Solar energy based entrepreneurship and rural development: Analysing institutional arrangements that support solar energy entrepreneurs in India

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I hereby declare that this thesis has not been and will not be, submitted in whole or in part to another University for the award of any other degree

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"tasmad asaktah satatam
karyam karma samacara
asakto hy acaran karma
*param apnoti purusah" (**Bhagavad Gita**)*

TRANSLATION: Therefore, without being attached to the fruits of activities, one should act as a matter of duty; for by working without attachment, one attains the Supreme.

Abstract

Renewable energy (RE hereafter) has been observed as a potentially significant new source of jobs and rural growth in both OECD and BRICs countries, and a means of addressing environmental and energy security concerns. The global deployment of RE has been expanding rapidly. For instance, the RE electricity sector grew by 26% between 2005 and 2010 globally and currently provides about 20% of the world's total power (including hydro-power) (OECD, 2012). Rural areas attract a large part of investment related to renewable energy deployment, rending to be sparsely populated but with abundant sources of RE. Several case studies have found that RE deployment can provide hosting communities with some benefits including new revenue sources, new job and business opportunities, innovation in products/practices/policies in rural areas, capacity building and community empowerment, and affordable energy. There is a growing body of evidence on the instrumental role that entrepreneurs and small businesses play in driving local and national economies. The structure of rural economies is essentially composed of small enterprises, which are responsible for most of the job growth and the innovation. Rural development is a key element of strategies to reduce poverty and create income and employment opportunities (UNIDO, 2003). It is important to unleash and harness the creativity of grassroots entrepreneurs but they are posed with many challenges, the biggest being these grassroots inventions don't scale up. To overcome these challenges and promote rural entrepreneurship, support roles are required; this is also where the importance and role of institutions and their planned arrangements (for example, partnerships) are much debated in both domestic and international forums.

This research investigates the current institutional arrangements that support solar entrepreneurship which creates solar energy based income-generating micro enterprises in rural India. In addition to that, it explores the wider implications on rural development that these entrepreneurships have while using these solar RETs. Institutions and individuals promoting rural development see entrepreneurship as a strategic development intervention that could accelerate the rural development process (Ezeibe, 2013). India, being the only country with a national ministry dedicated to RE initiatives (the MNRE, Government of India) and also ranking third on the renewable energy country attractiveness index (E&Y, 2013; 2016) makes an interesting country choice for investigation. The thesis applies a qualitative research method with an exploratory design to understand the interaction process between institutions and how different institutions support rural development to generate an in-depth analysis of existing institutions using a conceptual framework.

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Chapter 1 – Introduction

1. Background

India's energy consumption has doubled since the year 2000 and is expected to more than double by 2040, which will account for one-fourth of global increase in that same period (MNRE, 2014). With a production capacity of 1,174 TWh (FY14), India is the fourth largest producer and fourth largest consumer of electricity in the world (IBEF 2016) (see Figure 9.3. in appendix). Although India is the third largest market in terms of gross electricity generation yet it still has almost 250 million people without access to power (Galan, 2015). With a growing middle class and a population of 1.3 billion people India is expected to have some of the fastest growing energy needs that are certain to have a dramatic impact on the global economy and its energy market (Hubacek, 2007). The focus is on promotion of hydro, renewable energy and gas-based products, as well as adoption of clean coal technology. Renewable energy (RE hereafter) is fast emerging as a major source of power, with increases to 41 GW planned by 2017 to meet the growing energy demand (Cornot-Gandolphe, 2016).

The current energy scenario in India is encountering both challenges and opportunities. Coal production remains key to the energy mix. India produced 557 million tonnes (metric tons) of coal in 2012-13, and India's rapidly growing power industry consumed the majority of it - production goals are aiming for an increase to 795 million tonnes by 2016-2017 (Kimura et al, 2014). At the same time satisfying natural gas needs has become one of India's most urgent challenges as a decline in production means that the country is having to rely on imports to meet the the growing demand (Mondial, 2013).

Energy poverty and major inequalities of access plague the subcontinent. According to one

census, 77 million households in India still use kerosene for lighting (Lam et al, 2012). A person is in *energy poverty* if he/she does not have a) the equivalent of 35 kg LPG per capita year year (PCPY) from liquid and /or gas fuels or from improved supply of solid fuel sources and improved (efficient and clean) cooking stoves, and b) 120kWh electricity PCPY for lighting, access to the most basic services (drinking water, communication, improved health services, education improved services and others) plus some added value to local production (Palaniappan et al, 2010). The problem is even more acute in rural India where up to 44 percent of households lack access to electricity (Athreya et al, 2010). In the case of rural villages, access issues and geographical hindrances make addressing the issue extremely costly and difficult. This does hamper rural development because energy is a basic need for both household and agricultural needs and consequently affects job creation and income in rural areas – both small and large scale rural development schemes in India address energy security as a priority for improving the quality of rural life.

In light of the above challenges in relation to India being extremely coal dependent in the power sector and the lack of energy availability in rural areas, studies point to developing solar and nuclear capabilities as essential. If India is to reach the target of 40% renewables by 2040, $120-130 billion dollars will be required for the implementation of its renewable energy target of 175 GW by 2022 (TATA Power Solar, 2014). In light of the above challenges, there is a move towards alternative sources of energy. In addition to the Ministry of Power, the Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of Government of India (GOI) for all matters relating to new and RE. The objective of this Ministry is to develop and deploy new and RE for supplementing the energy requirements of the country. It is useful to point out where the demand for energy comes from and what causes the same before exploring the need to move towards non-conventional sources of energy.

Rising energy needs in rural India

There are many other uses of energy in rural areas besides the need for household and agricultural purposes. About 75% of Energy in Rural India required only for Cooking and Lighting, is largely met by locally available bio mass and kerosene, supplemented by electricity from the grid. 75% use biomass (firewood), 10% use dung -cake and only 5% use LPG for cooking. 50% use kerosene and 48% grid electricity for lighting (World Bank, 2015). Agriculture

is the second largest rural energy demand, electricity and Diesel are the main sources. Human and Animal Energy are the major sources for domestic and agricultural requirements. Use of kerosene, inefficient use of biomass and lack of ventilation creates negative health impact (Khamati-Njenga and Clancy, 2005). Table 1.1. states the sources of energy for different household/commercial purposes in rural India.

Need	**Use and sources**
Domestic	1. Cooking - Biomass, kerosene, LPG, Kerosene, LPG, grid electricity 2. Lighting (including street lighting) - Kerosene, Grid electricity, solar 3. Other uses - Grid electricity, renewables (solar, biomass, etc.)
Agricultural	Grid electricity, renewables, animal/human energy
Industrial or commercial (including institutions and Government)	Grid electricity, captive generation (diesel/kerosene/petrol), Renewable
Transport	Diesel/Petrol, Grid electricity, Coal (very limited in railways)

Table 1.1: Need for energy in rural areas and sources

Causes of rising energy demand trend

According to BP (2014), India is expected to replace the US as the second largest coal consumer in 2024 (after China). China and India would account for 63% and 29% respectively, of global coal demand growth up to 2030 (BP, 2015). The Centre for Rural Information and Insights (Kearney, 2010) identifies several areas of concern that could be considered as primary factors behind this rising energy demand trend over recent years, as seen in Table 1.2.

Causes	**Nature**
Everyday necessities in rural India	Energy demand is not just there for cooking purposes; but also an increasing percentage of households rely on it for pumping drinking and irrigation water, lighting and heating homes, and powering electronics.
Agricultural subsidies and initiatives encourage increased energy consumption	At 22 per cent of total energy consumption, agriculture is the third-largest consumer of power in India. Subsidies have contributed to increased consumption
Government regulations can lead to inefficient providers	Independent providers**,** such as Rural Electric Cooperatives, now face strict regulations from the government and must contend with increasing prices or decreasing quality.
Inadequate infrastructure cannot support increased demand	Even when power is available, it isn't always getting to houses and businesses in rural India. Energy audits have shown that a great deal of energy is lost in transmission due to sub-standard power equipment, such as transmission lines. This triggered the necessity for building hydro dams and wind turbines in areas in Meghalaya and Tripura.

Table 1.2: Nature and cause of energy need (Ranjit, 2011)

Issues with expanding the coal based power infrastructure in India

Over the past 5 years, challenges associated with the availability of coal have led to a reduction in output and the plant load factor (PLF) of coal-fired power plants in India from 79% in 2007-08 to 69% in 2012-13 (NTPC, 2012). There are numerous challenges associated with perpetuating the status quo continuing with the same which can be divided into four main categories:

- Firstly, the availability and nature of coal is a challenge in itself: Indian coal has a 30% lower calorific value than imported coal (Sloss, 2015);
- Secondly, the growing environmental concern related to land degradation, waste disposal, dumping of fly ash, destruction of soil due to accumulation of trace metals and water pollution. As per the study carried out by New York Academy of Science, the externalities associated with coal power cost as much as Rs. 11.16/kWh ($0.18/kWh);
- Thirdly, the trade balance is a growing concern - energy imports in 2013, constitute 7% of GDP, which is almost twice that of Germany (3.3%) and Japan (4%). A 21% increase in imports of coal between 2012 and 2013 (TATA power solar, 2014);
- Fourthly , there are several challenges with/arising from the inadequate infrastructure - coal production increased by 4% annually between 2006-07 and 2011-12 compared to the 7% increase in demand. Meeting a domestic demand of 500 million tones per year would cost Coal India INR 360 billion (US$ 6 billion), which would also call for new railway corridors to transport coal from the eastern states of Odisha, Jharkhand and Chattisgarh to demand centers, which would have to be built (TATA power solar, 2014).

The eventual move towards alternative energy is visible in both installed capacity installations as well as investments made in the sector. Solar power has an installed capacity of 3.74 GW with the potential of 7.48 GW (IRENA, 2016). The Solar Policy of Rajasthan notified in 2011 envisages the setting up of solar manufacturing facilities at proposed solar parks. The Gujarat Solar Park also makes special provisions for encouraging on-site manufacturing facilities to provide equipment to projects coming up within the park as well as adequate repairs, maintenance and skilled manpower to service projects within the park. In terms of Foreign Direct Investment (FDI), up to 100% is permitted under the automatic route for renewable energy generation and distribution projects subject to provisions of The Electricity Act, 2003

(NTPC, 2014).

As per the UNFCCC (2007), India needs to add 545GW of additional power capacity in the next twenty five years. A recent report by Mahindra's Centre for Rural Information and insights (2013) identified India's energy challenges, regions in India where RETs are successfully creating opportunities for future growth in sustainable energy development. They report that India is currently facing an energy shortfall of 10.3 percent – 15.4 percent during times of peak demand. And as the economy and population grow, India's energy needs will only get steeper. However, the growth in production and installed capacity of RETs are promising - from barely 20 MW in 2011, India's installed solar capacity has increased to 3.74 GW as on 31st March 2015 (Martin, 2015) .

