126 in dependent variable. Furthermore, it is

also indicated in table-4 that all variable has significant relationship with accepted values greater than 0.05 except effective measure with risk acceptability and tolerability. It means that there is no relationship between effective measure and risk tolerability and acceptability.

Table 5: Hypothesis

No	**Hypothesis**	**Status**
H1	Barriers to Energy transition -> Risk acceptability and tolerability	Supported
H2	Effective Measures -> Risk acceptability and tolerability	Rejected
H3	Government support -> Risk acceptability and tolerability	Supported
H4	potential effects of energy transition -> Risk acceptability and tolerability	Supported

The above table illustrates that hypothesis two is rejected as its value is above the significant value of 0.05 hence it is not supported according to statistical values. All other variables are supported due to significant value less than 0.05. hence, it is assumed that there is significant relationship between variables other than effective measure and risk acceptability and tolerability.

5. Discussion & Conclusion

This study is helpful for power organizations to predict the level of risk in context of Pakistan. according to results of the study it is indicated that the people of Pakistan are predictive in terms of risk taking and risk acceptability. When they are asked either they are willing to take risk for or not, the findings reveal that 84% of the participants mentioned their support in favor of taking risk. On other hand the support of government was taken as a positive edge by the participants because it is pivotal element that can affect the risk acceptability and tolerability in either way but the participants encouraged the factor of positive role of government by providing financial and governance support to hedge the risk. According to the findings if government provide technical and regulatory support to organizations, the organizations can make their plans and policies for long term. Furthermore, it is also evident that measures of organizations can make organizations stronger to fight against unexpected circumstances by readily available backup plans. The societal impact on risk acceptability in terms of Pakistani culture is moderate as people conceive this new technology as source of unemployment. Due to that reason a few numbers of people are not in favor of taking risk, but majority of the participants perceived it positive move for the benefit of society at large. In this regards acceptability of risk become vivid and it gives positive signs to the organizations. The risk acceptability and tolerability are also affected by barriers to the sustainable energy transition. The main problems that cause energy transition as risk oriented is behavior of people and avoidance of technology. The people of society are technophobes due to which companies sometime feel risky operations and do not get motivated. Another factor that contributed to measurement of risk acceptability and tolerability was potential effects of energy transition. Any projects will be considered risky if it is not yielding profit to the organizations. In this regard, the companies are found profitable and sustained due to a huge potential in the market. Infect this market is untapped and need explorations hence, the companies can get the benefit of first mover advantage.

To draw the conclusion on present research and to narrate about hypothesis, the study has come up with numerous findings in accordance with discussion and results presented before.

The findings significantly indicate that risk acceptability and tolerability in context of Pakistan is an important phenomenon that companies need to address. Furthermore, it is indicated that risk should be measured in quantitative terms rather a qualitative term. It is

evident from findings that government support to organization to mitigate the risks associated with energy transitions is central for sustained operations. Results indicates that maximum of the people of Pakistan are willing to sacrifice their financials and are ready to take new risk of energy transition. It is encouraging for companies to use their full potential in order to serve the energy market for better future of Pakistan specifically and for better future of world generally. However, the presence of literature on risk acceptability and tolerability is in dearth specifically in context of Pakistan. but the understanding of connotation of risk acceptability at industrial level is as better as to functionalize the industry. Addition to gauging the readiness of people to take new risk of energy transition, people with huge number are willing to access the risk in quantitative terms in order to make decision on factual basis. It supports the situation of changing the energy production and consumption perspective from conventional to sustainable.

