Exploring Feasibility of Biomass Based Green Venture and Its Financing Strategies

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CERTIFICATE

This is to certify that this thesis entitled: **"Exploring feasibility of biomass based green venture and its financing strategies"** submitted by Mr. Tayyab Ahmed Qureshi is accepted in its present form by the Department of Business Studies, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Science in Management Sciences.**

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Dedicated

To My Beloved Parents

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ABSTRACT

World is going for renewable and Pakistan also must go for it. There are number of option for renewable i.e., solar, hydro, biomass &wind. Cost effectiveness/technology does not allow everyone to contribute for energy generation. Biomass is the most reliable and auspicious method for generation of energy because this method provides economical & sustainable alternative to other renewable and fossils fuels plants at small and medium levels. Biomass is a renewable and ecofriendly, but not known. This study discusses a number of biomass sources, provides financial analysis of these biomass resources. This analysis shows that both biogas for cooking and electricity can be high recommendable for both rural and urban areas. Utilization of biomass energy is more feasible with favorable NPV and high cost benefit ratio. Waste management for metro areas can be easily addressed through effective way by utilization into biomass energy. The SWOT analysis highlights how to solve major problems and effectively utilize opportunities for future. There is need for some government initiative to support small and medium sector to flourish this renewable concept as part of “Clean and Green- Pakistan”.

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Abrevations

CC	Capital Cost
CT Bank	Connecticut Bank
CTGC	China Three Gorges Corporation
GWh	Gigawatt hour
FV	Future value
IRR	Internal rate of return
IPO	Initial Public Offer
KWh	Kilo Watt Hour
LPG	Liquid pressed Gas
MSW	Municipal Solid Waste
MW	Megawatt
MJ	Mega Joule
MWh	Megawatt Hour
NEPRA	National Electric Power Regulatory Authority
NPV	Net Present Value
OECD	Organization for Economic Co-operation and Development
O&M	Operating and Maintenance
ORC	Organic Rankine Cycle
PCRET	Pakistan Council of Renewable Energy Technologies
PKR	Pakistani Rupees
PV	Photovoltaics
SBP	State Bank of Pakistan
SEC	Securities and exchange Commission
SMEs	Small and medium enterprises
SWOT	Strengh, Weakness, Opportunities and Threat

Chapter 1

Introduction

Climate change is one of the greatest challenges for the globe today. According to global climate index (2017), Pakistan scored the 7th position as a country that is adversely affected by environmental issues. Smog in different areas of Pakistan is one of the consequences for these environmental issues. These issues emerge mainly due to the emission of carbon dioxide .The major contribution to this emission from fossil fuels and the mismanagement of municipal solid waste.

Energy is a need for everyone and every household must consume energy to survive. In past popular energy source was wood which has been serious environments hazards. Today, the most popular source of energy is fossil fuel in the form of petrol (commercial) and natural gas (domestic). These sources add carbon dioxide to the environment which further increases environmental problems.

In the above circumstances, there is a need to introduce green entrepreneurial ventures. Green ventures can contribute towards the economic sustainability and mitigation of environmental problems simultaneously. Green ventures can be in the shape of different innovations: renewable energy projects, recycling and using waste management for energy. These innovative technologies are used directly or indirectly to minimize environmental concerns and an alternative for traditional energy (Hall & Helmers, 2013). There are two main actors within green ventures: entrepreneur and venture capital firms/investors.

Today, we are using fossils fuel as the main source of energy. One of a study reveals that 80% of the world's energy comes from fossil fuels resources (Bhutto et al. 2011). Although these resources have a high potential for energy, they have adverse effects on the environment due to huge carbon dioxide emissions. In addition, Pakistan is not self-sufficient in fossil fuels production and a huge amount of foreign exchange is consumed for imports of fuels. According to SBP (2017-18), the crude oil import was $ 12.93 billion and recent fluctuations in international oil prices can cause a further increase. There are a lot of green ventures that can be applicable in Pakistan. First in the shape of renewable energy sources which include solar, wind and hydro. The second green venture can be in the shape of renewable biomass sources which include municipal solid waste, agriculture waste, energy crops, and animal residuals.

In these circumstances, Pakistan has a desire need of green ventures. The feasibility study shows that Pakistan has the potential of solar projects in deserts and wind-based set up in coastal areas (Sahir & Qureshi, 2008) and hydro in coastal in the northern region. These renewable technologies can reduce carbon emission and import of fuels, but these projects require a huge amount of investment. Even their maintenance and operation are not possible without government support. High technical and professional skills are required for operating these types of projects. Hydro energy does not pollute the air or water, but hydropower has huge ecological impacts by climate changing and disturbing people, houses, and natural surroundings in the area where dam to be constructed. Furthermore, hydro energy needs a huge amount of investment, the average initial investment for construction is being accounted as 1.5 million to 2 million US $/ MW (Private Power & Infrastructure Board)[1].

[1] http://www.ppib.gov.pk/

Another option to produce green energy is to introduce bio green initiatives in Pakistan. Bio green initiatives consist of renewable energy through biomass including of municipal solid waste, virgin fruits, energy crops, agricultural residuals, and livestock manures. These waste materials can be converted into energy with low cost and a short duration of time. Biomass energy plants are decentralized and can be placed at different locations. These technologies are easy to use, and low technical skill is required for their operations. Moreover, biomass energy can reduce a considerable amount of carbon emission. There are different kinds of biomass, such as wood chips, straws, and some types of garbage can be used to produce energy and electricity.

People are unaware of the biomass energy ventures except for the biogas plants. Therefore, this study introduces some bio-mass based green venture along with their SWOT analysis and cost-benefit analysis. Furthermore, for the developing country financing green initiatives could be problematic, therefore this study introduces some financing strategies for such green ventures.

1.2. Objectives of the Study

Following are the objectives of the study:

- To explore the feasibility of a biomass-based green venture.
- To check strengths, weaknesses, opportunities, and threats for these green ventures.
- To describe financing strategies for the proposed venture.

1.3. The significance of the Study

The importance of climate change in Pakistan cannot be overstated. Some renewable source of energy is either cost inefficient or highly technical with a number of years to complete mega projects. Renewable energy through biomass requires low cost, save environmental concerns and can be adopted locally. Therefore, this study focused on a framework where an ordinary farmer

can also contribute to green and sustainable energy development. This study analyzed and compared biomass-based energy with other options for renewable energy to promote this sector for development. This study also examined the socioeconomic impact, ecological impact, suggest financing option and to formulate a guideline for biomass-based energy entrepreneurship.

1.4. Overview

1.4.1.What is Green Venture?

Green ventures are basically enterprises where investment activities are the focus on specific companies or projects to commitment for the preservation of natural resources, discovery, and production of alternative sources of energy, the implementation of carbon-free policy and additionally other ecologically business practices. Green ventures may fit under the umbrella of Social Responsibility Investment, however, are in a general sense significantly more particular.

1.4.2. What is Green Finance?

Green finance is the financing of public and private green ventures (capital expenses) in the accompanying areas;

- Ecological products and services (for example, water management or insurance of biodiversity and nature).
- Aversion, minimization, and compensation of damages to nature and to the atmosphere, (for example, energy production or dams).

The financing of public policies (counting operational costs) that revitalize the usage of natural and environmental hazards or adjustment tasks and activities (for instance encourage in-taxes for renewable power sources).

This segment of the economic framework is relating particularly with green financiers, for example, the Green Climate Fund or money related instruments for green investment (e.g. green securities and organized green assets), including their legal, financial and institutional structural conditions.

1.4.3. Green Financing – Practice in Pakistan

Currently, Pakistan has a shortage of resources, poverty, diminished fuels in stock and health issues, etc. Unexpected and transcending energy needs, broken-down oil costs and movements to check global warming are few forces which constrain Pakistan to put resources into clean energy, named as green financing. The International Energy Agency (IEA) has predicted that demand for essential energy will be 40 percent more between now and 2030. The high energy demand in Pakistan is a challenge for improvement and stability. In subsidiary policy, amounted Rs. 2,245 billion has been provisioned for the power industry amid the most recent five years however conditions are more undesirable than the past. The government of Pakistan is encouraging green financing through following initiatives.

- National bank of Pakistan introduced a green financing scheme for farmers to install solar tube wells systems.
- Bank Al-Falah limited partnership with Buksh energy to introduce different product under green financing.
- German Energy Company is interested in solar energy with the amount up to Rs. 12.9 billion.
- Bank of Punjab is also going to introduce solar financing schemes with a directive of SBP.

1.4.4. Bio-Mass as Green Venture

Energy through biomass is a business term by burning wood and other organic material. Commercial biomass would also produce Carbon dioxide if burnt. However, production of biomass requires the consumption of carbon dioxide from the environment and emission during combustion can't exceed the quantity of carbon used during production. Therefore, net carbon dioxide emission is zero.

In addition, empirical research conducted by the University of Florida concludes that for every 100 tons of energy crop fuel used, 58 tons of CO2 emission reduction occurs due to agriculture source carbon sequestration in the roots below ground. This fact naturally points at the increased use of biomass as a source for meeting future energy needs which is not only renewable but also does not contribute to increases in carbon dioxide content in the atmosphere and consequently global warming. Further, since biomass fuels contain almost no Sulphur or Mercury, the contribution of biomass combustion to acid rain (SO2) and mercury contamination in water is almost nil and comparable to zero pollutant emission technologies such as micro-hydro, wind and solar.

According to Earth Institute of Columbia University (2016) biomass as a renewable energy source resulting from organic matter such as residual wood, agricultural waste, or garbage, makes up 4.8 percent of total U.S. power consumption and about 12 percent of all U.S. renewable energy.

1.5. Outline of the Study

The rest of this thesis is organized as follows. The second chapter contains previous literature for study. The third chapter comes with methodology and data. Fourth chapters present feasibility for

biomass-based green ventures, SWOT analysis, and green financing strategies. The last chapter concludes the research with a policy recommendation.

Chapter 2

Literature Review

Short Outline for Chapter

The literature review presented here is as follow: First describing the relationship between the energy economy. Second, the literature describing ventures and third section insight on technical studies on green venture/enterprises. In the fourth section, the literature reviewed the role of SMEs in energy production and follow by the fifth section where renewable energy in different countries being reviewed. Next sections consist of potential for biomass renewable energy through SMEs on Pakistan, Biomass as a source for renewable energy, Different sources of biomass, Potential of biomass-based energy in Pakistan, why green financing is different from ordinary finance and literature gap.

2.1. Energy and Economy

Power and energy is a key factor in the success of any economy. Pakistan has been confronting energy crisis and this has been the hurdle in the economic development and growth. Economy and Energy generation is are strongly interconnected for success in future (Rashid & Haq, 2016). Power crises in Pakistan economy demonstrate that the economic crises caused an expected loss of billions of rupees for every day to Pakistan economy, other than 4.1 million unemployed workforces (Raza et al., 2016). This experience of unemployment through its association with financial destitution has lead toward the mutilation of economic progress (Halvorsen, 1997). There is a direct relationship of energy generation with reduction of unemployment (Rashid & Haq, 2016). Moreover, most SMEs don't look for updating their technology that causes low quality to

exports and their production capacity cannot meet international consignments(SME policy, 2007)[2]. In the USA, 36055 jobs can create through 500 MW biomass energy projects (Amer et al., 2011). If we consider the same ratio for Pakistan we can generate 576,880 jobs by using livestock and bagasse resources of 8000 MW projects which will reduce 17.1 % of unemployment in Pakistan (Zuberi et al., 2013).

2.2. Green Venture

The green venture is the activity which is deliberately tending to an ecological or social issue require through the acknowledgment of entrepreneurial idea with an abnormal risk, which has a net beneficial outcome on the environment and in the meantime is financial sustainability (Schaper, 2013). Many innovative technology and ideas are available throughout the world to attract SMEs sector (Qureshi & Herani, 2011). The green venture is capturing the eyes of social awareness in shape corporate responsibility and also playing an important role important role in the sustainability of strategic business development (Demirel et al., 2017). Green venture derives benefit from opportunities in the competitive market which lies behind ecological market future (Dean & McMullen, 2007). But, green entrepreneurial venture literature is in it's developing stage yet have unsolved foil issues, that is a key factor for growth and development (Mrkajic et al., 2017). The green entrepreneurial venture is steadily increasing across countries with respect to ecological issues but the question about behavior and performance yet have to be solved (Demirel et al., 2017).

[2] SMEDA

2.3. Technical Studies on Green Ventures/Entreprises

There is some case study based on a green venture which is as follow:

A case study of Bosnia and Herzegovina shows Ecotourism town built utilizing renewable materials (straw, mud, and wood) generally, utilizing recycle of water and energy, utilizing sustainable power tunnels for warming, offering natural nourishment developed by the proprietors and the particular offices for amusement, recreation, entertainment, and training. To change the behavior of B&H residents toward the earth and nature of life, particularly in light of environmental change and economical living (Silajdžić et al., 2015).

A case study of China, SGC Ltd. is a state-owned gas green venture occupied with city funneled gas supply, LPG, LPG retail, and gas investment. SGC is one of the primary domestic gas undertakings in China that offered its offers to investors through a fruitful first IPO. Right now, the organization has an aggregate resource worth of 7.36 billion-yuan, net asset worth of 2.57 billion yuan and a yearly sale return of 4.6 billion yuan. The enterprise has taken full advantage of its brand position to grow its customers. At present, the organization has more than 1.96 million consumers has for quite some time been focused on the advancement and utilization of clean energy in the city and has proceeded with its great exertion in building a low-carbon and green city. Therefore, SGC has altogether added to the change of air nature of the urban air condition (Ngai et al., 2018).