Renewable energy potential in India: actors and institutional structure

Renewables contribute about 12.3% of the total installed capacity in India (Krithika, 2014). Around 97% of the installed capacity is grid-connected and off-grid power constitutes a small share (MNRE, 2013). Globally, India ranks sixth in terms of renewable electric power global capacity (REN21, 2013). The historical growth of renewables has been tremendous with a compounded annual growth rate of 22% over the last decade (2002–2012). The rate of growth has been particularly significant for solar energy over the last three years (2009–2012), which grew from less than 10 MW to more than 0.7 GW MW in 2005–2006 to about 30 GW in 2013 (MNRE, 2013).

There are multiple institutions involved in the renewable energy sector in India. At the central level, the Ministry of New and Renewable Energy (MNRE) is the nodal ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country. MNRE also conducts resource assessments for renewable energy and supports R&D in renewable energy technologies. There are specialized technical institutions set up under MNRE such as the Solar Energy Centre, C-WET, and Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE), which serve as technical focal

institutes for solar, wind, and bio-energy, respectively. At the state level, there are nodal agencies and departments that operate under the purview of the respective state governments for the effective implementation of all renewable energy and cogeneration schemes. These agencies promote renewable energy deployment at the local level by channelling central-level subsidies, implementing demonstration projects, and providing assistance to interested parties. In addition, there are a number of private sector players who are suppliers of RE technologies designed for rural households and agricultural uses alongside supporting rural entrepreneurs to set up micro businesses using such technologies.

	Centre	**State**	**Private**
Policy	MNRE/ IREDA	State energy departments (e.g., GEDA, KREDL)	
Regulation	CERC	SERC	
Solar manufacturing	BHEL, BEL		TATA Power Solar, Others
Wind manufacturing	BHEL		Suzlon, others
R&D	MNRE R&D institute (SEC, C-WET, etc.) R&D centres under central Universities, Department of Science and Technology (DST)	Research institute under the state PSUs and state Universities.	University research institute, private company R&D centres, etc. The Energy Research Institute (TERI)

Table 1.3: Key players in the renewable sector (MNRE, 2015)

Table 1.3 shows the different institutions at various levels who are engaged in the renewables sector in India. The MNRE has been facilitating the implementation of broad spectrum programmes including harnessing renewable power, renewable energy to rural areas for lighting, cooking and motive power, use of renewable energy in urban, industrial and commercial applications and development of alternate fuels and applications. In addition, it supports research design and development of new and renewable energy technologies, products and services providing it in rural areas where individuals are using these new technologies to make a living from creating energy based micro enterprises.

The government has actively promoted the adoption of renewable energy resources by offering various incentives, such as generation-based incentives (GBIs), capital and interest subsidies, viability gap funding, concessional finance, fiscal incentives etc. The National Solar Mission aims to promote the development and use of solar energy for power generation and other uses, the objective of the Mission was to reduce the cost of solar power generation in the country through long-term policy, large-scale deployment goals, aggressive R&D and the domestic production of critical raw materials, components and products. Renewable energy has become increasingly cost-competitive compared to fossil fuel-based generation. The establishment of a dedicated financial institution – the Indian Renewable Energy Development Agency (IREDA), makes for renewed impetus on the promotion, development and extension of financial assistance for renewable energy and energy efficiency/conservation projects.

In April 2002, renewable energy based power generation installed capacity was 3475 MW, which was 2% of the total installed capacity in the country. By the end of 2010, it had reached 18,655 MW, which is about 11% of the total installed capacity of 1, 68, 945 MW and corresponds to a contribution of about 4.13% in the electricity mix (MNRE, 2011). Over the last few decades, many governmental and private-sector agencies have put significant effort into developing alternative solutions using RETs in India, such as solar, wind, hydro (water), waste, and bio-mass. Several Indian states are even paving the way for India's future by promoting the generation of renewable energy – Gujarat is pioneering solar energy, Tamil Nadu is exploiting

wind, Himachal Pradesh is building small hydro, and Punjab and Haryana are leading in biomass.

To summarise, renewable energy is an essential part of India's energy mix, and is essential to enhance energy security and provide universal energy access to the population, as well as contributing to rural development. Supported by strong governmental initiatives, renewable energy, mainly wind and solar, will grow considerably in the near future. A considerable proportion of the Indian population (44% of rural areas) lacks access to clean and modern energy, implying that a significant increase of/in the energy demand is still on the way. With vast potentials, renewable energy is no longer seen as an alternate energy source to conventional energy, but as a critical element in pursuit of key policy objectives (MNRE, 2011a). It enhances India's energy security by diversifying its energy mix and reducing import dependence on fossil fuels. Solar power, especially, is seen as having the potential for India possibly to attain *energy* independence in the long run (PC, 2006) with a strong focus on rural areas. In providing energy access to India's people, renewable energy is expected to supplement conventional power generation and meet basic energy needs, especially in the rural and remote areas (PC, 2007). Private investment has also been the key driver behind the growth of renewables in India.

A transformational shift towards solar

In contrast to all other energy sources, the raw potential of solar in India is virtually limitless. If we were to envision a scenario wherein half the district of Barmer in the Indian state of Rajasthan (0.5% of India's land area) is covered with solar panels, installed capacity of the area will reach 1,000 GW. The total resultant electricity generation will be around 1,500 TWh per year, which interestingly is more than the total electricity requirement of India ("Solar unlimited in India: 1,000 GW on 0.5% of the land", http://bit.ly/1qlXzki). Solar plants can be built very quickly and in very different sizes. Moreover, they contribute to India's energy security and lead to lower levels of local pollution and carbon emissions. Solar would be a

strategic energy option for India, as is evident from the facts and figures presented in Table 9.2 (please see Appendix)

Type of solar technology	*Type of usage*
Solar lantern	Street vendors using after dark and thereby adding 2-3 extra business hours in the evening
Solar home lighting system	Used both for household and home based business purposes, inclusion of multiple household members for activity generation
Solar air dryers/ headbands	Used for hygeinic ways of agriculture crops/ fruit drying purposes before selling them, also by flower/ tea pickers in very early morning (dark) hours, midwives using for child delivery

Some quick statistics:

India's Annual Solar installations to grow over four times by 2017. 10.86 GW of utility-scale solar and grid connected rooftop solar capacity will be added by 2016-17 (Pritwani, 2016)

The Government of India's target would take the total renewable capacity to almost 175 GW by the end of 2022. This includes 60 GW from wind power, 100 GW from solar power, 10 GW from biomass power and 5 GW from small hydropower. (NITI, 2015)

Prices for solar modules have declined by almost 80% since 2008 and wind turbine prices have declined by more than 25% during the same period. (IRENA, 2014)

The MNRE is already assessing the possibility of setting a much higher target of 100 GW for solar by 2027 as envisioned by the Prime Minister's Office (PMO). (MNRE, 2015)

1.1. Research context

In 2011, the *global public and private investment* in renewable energy amounted to USD 211 billion (UNEP, 2011). In the United States, the share of investment going to renewable energy in rural

areas is around 55%; even in a country as densely populated as Germany, rural regions are attracting more than 20% of the renewable energy investment (OECD, 2012) and it amounts to approximately 30% in India. Besides urban use of REs for electricity, climate change and economic development, rural areas have attracted a large part of investment related to renewable energy deployment, tending to be sparsely populated but with abundant sources of RE in some rural regions.

Following the attention being more towards alternative energy sources, most of the renewable energy projects implemented in the rural areas of less industrialised countries have concentrated on residential applications such as illumination and media access (i.e. radio and television), and also, albeit to a lesser extent, on community needs (e.g., electricity provision for health clinics and schools). A limited but growing number of rural projects are currently being implemented to use renewable energy for productive uses. The term 'productive use' refers broadly to projects that aim at enhancing income generation opportunities and productivity in rural areas (e.g., small industry, commercial activities, education and health facilities, clean water and so on), to improve the quality of life and increase local resilience and self-reliance (Etcheverry, 2003). These new initiatives are based on the notion that renewable energy projects need to evolve from their 'traditional' focus on residential needs (such as lighting for example) towards a much broader local community development approach.

Several case studies have found that RE deployment can provide hosting communities with some benefits (UNDP, 2004). These include new revenue sources, new job and business opportunities (especially when a large number of actors is involved where the RE activity is embedded in the local economy), innovation in products/practices in rural areas, capacity building and community empowerment, and affordable energy. This research stresses the importance of institutions in supporting RE initiatives in rural areas, through various interventions. This could range from upgrading the skills and competencies of the local population, improving the balance between labour market supply and demand, by widening access to higher education (OECD, 2007) as well as creating a supportive environment for promoting entrepreneurship.

Institutions and individuals promoting rural development see entrepreneurship as a strategic development intervention that could accelerate the rural development process (Paul and Sharma, 2013). It could be argued that as much as promoting rural entrepreneurial structuring mechanisms and an entrepreneurial culture to attract resources for the development of entrepreneurship in rural areas is important, it is equally important to form strategic development alliances encouraging research & increased collaborations between rural and urban areas (Keeffe et al, 2009). At the same time, developing social investment funds by financing and supporting small business development, and increased inter-connectedness between institutions at different levels needs to be stressed. There are a range of cases where successful partnerships between rural entrepreneurs, state government and other formal institutions supported *green* initiatives in the agricultural sector that can be drawn from the West, Africa and South Asia. '*Green'* in particular draws a lot of attention in the past ten years due to increasing investment in both African and South Asian countries, it is also evidenced by the Ernst & Young Country Attractiveness index for renewable energy, where they list potential countries for increased 'green investment'. These factors draw both formal and informal sectors to come together and function towards a shared goal. This makes the case for 'green' a curious case to investigate.

The concept of rural development is multi-faceted as evident in contemporary literature, and one way to understand this would be by looking at it as a key element of strategies, amongst other broader development ones, designed to reduce poverty and create income and employment opportunities (UNIDO, 2003). It is important to unleash and harness the creativity of grassroots entrepreneurs but they are posed with many challenges, the biggest being these grassroots inventions do not scale up (Paul and Sharma, 2013). There is a strong need for support roles that includes infrastructural development by the government to increase the possibility for the business service provider and the industrial sector to enhance the entrepreneurship, micro finance assistance by government to rural micro businesses on a larger scale, marketing assistance by marketing the products, conduction of trade fairs specifically to advertise the work of rural entrepreneurs (Chakravarty, 2013). Such support roles are required to overcome challenges and promote rural entrepreneurship (i.e. implies entrepreneurship emerging in rural areas), the above also brings out the importance and role of institutions and their planned arrangements (including partnerships) as is much debated in both domestic and international forums. There is a big gap in the research that fails to systematically bring in and

connect the role of institutions, support provided to rural entrepreneurs with a greater focus on REs.