Results suggests that potential effects of energy transition support new risk taking and risks acceptability to improve the energy mechanisms. It can be concluded that risk acceptability and tolerability can be adjusted up to thirty five percent. The potential effects of energy transition can be positively used in mind making and psychological pressure handling. Another element that has prominent and deeper effect on risk acceptability and tolerability is related to government support. The study concluded that government support in Pakistan is enabling organizations to take risks in energy sector as, it is providing friendly and lucrative environment to organizations for operations. The contribution of government support is healthy with percentage of twenty-seven. However, another factor that is not supportive in risk acceptability and tolerability is, effective measures. That indicates that, the measures taken in context of Pakistan are not matured enough to handle the energy risk and need more refinement and smoothness. Hence, it is concluded that the scale of risk acceptability and tolerability in context of Pakistan is moderate that encourages companies to work progressively and increase socio-cultural activities to make the society as partner of this new shift in energy transition that will increase the level of risk acceptability ultimately. Furthermore, addressing the main research question, the risk acceptability and tolerability level in context of Pakistan is moderate. As a society, people are not high-risk taker neither risk avoider due to limitation of income, uncertainty, and political instability.

Numerous recommendations can be suggested to researchers, practitioners and policy makers based upon results and conclusions.

1. As, maximum people are willing to take financial risk for energy transition the companies can make alliances with communities and can generate pool of fund to invest and operate. This act will increase the acceptability level of risk as communities are partners with these projects.
2. According to results, the government is supportive in increasing the level of risk acceptability so, it is recommended to companies to get guarantee of state in new projects installation about compensation of any loss due to difference between demand and supply. The government assure the companies that their services will get market at any cost, otherwise the state will pay the difference.
3. It is recommended for companies to provide alternate use of oil and gas utilities so, that the energy transition barrier can effectively be solved and increase level of risk acceptability and tolerability in energy market. Moreover, the companies should use latest technologies that have less wastage of resources with maximum output.
4. For companies it is suggested to take effective measures and use modern risk acceptability models such as ALARP for effectual operations. The companies should deeply study the meta-constitutional laws and activities in contextual setting for sustainable operations.
5. It is highly recommended to organizations to focus on agriculture R & D also, as energy transition risk is associated with food shortage and squeezing of farming land. Resultantly an alarming situation for wildlife and livestock.

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Appendices

Questionnaire

Understanding the impact of Sustainable Energy transition on risk acceptability

Dear Participant,

I am a postgraduate student undertaking a **master's** degree in 'Risk Management' at the **University of Stavanger.** I am currently carrying out a research on "**Understanding the impact of Sustainable Energy transition on risk acceptability**". All the information provided by you will be kept confidential and anonymous. The overall results of the study would be shared with you upon your request (by sending an e-mail to the below corresponding address)

Thank you for your participation.

E-mail : danishhaider060@gmail.com

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Department of Security, Economics and Planning,

Faculty of Science and Technology,

University of Stavanger,

Stavanger, Norway

Understanding the impact of Sustainable Energy transition on risk acceptability and Tolerability

Section A. General Information

Gender

Male [ ] Female [ ]

Please indicate your age bracket below;

25 years [ ] 26-35 years [ ] 36-45 years [ ]

46-55 years [ ] Over 55 years [ ]

Designation

1. None - I am answering as an individual
2. Senior Management
3. Management
4. Researcher
5. Strategy/Policy function
6. Specialist/Expert
7. Other (please specify) _____

For how long have you worked in the organization?

Less than 2 years [ ] Between 2-4years [ ]

Between 5-7 years [ ] Over 7 years [ ]

Is it a good idea to put a number on risk? Yes No

Are you ready to take higher financial risk to secure a cleaner environment Yes No

Section B: Risk Acceptability and Tolerability

Please indicate your level of agreement with the following statement concerning the extent to which adoption of risk acceptability and tolerability. Where 1=strongly disagree, 2= disagree, 3= Neutral, 4= agree, and 5= strongly agree.

Risk Acceptability and Tolerability		1	2	3	4	5
1	In your opinion, is economic situation of Pakistan strong enough to afford risks involved in energy transition?					

2	In your opinion should society be ready to accept more risks for the sake of cleaner energy					
3	In your opinion people are willing to take new risks due to sustainable energy transition?					
5	Are people ready to pay more to support the energy transition					
6	Do you think that the risks involved by the energy transition are likely to have an impact on other human activities in Pakistan?					
7	Do you think risk of new technology is a factor to consider?					
8	Do you think that new more environmentally friendly technologies are safer, entails less risk than the previous one?					
9	Do you think that new technologies may involve more risk for the sake of being cleaner?					