A case study from India, Firm “A” was started green venture "A" and three founder members in 2015 as an activity to offer financially suitable and innovatively prevalent arrangements in building, acquisition, and development of sun-powered energy ventures. The venture essentially manages outlining and lifecycle administration of solar photovoltaic frameworks for utility-scale

sun-based PV, off-grid and on-lattice roof-based PV systems. Aside from the ecological objectives, green entrepreneurship they trying to create small businesses and prepare different entrepreneurs to come up in the renewable sector. The fundamental inspiring elements for setting up of Firm "A" were that the Ecopreneur. "A" has a group of specialized specialists who have five years' involvement in PV exploration. In addition, his involvement in the corporate segment and inclination to make social, monetary and ecological incentive and in addition extend his own abilities prompted the foundation of this green venture (Haldar, 2018).

Survival and growth in the market are based on the technology life cycle at the point to make entry (Verreynne & Meyer, 2010). But meanwhile, a government can play a critical role as a formal body to introduce green entrepreneurial venture by regulatory measures (Berrone et al., 2013). Higher the support from the government for green entrepreneurship is directly linked with the development of ecological concerns throughout the globe (Hörisch et al., 2017). The proposed green concept is still it's initial stage in the modern era as far as commercialization and market acknowledgment (Petkova et al., 2014). The knowledge spillover theory focuses the opportunities for entrepreneurs that arise from a knowledge-based economy and these ideas yet have to commercialize (Acs et al., 2013). These arguments need to aid in line with Porter's hypothesis which states that ecological improvement gives opportunities to picking competitive advantages (Porter & Van der Linde, 1995).

2.4. Role of SMEs in Energy Production

SMEs have a key role development of nations. In a different country like Germany, India, China, USA, UK, Indonesia etc., many SMEs are doing business for energy production. In Burkina Faso, thermal energy is for the most part delivered by SMEs from wood. In this case study, cashew

enterprises create a lot of waste (shell, squeeze cake, nutshell fluid) which can be changed over into fuel (Sawadogo et al., 2018). The literature from recent decade indicates the incredible significance of the capability of renewable energy sources as alternatives of traditional fuels are insufficient to take place for increasing demand of energy throughout the world but this can generate investment opportunities for SMEs. Three centuries before, the world completely depended on the source of energy generation that is completely sustainable and now economies have been changing over to the past.

Sky mill Energy[3] is an SME, US/Indian enterprise attempting to tackle the boundless high-elevation jet stream winds that blow at more than 200mph at more than 30,000ft. Others have attempted with wings, yet Sky mill think they have split the issue by utilizing a remote turning lift aeronautical vehicle, like a helicopter, which is joined to a generator on the ground.

2.5. Renewable Energy in Different Countries

Like other developing nations, Bangladesh is likewise an energy deficiency nation. Just 10% remote areas approach nationwide grid station and might be some distant regions won't be associated with grid stations until the next thirty years. For such sort of circumstances, alternative energy resource is the best alternative. There are various renewable sources in Bangladesh. Algae and Jatropha are using for biodiesel, both are found in abundance quantity and can give them enough measure of biodiesel. The normal sun-powered illumination is 4 to 6.5 Kwh and the most extreme bright months are March-April. The coastal area of 724 km helps Bangladesh to utilized for wind plants. Quick river and streams of water in a waterway can be the best alternative of hydroelectricity (Habib and Chungpaibulpatana, 2014). In Asia, China is one of the quickly

[3] http://www.skymillenergy.com/

developing economies that requires a generous measure of energy. The government of China has been giving careful consideration toward the renewable energy sources, as it set the objective of getting 10% sustainable power source of its aggregate utilization by 2020. Wind power of China can possibly be positioned first on the planet. Round about 50 million MW energy in 2010 through wind and the objective is eight times developed than till 2020 (Zhao et al., 2014). The geographical and land circumstance of India is proper for different sustainable power projects and it is using these resources productively. Toward the finish of March 2013, the introduced limit of renewable energy was 28.1 GW. The study represents 68% of this limit making India's wind power manufacturing units are the fifth position around the world. Although the offer of renewable energy is expanding, yet at the same time India has numerous unexploited resources (The sustainable power source India expo, 2013).

2.6. Potential of Renewable Energy Through SMEs in Pakistan

Many of the developing nations are in the radiant zone and can possibly produce electricity from the sun. Pakistan has the 250-300 sunny days every year and 8-10 bright hours in a day that can be used to produce enough energy (Khalil & Zaidi, 2014) ascertained the potential of PV power in various cities of Pakistan and reasoned that 0.22 KW was the most noteworthy potential and 0.17 was the least accessible potential in these cities in a day. As per the feasibility of wind speed directed by the Pakistan Meteorological Department, it is assessed the potential of energy through the wind in Pakistani coastal regions of Baluchistan and Sindh. It is reasoned that the speed of wind is appropriate to generate the energy of very nearly 43,000 megawatts on the coastal belt of 9700 km per square, however, because of the limitations of the land used region is 2481 km per square. This region is accessible to introduce wind processes that can generate the 11,000 MW (Farooq & Kumar, 2013). Pakistan has a great potential for hydroelectricity generation which is

for the most part of the northern part of the country. The Installed capacity of hydroelectricity is 6928 megawatt and major contribution comes from Northern areas (Private Power and infrastructure board)[4]. Stream and river water can be the best choice of hydroelectric generation (Habib & Chungpaibulpatana, 2014). These all renewable projects need a huge amount of investment and there is natural disaster risk at peak for these types of projects. According to Private power and infrastructure board of Pakistan hydropower projects recently under construction, the average initial investment for construction is being accounted as 1.5 million to 2 million US $/ MW. The absence of a financial strategy for these renewable projects was a major problem for this sector because the investor doesn't invest in the projects with huge risk and unpredictable nature (Dyner & Bunn, 1997).

2.7. Biomass as a Source for Renewable energy

The situation of Pakistan with respect to energy is similar as for other emerging nations. Energy through renewable source is enough to overcome the energy problem of the nation. In past biomass was utilized generally in the household for cooking and heating. Research has demonstrated that organic waste can be utilized as a fuel of different industries. Evaluated diverse sources of biomass are used as a fuel in cement factory as in Ethiopia (By et al., 2009). Biogas is a form of biomass energy in which residual or dung can easily be converted into gas. Biogas plant deals with the organic and inorganic wastes as the source that is an ecological positive impact. The biogas innovation is exceptionally basic and raw material is easily available. The non-problematic moderateness of biomass raises the financial existence of farmers (Ali et al., 2013). Energy through biomass is accessible in the local domain, rationally evaluated and effectively administered for the

[4] http://www.ppib.gov.pk/

local's consumers for the source of energy. Anaerobic processing of energy creation framework is one of the innovations that change over creature and harvests buildups into energy. This structure is especially basic shrewdness and can work in urban and remote areas on both small and huge scale (Amigun et al., 2012). There is enough capability of getting energy through renewable power sources particularly through biomass. If the potential resources of sustainable sources of energy are truly utilized, they can oversee and ease the energy issues of Pakistan (Chaudhry et al., 2009).

2.8. Different Sources of Biomass

There are various kinds of biomass resources which includes short rotational crops, municipal waste, animal manure and agricultural waste for seasonal crops. Short rotational energy crops are perfect biomass energy crops since they are high yielding, can be developed on an empty patch and require little sources for growth. In spite of the fact that their development can be very concentrated as far as diesel fuel necessities for foundation, reaping, and possible end, sustainability has demonstrated that these products can accomplish ozone-harming ingredient (GHG) outflow investment funds of more than 80%, if used to traditional non-renewable energy sources in energy and power generation (Whittaker & Shield, 2016). Municipal Solid Waste is a heterogeneous material and its physical synthesis is subject to cost-efficient and environmentally healthy conditions (Qdais et al., 1997). Animal manure becomes the great source of biomass because they contain an organic matter and supplements. Utilizing manure as biomass offers numerous points of interest for domesticated animal's tasks by reducing waste disposal cost and diminishing odor and contaminants (Borole et al., 2006). Agriculture waste materials being financial and eco-friendly because of their exceptional synthetic creation, accessibility is easy, sustainable, low in cost. Studies insights that different horticultural waste materials, for example, rice grain, rice husk, wheat grain, wheat husk, saw residue of different plants, howl of the trees,

groundnut shells, coconut shells, dark gram husk, hazelnut shells, walnut shells, cottonseed structures, squander tea leaves, Cassia fistula leaves, maize corn cob, jatropha defiled slabs, sugarcane bagasse, apple, banana, orange peels, soybean frames, grapes stalks, water hyacinth, sugar beet mash, sunflower stalks, espresso beans, Arjun nuts, cotton stalks and so forth has been attempted (Hashem et al., 2006).

2.9. Potential of biomass-Based Energy in Pakistan

Pakistan's is an agricultural country which produces a large quantity of biomass material in the shape of agricultural waste, for example, bagasse, dung, rice husk, and so forth (Asif, 2009). The potential of these sources is described by various studies as under:

Pakistan is the world's fifth producer of sugarcane with a normal generation of almost 50 million tons of sugarcane every year created residual of 10 million tons of bagasse that is a biomass resource for energy production (Amjid et al., 2013). There are an expected number of 80 sugar processes in Pakistan having the capacity to produce 3000 MW of energy as biogas yet right now, just 700 MW has been used (PBIT, 2011). Pakistan has a huge potential of biomass resources for energy generation in the future. With the current growth rate for production of agricultural waste and livestock manure, we able to generable 535000 GWh energy per year (Valasai et al., 2017).

According to Biomass Atlas of Pakistan report (2016)[5], both theoretical and technical potential has been analyzed. The theoretical potential was assessed at about 25.3 million tons/year (62,785 GWh/year of thermal energy) for direct handling material and 114 million tons/year (456,440GWh/year of thermal energy) for trim collecting deposits. Considering the current engagement of the deposits, the technical capability of collecting material was assessed at 25.1

[5] http://www.aedb.org/component/judownload/15-bioenergy-reports/87-biomass-atlas-of-pakistan#

million tons/year (96,890 GWh/year of thermal energy). Because of farmers' willingness to offer their biomass deposits, the technical potential of product agricultural residual declines to around 20.5 million tons/year (79,250 GWh/year of thermal energy). The reports further analyzed bagasse offers the most noteworthy potential by means of their use as fuel in biomass-based plants. The aggregate introduced control capacity of the biomass plants utilizing bagasse produced from the 86 existing sugar processes in Pakistan is assessed at 1,840 MWe. Municipal Solid Wastes (MSW) can likewise be utilized in huge scale grid-connected power plants with a consolidated introduced control limit of 370 MWe. None the less, rice husk and dairy cattle fertilizer appear to offer a limited energy potential which is restricted to hostage control plants that generate power that covers the power necessities of the rice mills or domesticated animals' residuals. It ought to be noticed that the research does not include all the current MSW landfills, rice plants, and domesticated animals cultivate in Pakistan because of the lack of information or data (Alternative Energy Development Board).[6]

2.10. Why Green Financing is Different from Ordinary Finance

There are some hurdles to introduce financing for green ventures. The high political and technological risk with high pay-back period makes green venture is a less favored option for financiers (Migendt et al., 2017). As more research also, an insight that financing of green technological barriers due to asymmetric information within the capital market such as instability and uncertainty in market demand (Demirel & Parris, 2015). The previous literature is about the efforts of the researchers to find which one is relevance type of finance, that must have utilized operation of green ventures (Migendt et al., 2017). The impacts of the financial crisis have driven

[6] www.aedb.org › Root › Bioenergy › Reports

institutions (and especially financial institutions), regulators and analysts to think about the effect of finance on society and about the sustainability of financial system (Sun et al., 2011). Another insight can be found in the comprehension of the commitment that the financial sector can give to the supportable development both as far as products and services and the new arrangement of financial institutions (Carè et al., 2018). The green bond market is an emerging way of finance for these types of ventures. Green bonds are becoming famous with both borrowers and lenders as concerns mount regarding the environmental threat of global warming that is being affected throughout the world (Pittalis, 2017). The concept of social banks is new and yet not properly defining but researcher consider the social banks as a monetary body that takes after the ideas of social finance and mixed esteem and leads their business with the expectation to make social or environmental advantage (Weber, 2011). Another way to finance these green ventures in impact investment. The term characterizes those investments that look to have a financial return and, in the meantime, a social impact. In this sense, impact contributing separates itself from investments that look for just a social impact and from those that look for exclusively financial returns. Impact investing remains a specialty part contrasted and conventional mode (Brandstetter & Lehner, 2015). Recently, the entrepreneurial finance research has emphasized the part of venture capital and social business financiers (Bellavitis et al., 2016). The arrangement of both conventional debt and equity start-up funding (e.g. relative, social investors and venture capitalists), microfinance, crowdfunding, small lending and different types of financial developments (Bruton et al., 2015).