Entrepreneurs add greatly to the social and economic value of local economies, and the short run effects include the creation of synergies in communities where entrepreneurial initiatives are emerging and growing, and are accompanied by long run effects through value generation at both the national and local levels (Wang, 2012). Entrepreneurial orientation to rural development, contrary to development based on bringing in human capital and investment from outside, is based on stimulating local entrepreneurial talent and the subsequent growth of indigenous companies (FAO, 1994). This creates jobs and also adds economic value to a region and community and at the same time keeps scarce resources within the community. These values created by the entrepreneur create a synergy that stimulates an autonomous entrepreneurial process, as well as dynamic entrepreneurship, thereby supporting rural development alongside the policy mechanisms and the varying roles of institutions in a society. Both practitioners and scholars increasingly believe that '*getting institutions right'* (Barrett, Lee & Mcpeak, 2005) is a key pre-requisite to fully actualise the impact of institutions on development.

From the above paragraphs, it can be said that there are literary evidence that established the following three factors:

1. Institutions and individuals view the strategic role of entrepreneurs in promoting rural development (Paul, 2013),
2. Impact of investment in REs in rural areas on boosting rural development (as mentioned earlier), and
3. The role of institutions in supporting rural entrepreneurs in helping to overcome the latter's barriers and creating an enabling environment.

However, these three have not been studied together and thus current research does not explore the role and importance of institutional support provided to RE based entrepreneurs in rural areas that contributes to rural development. Ernst and Young (2011) in their E&Y Renewable Energy Country Attractiveness Indices ranks India as a third destination for solar energy development and also one of the top 5 international investment destinations in the Renewable energy sector, this country also shows a variety of private and public actors that have taken place in the green sector and empowers energy based entrepreneurship (Ernst and Young,

2013). With a greater emphasis on RETs and associated green initiatives in rural areas, there exists a need to explore the rural development potential that lies ahead when there is an enhanced integration of institutions at different levels to support the emerging RE based entrepreneurship.

2. Research aim and specific questions

The research aims to understand the institutional arrangements that helps in the creation of an enabling environment for supporting solar based entrepreneurial initiatives that contribute towards rural development. In analysing institutional arrangements, it will also explore the impact of entrepreneurship on rural development, particularly looking at the entrepreneurial benefits., i.e. job creation and exploring its incidental effects. Recognising that rural entrepreneurship is fostering the pro-poor development process (Davis, 2006) as seen in Africa, South Asia as well as Latin American countries, detailed examination of the role of renewable energy entrepreneurs is needed. In particular, the potential for enhanced engagement between RE dedicated institutions at the national level as well as formal state level institutions who are working in collaboration with NGOs and other community-level organisations and 'last mile' agents (this can be defined as the final leg of the RETs networks delivering the service to the end consumers, the part/agent that actually reaches the end customer) in India.

Core research question

What type of institutional arrangements creates an enabling environment for supporting solar based entrepreneurial initiatives that contribute towards rural development in India?

Specific Research Questions

Sub-Question 1: *How do the current institutional arrangements support the development of rural solar based entrepreneurial activities in India?*

Whilst various different forms of institutional arrangements have been supporting solar based entrepreneurship, there has not been any academic framework or research carried out that can systematically explain the supporting mechanisms for solar RET based initiatives in India so far. Also, there are not any studies that explain how the current institutions are formed and created. This is where a big research gap exists. Previous research has indicated that at both national and state levels, the institutional arrangements that are in place need to be critically studied and analysed so as to evaluate the nature and effectiveness of the support provided to solar RETs based entrepreneurs by different key actors and institutions involved in the process (OECD, 2007). A study of how these institutions act, react and interact with one another and which leads to a set of defined deliverable outcomes, would enhance understanding of how RE, specifically solar, based entrepreneurship can be effectively supported in relation to the goals and objectives of key stakeholders.

Sub-question 2. *What opportunities for rural development could be created by partnership arrangements that support solar based entrepreneurship in India*?

This question aims to explore the opportunities created by RE, specifically solar for this research, based entrepreneurship that the current institutional setting in rural India creates for rural development. Recent findings show that the current setting in India allows the Public, Private and People (PPP hereafter) partnership model to holistically support solar based entrepreneurs. This partnership model is new and is beyond the traditional understanding of PPPs (i.e. fund raising and capital sourcing being the main reasons for forming a partnership) but more inclusive and focuses on reaching out directly to the end users. In the Indian context, considering the country has a RE dedicated ministry at the central level, the Ministry of New and Renewable Energy (MNRE), it would be useful to explore what partnerships are formed between different actors in the RE sector to support solar based entrepreneurs and their impact on rural development.

Structure of the thesis

Rural development will be studied by looking at the gains from personal, social and intellectual dimensions only. In the introduction chapter, the thesis will review both seminal and

contemporary literature on selected topics and areas of discussion which involves a) *institutions, b) rural entrepreneurship, c) renewable energy technologies and d) rural development*. While each of them have vast literary contributions that are already in place, this research will be focusing on a set of identifiable components that are relevant for the purpose of this study.

Chapter 2 discusses various theoretical frameworks to analyse institutions and entrepreneurship. It also introduces and discusses a conceptual framework proposed to analyse the role of institutions in contributing to rural development through entrepreneurship. The novel framework brings together two established frameworks to analyse the research questions. It draws upon specifically selected elements from existing theoretical studies carried out on institutions and entrepreneurship. It also explains how the framework would guide the research and its design. Chapter 3 introduces the research methodology and research design adopted to fulfill the main research aim as well as explains the energy sector in India with an emphasis on solar energy technologies to see what are the institutional arrangements that are currently in place which support solar based RE initiatives to promote rural development.

Chapters 4 and 5 present the findings of the sub-research questions. In these chapters, the focus is on conducting a thematic analysis of three institutions and their settings in terms of contributing to entrepreneurship development, and the consequent impact on rural development. Chapter 6 presents the conclusions with the/a discussion of the research implications and future research.

3. Reviewing key concepts

3.1. Rural Development

One of the most widely accepted definitions of rural development refers to it *as the creation of new products and services and the associated development of new markets. It also incorporates the*

development of new forms of cost reduction through the elaboration of new technological trajectories, and the production and reproduction of specific, associated knowledge bases (Van der Ploeg et al, 2007). Rural development can be understood as a multi-level, multi-actor and multi-facetted process (Lorenzini, 2010). At the global level, rural development is also related to a general restructuring of the economy, which had led to substantial changes in the patterns of interaction between society, institutions and the firm (Hull, 2006).

Omofonmwan & Odia (2009) defines it as "*Rural Development is a process of change, by which the efforts of people themselves are united, those of Government authorities to improve their economic, social and cultural conditions of communities into the life of the nation and to enable them to contribute fully to national programme. Rural Development is a process of bringing change among rural community from the traditional way of living to progressive way of living. It is also expressed as a movement for progress*". Sociologist James H. Crops (1974) defines rural development as a process through collective efforts, aimed at improving both well-being and self-realisation of people living outside the urbanised area. It could be further contended that the ultimate target of Rural Development is people and not infrastructure and according to him one of the objectives of rural development should be to widen people's range of choice. Rural development is not merely development of rural areas but also the development of quality of life of the rural masses into self-reliant and self-sustaining modern little communities (Lowe et al, 1998).

The empirical literature defines rural development in light of the individual interpretive frameworks such as *culture* (Ray, 2001), *personal beliefs* (Ray, 2000), *cultural and political beliefs* (Boussevain, 1996) and the pragmatics of translating policy into *real world action in localities* (Lowe et al., 1998). Rural Development has been identified with terms such as *'integrated'*, *'multi-functionality'* and *'sustainability'*, concepts that were '*fuzzy*' (Kostov and Lingard, 2001). Studies carried out across the world looking at the dynamics of rural development enhanced the latter's scope and understanding, especially when one looks at culture, it is more than language but norms, identities, gender, psychic distance and also to some extent power.

This concept has been studied and defined using several different ideas and issues, but to summarise there are broadly four groups, of which the last three have been used for this research:

1. Traditional definition, identifying the concept with psychic distance, norms, identities (FAO, 2011)
2. Contemporary definition (participatory (Chambers, 1983), integrated and synergy (Kostov and Lingard, 2001))
3. Definition that identifies rural development with public participation as an important component (Bass et al, 1995)
4. Rural Development as multi-level, multi-actor and multi-facetted process (Pugliese, 2001)

A rural development perspective can be perceived not only to be implicitly integrative, but also actively integrating. This is also part of the reason why the understanding of the concepts of rural development is studied alongside issues of sustainability, poverty reduction, climate change adaptation and other broad issues of international development (Scoones, 2009) (ODI, 1999). Rural development, as a concept, a field of practice and a policy field, is virtually boundless, encompassing complex issues and open systems conditions around the health of the biophysical environment, culture and heritage, the economy and livelihood, physical infrastructure, social provision and a host of other considerations, including governance structures and systems (Bezanson, 2005). The continuous quest in the literature still exists to come to terms with the meanings and implications of rural development, and the more recent initiatives in ecosystems health, sustainable livelihoods (Krantz, 2001) where the concepts have mutually helped in developing their perspectives and practical applications.

These perceptions have directly tried to put the discussion on rural development at a holistic level where it is studied and understood with a multi-level approach. The integrated character of rural development suggests that there are many relevant variables that impact on its outcome; the latter however matters more when the actors who decide the nature of it are involved in the process in a participatory form rather than approaching it from the top-down. While it is important to consider that rural development is an umbrella term that encompasses

all the different ideas and themes, it is also important to draw a boundary to the concept because this thesis is only looking at the social, personal and intellectual effects of the same. So, the ideas that will be used and considered for this thesis would be the 'integrated and synergy' approach alongside related aspects of 'public participation' and a 'multi-actor/level' process.

Sachs (1984: 15) advises, "*The process of development requires a flexible institutional procedure in which a great deal of importance is attached to debating alternative*". As can be noted from the research questions, this thesis involves discussions around institutions that are multi-nested by nature. This is because the research is looking at multi-partnership arrangements that exists between different stakeholders, in both formal and informal institutional set up. Relating to this process, a second criterion to guide the development process, the principle of subsidiarity – the intent is to ensure that there is a minimum distance between the stakeholders who have a direct interest in any decision that affects their lives and interests, and the decision-making and taking that brings that decision into action, and therefore into their lives.