Section C: Sustainable energy transition

Please indicate your level of agreement with the following statement concerning the extent to adoption of sustainable energy transitions. Where 1=strongly disagree, 2= disagree, 3= Neutral, 4= agree, and 5= strongly agree.

Energy transition is a concept that generally refers to significant structural changes in an energy system ideally from conventional to renewable.

Potential effects of Energy Transition		1	2	3	4	5
1	Is society ready to substitute the traditional method for sustainable energy transition					
2	Do you think that due to technology shift people will compromise other things like less land for fertilization due to wind and solar farms?					
3	The energy transition increases new job opportunities					
4	The energy transition is helpful to control environmental pollution					
5	The energy transition positively impacts on human health and reduces health cost					
6	The energy transition empowers citizens in terms of energy consumption, storage, and supply					

7	One impact of the energy transition is that the grid maintenance cost is significantly reduced.					
Effective measures						
1	Do you think that traditional players are encouraged to switch to renewable energy sources					
2	In your opinion is Investment in renewable sector increased?					
3	Financial and non-financial incentives are increased to support renewable energy					
4	In your opinion, Government authorities should lead by example					
5	In your view, the implementation of environmental policies should be a priority.					
Government Support						
1	In your view, government should develop a comprehensive regulatory framework.					
2	Are you concerned about collaboration between government and private companies					
3	In your view, should government encourage an open market approach to secure the energy transition?					
4	In your opinion, should government increase funds for R&D support					
5	Should the government run campaigns to increase awareness about energy alternatives and about its incentives?					
6	Are you satisfied with the Pakistan government energy policy?					
7	In your opinion is the Pakistani government transitioning from fossil oil to other cleaner energies?					
8	How clear do you find the government target policy for energy transition?					
Barriers to energy transition						
1	Are you concerned that the energy transition may damage the coal or gas industry?					
2	In your opinion, does the government of Pakistan have the capacity to create significant social awareness.					

3	Do you think that the government of Pakistan has interest in making the energy transition happen?					
4	Do you find that the Pakistani government's targets are clearly set towards the energy transition?					

Source: (Gölz, S., & Wedderhoff, O., 2018; Intelligent Mobility for the Energy Transition)