2.11. Literature Gap

From the detailed literature review, we have observed that majority of the biomass-based green venture has discussed case studies and scenarios by the perspective of developed countries. Less evidence/case study has been found in the case of Pakistan. In previous researches, the studies

were only focused on a single dimension. Some researchers were focused on biomass recourses, some on potential and other how to finance by traditional financing. However, many of researches were only focused on biogas for household or certain public projects. Meanwhile, this study has comprehensive program how we can initiate bio-based green venture with the help of SMEs. Biomass resources have a potential for the green venture to convert different types of wastes into energy and comparison of this biomass with solar energy projects for economic feasibility. Further, in this study, we do SWOT and Cost-benefit analysis to check either these projects are economical as for as public interest. In the end, we sort out the financing problem by using alternative finance options in Pakistan, going to present emerging source of funding for SMEs sector. Development and innovation in western economies, however, the new regulatory approach has enhanced access to finance for SMEs, it appears to have a positive effect on growth and sustainable development.

After this study provides a guideline on an alternative renewable solution where public-private or private sector in shape of green venture contribute for energy problem where the potential for these biomass resources is 517511 GWh per annum (approx. 58800 MW / year) in Pakistan[7].

This potential capacity of electricity is estimated by using different source at current availability.
https://www.bioenergyconsult.com/biomass-pakistan/
https://www.researchgate.net/publication/261348740_Assessment_of_biomass_energy_resources_potential_in_Pakistan_for_power_generation
[7]https://www.researchgate.net/publication/323527198

Chapter 3

Methodology

(a) Data

Research area/case study for the feasibility of biomass green venture would carry out in different sites in Province of Punjab and Federal administrated territory.

(b) Methodology

The objective of the study is to introduce SMEs into renewable energy projects especially biomass as a source for energy generation. The study also insights the role of these ventures in economic growth and developments and how to utilize different financing schemes to promote this sector. This is an exploratory research, and we don't need to develop hypothesis; because this is a pure/basic research work and under the basis of this study applied research can be carried. To accomplish these objectives, we have followings to discuss.

- **Feasibility of biomass-based green ventures**
- **A SWOT analysis of these green ventures**
- **Describe the financing strategies for green ventures**

3.1. Feasibility for Bio-mass Based Green ventures

i. Exploring Bio-mass Resources within Pakistan

The feasibility study of biomass resources is investigated in various regions of Pakistan. The correlation of various sources of biomass is influenced considering four key points, which are:

1. The initial cost of the project

2. Skills required for operation
3. Expected revenue from the project
4. Environmental Impacts on the surrounding

The data collected through secondary sources. Expert's opinion about different sources of biomass are gathered through the internet.

ii . Economic Feasibility for Bio-mass Projects

Decision-making with respect to the practicability of a sustainable energy investment by entrepreneurial green venture needs to consider over the compensation in future. There should be a beneficial introduction of the organization, and the capacity to make utilization of accessible resources.

The following analysis will be utilized to acquire the most comprehensive financial outcome for the organization's investment:

- Costs and revenues will be estimated to draft a small income statement for the plant itself. Some of these estimates will be obtained by analyzing a sample of plants with characteristics like those of our case study;
- Finally, considering the outcomes got, the NPV (Net Present Value) of the investment will be ascertained to assess the budgetary preferences.

NPV is a procedure that characterizes the present value of expected cash flows, by including them into the accounting as well as by reducing them based on the rates of return (opportunity cost of assets).

NPV will be calculated using the following formula:

In which,

$$NPV = \sum_{j} \frac{FC_j}{(1 + c_c)^j} - I_0$$

- FC_j is expected financial flow at time.
- $(1 + C_c)^j$ is the expected discount factor of the cash flow?
- C_c is the expected average weighted cost of capital.
- I_o is in the initial cost of Capital

These projects would be for 20- 30 years and opportunity cost will be deposit rate. Alternative for comparison would be solar, wind or hydro projects. This study compares biomass and solar energy project only because every six hours the sun bathes the lands of the earth in as much energy as the world consumes in a year (Blakeslee, 2010)[8]; if we could just find a way to collect and distribute that energy our energy problems would be solved. Unfortunately, most of our energy consumption is in the places with the least sunshine; and biomass captures and stores the suns energy for later use. In tropical zones biomass grows year round and can be five times more productive than in the temperate zones. Biomass can be converted to denser forms and shipped to where it is needed surprisingly economically.

If the NPV is positive, it implies toward the finish of the life of the investment, the marked down cashflows delivered will have yield more than the underlying venture cost and, in this manner, the investment of the plant is favorable; then again, if the NPV is negative, the Investment isn't favorable.

[8] https://www.renewableenergyworld.com/articles/2010/01/importing-solar-power-with-biomass.html

Another method to calculate feasibility is the internal rate of return. The IRR is a value of the Capital cost for which net present value is equal to zero and shows the gainfulness of a venture being evaluated as financial tools. If IRR is higher than the estimation of opportunity cost accepted for the NPV, it implies that the proposed investment would be favorable and vice versa. The internal rate of return (IRR) is generally considered inferior to the net present value (NPV) as a tool for evaluating and ranking projects, despite its inherently useful comparability to the cost of capital and the return of other investment opportunities (Weber, 2014). As a practical matter, it is unreasonable to expect future investment opportunities to have the same IRR as the project under consideration. This is especially the case with high-risk investments demonstrating high potential returns (Kierulff, 2012).

3.2. SWOT Analysis of these Green Ventures

SWOT is a flexible concept that can be utilized in different situations from assessing projects or business ventures, deciding, tackling issues for the organization. In this section, we will utilize it to break down the renewable power source (biomass) based green venture in Pakistan.

A SWOT analysis will assist us with understanding the qualities and reveal to open doors that can put our investigation in a beneficial position and accomplish the bio-energy targets. It likewise tosses light on the frail target territories and calls attention to outside threats. If anticipated ahead of time, the components affecting areas contrarily can be excluded or looked with certainty and readiness, so they probably won't turn out to be huge problems for the improvement of a key ground-breaking strategy and bio-energy activities.

Internal factors describe the region itself and can be influenced by local decisions and actions.

STRENGTHS are inner attributes that enhance the green ventures idea. They give great beginning position for setting up or reinforcing a biomass-based energy venture.

WEAKNESSES are inward factors that may diminish applied potential. These ventures can be inside the control and may be impacted by neighborhood and regional choices.

OPPORTUNITIES are external positive factors confronting the green venture like ideal enactment for renewable power sources which can reveal a more noteworthy potential for advancement of a bioenergy division. These tasks are conditionally amicable and utilize wastes as raw material, which will reduce the cost of electricity generation.

THREATS are external obstacles that are beyond any control. They are characterized by unfavorable trends like price wars or changing technology. There is also the possibility of the blast in the plant if not properly checked or maintained and may affect the environment in case of leakage of gasses as well.

3.3. Describe the Financing Strategies for Green Ventures

As per literature of Capital Asset Pricing Model theory, if Net Present Value for any investment is higher than initial cost (positive value) there must be low discount rate and beta (Market risk) for that investment. Low level of market risk encourages different types of an investor in the financial system for these products. In the end, I will describe recent trends in entrepreneurial finance to propose different financial strategies for biomass green ventures with the prospect of market risk. For this purpose, I will explore the internet and case studies for future consideration.

Chapter 4

Feasibility for Biomass-Based Green Ventures

4.1. Exploring Bio-mass Resources within Pakistan

This section of the chapter discusses the potential, requirement and technical examination of biomass sources. The biomass is a natural material, got from living beings that is renewable and economical. It can be changed over into different sources of energy like power, heat, ethanol, and bio-diesel. Following types of biomass resources are as under

- Short Rotation Energy Crops
- Agricultural waste
- Animal waste
- Municipal Solid Waste

4.1.1. Short Rotation Energy Crops

The short rotational crop is the woody biomass which requires less time to produce the bulk of biomass. There is a number of small trees, shrubs which take 2-3 years to be ready for harvesting. The biomass can be burnt directly or can be gasified or can be converted into biogas. A few researches investigate in 10-45% of world basic energy needs will be fulfilled through biomass energy and countless take that short-run energy crops would be the best essential energy (Berndes et al., 2003). These are as follow;

- Willow
- Bamboo

- **Willow**

There are roughly 526 varieties of willow. Most of these are in the Northern regions. There are 375 kinds of willow in Asia contains 71.29 of world ratio. Among these 375 species, 328 are neighborhood or close-by to Asia (Fang, 1987). In a century back, Willow was utilized for soil confirmation, roof, burning fuels, and medication by the Egyptians and Romans (Keoleian & Volk 2005). There is much potential has been observed for development as a biomass source.

They can develop rapidly and in the fourth period of their growth, they are set up to bring together and their size is practically 15-20 feet. The gathering ought to be conceivable at whatever point after the fourth season after leaves the takes off.

There are different types of willow can create in different regions of Pakistan like Rawalpindi, Abbottabad, Mansehra etc. Willow needs more bulk of water to stand out from various products beside weepy willow. They are set up to accumulate following 3-4 years and new leaves will reproduce. They can be on and on gotten together to 15 years and can make 4-5 tones dry wood. For the most part, they are grown at the bank of stream and lakes since they can save the banks of rivers and work as a shield. The requirement for willows are as under

i. Technology Required

There is no need for technology to grow willow. Plantation method is easily learned by farmers in different villages.

ii. Inputs

The major requirement for growing willow is water. They can become even in waterlogged regions and change over the territory into capable of the plantation of different crops**.**

iii. Planting Design

Cultivation process needs much care for aligning willows on two rows. These lines allow the free advancements of cultivating with high thickness. However, 4,000-8,000 plants can be cultivated in one section of land. It is prescribed that a 20-feet separate should be kept up after every 500-600 feet area along the sections. Generally, willow planting is done with un-established cutting and 8-10 inches of length should be cut. After the completion of the first cultivation period cut from the stems. In the second and third season, willows can be treated for getting more yield. After the fourth season, willows are set up to acquire and have length is appropriate around 15-20 feet. The harvesting ought to be possible at whatever point after the fourth season after leaves have fallen off.

iv. Harvesting

The leaves fall from the plant can include the supplements in the dirt which use as fertilizer for the better growth in next season. The yield of willow increment in each yield and to get its full advantage no less than seven rotations must be finished. In first yield it gives very nearly 3.7-5.1 tons dry willows for each unit of land and after two crops yield improved up to twelve tons (Scurlock et al., 2000).

v. Economic Assessment

The collection of willow requires a suitable time with the amount of around fifty thousand per acre of land, it consists upon the cost of cultivation, cuttings of trees and their storing. The understood yield of willow is 18 tons. At the end that this is sold at the rate of 300 per maund, a farmer can acquire practically 135000 per acre of land in the key procure season. (1 maund = 37.32 kg)

- **Bamboo**

Bamboo has a place with the woody grasses which have pretty much 1,250 types. Its stature between 10 cm to 40 meters. This is utilized as a source of food and fiber in habitual routine life. The 36 million hectares are under bamboo forests in Asia and area under progress of forests is round about 24 million hectors. They have developed usually in tropic and smooth zones of with or without islands from Europe in any case, for the most part, made in subtropics zones. In 1980s Pakistan imported some bamboo species from Sri Lanka, China, Bangladesh, and Thailand.

i. Inputs

They expect much to encourages and even rich soil can be depleted after a couple of farms, so it is easy to treat the land. Green dung, wood burning residuals, or synthetic composts can be used. They develop better in a tropical area. They are free from bacteria and diseases anyway for first-year emptying of weeds is vital.

ii. Yield

Bamboo yields rely upon the production of culms in the group. They are prepared to gather the following 5 years and around then, for the most part, it contains six culms per cluster. After consistently the number of culms expanded and the culms that are maybe a couple-year-old ought not to be reaped.

4.1.1.1. Technology Requirement

The technologies change over these woody grasses into heat by simple combustion or along with new technologies that are utilized for production petroleum by-products. Following methods are for conversion into energy.

a- Combustion

Recent days it is being used to change over the biomass into energy through flame or direct combustion. In this system, fuel is set apart into boilers to make the mix imperativeness set away in the fuel. Any kind of fuel can be stamped yet it is more able to use the fuel which contains under half water-logged quality substance. In case the wetness content is high, it must be dry first. The temperature required for combustion is 800 to 1000C. The extent of warmth made by the forested zones relies on the sort of fuel, yet everything thought of it as is evaluated that one kilogram of dry wood produces energy of 20 joules. This technique is moreover used to get eco-friendly product from oil-based stock like coal because it uses wood which intake carbon during photosynthesis and emission remain the same impact on the surrounding. In this strategy, biomass is burned in a chamber to pass on high-weight steam. This steam is utilized to turn the turbines that relate to the electric generator which make a control (Overend, 2004).

b-Combined Heat and Power

By using this technology, we can produce thermal based energy and electricity. There is no separate step required for thermal or electric since both can be gotten in a single step. Combined Heat and Power is used at sugars mill or paper factory where wastes can be utilized for energy generation. Its source is a more feasible stand out from other thermo-electric methods because electric units simply convert over the one-third of fuel in energy remain heat will be waste and evaporated which hazard for the environment and financial loss. This method converts more degree of fuel into energy (Overend,2004).

c-Gasification

Gasification is the method in which biomass is changed over into flammable gas through halfway oxidation. Frequently, the burning process is done at the 800-900C temperature. Gasification process can be done in many ways to direct burnt directly or converted into electric power. This gas in like way can be utilized to run turbines where electricity is produced by a mixture of gas and heat. The period of gas through gasification from biomass allows the creation of methanol that can be utilized as a transportation fuel (McKendry, 2002).

d-Pyrolysis

Pyrolysis is a method where the material is decomposed into gas, liquid and solid residual contain carbon .in chamber there is the temperature of 430C without oxygen. The gas made in pyrolysis needs some extra filtration for the expulsion of small fiber and wet scrubbers. On the off chance that sparkle pyrolysis is utilized, it can change over the biomass into bio-diesel with the ability of 80%. This oil can be used in motors and turbines (McKendry, 2002).