"*Development strategies often require behavioral change which may be easier to achieve if those expected to do the changing are involved in the planning."* (Lang, 1988: 91)

This brings into the multi-approach functionality of the concept and aids in understanding slightly more complex issues around stakeholder decision-making in a rural development context where the role of the actors needs to be clearly defined without a clash or overlap in their clearly defined deliverables.

In the interest of the above context, it is important to note that rural development is also positioned in the *local dimension* considering a host of formal institutions can unpack their broader development plans only while working in collaboration with local partners. The local dimension, thus need to be defined, to rural development is central to Moseley's thesis (Moseley, 1999). Drawing on a variety of researchers and practitioners in the European context, he sets out the argument for conceptualising rural development as a process that is fundamentally centered on, and emanates from the local level (Moseley, 1999: 4-8). Although

the discussion in his work is very much context and case-specific, but lessons learnt from the European context help in understanding the dynamic nature of rural development while approached from a local level dimension anywhere else. One thing that would need emphasis here is while stressing on the local level dimension, one of the key dimensions of the study suggests that understanding the nature of the problems of a local area can only come from an inclusive and participatory approach and not from a general perspective lacking the specifics that can only emerge from the former approach.

Overlapping with Sach's (1984) critique, Friedman (1987) questions the dominance of our post-enlightenment inheritances, notably the prevalence of the scientific rationality and reductionist process in our attempts to understand development realities and the consequent intellectual hegemony of scientism, and what he calls policy analysis in our prescriptions and approaching a definitive solution. Emanating from this critique, Friedman proposes a process within which social learning is the dominant form of knowledge creation and validation where he extends this process of social learning and mutual knowledge construction into a project of social mobilisation through a federated network of cellular, nested communities. One of the common observations in both Ostrom (1990) and Friedman's work is the concept and understanding of a network of cellular and nested communities. Looking at rural development from a community management perspective, the work by David Korten (1987: 19) depicts rural development in his term '*community management*' where the latter takes as its point of departure, not the bureaucracy and its centrally mandated development projects and programmes, but rather the community itself: its needs, its capacities, and ultimately its own control over both its resources and its destiny. And it focuses on empowerment – specifically the control over and ability to manage productive resources in the interests of one's own family and community. It invokes a basic principle of *control* and *accountability* (Fellizar, 1994) and this maintains that the control over an action should rest with the people who will bear its consequences. Korten (1987) recognises that a balance has to be achieved between legitimate (usually government directed) top down initiatives and local democratic bottom-up development processes. This study is particularly relevant for this thesis considering the nature of actors and institutions studied follow the same principles and the issues of control and accountability that Korten suggests becomes prominent with the examples and cases cited in this thesis later on. This discussion also re-emphasises the quote from Lang (1988) mentioned earlier.

Welsh (1995) views that scaling down of top-down interventions previously organised is a radical response that seeks to achieve new objectives in relation to the rural development process by focusing on such concepts as *multi-dimensionality, integration, co-ordination, subsidiarity and sustainability* (Moseley, 2003). This thesis, as we progress through the different sections would highlight why the concepts of *integration* and *co-ordination* of actors plays a key role in understanding the concept of rural development and relating it to sustainability and understanding the nature of its multi-dimensionality. Though many national and international agencies claim commitment to participative approaches to helping the rural poor, little progress has been made in translating ambitious plans into effective action (Kibreab, 1999). This can be after all backed up by the record of earlier community development and cooperatives efforts that is largely about a history of limited success, resulting more often in strengthening the position of traditional elites than in integrating poorer elements into the national development process (Korten, 1980). In some of Korten's work where he investigated rural development interventions in Asia, he mentions that a degree of fit between beneficiary needs, program outputs, and the competence of the assistance organisation is essential. His study showed that the success of rural development following a participative approach was not the preplanning, but an organisation with a capacity for embracing error, learning with the people, and building new knowledge and institutional capacity through action.

Korten (1980b) mentions how it, *"…involves effective popular participation by the poor…in decision making so that their needs, desires, capacities and indigenous institutions are recognised, understood, and given major weight"*

Development planning must acknowledge and respond to the realities of what Lang (1988) terms interconnectedness, complicatedness, uncertainty, ambiguity, pluralism and conflict, and societal constraints (Lang, 1988:86). According to Lang (1988), these 7 constraints of rural locations needs a long-lasting integrated and interactive approach, focused on shared interests and values. Since 1991, the LEADER programme (Links between Action for the Development for the Rural Economy) for rural development in the EU has tried to address these needs by promoting a participatory bottom-up approach to rural development (Ray, 1998) with an involvement of local people. Rural Development also means "development by and of the local

community, not just for it" (Moseley, 1997: 202) because decisions are more likely to 'stick' if they are made locally and reflect a community consensus (Scott, 2003). Dykeman (1988: 151) approaches community/rural development approach in his work as well, where he states that "*it is process oriented and functions as a facilitator of communication and coordination among diverse groups within the community – local government, unions, business, special interest, educational institutions and senior government departments. It deals with the community in a holistic manner*".

Economic agents are embedded in their socio-economic networks and should not be regarded outside this context. Focusing on these networks will contribute to elaborating a holistic systems view of the problems of integrated rural development. Callon (2003) views that the markets are not embedded in networks as markets are not an objective feature that exists on their own, markets are social constructs, created and modified. A market is the result of the circular causation process of "*disentanglement, framing, internalisation and externalisation*" (Callon, 1998:56). The World Bank's (1978) discussion on "*new-style*" rural development projects maintains that *"It is frequently suggested that what is needed is more private initiatives in attacking the problems which government bureaucracies cannot manage... There is little evidence to suggest that, when undertaken on anything approaching the scale required, private voluntary efforts are consistently more effective than those of Government."*

The *synergy* approach (Kay, 2009) to rural development could be expressed as a process of internal restructuring of the social capital (which is defined as the norms and the networks that enable people to act collectively (Woolcock and Narayan, 2000: 226)). The understanding of market from this study is very crucial, especially while investigating the creation and modification of the same over time. The synergy approach in the study by Woolcock and Narayan (2000), although reading as somewhat limited in the discussion bound within social capital, can have varied dimensions - because this study also inspects how the interaction and collaboration between the actors and the target beneficiaries in rural areas can also bring about a synergy at a multi-nested level. The literature on social capital, despite surrounded by the limited literary growth around *bonding and bridging*, can have multiple implications as can be observed later on from this thesis. While looking at the role of organised institutions interacting with the local actors and beneficiaries, it can be argued to carry a win-win scenario for all when

the collective approach is maintained and deliverables clarified amongst functional stakeholders.

Continuing with the synergy concept and in connection with the ideas around social capital, Woolcock (2000) defines two types of social capital – *bonding*, based on strong ties within the network and *bridging,* which relies on weaker ties. Bonding social capital is a characteristic of traditional societal and preserves their coherence by fostering solidarity and mutual trust. Bonding in social capital reduces risks but reduces the incentives to change. The process of development is dynamic and both types of social capital are continuously being transformed into each other. This shifts attention from the 'quantity' of social capital to its 'quality'. Geys and Murdoch (2008) recently argued that two conceptually distinct interpretations and methodological approaches to measure bridging and bonding co-exist: one built on connections within a given group (referred to as 'internal' bridging) and one relying on links between different groups ('external' bridging). A 'group' hereby refers to any set of individuals that comes together either on a voluntary or involuntary basis (though, in empirical applications, reference is most often made to voluntary associations). Flora et al. (1997) argued that with regard to sustainable rural development, social capital could be too 'strong' or too 'weak'. The entrepreneurial social infrastructure (ESI) (Flora and Flora, 1993) has been suggested as an alternative 'qualitative' form of social capital. While ESI refers to a set of concepts, principles and indicators of communities' ability to address issues and solve problems collectively, it is regarded as a means of converting social capital into organisational forms that facilitate collective action.

Flora et al (1992) found that 'entrepreneurial communities' i.e., communities that succeeded at community development were those whose social organisation was conducive to high levels of entrepreneurial social infrastructure. This literature focuses more on the qualitative side of things and 'bridging' is a core aspect of the research outcome (e.g., community members can work together to achieve community economic development). Putnam (2000) distinguishes between bonding and bridging social capital – networks that help individuals to get by and those that enable individuals to get ahead in life. This discussion on social capital in this section doesn't connote that the thesis is addressing the issue in the context of rural energy-based entrepreneurship, but the fact that the nature of institutions studied and the relationships

investigated between the stakeholders elucidates some of Putnam's and Flora's work in an indirect way to some extent. This will become clearer with examples presented later in the thesis.

3.2. Entrepreneurship

The concept of entrepreneurship

Entrepreneurship is a process by which individuals pursue opportunities without regard to resources they currently control (Stevenson and Jarrillo, 1990). An entrepreneur is perceived as an individual who initiates, organises, manages and controls the affairs of a business unit. While Say (1803) and Marshall (1961) put him as an organiser and speculator of a business enterprise, Schumpeter (1934) refers him as an innovator. Schumpeter's work has been far developed over time and the discussions around *'creative destruction'* and then with *'destructive creation'* had their ongoing debates. Prior to Schumpeter's classic work (1949), Cantillon (1755) looked at entrepreneurial traits in renting out assets and leading the business from the centre of all activities. Entrepreneurship is invoked in an ad hoc fashion, when needed, to explain aspects of firm organisation (Knight, 1921), economic development (Schumpeter, 1911), market dynamics (Kirzner, 1973), and leadership (Witt, 1998a).

Enterprising individuals can be generally found in all sectors of society, and today there are several types of entrepreneurs that can be reported. Traditionally, the concept of entrepreneurship has been closely aligned to that of *small business management:* the *classical archetypal entrepreneur* is often regarded as an individual who starts his or her own business, which may eventually grow into a much larger and more successful corporation. But entrepreneurs can also be found within existing large corporations, where they help create new business divisions, products and changes to internal operations, and are known as *corporate entrepreneurs or intrapreneurs* (Pinchot, 1985). There are also many social entrepreneurs working within non-profit organisations, who attempt to bring about innovations to resolve community problems (Ashoka Foundation, 2003). Also, the concept of sustainable entrepreneurship or

'sustainopreneurship', as Hockerts & Wustenhagen (2010: 82) defines "*the discovery and exploitation of economic opportunities through the generation of market disequilibria that initiate the transformation of a sector towards an environmentally and socially more sustainable state*". This concept gained relevance since the early 90s following the Brundtland Commission report on sustainable development published in 1987.