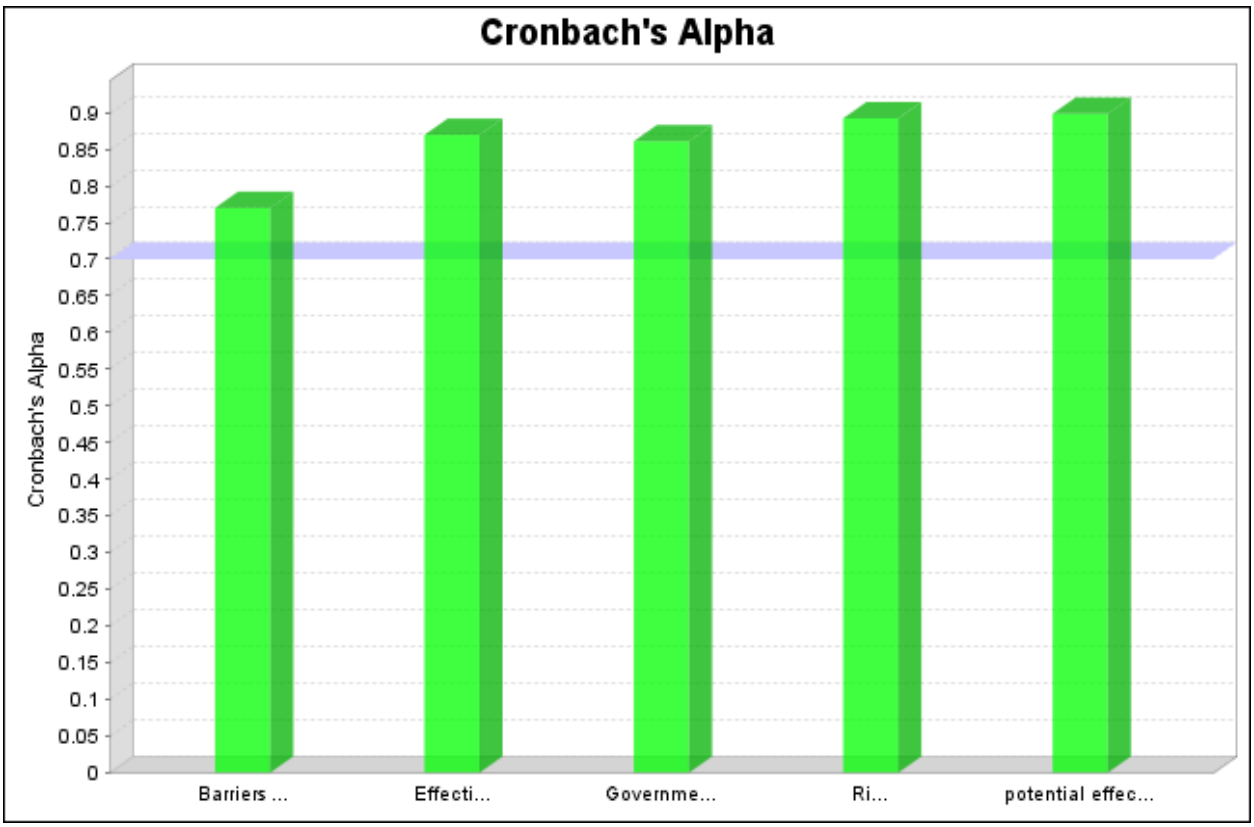
Thank you for your kind cooperation

Table 6: Demographic table

Items		Frequency	Percent
Gender	Male	222	72.8
	Female	68	22.3
Age	20–25	14	4.6
	26–30	25	8.2
	31–35	76	24.9
	36–40	70	23
	41–45	62	20.3
	46–50	32	10.5
	Above 50	17	5.6
Designation	Upper level	18	5.9
	Middle level	209	68.5
	Operational level	69	22.6
Experience	Less than 2 years	44	14.7
	Between 2 and 4 years	84	27.5
	Between 5 and 7 years	109	35.7
	More than seven years	58	19

Table 7: Reliability table

Variables	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Barriers to Energy transition	0.770	0.843	0.574
Effective Measures	0.870	0.906	0.657
Government support	0.861	0.891	0.508
Risk acceptability and tolerability	0.892	0.915	0.577
potential effects of energy transition	0.898	0.924	0.673



graph 7: Reliability Graph

Table 8: Discriminant validity

	Barriers to Energy transition	Effective Measures	Government support	Risk acceptability and tolerability	potential effects of energy transition
Barriers to Energy transition	0.758				
Effective Measures	0.424	0.811			
Government support	0.513	0.770	0.713		
Risk acceptability and tolerability	0.524	0.670	0.758	0.760	
potential effects of energy transition	0.460	0.812	0.783	0.773	0.821

Table 9: Factor loading table

Variables	Constructs	Items	Values
Sustainable Energy Transitions	**Potential effects of Energy transition**	pte2	0.891
		pte3	0.893
		pte4	0.86
		pte5	0.84
		pte6	0.591
		pte7	0.809
	Effective Measures	em1	0.853
		em2	0.815
		em3	0.808
		em4	0.792
		em5	0.784
	Government Support	gs1	0.678
		gs2	0.734
		gs3	0.754
		gs4	0.833
		gs5	0.695
		gs6	0.705
		gs7	0.665
		gs8	0.617
	Barriers to Energy transition	bet1	0.706
		bet2	0.841
		bet3	0.796
		bet4	0.678
Risk Acceptability and Tolerability		rat1	0.849
		rat2	0.842
		rat3	0.782
		rat4	0.844
		rat5	0.77
		rat7	0.706
		rat8	0.627
		rat9	0.615