4.1.2 Agricultural Waste

Agricultural-residues use as source biomass. These residues are full of organic waste and are collected by minimum efforts. They are available around the year and they can serve various sorts of essentialness in the normally positive way.

The capability of the source from where energy can be produced from the harvests deposits is given in the table 4.1[9]:

[9] https://www.researchgate.net/publication/323527198

Table 4.1 Recourses in Pakistan for agricultural residual

Crop	Annual output (thousand MT)	Residue type	Residue/kg	The available residue (Thousand MT)
Sugar cane	49500	Bagasse Top and leave Pod	0.33 0.05	16500 2800
Wheat	24000	Stalks Husks	0.3 1.5	7200 36000
Rice	6900	Stalks Straws Boll Shells	0.2 1.5 1.5	1400 10400 10400
Cotton	3000	Husks Stalks Cobs	1.1 1.1 3.8	3300 3300 11900
Maize	300	Stalks Stalks	0.3 2	90 600
Dry chilly	190	Stalks	1.5	285
Barley	85	Stalks	1.3	110

Source**:** International Journal of Hydrogen Energy

i. Cost Estimation of Agricultural Residues

Agricultural residues industry isn't developed at all in Pakistan and that is the reason the value and cost of agricultural residues aren't built up. Generally, its cost includes dumping and transportation cost as the manufacturing cost is secured by the wage of individual products. Transportation cost relies on the kind of truck, a distance of the market from the field and mass density of the agricultural residues.

ii. Technology Requirement

Energy can be generated from agricultural residues from a number of existing technologies i.e. they can be directly combusted like other woods, co-fired with coal and can be converted into

pellets. They can be gasified, and pyrolysis technique also can be used by considering the type of residue.

iii. Output Potential

Agriculture residues have a potential capacity of 394908 GWh/year electricity in Pakistan.

4.1.3. Animal Manure

Domesticated animal's manure is a waste item created by the livestock. This dung can be recyclable because food nutrient is not fully digested by animals. These nutrients can be used without paying for them. Dung can easily be converted into biogas with a simple process.

i. Potential

Due to the agricultural country, Pakistan economy merely depends on 21% GDP and 43% contribution toward workforce generation.

Dairy animals contribute 55.9% in agribusiness. In 2017 -18 there are 84.9 million dairy cattle's (Buffalo and Cow) available in Pakistan which makes around 849-million-kilogram dung every day. As indicated by FAO half of this waste is gathered and used as fuel and fertilizers. In Addition to that, there are 71.2 million goats, 30.5 million sheep, and 1270 million poultry which are used to make a huge proportion of fertilizer.

ii. Technology Requirement

Simple and easily use technology is required for biogas. There are four key elements i.e., Organic Material, Bacteria, Anaerobic Condition and Heat for using different types of digesters.

iii. Output Estimation:

As per the Pakistan Economic Survey (2017-18), the number of livestock (Cows and Buffalos) is 84.9 million in Pakistan. An average size animal delivers ten kilograms of manure per day. Thus, this livestock can produce 849-million-kilogram dung per day. If roughly we able to gather half of the fresh dung that makes 425-million-kilogram manure in Pakistan every day. Using this dung 21.25 million cubic meters of biogas (at the rate of $.05m^3$ for each kilogram of creature dung) can be converted per day. Add up to the population of Pakistan is 207.77 million and 62% of which is 128.82 million residuals in rural areas. From this rural population, we can satisfy the cooking needs of 32.29 million of the rural population can be satisfied by 21.25 million cubic meter biogas. This can alternatively use for electricity generation of 92760 GWh / year in Pakistan.

iv. Economic Impact

This is a methane-rich gas which can displace the all oil, deiseal, and impact in the rural regions of Pakistan. As one cubic meter biogas is relative to 6.4 KW/h and proportionate of one liter for energy is 10 KW/h. So, if that we can say 1.5 cubic meters of biogas is equal to 1 liter of diesel (Ahmad, 2010). A biogas purchaser family containing 8-10 individuals can save up to 3000 rupees per month by using biomass.

v. Environmental Benefits

Net carbon emission is considered as zero and produces less amount of carbon dioxide with other sources of energy even study reveals 1 Kilowatt of the intensity of electricity production from biogas reduce 7 kg of CO2 consistently (Ali et al., 2013). Changing over livestock manure into biogas through anaerobic digestion can moderate the odor up to 70-97% and pathogens up to 99% (White et al., 2011).

4.1.4. Municipal Solid Waste

The MSW contains solids, semi-solids, and non-dissolvable materials. As demonstrated by the Finance Ministry (1996) the solid waste proportion in Pakistan was assessed between 0.612 kg for each capita on a consistent schedule and increase at the rate of 2.6% consistently. According to the recent census (2017), the population of Pakistan is 207.77 million. If we apply a waste rate of 2.6% and we can get 76500-ton municipal solid waste daily for the year 2017. The proportion of waste created and went to the dispose of depends upon the plan of waste managing authority. All waste material isn't going for decomposition which may pollute soil, water, and air. If there would be an appropriate waste administration structure, this can be used as a biomass source in the energy generation. The energy generation of MSW is assessed at 6.89 MJ per kilogram. This can generate electricity up to 29843 GWh.

i. Technology Requirement

Before changing over the waste into energy, it is desirable to separate the recyclable and risky waste from the municipal solid waste. There is the number of innovations which are being utilized to change over the biomass sources into energy. Biogas can be created from municipal strong waste through anaerobic processing. The techniques which are being utilized to change over MSW into energy other than anaerobic digestion are:

a Incineration:

This procedure is utilized to change over the waste into energy, the mass consumes burning is the best choice as it doesn't require additional labor to isolate the metals and risky waste from municipal strong waste.

b Gasification:

It is a procedure in which the components of waste are separated at high temperature into oxygen-free reactors. This procedure is additionally being utilized to blend waste and syngas is set up in this procedure which comprises methane, carbon dioxide, hydrogen, carbon monoxide, and water vapor.

In this section, we have discussed the potential and the various sources of biomass. It tends to be reasoned that Pakistan has the capability of biomass sources and all sources are exploitable by utilizing the data sources accessible inside the nation. Most of the biomass sources don't require any sources but some of them require proper systems and technologies to convert into different energies. Biomass can be the best option for renewable power generation.

4.2. Economic Feasibility for Green Venture

These biomass-based green ventures can be further classified as domestic and public projects through IPP (Independent power producer) or Public-private partnership. When we talk about the domestic project then there are two different types of biomass plants without operational cost. These projects can use different residual to convert them into biogas through fermentation.

- Portable domestic plants
- Fixed domestic plants

4.2.1. Portable Domestic Plants

These portable domestic plants can easily be used within cities for the stove. These plants can easily clean and manage kitchen waste into energy and easily movable within premises. Residuals can be used as for energy fertilizer. These plants can be used in hotels to manage waste and produce

enough energy for use. Currently, these plants are manufacturing in India and China so industrial unit setup also establishes for manufacturing at low cost.

Cost for these plants starts from 15000 to 20000 rupees. These portable plants can easily for 3-4 member with the lifetime of 8 – 10 years. For these projects discount rate is prevailing rate determine by SBP to the bank for operations. And in 2017 discount rate is prevailing @ 6%. There is no operational cost for this plant then future benefit from this plant will be derived through

$$\mathbf{PV} = \boldsymbol{FV}/(\mathbf{1} + \boldsymbol{i})^{\boldsymbol{n}}$$

If the discount rate is 6% prevailing at market

Cost of saving for cooking is considered a benefit

Per capita, LPG consumption is 2.5 for each month[10]

The average rate of LPG is (PKR) 120/ kg.

LPG per person consumption is amounted (PKR) 300

Benefit for 10 years = PKR 105985*

*Here Benefit is the cost of saving of LPG per month/capita.

Cost-benefit ratio = 5.3

Here we can see future benefit of PKR 105985 can easily be derived through this investment of PKR 20000.

[10] World LPG Association Statistics, (2015).

4.2.2. Fixed Domestic Plants

These plants are very feasible for rural areas. We have a different estimation for fabrication of fixed domestic biogas plants based on dung from cattle. Environmental and fertilizer benefits are out of the calculation. Data is collected through PCRET head office Islamabad. This detail is as follow:

Table 4.2 Fabrication of Biogas Plants for Household (estimated)

Contents	**5-6 members**	**8-10 members**	**12-14 members**	**15-16 members**
Area	(6ft*13ft)	(7ft*15ft)	(7ft*18.5ft)	(8ft*18.5ft)
Calculation for digester	35000	60000	70000	90000
Base designing	15000	20000	30000	40000
Inlet tank	10000	10000	10000	10000
Outlet tank	10000	10000	10000	10000
Gas holder	30000	40000	50000	50000
Total Plant cost (PKR)	**100000**	**140000**	**170000**	**200000**
Discount rate	6%			
No. of years	15			
Discounted Value	$FV/(\mathbf{1}+\boldsymbol{i})^{\boldsymbol{n}}$			
Per month saving (Benefit)	1800*	3000*	4200	4800
Discount value for 15 years**	199658	332763	465868	532420
Cost-benefit ratio ***	1.99	2.37	2.74	2.66

* Source: World LPG Association Statistics (2015). Per capita monthly cost is 300 (per capita consumption*average LPG per kg).
**Discounted value is calculated up to 15 years saving the cost of fuel (cooking).
***Saving cost for cooking is considered as a benefit in this analysis.

This table shows that cost-benefit analysis is based on monetary input/output. The project also produces organic fertilizer and help in keeping the environment clean.

4.2.3. Biomass-Based Public Power Plant

These projects need huge investment and operational cost as compare with domestic plants. These can be initiated through the private sector or private-public partnership in the shape of SME. Financing is still having an issue, but it is easy to approach commercial banks for green finance credit after regulation issued by SBP in 2016. We have different capacity biomass plant which can be initiated by different SMEs and these plants can be compared with solar of the same capacity.

a ORC Plants with Different Capacity

The Organic Rankine Cycle (ORC) is termed for its operation of a natural, high atomic mass liquid with a fluid vapor phase change, or breaking point, maintaining at low temperature then stream plants. The liquid permits Rankine cycle warm healing from bringing down temperature sources, for example, biomass ignition, mechanical waste warmth, geothermal warmth, sunlight-based lakes and so on. The low-temperature warm is changed over into helpful work, that would itself be able to

be changed over into power. These plants can be utilized with an ultimate limit of 2-megawatt, 4-megawatt, 6-megawatt, 8-megawatt, and 10-megawatt. Lifetime for these plants up to 30 years and discount factor is 6% prevailing in the market. An initial cost of capital for ORC plant is PKR 0.12 billion /MW and for PV solar plant PKR0.18 billion /MW rupees respectfully.

Capital cost and other data relating to these biomass and solar energy project can be calculated through different sources available on the internet.[11] However, the cost of solar is very high as compare to the ORC biomass plant.

ORC plant capacity is average of 40 tons per megawatt with an increase up to 500 tons for 10 megawatts projects and 1 ton can generate 0.70 MWh from organic biomass. So, per day generation capacity for one megawatt is 28 MWh. Variable cost for the plant is RS 720 / MWh and fixed variable cost is 1.5% to 2.5% of the initial investment of plant of different capacity per year, along with 1 % is insurance cost for plant up to 30 years. Cost for biomass material is RS 5000 which declared by NEPRA along with tariff for electricity through biomass plant which is 9.17/kwh.

b PV Solar Plants

PV solar has a capacity of 1459500 KWh per year for one megawatt per plant. Operation and maintenance cost are fixed up to Rs. 3184920/MWh per year (US $26541/MW). One percent (1%) is insurance cost for plant and Rs 11.53 is tariff rate declared by NEPRA. The following data is used for the development of these projects. These are mentioned only for comparison.