Social entrepreneurship

Dees (1998:15) defined that social entrepreneurs "*play the role of change agents in the social sector, by adopting a mission to create and sustain social value (not just private value), recognising the relentlessly pursuing new opportunities to serve that mission, engaging in a process of continuous innovation, adaptation, and learning, acting boldly without being limited by resources currently in hand, and exhibiting heightened accountability to the constituencies served and for the outcomes created*". His understanding of social entrepreneurship has an emphasis on innovation and impact, meaning that social entrepreneurship is about introducing a novel, innovative technology or approach aiming to create social impact. This view is consistent with the Schumpeterian thoughts on entrepreneurship, which has been linked to social innovators (Casson, 2005; Certo & Miller, 2008). Dees' (1998) definition of entrepreneurship is what is taken for the purpose of this research, while recognising the fact that all these different entrepreneurial concepts are equally important for entrepreneurial ventures.

The concept of Renewable Energy Entrepreneurship

This research particularly discusses 'renewable energy based entrepreneurship' creating micro enterprises in rural areas but the definition of RE entrepreneurship is lacking because it has not been coined academically yet. It is thus important to firstly position the concept theoretically before using it in line with Dees' definition of social entrepreneurship chosen earlier. 'RE entrepreneur' falls under the category of 'energy entrepreneurs' and that comes under 'green entrepreneurs'. However, these concepts albeit closely connected are however different in nature. The concept of green entrepreneurship itself is relatively recent and has been receiving growing attention mainly since the 1990s considering the timeline. The interest in green

entrepreneurship is not only reflected in the growing literature on the topic but also in the proliferation of terms used to identify the concept itself.

The definition of green entrepreneurship adopted is based on the type of output produced by firms. Put simply, the term *'green entrepreneurship'* will be interpreted as 'entrepreneurship' in 'green' sectors, where 'green' refers to specific types of output. Among the terms available to describe green entrepreneurship, the following are the most commonly used: *eco-entrepreneurship, eco-preneurship, environmental entrepreneurship, sustainable entrepreneurship, ecological entrepreneurship, environ-o-preneurship or sustain-o-preneurship*.

Isaak (2002) maintains that an eco-preneur is a person who seeks to transform a sector of the economy towards sustainability by starting business in that sector with a green design, with green processes and with the life-long commitment to sustainability in everything. This may carry the dimension of maintaining a green supply chain as proposed by Porter and Van Der Linde (1995) as well. Volery (2002) defines two types of eco-preneurs: 1) '*Environment-conscious* entrepreneurs', are individuals who develop any kind of innovation (product, service, process) that either reduces resource use and impacts or improves cost efficiencies while moving towards a zero waste target. 2) *'Green entrepreneurs'*, are those who are both aware of environmental issues and whose business venture is in the environmental marketplace. Such entrepreneurs pursue environmental-centred opportunities that show positive profit prospects.

Anderson (1998) views that both entrepreneurship and environmentalism are based on the perception of value. The attitudes that inform environmental concern create areas of value that can be exploited entrepreneurially. '*Environmental entrepreneurs'* not only recognize opportunity, but also construct real organisations to capture and fix change in society. This *'capture and fix'* changes in society comes with improving effectiveness, developing efficiency and working towards expansion of operations.

The concept of 'green' has been discussed well by OECD Green Growth Strategy (OECD, 2010) that puts forward a basic measurement framework that reflects the common double-faceted

approach on 'green'. On one hand, it looks at efficiency in production (business going green – process approach from some literature discussed earlier), and on the other hand looks at economic activity in conjunction with environmental goods and services (green business – output approach). The former is sometimes referred to as a process approach in defining green business, while the latter as an output approach where the business goes green (adopts eco friendly input-output process). This concept can add complexity by often incorporating ethical, social or environmental motivations in definitions of green entrepreneurial activity. Importantly, renewable energy entrepreneurship comes under the output approach and this is where it fits in the broader area of literature in this field.

Entrepreneurial orientation to rural development, contrary to development based on bringing in human capital and investment from outside, is based on stimulating local entrepreneurial talent and subsequent growth of indigenous companies. This in turn would create jobs and add economic value to a region and community and at the same time keep scarce resources within the community. To accelerate economic development in rural areas, it is necessary to increase the supply of entrepreneurs, thus building up the critical mass of first generation entrepreneur (Petrin, 1992), who will take risks and engage in the uncertainties of a new venture creation, create something from practically nothing and create values by pulling together a unique package of resources to exploit an opportunity. By their example they will stimulate an autonomous entrepreneurial process, as well as dynamic entrepreneurship, thereby ensuring continuous rural development.

Rural entrepreneurship can be defined as *a force that mobilises other resources to meet unmet market demand, the ability to create and build something from practically nothing, the process of creating value by pulling together a unique package of resources to exploit an opportunity* (Jones and Sakong, 1980; Timmons, 1989; Stevenson, et al., 1985). The success of the Grameen bank in Bangladesh under the leadership of Dr Mohammad Yunus can be taken as an example in this definitional context. Entrepreneurs add great value to local economies; at the rural community level entrepreneurs create new jobs, increase local incomes and wealth, and connect the community to the larger, global economy. Many state and local governments recognise the value of innovative entrepreneurs and are shifting their focus from recruiting firms from other places to growing their own. It is important to stress that rural entrepreneurship in its substance does not differ

from entrepreneurship in urban areas. Entrepreneurship in rural areas is about finding a rare blend of resources, either inside or outside of agriculture (Paul, 2013). It could be argued that the economic goals of an entrepreneur and the social goals of rural development are more strongly interlinked than in urban areas (Sherief, 2005).

3.3. Entrepreneurship contributing to rural development

Institutions and individuals promoting rural development see entrepreneurship as a strategic development intervention that could accelerate the rural development process (FAO, 2004), and realise the urgency to form and sustain rural enterprises (Eziebe, 2013). This idea overlaps with the work of Petrin (1992) who views that entrepreneurship is an important tool for rural development. To different stakeholder groups of rural development, development agencies, farmers, rural women and youth, however, entrepreneurship stands as a vehicle to improve the quality of life for individuals, families and communities and to sustain a healthy economy and an environment, providing autonomy, independence and a reduced need for social assistance (Petrin, 2004). Development theories of rural economic growth have largely ignored the existence of entrepreneurship (Christy, 2000), but pressures resulting from global competition and corporate restructuring have prompted development scholars and professionals alike to focus more attention on entrepreneurship as an area of policy and practice (Khan et al., 2007). In light of the gap in the literature as mentioned above, this research thus specifically focuses on entrepreneurship for rural development.

As an example, TATA BP Solar (in India) commands 30% of the Indian solar market by producing domestic and industrial solar water heating systems, home lighting, water pumps and streetlights (Wilson and Zarsky, 2009). This being a joint venture with the Government provides a long-term service to customers, underpinned by contractual relations with local Government; and benefits from government subsidies and tax incentives for solar Photo Voltaic (PVs hereafter). Users are charged for installation and maintenance, while local residents are trained in operations and maintenance skill. This has spurred local level entrepreneurship amongst the youth and the women in these communities.

Developing entrepreneurs requires a much more complex approach to rural development; it requires not only the development of local entrepreneurial capabilities but also a coherent regional/local strategy. The top down approach gains effectiveness first by tailoring development programmes to fit the local environment that it intends to support, secondly by giving ownership of the initiative to the members of the local community (Chambers, 1995).. The regional development agencies that fit both criteria can contribute much towards rural development through entrepreneurship (Low et al., 2010). This argument is reasonable in this discussion considering the ownership part of the discussion, this changes the way development and more importantly the tools of development are looked at. This is because the users are also the managers and owners of the tool (finance, technology, education) instead of being 'given' the solution from the outside.

Another successful example in light of the above paragraph would be the initiative called Tecnosol in Nicaragua that sells and installs distributed solar photovoltaic (PV), wind and hydropower systems to mostly rural Nicaraguans lacking access to electricity (Technosol, 2008). Women usually set up the small micro enterprises from a poor household. Much alike is the project of Grameen Shakti (Bangladesh), a renewables company with a market driven approach to deliver energy services to the poor; its financing system is based on Grameen Bank's micro credit programme and includes payment methods like supplying livestock on credit.

3.4. Institutions and institutional arrangements

One of the most widely cited definition of institutions perceives the concept as ''*enduring regularities of human action in situations structured by rules, norms, and shared strategies, as well as by the physical world. The rules, norms, and shared strategies are constituted and reconstituted by human interaction in frequently occurring or repetitive situations*'' (Crawford and Ostrom 1995, p.582), while North (1990, p.3) defines institutions in a more crisp manner, saying "*the rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction*." Institutions are brought to life by people and organisations (North, 1990; Leftwich & Sen, 2010),

they provide a relatively predictable structure for everyday social, economic and political life (North, 1990: 6). Institutions lead to enduring patterns of behaviour over time but they also change as are constantly being reformed through people's actions (Giddens, 1984). They produce positive or negative development outcomes. This depends on the kinds of relations and behaviours that institutions enable, and the outcomes for the enjoyment of rights and allocation of resources in society (Leftwich & Sen, 2010). Alan Wells (1970, 3) views that "social institutions form an element in a more general concept, known as social structure." Thorstein Veblen and John R. Commons (Hodgson, 2003), understood institutions as a special type of social structure with the potential to change agents, including changes to their purposes or preferences.

Empirical studies draw on insights from institutional theory (North, 1990) and social theory (Coleman, 1988, 1990; Dasgupta & Serageldin, 2000) for studying institutions and development (Della Guista, 1999, 2009) also highlights the relationship between formal and informal institutions and development outcomes. *Formal* institutions are a crystallisation of informal ones and that both co-evolve through the operation of organisations (informal and formal social groups, from households and villages to networks, firms, parties and governments) (North, 1990). Formal institutions include the written constitution, laws, policies, rights and regulations enforced by official authorities. Informal institutions are (the usually unwritten) social norms, customs or traditions that shape thought and behavior (Leftwich & Sen, 2010; Berman, 2013). Development practitioners have tended to prioritise formal institutions, viewing informal ones as separate and often detrimental to development outcomes (Unsworth, 2010).

Institutional arrangements play a significant role in determining the efficacy of a given set of policy or technological intervention (North, 1990). Similarly, institutional design is key to development as it determines whether an institution promotes socially productive ends that benefit all members of society or are redistribute and benefit a small segment of society at the expense of others (Firmin-Sellers 1995, p. 204). It is the outcome that triggers the potential of future initiatives and actions, so studying the nature of institutional arrangements gives a clearer picture of what constitutes the arrangements, what it is comprised of and who are the actors involved in the making. This would lead a clearer understanding of how specific outcomes are reached. Following these steps, studying the outcomes thereafter becomes more

meaningful with clearly defined aims and objectives that carry along the goal of a particular institutional arrangement, what it is comprised of and who are the actors involved in the making. This would lead a clearer understanding of how specific outcomes are reached. Following these steps, studying the outcomes thereafter becomes more meaningful with clearly defined aims and objectives that carry along with the goal of a particular arrangement.

One of the commonly used concepts in the institutional context is the idea of 'nested' institutions. Ostrom (1993) suggests that 'multiple, nested institutions' matters because 'in many urban policy spheres private and social benefits are mixed together defying attempts at pure market or pure government classifications for the provision of services'. In other words, multiple institutions, 'appropriately nested' can correct either gross market or state failure when single rather than multiple institutional provisions are applied (Pugh, 1996). This multi-nested approach constituted by Ostrom's work plays a key role in the making of institutional design and goals, since this can be seen as background information that informs any given institutional arrangements. This study is specifically studying the rural context and more particularly interested in renewable energy based entrepreneurship and thus capturing the institutional setting that works in support of the former and the individuals who are embedded within the frame are important dimensions of the research.

Institutional arrangements and design

Institutional arrangements are the policies, systems, and processes that organisations use to legislate, plan and manage their activities efficiently and to effectively coordinate with others in order to fulfill their mandate (UNDP, 2014). Institutional arrangements are interpreted as different (in)formal regimes and coalitions for collective action and inter-agent coordination, ranging from public-private cooperation and contracting schemes, organisational networking to policy arrangements (Geels, 2004; Klein & Teisman, 2000). They include both formal and informal arrangements; they can range from local to global level, and may give rise to com-pliance or resistance. Institutional arrangements, understood as the dynamic set of formal and informal regulations and networks, are shaped by economic exchange, socio-cultural norms and political regimes, and may provide welfare, identity, solidarity and sense of belonging

(Keefer, 1990). When related to development, the challenge is to under-stand the correlation between weak, missing or perverse institutional arrangements and poverty, inequality and resource degradation (Rodrik, 2002; Knack and Keefer, 1995).

As Geels (2004) puts it, institutional arrangements can take several forms such as public-private cooperation and contracting schemes, organisational networking, and public to private outsourcing to policy arrangements. Public private cooperation and partnership being the most widely observed form could be categorised into two types: a PPP of a purely contractual nature and a PPP of an institutional nature. In a PPP of a purely contractual nature, the partnership between the public the private sector is based solely on contractual links, whereas in a PPP of an institutional nature there is cooperation between the public and the private sectors within a distinct entity. Both arrangements involve delegated management of the traditional public sector activities to the private sector. In the first type of PPP, the rights and obligations are regulated by an administrative contract or series of contracts. In the second, they are guaranteed by the company's statutes and by the shareholder agreement between public and private parties. There is contractual regulation in both situations. This research considers both forms of PPP.

In order to understand the pros and cons of public-private partnership, it is firstly essential to understand that in order to maximise the advantages of PPP all potential participants must enhance their understanding of the different approaches and the optimal methods to structure such arrangements. Initially, these types of arrangements were driven by funding objectives but also by efforts to enhance the quality and efficiency of public services. Four principal roles for the private sector in PPP schemes as identified by O (2003) were *a) providing additional capital b) providing alternative management and implementation skills, c) providing value added to the consumer and the public at large, d) providing better identification of needs and optimal use of resources.* Despite the advantages, these schemes can also be complex both design and implementation-wise.

The overall aim of PPPs is therefore to structure the relationship between the parties, so that risks are borne by those best able to control them and increased value is achieved through the exploitation of private sector skills and competencies. This research, focusing on rural areas

specifically and investigating institutional arrangements supporting renewable-energy based entrepreneurship looks at b, c and d from above. Point d (from above, i.e. *providing better identification of needs and optimal use of resources*) can be better understood and studied if there is inclusive and participatory approach towards studying rural lives, and this is often not possible for formal institutions at all times given bureaucracy and access to information at the grassroots. PPP arrangements come in many forms and the concepts are still evolving which must be adapted to the individual needs and characteristics of each project and project partners. Next section will be looking at the concept and importance of renewable energy technologies (RETs, hereafter), since the entrepreneurship in context and rural development investigated in this thesis circumscribes around RETs based initiatives.

Social and institutional arrangements are often ignored or seen as impediments to technological change. Social refers to interaction among organisms and implies more than one individual. Groups and organisations are forms of social congregation and interaction. Because humans are social by nature, we congregate in groups, share symbols and meaning and develop culture. Institutions, on the other hand, represent regularised ways of meeting recurring problems in society. Herbert Spencer, one of the first sociologists, defined institutions as *the organs that perform societies functions* (Poerschke, 2016). Usually institutions use characteristic procedures to perform tasks. Examples of institutions would include family, education systems, church, non-government organizations, development agencies, research institutions and governmental units charged with particular functions (e.g., department of energy or education).

3.5. Renewable energy technologies

The Renewable Energy Association (2009, p.8) defines "*Renewable energy technologies are energy providing technologies that utilise energy services in ways that do not deplete the Earth's natural resources and are as environmentally benign as possible. These sources are sustainable in that they can be managed to ensure they can be used indefinitely without degrading the environment*". These technologies favor power system decentralisation and locally applicable solutions more or less independent of the national network, thus enhancing the flexibility of the system and the economic power supply to small isolated settlements (Byrne et al, 1998). Several research shows

that renewable energy technologies, energy conservation (*read: efficient energy utilisation*), cogeneration and district heating, energy storage technologies, alternative energy dimensions for transport, energy source switching from fossil fuels to environmentally benign energy forms, coal cleaning technologies, optimum monitoring and evaluation of energy indicators, policy integration (Cabraal et al., 1996; Hammad, 1995; Liebenthal et al., 1994), recycling, process change and sectoral shiftment, acceleration of forestation, carbon or fuel taxes, materials substitution, promoting public transport are broadly the solutions for the environmental challenges that developing nations are threatened with at large (World Bank, 2000).

Renewable energy sources currently supplies somewhere between 15% and 20% of total world energy demand. It is estimated that in 1990, all renewable energy sources produced nearly 2900 TWh, accounting for about 24% of the world's total electricity supply (IEP, 2010). If traditional uses of biomass were also taken into account, then renewables would supply nearly 18% of global energy demand. Most of the renewables contribution to current electricity supply is provided by hydroelectric schemes, a large proportion of which has been in place for a considerable time. From a small base in the 1970s, the 'new' renewables (i.e. biomass, geothermal, PV, small-scale hydro, solar thermal electric and wind) have grown proportionally more rapidly than any other electricity supply technology. The International Energy Agency (2011) projects that, without policy initiatives, fossil fuels will account for more than 90 of total primary energy demand in 2020. Major international studies indicate significant growth-potential for renewables, particularly in scenarios where environmental constraints are imposed, for example on C02 emissions.

Figure 9.1 (see appendix) shows that three of the BRICS are among the five top countries for energy capacity produced from different modern renewable sources. The main difference between developed countries and the BRICS for installed capacity based on modern renewables refers to the primacy of developed countries in establishing the capacity to use solar photovoltaic (PV) sources (grid-connected). In order to investigate the importance of electricity in total energy used and produced, examining the different sources of energy on which countries rely for electricity production (see Bodas Freitas et al., 2010) is important. According to the WBI (2005), natural gas was the main input for electricity production in Russia (45%), and coal was the main input for electricity production in South Africa (90%), China (80%) and India (70%), while hydropower was important in Brazil (82%). Similar differences for reliance on renewable sources for electricity production occur in the industrialised countries.

This analysis suggests that there is heterogeneity among the BRICS as well as with the developed countries in terms of reliance on different energy sources, and the composition of and extension to their portfolios of renewable energy sources. Although, the intensity of reliance on renewable sources is uneven across countries, there is not a huge divide between the BRICS and the group of developed countries. In 2006, Brazil and India were among the countries with highest level of reliance on renewable sources. The major difference between the BRICS and the developed countries seems to be related to the use of solar PV technology, which is higher in the advanced countries.

In the period analysed, India, Brazil, and China show the highest levels of use of renewable combustibles - higher than the developed countries, while Russia has the lowest level. India has the highest level of use of combustible renewables and waste in total energy, despite experiencing a major decrease in these levels overtime. In the 1990s, around 40% of total energy use in India was renewable combustible; in the 2000s this ratio decreased to 30%. This high share seems due to India's reliance on non-commercial energy sources in rural areas, including wood, crop residues and animal waste, whereas the decrease in the use of renewable combustibles would seem attributable to the replacement of traditional sources by more efficient commercial energy sources (India Energy Portal, 2010; KPMG, 2007).

Similarly, in the 1990s, 30% and 20% of the energy used in Brazil and China, respectively, was renewable combustible; in the 2000s it was about 25% in Brazil and 13% in China. The decrease in the use of renewable combustibles in India, China and Brazil may indicate that economic development initially leads to reduced use of traditional renewables and increased use of fossil fuels, rather than an increase in the use of modern renewables (Arnold et al, 2006; Goldenberg and Coelho, 2004; van der Horst and Hovorka, 2009). In Russia and South Africa, on the other hand, the levels of renewable combustibles in total energy consumption were stable and significantly lower during the same period, by about 1% and 10%, respectively.

4. Solar energy based entrepreneurship contributing to rural development

The literature reviewed in previous sections looked at how entrepreneurship is a strong tool to boost rural development followed by studying the growing phenomenon of increased investment in RETs in rural areas with a strong focus on India. This research investigates how

solar based entrepreneurship contributes to rural development, some successful examples and observations from India and other developing nations can be taken below in order to look at three different aspects *a) in what ways renewable energy technologies contribute to rural development, 2) the link between solar renewable energy technology and entrepreneurship, and 3) the missing link for impact of successful solar based entrepreneurship for rural development.*

Bangladesh's experience with solar RETs and dissemination of the same to poor rural household and building entrepreneurs has been highly successful, making it the first 'solar nation' in the world (IDCOL, 2009). Penetration of RETs in the form of Solar Home Systems (SHS) in rural households and the use of the technology for creating micro enterprises has been widely cited as a successful case of solar RE contributing to communities and wider society. Households who received the SHS used the technology to start micro enterprises from home by making and selling different home made handicraft goods e.g., jute and silk products. In many communities, these micro enterprises also hired other people from the local community. The myth that solar energy was not affordable has been broken, over one million SHS have been installed in Bangladesh, benefitting over 6 million rural people (IDCOL, 2011). This has encouraged local entrepreneurship (especially women, who counts for 36% of the same) (UNEP, 2009), rural women are assembling solar accessories in village based technology centres, solar engineers are increasingly employed in designing SHS, working in battery factories, and other accessory related businesses.