[11] https://www.ifc.org/wps/wcm/connect/7a1813bc.../BioMass_report_06+2017.pdf
https://www.irena.org/-/media/.../IRENA/.../2018/Jan/IRENA_2017_Power_Costs_2018
www.irena.org/publications/2018/Apr/Renewables-Readiness-Assessment-Pakistan

Table 4.3 Two- Megawatt Renewable Project (cost in '000 PKR)

Capital Cost Biomass Plant = 240000 Capital Cost Solar Plant =360000

Year	**Gross Return**		**Total operating cost**		**Net return**		**Discount Factor @ 6%**		**PV of Net Return**	
	ORC Plant	Solar Plant	ORC Plant	Solar Plant	ORC Plant	Solar Plant	ORC plant	Solar plant	ORC plant	Solar plant
1	184867	33664	165715	9970	19152	23694	0.94		18068	22353
2	184867	33664	165715	9970	19152	23694	0.89		17045	21088
3	184867	33664	165715	9970	19152	23694	0.84		16080	19894
4	184867	33664	165715	9970	19152	23694	0.79		15170	18768
5	184867	33664	165715	9970	19152	23694	0.75		14311	17706
6	184867	33664	165715	9970	19152	23694	0.70		13501	16703
7	184867	33664	165715	9970	19152	23694	0.67		12737	15758
8	184867	33664	165715	9970	19152	23694	0.63		12016	14866
9	184867	33664	165715	9970	19152	23694	0.59		11336	14025
10	184867	33664	165715	9970	19152	23694	0.56		10694	13231
11	184867	33664	165715	9970	19152	23694	0.53		10089	12482
12	184867	33664	165715	9970	19152	23694	0.50		9518	11775
13	184867	33664	165715	9970	19152	23694	0.47		8979	11109
14	184867	33664	165715	9970	19152	23694	0.44		8471	10480
15	184867	33664	165715	9970	19152	23694	0.42		7991	9887
16	184867	33664	165715	9970	19152	23694	0.39		7539	9327
17	184867	33664	165715	9970	19152	23694	0.37		7112	8799
18	184867	33664	165715	9970	19152	23694	0.35		6710	8301
19	184867	33664	165715	9970	19152	23694	0.33		6330	7831
20	184867	33664	165715	9970	19152	23694	0.31		5972	7388
21	184867	33664	165715	9970	19152	23694	0.29		5634	6970
22	184867	33664	165715	9970	19152	23694	0.28		5315	6575
23	184867	33664	165715	9970	19152	23694	0.26		5014	6203
24	184867	33664	165715	9970	19152	23694	0.25		4730	5852
25	184867	33664	165715	9970	19152	23694	0.23		4462	5521
26	184867	33664	165715	9970	19152	23694	0.22		4462	5208
27	184867	33664	165715	9970	19152	23694	0.21		3972	4913
28	184867	33664	165715	9970	19152	23694	0.20		3747	4635
29	184867	33664	165715	9970	19152	23694	0.18		3535	4373
30	184867	33664	165715	9970	19152	23694	0.17		3335	4125
Total (PKR)	**5546016**	**12478536**	**4971456**	**276476**	**574560**	**710823**			**263876.6**	**336145**
Average Return	**18313**	**23694**								
NPV	**334560**	**-359,537**								
Cost benefit Ratio	**1.09**	**0.93**								

In above table 4.3, the biomass-based plant has a capital cost of 0.24 billion, but solar capital cost increases up to 0.36 billion. The initial cost of investment has key point for the feasibility of any project either that meet benefits in future or lack behind the initial cost. Net return for biomass plant is lower as compared to solar because of high operational cost as fuel material for the biomass plant. NPV shows that biomass plants are more favorable for investment rather solar which has negative NPV because cash flows don't meet its capital cost. Cost-benefit analysis clear picture by showing 1.09 for biomass as compare with solar at 0.93 which is unfeasible.

Table 4.4 Six-Megawatt Renewable Project (cost in '000 PKR)

Capital Cost Biomass Plant = 720000 Capital Cost Solar Plant = 1080000

Year	**Gross Return**		**Total operating cost**		**Net return**		**Discount Factor @ 6%**		**PV of Net Return**	
	ORC Plant	Solar Plant	ORC Plant	Solar Plant	ORC Plant	Solar Plant	ORC plant	Solar Plant	ORC plant	Solar plant
1	693252	100992	1026720	29910	80820	71082	0.94		18068	67059
2	693252	100992	1026720	29910	80820	71082	0.89		17045	63263
3	693252	100992	1026720	29910	80820	71082	0.84		16080	59682
4	693252	100992	1026720	29910	80820	71082	0.79		15170	56304
5	693252	100992	1026720	29910	80820	71082	0.75		14311	53117
6	693252	100992	1026720	29910	80820	71082	0.70		13501	50110
7	693252	100992	1026720	29910	80820	71082	0.67		12737	47274
8	693252	100992	1026720	29910	80820	71082	0.63		12016	44598
9	693252	100992	1026720	29910	80820	71082	0.59		11336	42074
10	693252	100992	1026720	29910	80820	71082	0.56		10694	39692
11	693252	100992	1026720	29910	80820	71082	0.53		10089	37445
12	693252	100992	1026720	29910	80820	71082	0.50		9518	35326
13	693252	100992	1026720	29910	80820	71082	0.47		8979	33326
14	693252	100992	1026720	29910	80820	71082	0.44		8471	31440
15	693252	100992	1026720	29910	80820	71082	0.42		7991	29660
16	693252	100992	1026720	29910	80820	71082	0.39		7539	27981
17	693252	100992	1026720	29910	80820	71082	0.37		7112	26397
18	693252	100992	1026720	29910	80820	71082	0.35		6710	24903
19	693252	100992	1026720	29910	80820	71082	0.33		6330	23494
20	693252	100992	1026720	29910	80820	71082	0.31		5972	22164
21	693252	100992	1026720	29910	80820	71082	0.29		5634	20909
22	693252	100992	1026720	29910	80820	71082	0.28		5315	19726
23	693252	100992	1026720	29910	80820	71082	0.26		5014	18609
24	693252	100992	1026720	29910	80820	71082	0.25		4730	17556
25	693252	100992	1026720	29910	80820	71082	0.23		4462	16562
26	693252	100992	1026720	29910	80820	71082	0.22		4462	15625
27	693252	100992	1026720	29910	80820	71082	0.21		3972	14740
28	693252	100992	1026720	29910	80820	71082	0.20		3747	13906
29	693252	100992	1026720	29910	80820	71082	0.18		3535	13119
30	693252	100992	1026720	29910	80820	71082	0.17		3335	12376
Total (PKR)	**5546016**	**3029755.6**	**8372960**	**897285**	**2424600**	**2132470**			**1113539.5**	**978436**
Average Return	**80820**	**71082**								
NPV	**393539.5**	**-1079021**								
Cost benefit Ratio	**1.54**	**0.90**								

The above table 4.4 explains initial cost for biomass is 0.72 billion rupees as compared to solar which is high up to 1.08 billion rupees. Six -megawatt renewable projects for biomass-based has positive NPV as compare to solar plants due to which negative to high capital cost. Here the concept of large economies considers because net return getting high for biomass as higher operational cost compares to solar. Cost-benefit analysis for biomass-based energy plant also shows a higher ratio as compared with solar, which is less than 1. The average return is higher for six-megawatt biomass project as compared to solar.

Table 4.5 Ten- Megawatt Renewable Project (cost in '000 PKR)

Capital Cost Biomass Plant = 1200000 Capital Cost Solar Plant = 1800000

Year	**Gross Return**		**Total operating cost**		**Net return**		**Discount Factor @ 6%**		**PV of Net Return**	
	ORC Plant	Solar Plant	ORC Plant	Solar Plant	ORC Plant	Solar Plant	ORC plant	Solar Plant	ORC Plant	Solar plant
1	184867	168319.8	1026720	49849	128700	118471	0.94		18068	111765
2	184867	168319.8	1026720	49849	128700	118471	0.89		17045	105438
3	184867	168319.8	1026720	49849	128700	118471	0.84		16080	99470
4	184867	168319.8	1026720	49849	128700	118471	0.79		15170	93840
5	184867	168319.8	1026720	49849	128700	118471	0.75		14311	88528
6	184867	168319.8	1026720	49849	128700	118471	0.70		13501	83517
7	184867	168319.8	1026720	49849	128700	118471	0.67		12737	78790
8	184867	168319.8	1026720	49849	128700	118471	0.63		12016	74330
9	184867	168319.8	1026720	49849	128700	118471	0.59		11336	70123
10	184867	168319.8	1026720	49849	128700	118471	0.56		10694	66153
11	184867	168319.8	1026720	49849	128700	118471	0.53		10089	62409
12	184867	168319.8	1026720	49849	128700	118471	0.50		9518	58876
13	184867	168319.8	1026720	49849	128700	118471	0.47		8979	55544
14	184867	168319.8	1026720	49849	128700	118471	0.44		8471	52400
15	184867	168319.8	1026720	49849	128700	118471	0.42		7991	49434
16	184867	168319.8	1026720	49849	128700	118471	0.39		7539	46635
17	184867	168319.8	1026720	49849	128700	118471	0.37		7112	43996
18	184867	168319.8	1026720	49849	128700	118471	0.35		6710	41505
19	184867	168319.8	1026720	49849	128700	118471	0.33		6330	39156
20	184867	168319.8	1026720	49849	128700	118471	0.31		5972	36940
21	184867	168319.8	1026720	49849	128700	118471	0.29		5634	34849
22	184867	168319.8	1026720	49849	128700	118471	0.28		5315	32876
23	184867	168319.8	1026720	49849	128700	118471	0.26		5014	31015
24	184867	168319.8	1026720	49849	128700	118471	0.25		4730	29260
25	184867	168319.8	1026720	49849	128700	118471	0.23		4462	27603
26	184867	168319.8	1026720	49849	128700	118471	0.22		4462	26041
27	184867	168319.8	1026720	49849	128700	118471	0.21		3972	24567
28	184867	168319.8	1026720	49849	128700	118471	0.20		3747	23176
29	184867	168319.8	1026720	49849	128700	118471	0.18		3535	21865
30	184867	168319.8	1026720	49849	128700	118471	0.17		3335	20627
Total (PKR)	**34662600**	**504992**	**30801600**	**1495476**	**3861000**	**3554116**			**1773231**	**1630727**
Average Return	**128700**	**118471**								
NPV	**573,231**	**-1798369**								
Cost benefit Ratio	**1.47**	**0.90**								

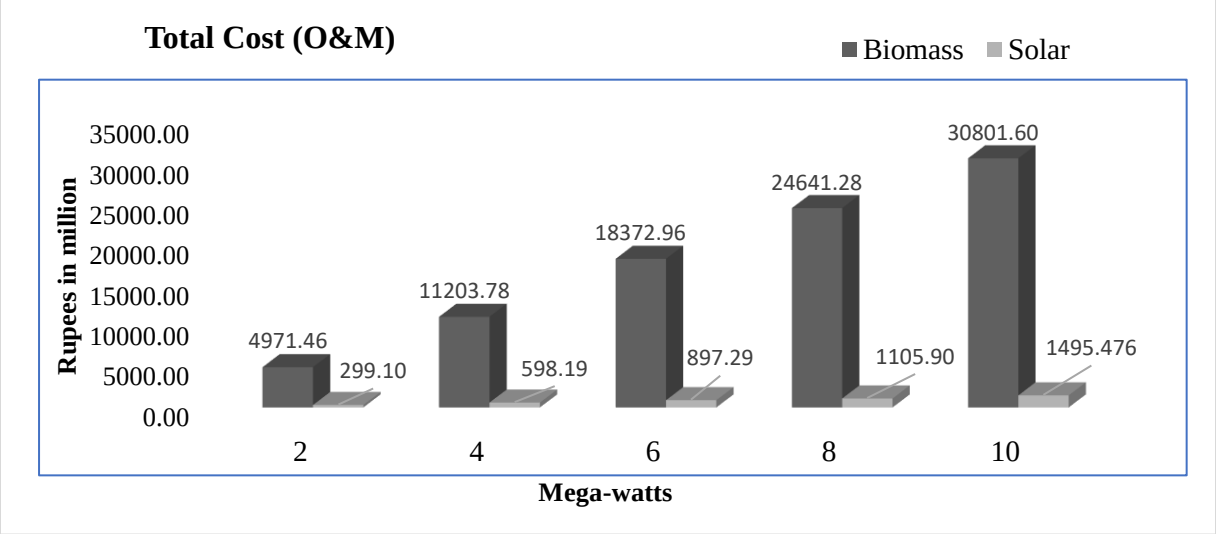
The above table 4.5 explains solar energy has a high capital cost of 1.8 billion rupees as compared to biomass. But ten-megawatts projects average return for both plants haven't much difference but NPV for a biomass-based energy project is up to positive as compared with solar due to the cost of investment. Cost-benefit ratio for the biomass-based project is slightly lower than the six-megawatt project due to high operational cost however, solar plant has less than 1 which is not feasible.

Table 4.6 Comparison of Biomass and Solar Projects (In PKR Millions)

PROJECTS	Gross Return		Total cost(O&M)		Net Return		NPV		Cost Benefit Ratio	
	Biomass	Solar	Biomass	Solar	Biomass	Solar	Biomass	Solar	Biomass	Solar
2 Megawatt	5546.02	1009.92	4971.46	299.10	574.56	710.82	334.56	-33.85	1.09	0.93
4 Megawatt	12478.54	2019.84	11203.78	598.19	1274.76	1421.65	254.26	-67.71	1.22	0.91
6 Megawatt	20797.56	3029.76	18372.96	897.29	2424.60	2132.47	393.54	-101.56	1.54	0.90
8 Megawatt	27730.08	4039.67	24641.28	1105.90	3088.80	2843.29	458.58	-135.42	1.48	0.91
10 Megawatt	34662.60	5049.59	30801.60	1495.476	3861.00	3554.12	573.23	-169.27	1.47	0.90

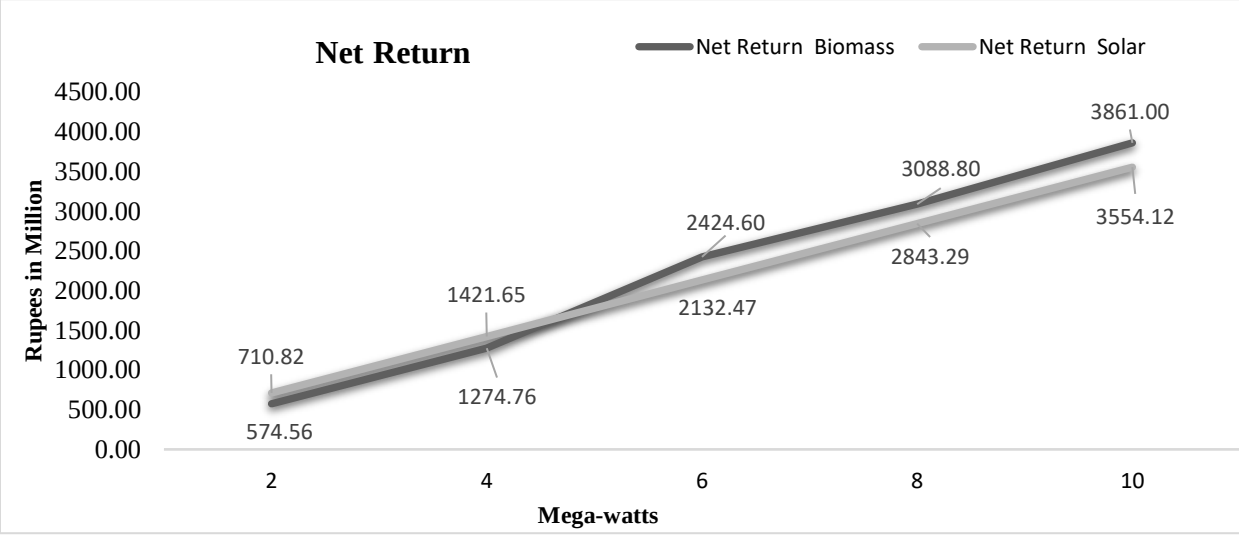
This table shows the comparison between solar projects and biomass. It shows that the more we increase in megawatt, the gross return increases as compared to solar projects. The operational cost of biomass is relatively high as compared to solar projects and net returns are comparably two projects up to 4 megawatts is low, because of the economy of scale. The more we produce, the lower will be unit cost. Above 4 megawatts, the net return is higher for biomass projects. Net present value, NPV shows the trend between solar and biomass, and the above figure shows that biomass is a positive and favorable investment than solar projects. Cost-benefit analysis of biomass is feasible and on the other side, cost-benefit analysis solar is less than 1 (0.90).

Figure 4.1 Total cost in Megawatt by Different Renewable Project



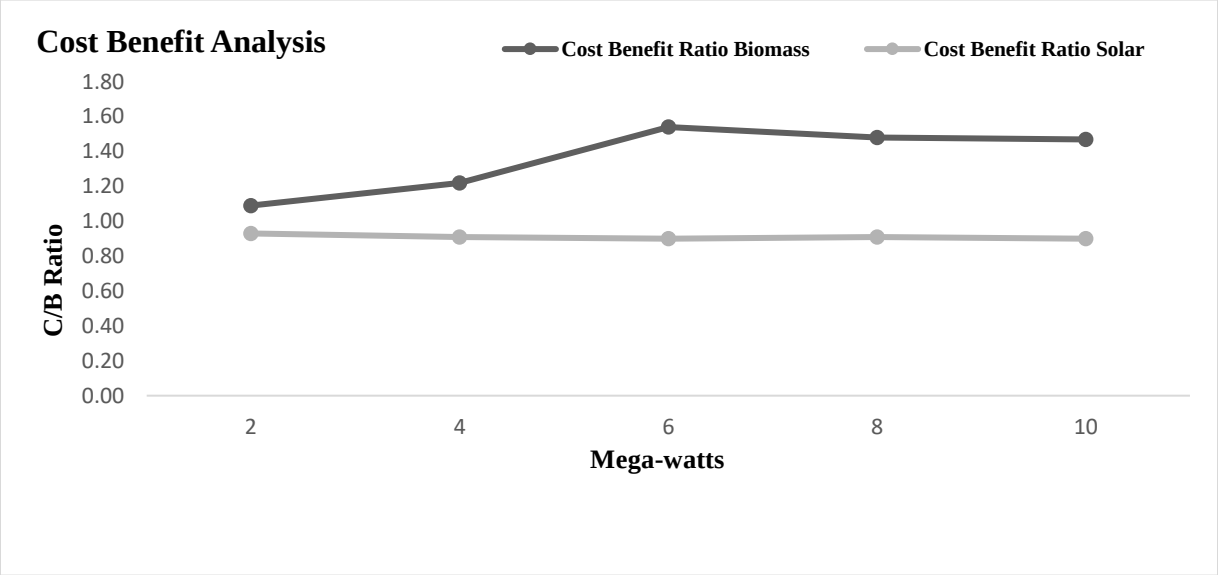
From all these projects total operational and maintenance cost for biomass energy plants is higher than the cost of solar energy plants and the difference between biomass and Solar keep increasing with the capacity of projects.

Figure 4.2 Net Return in Megawatt by Different Renewable Project



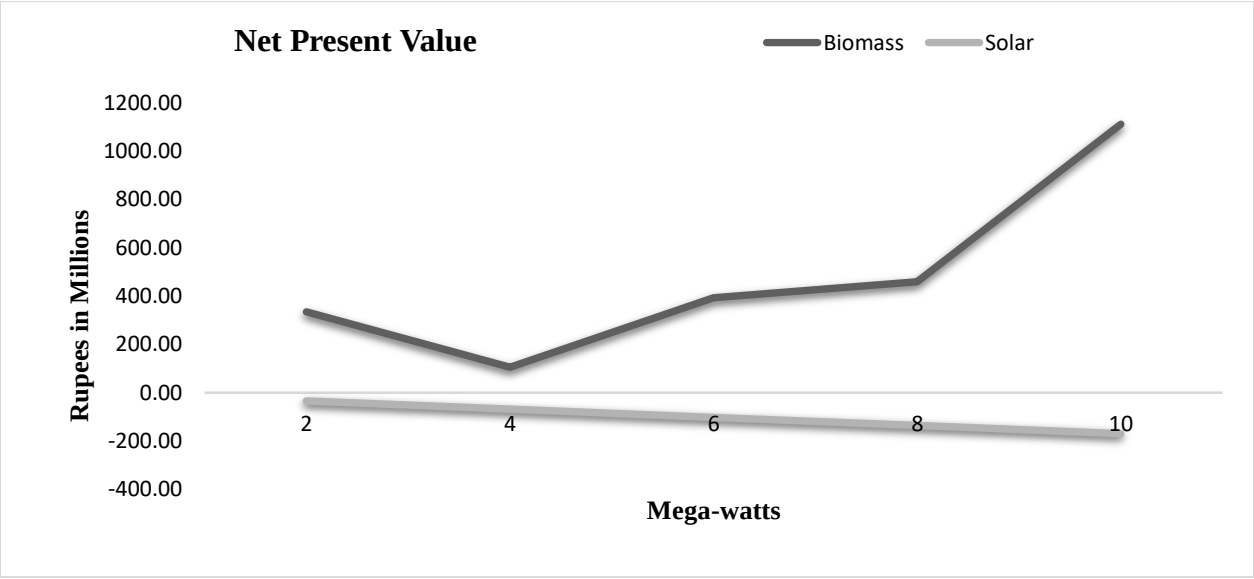
Net Return of Biomass energy plants is lower solar energy plants due to high operational and maintenance cost. Both project net return gradually increases but biomass remain low.

Figure 4.3 Cost-Benefit Analysis in Megawatt by Different Renewable Project



Cost-benefit analysis shows that biomass energy plants have gradually increase benefit up to 6 megawatts but after that biomass energy plants start decreasing after ten megawatts due to low net return and high capital cost whereas solar plants shows the unfavorable result.

Figure 4.4 NPV in Megawatt by Different Renewable Project



NPV shows that there is a gradual increase in biomass plants up to 10 megawatts. For solar plant remain negative and gradually decrease up to 10 megawatts.

4.3. SWOT Analysis

Pakistan is a relatively large market for the renewable energy sector and potential to grow it. SWOT analysis attributes how biomass-based energy project internally and externally play a role to overcome energy deficit problem and how much difficulties to manage these types of projects where possess high security and threat for investment due to multiple factors.

	INTERNAL	**EXTERNAL**
POSITIVE	STRENGTH • Agriculture based economy • Carbon reduction • Security against the price of hike in fossil fuel • Regional advantages and potential benefit • Waste management • Low cost of raw material • Low cost of production • Self-dependency • High-profit margin	OPPORTUNITIES • Jobs creation • Entrepreneurial activities • Additional revenue for the farmer • Integration of supply chain system • Technology and up-gradation in the agriculture sector • Increase in per capita income • Development of self-sufficient renewable energy

	WEAKNESS	THREATS
NEGATIVE	• High risk in the market for these businesses • Lack of infrastructure • Lack of political will • Underdeveloped market • High operational and storage cost	• Market competition • Increase in prices of raw material • Improper management of waste • Innovation • Leakage of toxic from plants • Maintenance and monitoring of plants • Shortage of raw material

4.3.1. Strengths

i. Agriculture-Based Economy

Pakistan is an agriculture-based economy so there is a high potential market due to the availability of raw material. Agriculture contributes 19.5 percent of the gross domestic product and contains 42.3 percent of the job labor market and several raw materials provide for value addition. It thus plays a central role in national development, food security and poverty reduction.

ii. Carbon Reduction

According to global climate index, Pakistan is highly affected by climate change due to carbon emissions. Biomass-based energy reduces carbon emission up to seven times as compared with ordinary fuels.

iii. Security Against the Price Hike in Fossil Fuel

Currently, Pakistan generates 65% of electricity through fossil fuels. Due to high demand prices fluctuates internationally but with biomass, we can easily allocate resources within local territory and effectively manage our reserve for another development sector.

iv. Regional Advantages and Potential Benefits.

Geographically Pakistan is in the hub of South Asia, they have the potential to generate low-cost energy and can import to the south and central Asian countries.

v. Waste Management

Waste management is a big challenge within Pakistan. Roughly more than 76500-tons waste has to generate daily. All big cities, Karachi, Faisalabad, Islamabad, Lahore, and Peshawar, are facing massive challenges in undertaking the problem of urban waste. So, utilization of waste as a raw material can manage the problem.

vi. Low Cost of Material

According to NEPRA, per metric ton cost for biomass is PKR 5000 and 1 ton of biomass can be generated electricity up to 0.70 MWh.

vii. Low Cost of Production

Due to easy availability of raw material, cost of production is low as compared with other alternative use for energy generation.

viii. Self-Dependency

Pakistan can be self-dependent in energy generation by using renewable technologies. There is always scarce fossil resources of fuel and supply can be cut due to the shortage.

ix. High-Profit Margin

Green energy can lead to maximum profits, but only with the right incentives and balance of price, technologies, capital, and operations.

4.3.2. Weakness

i. High Risk

The high risk for renewable technology due to fluctuation in prices and technology up gradation. So, investors always are reluctant for investment without some surety to get the minimum benefit.

ii. Lack of Infrastructure

In Pakistan energy sector has lack of infrastructure improvement due to high operating cost on up-gradation. Renewable technologies are changes with rapid growth, however, a developing country cannot manage this cost with our capital expenses and low-profit margin.

iii. Lack of Political Will

Due to rapid change in government structure, unstable political environment, no government makes any measure to keep mega projects.

iv. Underdeveloped Market

The renewable energy market is still underdeveloped within Pakistan. If we see statistics wind, solar and biomass contain less than 1% of total energy and more interesting is biomass account for 0.06 %.

v. High Operational and Storage Cost

These are costs allied to consumables, electricity consumption, purchase of raw material, disposal of residues, etc. that are directly related to the quantity of fuel used and the amount of power produced. The risk of seasonality can be moderated through the availability of proper storage services on-site. If satisfactory quality can be stored post-harvest while waiting for the biomass is needed for production, seasonality becomes less difficult.

However, the storage of huge quantities of biomass can be costly, and the need for storage facilities can disturb the capability of a biomass project.

4.3.3. Opportunities

i. Jobs Creation

The potential for substantial growth of biomass energy could inspire thousands of jobs and could help revive rural areas of Pakistan while these offering renewable technology which is an environmental benefit as well. Improved opportunities for industrial production, and thereby job generation, due to the stable energy supply.

ii. Entrepreneurial Activities

Potential market opportunities for existing businesses and industrialists are identified in fields of planning, construction and operating new, highly efficient Biomass plants, how maximum output can be utilized by introduction and expansion of Biomass technology, composting in municipal Bio-waste process, professional consulting of farmers and operators and better monitoring of Biomass plants.

iii. Additional Revenue for the Farmer

Raw material come from the agriculture sector make additional revenue for farmers and this will motivate them to utilize their efforts to boost food security and raw material for biomass plants.

iv. Integration of Supply Chain System

Biomass supply represents an agreement between outside biomass providers. Because of a task utilizing waste material delivered from the assembling procedure of the owner industrial plant, such understanding most likely won't be required. This may, nonetheless, be the situation if the in-house creation of biomass deposits is lacking to address the

industrial plant's issue for energy. Biomass supply understandings will be required if the venture is intended for the utilization of external biomass wastes**.**

v. Technology and Up-gradation in the Agriculture Sector

Income generates through biomass can be utilized for improving harvesting techniques and enable farmers to get maximum benefits from scarce resources.

vi. Increase in Per Capita Income

In Pakistan per capita income is very low in rural areas, these projects directly or indirectly impact on lives of peoples within this area and somehow overall impact on per capita income of citizens.

vii. Development of Self-sufficient Renewable Energy

Pakistan has the potential of 58500 MW (517511 GWh) power generation through biomass and current demand for the energy sector is average of 22000 MW. so, utilization of biomass-based projects makes Pakistan self-sufficient in a generation future.