The above case of Bangladesh is very similar to SELCO's initiatives in India. SELCO India Pvt limited identified that mobilisation of finance, realisation of niche markets for RETs and strengthening relevant institutions to introduce solar RETs in rural areas are possible avenues to empower women, the disadvantaged, create jobs and facilitate rural development (Islam, 2011). Apart from the above initiatives, Grameen Shakti and Bright Green Energy Foundation (winner of Zayed Future Energy Prize) in Bangladesh have been exceptionally successful in reaching out to the poor and building local level women entrepreneurs over time (UNEP, 2009). In India, the importance of women (i.e. the primary users of household energy for cooking and heating) in the context of energy have been widely recognised by successful organisations and networks like SEWA (Self Employed Women's Association), TIDE (Technology Informatics Design

Endeavour), AIWC (All India Women's Association) & SELCO (Solar Electric light company of India). The aim is to involve more women and transform them into energy entrepreneurs.

For example, the Gramin bank offers small credit to women entrepreneurs in rural Bangladesh; these women are already marketing PV systems and operate cell phone through solar energy (Barua, 2007). All India Women's Conference (AIWC) in India started providing rural women with solar lanterns and charging stations. Women charge their lanterns during daytime and then in the evening they rent the solar lanterns to street vendors and to those houses that do not have electricity or face long hours of power cut. AIWC has also initiatives on solar powered water purifier (women sell purified potable water to the locality at very nominal rates) (AIWC, 2009). Two other household level income generating activities started by women by solar RETs are bare foot engineers from TILLONIA Women's group not only install, maintain and repair but also manufacture parabolic solar cookers with confidence. Also, at BAHAI's women's group from Madhya Pradesh women are manufacturing, selling and also marketing solar cookers.

Nasreen and Rabbi (2011) identifies that *innovative credit system, appropriate product design, grassroots based effective and efficient after sales service plus other consumer friendly options* play a big role in above mentioned cases. One of the main factors behind the Bangladesh success story is that it empowers rural communities to own and use solar RETs and eventually become partners to bring and expand solar RETs in their communities. These organisations, besides providing the necessary technologies, also offer credit and market opportunities to their target users and clients.

Another endeavour made by AIWC and CRT (Centre for Rural Technologies) in Nepal where the solar RETs provided to women comes in the form of solar air-dryers which involves zero energy cost while processing fruits and condiments in clean and hygienic environment (Vigyanprasar, 2010; MOF, 2010). Also, Nepal Government's MHP (Micro-hydropower) scheme has emerged as one of the promising decentralised renewable technology and proved to be one of the most successful models among several other RETs in Nepal. Both the government and private sectors cooperates and partners in promotion of the MHP sector. In addition, the Agriculture Development Bank of Nepal (ADB/N) plays intermediary role between government

and private entrepreneurs for providing financial help (loan) in installing MHP plants in Nepal. This has spurred local entrepreneurs and solar RET based initiatives and have boosted local opportunities, it is apparent that having access to a reliable and affordable supply of electricity, rural households can create jobs at community level, which ultimately accelerate rural economic development (kirubi, 2009). Different effects of the scheme can be tabled as below.

Table 1.4: Time spent on different activities before and after installation of the MHP plant in Nepal

Work	Time in hr/day		Time saved
	Before	After	hr/day
Firewood collection	8	4	5
Cooking	3	1	2
Cleaning utensils	1	0.5	0.5
Grinding/milling	9	4	5
Fodder collection	10	5	5

Table 1.5: Changes in income and agricultural pattern after installation of the MHP plant

Particular	Increased	Decreased	Same
Khet (farm)	20	45	85
Bari (home)	13	40	97
Income	65	18	73
Abroad employment	110	0	40

(Gurung et al, 2011)

The 'packaging' of a rural energy based programmes is quite important, from the above examples a combination of various components such as *capacity building, technology transfer, training, financing, costing* can be observed. Rural eco-entrepreneurship development (REED) program for employment generation in environmental services is another initiative which promotes those enterprises with the focus in renewable energy (RE) and to assist and facilitate

setting up of environment service enterprises that provide services to people in renewable energy and bio-waste processing and helping them in running sustainably. REED programme focusses on facilitating rural youth, women, SHGs and micro enterprises to set up new ventures in the fields of waste-to-fertilizer projects, renewable energy and maintenance and equipment supply enterprises.

The success of green initiatives, especially with Renewable Energy Technologies in rural areas, in Africa has been grossly attributed to the public-private and private-private partnerships devised by formal institutions over the years. It is important to know more about this varying dynamics in order to feed into policy makers so to make solar RETs based interventions a mainstream development tool for rural development. Both success and limited success stories evidenced above brings up the concerns put forward by Sanderson (2004), the weakness of tropical states, communities, NGOs, markets and the absence of clearly articulated concepts for coordinating among organisations so as to establish and enforce rules that will provide both incentives to increase rural productivity while reducing rural poverty. Given similar concerns put forward by Lee & Barrett (2005), in the process of meeting the challenge of reconciling rural poverty reduction and renewable resource conservation, there needs to be a careful investigation and rethinking of the institutional arrangements on which such efforts so fundamentally depend. This is where the importance, timeliness and necessity of this particular research come in.

The example of 'Third Italy' (Emilia-Romagna region) where a rural region, based on small firms supported by state and national formal institutions in partnership with local entrepreneurs, propelled to the top of the international income earning region (Petrin, 1992). Rural entrepreneurism has also seen success in Western Massachusetts' small food growers (Pyke, 1991). Green initiatives particularly have seen tremendous growth-igniting potential in solar sisters, Africa where local level women and youth entrepreneurism has been supported by a variety of institutional arrangements like public-private partnerships, private-private partnerships and developing enabling factors for grassroots innovation practices (Smiler, 1987). These multiple inter-connectedness between different actors need further improved understanding in order to explore how an effective institutional arrangement supporting RE based entrepreneurial initiatives have an overall impact on rural development.

In the above examples, the role of institutional arrangements becomes contextually important for a variety of reasons. Most of the studies have largely concentrated with the impact that institutions, generally understood as formal and informal rules and regulations governing economic activity, have on economic growth (Acemoglu & Johnson, 2005; Acemoglu, Johnson & Robinson, 2001; Aghion, Howitt & Mayer-Foulkes, 2005; Hall & Jones, 1999; Knack and Keefer, 1997; Miguel & Gertler, 2005; Miguel, Ggertler & Levine, 2006). In both cases in Nepal and India, the partnership arrangements between the public and private sector and the consequent impact on rural community development can be observed.

This chapter introduces the research context, aims and objectives along with the specific questions. In addition to that, it provides a thorough review of literature of key concepts used in this thesis, namely rural development, entrepreneurship, institutions and institutional arrangements. Chapter 2 would introduce the theoretical frameworks that this thesis has borrowed constructs from in order to develop a conceptual framework used in this work.

Chapter 2 - The conceptual framework

2.1. Introduction

A conceptual framework is primarily a conception or model of what is out there, and of what is going on with a given set of things/variables and why. Following Ostrom (2009) and McGinnis (2011), 'frameworks' are considered to identify categories and sets of variables relevant for study, with limited specification of the nature of relationships between them, whereas 'theories' set out and evaluate general causal relationships between categories and sets of variables. 'Models' specify these relationships in particular circumstances (Dorward, 2014). Choices of theories, models, and frameworks in any analysis are determined by context, by the purposes of analysis, and by analysts' disciplinary interests (Schlüter et al. 2012).

A conceptual framework can be perceived a tentative *theory* of the phenomena that the research is investigating, the function of this theory is to inform the rest of the design — it helps assess and refine research goals, develop realistic and relevant research questions, select appropriate methods, and identify potential validity threats to drawing definite conclusions (Heinrich, 1999). What is often called the 'research problem' is a part of the conceptual framework, and formulating the research problem is a key task that designs the entire study. It is part of the conceptual framework (although it is often treated as a separate component of a research design or proposal) because it identifies something that is *going on* in the world (Galilei, 2008), something that is itself problematic or that has consequences that are problematic.

A conceptual framework is also something that is *constructed*, not found. It incorporates pieces that are borrowed from elsewhere, but the structure, the overall coherence, is something that is built, not something that exists ready-made (Lave, 1981). This is why the existing theories and research are relevant to the area of study, because these are often key sources for understanding what is going on with these phenomena.

The research problem (in combination with goals) functions to justify the study, to show why the research is important. In addition, this problem is presumably something that is not fully understood, or there's little idea available about how to adequately deal with it (Lave and March, 1975); therefore, need more information about it. Every good research design contains an implicit or explicit identification of some issue or problem, intellectual or practical, about which more information is needed. This is where a conceptual framework contributes greatly.

In regards to this study and the particular context, some of the most important approaches to entrepreneurship can be briefly described before discussing the importance of the frameworks that's been used in the research for analytical purposes later in the chapter; one approach is based on *personal* and *social* characteristics; *cultural, contextual and integral* approaches; and others that focus their study on *the levels of education and training.* However, a systematic analysis of contemporary literature would reveal that all these approaches have been found equally important (these studies have been reviewed in the literature in chapter 1). A good framework should be able to bring in all these different facets together so that no one aspect gains more importance than the others.

2.2. OECD/EUROSTAT entrepreneurial framework

The OECD/EUROSTAT framework (see Figure 2.1. below for a quick glance) identifies three separate but inter-connected flows from determinant to outcome, all of which are important in the formulation, assessment and appraisal of policy measures: '*determinants*', '*entrepreneurial performance'*, and '*impact'* (Ahmad & Hoffmann, 2008), where: 'determinants' reflects the key factors that affect 'entrepreneurial performance'; 'entrepreneurial performance' reflects the target indicators that policy makers believe have an impact on targeted objectives (impacts).

Given the diversity of outcomes and manifestations of entrepreneurship as a process, it stands to reason that no single indicator can ever adequately cover entrepreneurship, especially given the different set of objectives. One could measure entrepreneurship *ex-poste*, in much the same way that one can measure GDP ex-poste but this is too simplistic and overlooks the fact that the outcomes, or impacts, of and (GDP) related value-added. As described in chapter 1, this study is looking at the synergy approach and value-creation aspect of entrepreneurship (so an ex-poste measurement isn't suitable for this study). As such, it is obvious that the framework needs to be the vehicle that provides policy makers with the tools (i.e. indicators, for this study) needed to tackle whichever entrepreneurship related objective they determine. This reflects not only the measurement of any particular target indicator, for example, the number of firms producing new products, but also the factors that determine or influence these target and affect entrepreneurial performance.

OECD (2007) believes that most policy makers and researchers (i.e. institutions, for this research) studying institutional roles to support entrepreneurship would be more likely to use the indicators within the 'determinant' and 'entrepreneurial performance' sections of this framework to determine whether they correlate with any potential 'impact' indicator they wish to analyse. This partly explains the reason why this framework closely suits the purpose of this research that aims to unpack institutional arrangements which supports renewable energy based entrepreneurship and explore the wider implications of the same on rural communities.