4.3.4. Threats

i. Market Competition

Market competition for a biomass project plays a vital role in the future. Any decrease in oil prices or eco-friendly energy generation makes an impact on biomass ventures**.**

ii. Increase in Prices of Raw Material

In economics, there are universal phenomena that increase demand always boost the price for raw material while these increase in prices impact on operational cost and tariff for these projects.

iii. Improper Management of Waste

Residual after generation through biomass plants and dumping of raw material also impact on ecology and health issues for surrounding if not properly manage for utilization.

iv. Innovation

In an era of innovation if the better technology to be introduced for power generation which can able to generate enough within considerable price and haven't adverse effects on the ecology, also threat for investment in biomass ventures.

v. Leakage of Toxic Gases from Plants

Emission of nitrogen oxides is toxic either to the nitrogen content in the fuel or to the warm nitrogen oxide. The nitrogen content in biomass covers a wide range from 12 percent in hardwood to 2 percent or more in some agrarian waste items, which can incite high nitrogen oxide outflows. These discharges can be managed, where the basic ignition is sub-stoichiometric, whereby the fuel nitrogen is changed over to nitrogen gas.

vi. Maintenance and Monitoring of Plants

Operation and maintenance of a biomass plant are somehow, more unpredictable and requires as much staff than an ordinary oil-or gas-terminated plant, which might be the alternative to a biomass plant. The productive operating existence of a biomass plant could be 20 to 40 years relying upon the fuel, operational profile (number of begins, stops, and operating hours), and maintenance overhauling or restoration of key frameworks and parts may extend up to the operating period.

vii. Shortage of Raw Material

A primary risk when looking to shape up a supply chain for biomass-based green ventures is how to build a biomass supply market, including the essential transport, storage, and management of raw material. A biomass venture will most likely be unable to discover external suppliers who can ensure a predetermined amount, quality, and cost for the biomass waste for a reasonable period.

4.4. Financing Strategies for Biomass Green ventures

As for the domestic project, there is no need for external financing while in case of commercial projects the huge amount of investment is required to initiate, so we discuss different strategies for financing these projects. Each biomass-to-energy project is unique, but commonly, a project developer can choose to finance the project either by corporate financing or venture financing.

4.4.1 Bank Green Financing

Banks play a key role in supporting ventures and renewable projects with various lending activities. Banks indirectly can impact both on the ecology and society through green venture and renewable projects that they are supporting. While green financing schemes allow the Pakistani banks to engage in a scheme of financing which more sustainable concerns for ecology, governance, and society, however, most of the commercial bank not undertaken the responsibility of green financing.

Bank can launch different schemes for green financing toward renewable projects assessing climate change as an asymmetric risk. Commercial banks can provide a loan to with low rate of markup as per SBP regulation.

The incentive for Banks in Green Venture

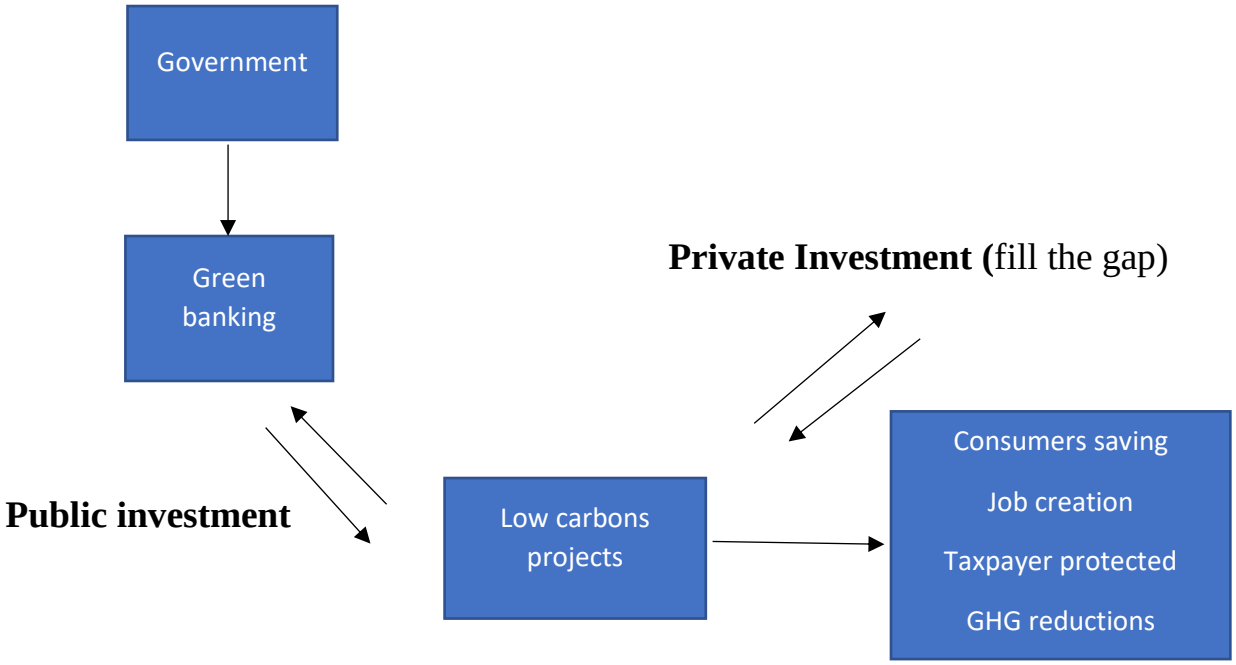
For acting as green banker, it can improve the risk profile of the current portfolio, we can say diversification of future cash flows through green financing. Secondly, the bank can acquire new market and customers which is bloodline for his sustainability. Bank can also contribute as social corporate responsibility, while get tax rebates form regulatory authority. Banks also provide leverage financial activities regards the use of energy as free or additional cash flow as per generated.

A Case Study of Connecticut Green Bank

The CT Green Bank is the first green bank in the USA which is established by the Connecticut General Assembly in 2011. CT bank supports legislative to make effective energy strategies to eco-friendly energy, less expensive and more sustainable energy while creating employment and local economic development. This institution has a separate board of governor and the primary objective is renewable energy plans. This bank uses P3 finance structure to gives a loan to a private investor and rapidly expanding distributed power and efficiency investing. Leverage ratio for these products can achieve $10: $1 (private: public leverage).

After 3 years of operations (2014), CT bank total investment was $ 350 million with a share of $100/$250 (public/private) investment. However, bank installed 65.3 MW renewable project for this period.

How Bank Sustain?



4.4.2. Corporate can Flo at Green Bonds

Green bonds were formed to fund renewable projects that have positive environmental or climate benefits. Most of the green bonds issued by corporate are green "use of proceeds" or asset-secured bonds. Proceeds from these bonds are reserved for green projects but are backed by the issuer's entire balance sheet.

Investor for these renewable projects will get handsome profit as well as social cause to protect this earth. Corporate must be float suitable number of bonds with local as well as international stock markets.

Cost-Benefit Analysis for Investor

Green bonds have some extra transaction cost because issuers must trace, check and report on the use of proceeds. Green bonds come with tax benefits i.e., tax exemption and tax credit, making them a more attractive investment compared to a comparable taxable bond. This provides a monetary benefit to handling prominent social issues such as climate change and an undertaking to renewable sources of energy. These bonds also highlight the green asset/business for investors.

Case Study of China Three Gorges Corporation

In June 2017, China Three Gorges Corporation ("CTGC") approved out an offshore issuance of 650 million-Euro green bonds guaranteed by CTGC. The issuance was evaluated by Ernst & Young, CTGC's independent auditors, confirming the orientation of the bonds with the key structures of the June 2016 GBP. To support the issuance, Ernst & Young issued an independent limited assurance statement regarding the bonds issued and the green bond guidelines recognized by CTGC concerning the use of proceeds. Under the CTGC's green bond rules, all the bond takings would be used to fund suitable for green projects in the category of renewable energy, which includes solar energy, wind energy, and biomass energy, the production, and transmission of

renewable energy and the manufacturing of renewable energy appliances and products. On regular basis, CTGC undertook to ensure that eligible green projects are appropriately screened and to carry out quarterly reviews of the projects approved. For so long as any of the relevant green bonds are outstanding, CTGC will disclose information on the use of the proceeds and the environmental performance of the eligible green projects on an annual basis on its official website, and through other channels where feasible, such as its annual reports or social responsibility reports. CTGC also expressed an intention to implement periodic reviews by a third-party verification body of the relevant green bond-related information.

4.4.3. Shares Through IPO

An initial public offering (IPO) is the process through which a privately held company issues shares of stock to the public for the first time. Also known as "going public," an IPO transforms a small business from a privately owned and operated entity into one that is owned by public stockholders. An IPO is a significant stage in the growth of many small businesses, as it provides them with access to the public capital market and increases their credibility and exposure. Becoming a public entity involves significant changes for a small business, though, including a loss of flexibility and control for management.

Cost-Benefit Analysis

IPO is an extremely costly and time-consuming process. However, The SECP registration process is quite complex and requires the company to disclose a variety of information to potential investors. It can also cost a company in underwriting fees, legal and accounting expenses, and printing costs. However, **t**he primary advantage a small business stands to gain through an initial public offering is access to capital. Moreover, IPOs hold for small businesses is increased public awareness, which may lead to new opportunities and new customers.

A Case Study of Indian Renewable Company

Reestablish Power, India's biggest renewable power source maker, is hoping to raise Rs2,600 crore ($390 million) through its first Initial public offer. The move comes within a few months after ReNew fixed India's greatest renewable power source bargain when it gained New Delhi-based Ostro Energy for around $1.5 billion.

The IPO will involve an issue of share worth Rs. 2,600 crores, while existing investors, including the Global Environment Fund, Green Rock Energy and GS Wyvern Holdings, a speculation arm of Goldman Sachs, will offer a portion of their value.

ReNew as of now has an introduced limit of more than 5,800 megawatts (MW) through the wind and sunlight-based power plants. The seven-year-old organization is sponsored by Goldman's Sachs, Abu Dhabi Investment Authority, Canada Pension Plan Investment Board, among different financial specialists, and is esteemed at around $2 billion.

While New Delhi-based sunlight-based power maker Azure Power opened to the world in 2016 and recorded on the New York Stock Exchange and become the first green renewable company in Indian markets.

4.4.4. Mutual Fund Investment

A mutual fund is a financial tool which collects money at one place from the different small investor. These funds are mostly open-ended funds which create and sell new shares to encourage new investor. An asset management company can invest on behalf of a shareholder in a different invest for profits and income.

Cost-Benefit Analysis

Mutual funds are a long-term investment option that protects the purchasing power of your money over the years. Additionally, they yield a higher return than bank deposits in the short term and

beat other assets of the same class when it comes to returns in the longer term. Secondly, you can get started with your first investment with as little as Rs. 500. It is advised that you first do your research on where to invest, calculate how much and for how long do you need to save to achieve your future goals, and then just start saving. Mutual funds offer multiple options based on risk/return tradeoff, conventional or Shariah compliant, small or big contributions and growth/income units. Since you buy a pool of securities, your risk automatically reduces. Assets will normally have a scope of various expenses. In mutual funds, the expenses are characterized into two classifications: investor fee and annual fund working expenses.

A Case Study of Indian Institutional Investment

Canara Robeco Mutual Fund will dispatch inside a year for connected to Switzerland based 'Sustainable Asset Management (SAM)' reserves stated, five Business Line dated 15 Dec 2009.

- **a** IDFC Private Equity had put Rs35 crore in Ahmedabad-based Doshion, a water administration firm, in the second 50% of 2007.
- **b** Tribe Embedded Technologies gets Rs. 10 CR VC Funding from Sequoia Capital (outlines gadgets for engine control and mechanical computerization – presents to 25% decrease in energy utilization).
- **c** Nexus India Capital contributes Rs. 12 Crores in Suminter India Organics (exporters of naturally developed agro deliver).
- **d** Rs. 4.5 Crores in Natura Fibretech (coir (coconut-fiber) is contributed by Canara bank to composites and other imaginative materials that fill in as an option for timber in the development division).
- **e** ICICI Bank puts INR.49.9 Million in HMX Sumaya (earth well disposed
  Air conditioning arrangements).

- **f** The launch of balanced assets like New Pursuits India.

Green venture alternative relies on what you are taking a glance at returns, how the manager of the Green Mutual funds manages the cash of the financial specialists. According to information accessible at different websites sources, Socially Responsible Investment Funds are 65 in numbers, which "assert" to be Socially. Out of these only 6 considers as Green Mutual Funds.

4.4.5. Crowdfunding

Crowdfunding is the practice of funding a project or venture by raising small amounts of money from many people, typically via the Internet networking which is very common in western countries. Crowdfunding is a form of public sourcing and alternative finance to social or society base project. Crowdfunding has been used to fund for-profit, green entrepreneurial ventures such as renewable energy projects, medical expenses, travel, or community-oriented social entrepreneurship projects.

More than $2 billion has put into entrepreneurial and imaginative thoughts through the intensity of crowdfunding since it began to rise in 2008. Since 2012, the buzz around has been overpowering, with every next month crowdfunding quickly picking up on customary financing like "bank credits." With all that sound and each one of that investment, an increasing number of little ventures are in perspective of getting in on what appears like a chance.

Cost-Benefit Analysis

Market validation is one of most effective reason to try crowdfunding over traditional fund seeking methods. Secondly, customer feedback is important to put it on the path for profit, they have multiple stakes in these projects. Most critical isn't overlook the genuine cash. What's great and terrible about the assets is that they are ordinarily traded for a reward, not value. Great since

you don't surrender any piece of your long-haul potential additions. However, these types of investment need trust and reward for trust simultaneously.

A Case Study of Abundance Generation (Lending-Based Model, UK)

Abundance Generation is crowdfunding that interfaces individuals with renewable power source ventures. Despite having been introduced in 2009, it started its activities in 2012. It had what's coming to it's of weaknesses and difficulties to survive however as the primary crowdfunding stage to be certified by the UK Financial Conduct Authority (FCA). Abundance Generation gives financial specialists a chance to put their cash in an extensive variety of elective energy extends inside the UK. Any can register which meeting the accompanying criteria: 18 years old and more age, a citizen of the UK or the EEA (European Economic Area), or in Switzerland. It was the primary managed to crowdfund in the UK and creatively utilizes regular monetary instruments by means of a web service that is agreeable with the Financial Conduct Authority. This offers interests on Debentures. According to FCA rules, this technique must make consumers aware of the considerable number of dangers. They include all information state on their debenture and give them all the applicable information to the investor, where finance is using to make the venture. An investor can invest by £5 in an undertaking. Abundance Generation offers a normal of 5-9% return on their venture with debentures that keep going for 20-25 years. The crowdfunding has been effective in raising around £39,495,021 by effectively financing 24 ventures.

4.4.6. Carbon Taxation

A carbon tax is explicit carbon prices directly associated with emissions of carbon dioxide, however, the maximum level of carbon reduction is impossible, a carbon tax is considered as a cost-effective financial tool.

Carbon taxes can be presented as a sovereign instrument or they can exist together with other carbon rating tool, such as an energy tax. Whereas the knowledge with the reliable implementation of a carbon tax is comparatively new, such tools are being familiarized at a fast step. These taxes can be used to finance green venture to leverage the emission and reduction.

Cost-Benefit Analysis

Through carbon taxes will increase prices on products directly or indirectly link with carbon dioxide, while the benefit for these taxes is a reduction in the use of carbon products and revenue generated can reinvest into the different green venture.

Case Study of Sweden

Sweden began its Carbon tax collection in 1991, alongside a Sulfur impose and a Nitrogen oxide charge (Ekins & Speck, 1999). The underlying charging rate was 250 Swedish Krona (SEK) or US$30 per huge amounts of CO2 transmitted, which was demanded on every single petroleum product (transport, warming, and power age), which expanded to 930 SEK (US$150) in 2007. The focal point of this charging plan is to meet the "twofold profit": natural tax assessment and open fund (Brännlund & Nordström, 2004). As per (Ekins & Speck, 1999), a few enterprises were mostly absolved from the carbon charging administration. For instance, assembling and agriculture enterprises just expected to pay 25 percent of the general carbon charging rate. OECD (2004) additionally refreshed that 65 percent of discounts are given for energy sources utilized as non-fuel contributions to gathering businesses.

SEPA (2012) found that, somewhere in the range of 1990 and 2010, CO2 discharges from traveler autos were additionally decreased, and additionally clarified that ecological strategies, for example, the charges on carbon and petroleum derivatives, impose exception for transport

inexhaustible powers and assessment help for green autos, together with rising oil and diesel costs, have empowered the changing to more eco-friendly autos. The carbon releases from substantial vehicles and light traffic vehicles decrease, predominantly because of use cargo practices.

4.5. Key Points of Findings

This study shows main objectives are to explore biomass-based green venture and to unveil financing strategies for these ventures. This research has been divided into three parts. In the first part we overviewed economic feasibility for these ventures along with potential resources available for these projects, in the second part we did a SWOT analysis for our ventures and in the third part, we discuss how renewable energy project could be successfully financed for sustainable development. Pakistan has the huge ability of different types of biomass resources. Utilization of these resources is not perfect with other edible and agriculture items. Most of the biomass materials are considered as waste and otherwise must dump or dispose of.

The utilization of biomass materials is found feasible. Because Pakistan is an agricultural country having residual as useless waste. Power generation through these will have more return and positive NPV as compared to the solar project with the same capacity.

Short rotational energy crop can be cultivated on wetland, a bank of lakes and running stream. They are not only fuel but also control soil disintegration and support river banks. Thus, non-woody bushes can be developed on empty patches. Many of these grasses are developed for double purposes, first, use as fodder and later utilized as biomass for energy conversion.

For the most part, these grasses are developed in tropic regions need few sources of cultivation and can be collected for the next 10 years. These grasses are recognized as sun ray's absorbers and grow with five times more energy than ordinary tress. The agriculture waste which is being wasted by burning in the agriculture fields is neither good for the environment nor for the land itself and can be converted in to as an energy source. The plantation, management and technological innovation of these resources are additionally analyzed and feasible for Pakistan.

Municipal solid waste management is one of the big challenges for developing economies, yet it is better to manage power generation by using ORC plants. Animal's waste is likewise the greatest resource of biogas and can produce 21.25 million cubic meters of biogas per year. Total potential of biomass energy available in Pakistan is 517511 GWh / annum (approx. 58800 MW) which contain agricultural residues of 394908 GWh, livestock 92760 GWh and 29843 GWh of municipal waste.

We analyzed economic feasibility for a different biomass-based project for domestic and public consumers. In domestic projects, we have portable and fixed plants for biogas production for urban and rural areas. These projects have an only nominal capital cost and can be used for 15 years and cost-benefit analysis show the project can get much more against initial investment. On the other hand, one can grow the green crops in own land with low cost. In addition, the project can produce energy without affecting the environment.

In further we analyzed renewable power project with different capacity. With comparison we found energy through biomass can cost 0.12 billion (PKR) per megawatt and solar would be 0.18 billion (PKR) per megawatt. Generation through biomass depends on raw fuel per ton and solar capacity remain constant up to 8-12 hours per day. Tariff rate for biomass energy is comparatively low than solar (NEPRA). High NPV and IRR showed above for biomass-based ORC energy plants have the potential feasibility to be carried on for investment and favorable outcomes.

A SWOT analysis for these projects gets deep insight view to systematize the knowledge, notice new possibilities or threats, sensitize to certain issues. The literature on the subject includes numerous examples of SWOT analysis application for the needs of the energy market. This is a

good opportunity to recognize the market/environment, verify the project assumptions and test the trends.

From different case studies across the countries in the renewable energy sector. This also helps to design financing schemes for these green ventures within Pakistan. There are some new concepts which are flourished in the market such as Green banking, Green bonds, and crowdfunding to pool little investment into megaprojects.

Chapter 5

Conclusion and Recommendation

5.1. Conclusions

From the last decade, Pakistan is facing an acute shortage of energy, which is ultimately causing Psychological as well as financial pressure on the economy. Moreover, Pakistan's major portion of energy production is through fossil fuel which is not only causing financial burden but also causing environmental concerns. Biomass is directly connected with the farming and can likewise build the financial Sustainability. The decrease in imports of petroleum products will prompt a reduction in import bills and indirectly impact everyone in the ecosystems considering the health and wealth too.

This feasibility of study shows that these waste materials are easily available to generate renewable energy. The technology innovation required to make these resources is directly connected with ecology and can be effortlessly taught to the farmers and different villagers for livestock and for the importance of these resources. For this instance, the development of digesters is simple and requires upfront work. The raw material is locally accessible. This will lead to generating new opportunities for employment and will reduce the burden of imports and unemployment.

The efficient use of biomass sources will enhance the earth condition by reducing the GHG emission. Renewable energy can also be generated through biomass residual which has a negative impact on the environment and health of living beings. Energy installment and per unit cost is lower than solar or wind energy, so the best option for an entrepreneur is to invest in these projects. There is an important economic impact to create different jobs for unemployed persons. The unemployed labor force is 4 million and in Pakistan National Mega Projects and other energy-related projects such as CPEC is expected to generate approximately 2 million jobs for skilled

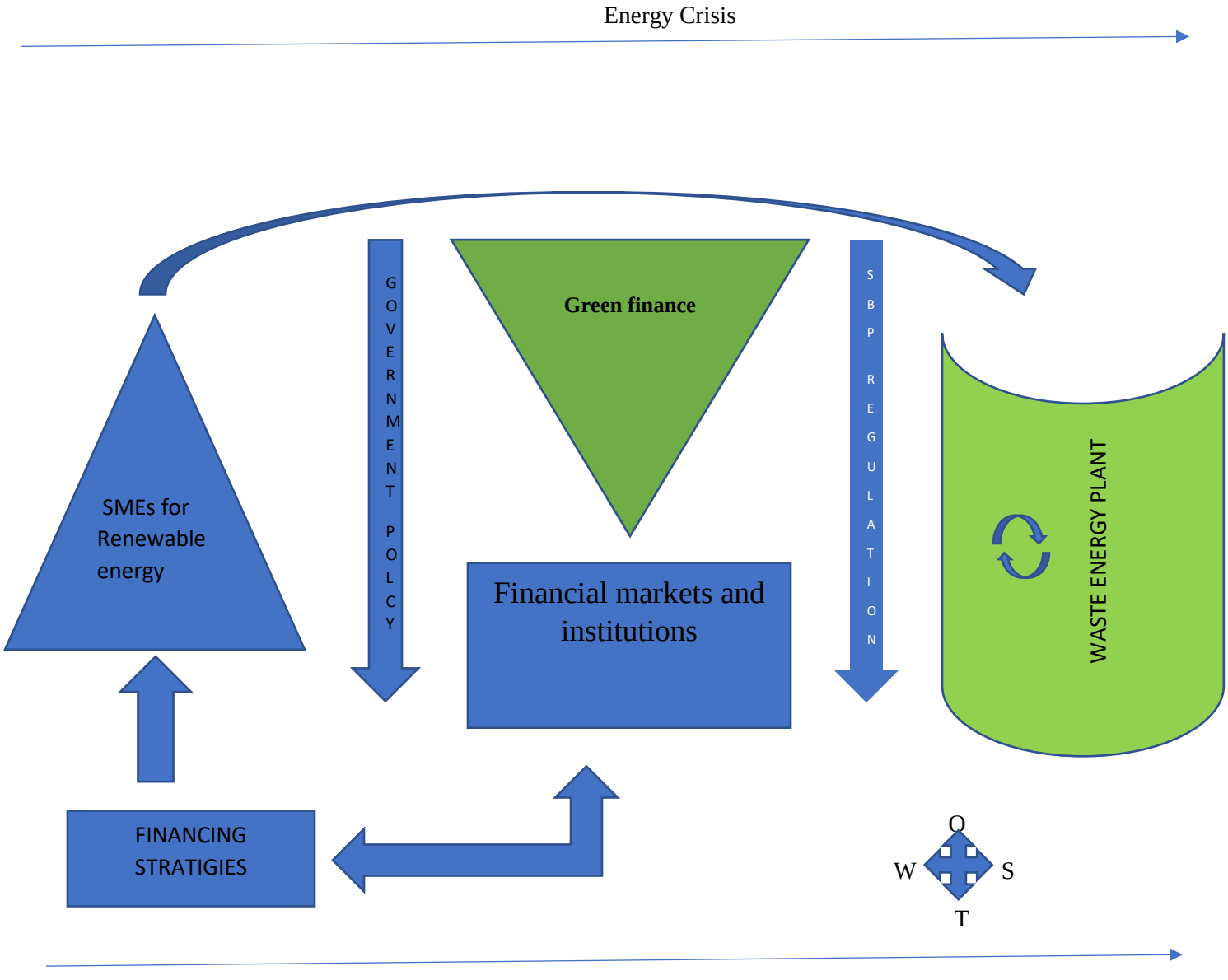
manpower. So, need to introduce innovative green energy project to accommodate labor force with cheap and clean energy. This will also boost the economy towards sustainability and development.

5.2. Recommendations

- There should be government policy to develop the renewable energy sector via private or public-private coordination. We can properly manage our biomass resources to get a total capacity of 58800 MW energy per year whereas would be an alternative for fossil fuel contain 65% total energy generation. SMEs sector should encourage and facilitate by the regulatory body to develop biomass-based plant which would be alternative or hybrid with other renewable projects to maintain tariffs.
- If Pakistan is able to utilize 1/3 of biomass resources in short run, then approx. 19600 MW of electricity can be generated through biomass power projects. Moreover, these green ventures will reduce 39% of unemployment directly or indirectly in Pakistan. This initiative will boost the overall economy.
- There should be a grant for these green ventures. Authorities should take initiative to protect climate change by empowering this segment. Assessment of case studies or pilot projects to enter for advancement in green ventures. Commercial bank ought to be guidelines for allowing delicate loans and in addition, the green bond market should be introducing get prospect investors.
- It is clear through literature that neighboring countries are in comparatively better position than Pakistan. There ought to be more exploration and advancements on the restraining strategy and innovation of these resources. The expert's opinions are to lead all insight of biomass not just to focus on livestock. A complete arrangement is expected to use all these resources to the management of waste, which is eco beneficial.

Here we studied the overview of biomass resources in Pakistan and biomass-based green venture to produce energy. It could be in more detail and insight but due to the limitation of data through secondary resources, the above biomass resources could be done and analyzed for energy conversion. Furthermore, we forecasted and used constant cost variable for 30 years, it would change with the economic position of the country.

Figure 5.1 Theme of SME's For Renewable Energy Model



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