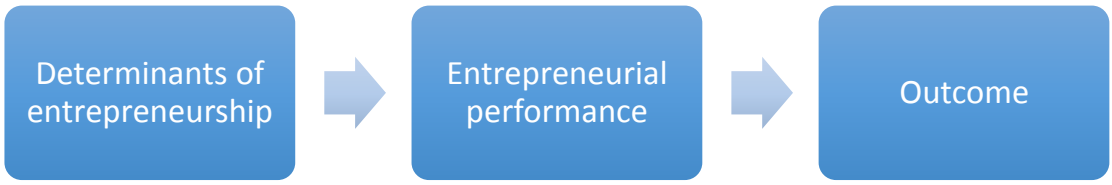

Figure 2.1: A quick snapshot of the elements from OECD/EUROSTAT framework as has been described above in the chapter

As a quick analogy, the basic idea behind the conceptual framework can be illustrated as a train journey. Passengers want to get from A to B by time t (reflecting the *'impact'* in the framework). There are various means of transport available, some more costly than others, with each means

having many variants (engine size, fuel consumption etc., which collectively form the '*determinants*'). During the journey, passengers are informed whether they are heading in the right direction and on time via speedometers and GPS readings, (the *'performance indicators'*). Different passengers (actors) will, of course, want to go to different places and get there at different times (different '*impacts*'), using, whether by design or necessity, a mode of transport ('determinant') that reflects the price they're willing to pay for a certain level of comfort.

The influence of other frameworks in making the OECD/EUROSTAT framework

An entrepreneurial performance depends on a myriad of underlying factors coupled with the personal attributes of entrepreneurs. The OECD/EUROSTAT framework brings these many factors together and for clarity pulls them together within separate themes, described below. It builds on many of the important contributions made to the literature in this area, such as Audretsch, Thurik and Verheul (2002) who identified fourteen dimensions that span the difference between the models of the entrepreneurial and managed economies and provides a framework for understanding how the entrepreneurial economy fundamentally differs from the managed (see appendix, Table 9.5); the policy framework developed in the works of Lundström and Stevenson (2005) that observes that policy measures to stimulate 'innovative' entrepreneurship are often of a different form than those to foster general entrepreneurial activity as are the target groups they seek to influence, and the composition of system members (Lundström & Stevenson, 2005; Stevenson, 2002) (see appendix 2, Figure 9.4). Innovation policy is broader than policy to foster innovative entrepreneurship, especially regarding objectives such as those to increase R&D investments or encourage the uptake of strategic technologies; and finally the Danish Entrepreneurship Index in which Hoffman (2007) provides a case study on Denmark to show that the level of entrepreneurial activity and the percentage of high-growth entrepreneurs can be explained by whether a country is capable of creating good framework conditions for entrepreneurs. The framework conditions for a country's entrepreneurial activity comprises of a number of factors that affect the individual entrepreneur's prospects of starting, developing and operating a new enterprise (see appendix, Figure 9.5). They include demand possibilities, supply of capital, supply of skills, incentive

structures and entrepreneurial culture. All these combined with a pragmatic policy approach, OCED/EUROSTAT comes up with its own framework as shows in Figure 2.2.

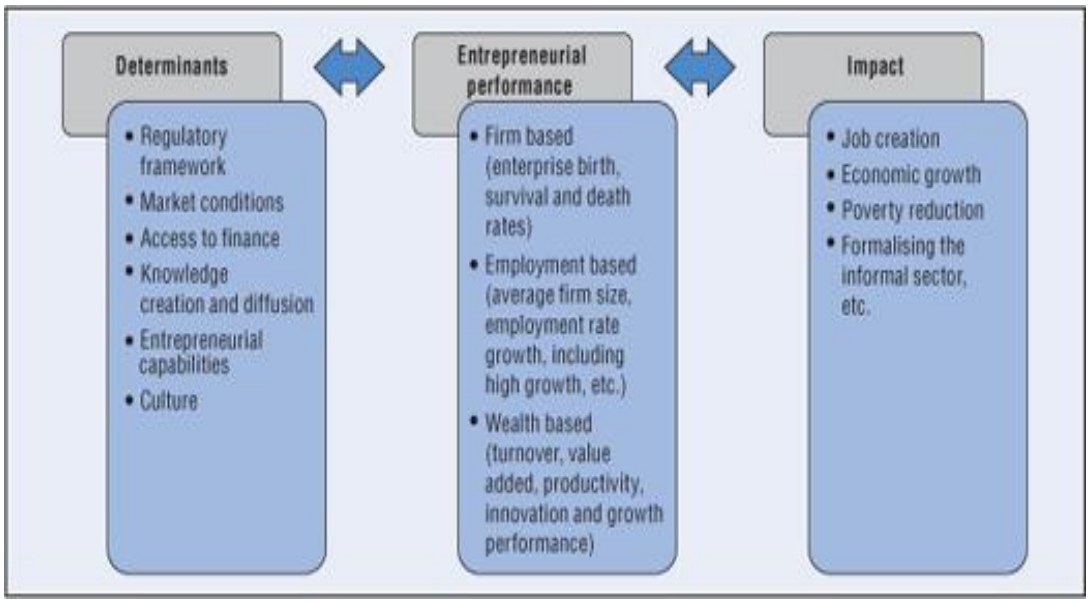

Figure 2.2.The OECD/EUROSTAT framework (OECD, 2009)

Themes of Entrepreneurship Determinants

Many phrases are used in the literature to describe the factors affecting entrepreneurship (Schramm, 2006). But the differences between these various studies are often largely semantic; In addition to the factors provided in the framework above, Ahmad (2007) states that entrepreneurs and entrepreneurship are created by a combination of three factors: opportunities, skilled people and resources. Resources reflect access to capital, R&D and technology. These are the factors that are important to entrepreneurs and entrepreneurship in general. Many studies on entrepreneurship highlight capital as one of the most critical factors for success (EU, 2003). Capital covers all phases of business life, from access to early seed funds to access to the stock markets. R&D creates new inventions that the entrepreneur and entrepreneurial businesses can turn into new products or processes. The R&D in this context should be understood as a resource that can be created or purchased, whether directly or in an

embodied or diffused form. Skilled people in this context relates to the capabilities of the entrepreneur and access to other capabilities within the entrepreneurial infrastructure (Lee et. al, 2000). Sen (1995) also introduces human capabilities and entitlement in his work in development economics. In other words, the entrepreneurial capabilities include the human and social capital of the entrepreneurs. A culmination of the factors highlighted in the above studies can be found in the OECD/EUROSTAT framework which confirms the viability of the study since it has been tested empirically.

Opportunities are created by the market conditions in a country. These market conditions include public involvement and competition in the markets (both of these include a host of actors and institutions and their constant interplay), access to foreign markets, procurement regulation and so on. A regulatory framework can affect entrepreneurial performance both positively and negatively by defining a business setting in a particular way, putting in rules and customs. A combination of opportunity, capabilities and resources does not necessarily lead to entrepreneurship if opportunity costs (e.g. forgone salary and loss of health insurance) and start-up costs outweigh the potential benefits. Since in this event, a rationale, potential entrepreneur will not pursue the opportunity and will not create value through a new product, process or market. In this framework, the regulatory framework is defined very broadly and includes all taxes, regulations and other public rules and institutions affecting entrepreneurship. A combination of these above-discussed factors is particularly pertinent for this research.

Finally, culture can also affect the model and is included as the final factor in the framework. Culture influences an entrepreneur's behavior, attitudes of society towards entrepreneurs and entrepreneurship which affect the latter's effectiveness and, moreover, is often unnoticed by the entrepreneur (Ivancevich & Matteson, 1996). In this framework, culture comprises each individual's assumptions, adaptations, perceptions and learning. In addition, nature of the support that entrepreneurs receive from institutions around them besides local community support such as NGOS, private and public institutions can equally affect their motivation, activity and performance levels.

Summarizing, six themes (Resources and capital - access to funding and R&D of technologies, capabilities, market conditions, regulatory framework and culture) have been generally used to describe the determinants affecting entrepreneurial performance (see Figure 2.2 above). These themes also helped identify codes used during data collection to help the thematic data analysis purposes.

The OECD/EUROSTAT entrepreneurial framework systematically captures the essential elements of business environment and how institutions can create opportunities for entrepreneurs to grow and develop over time via financial access, market operations, regulatory framework, knowledge creation and diffusion, so on and so forth. So, essentially this framework has got two sides – firstly, it shows a list of factors that can determine an entrepreneurial performance (and if studied carefully, it would reveal which ones are more stronger than the others in a particular context) and secondly, what is the impact of the entrepreneurial performance on the final outcome. The outcome, however, can be defined and determined suiting to the purpose of the research so in this study the outcome is about the holistic impact (fostering development) on local communities derived from the quality of performance and initiatives taken up by renewable energy based entrepreneurs.

The limitation of the next framework, i.e. OECD/EUROSTAT entrepreneurial performance indicator framework is firstly, the OCED/EUROSTAT describes that the framework is deliberately targeting business related/for profit entrepreneurship and it explicitly ignores social entrepreneurship (OECD, 2007b) and that's not because it undermines the latter but the framework was developed to capture a particular aspect of entrepreneurship related specifically to business. Thus, for analytical purposes some sections of the model has been modified and enhanced, this is presented later in this chapter (Figure 2.4). Secondly, the framework stresses on the importance of regulatory framework and market conditions being two of the dominant factors that influences entrepreneurial performance while in reality (at least, empirical reality), research would show that these may not be the only ones that are dominant and increasingly relevant. So, while the framework helps in identifying 'causal factors' (as described above in the chapter), these may not be exhaustive. Empirical findings add newer and relevant ones as context and times change, this research also adds a list of useful indicators as a part of its contributions in the end.

So, the elements that have been selected for analytical purposes and what guides in the research design further are entrepreneurial access to capital and R&D of technologies, capabilities, knowledge creation and diffusion, and culture. Various aspects of these elements guide the nature of data collection methods used during fieldwork, as well as formulating the research approach.

Clearly, these elements highlighted in the OECD/EUROSTAT framework guides the path of research method further as they identify the 'source' of information and advises on 'what' to look for – considering there is a specific list of relevant actors and institutions who are approached during the fieldwork, having a pre-understanding of the nature of query and how to approach the research problem by knowing what to inquire serves greatly in favor of the research journey – this is where the role of framework fits in.

2.3. Institutional Analysis and Development (IAD) framework

The IAD framework (see Figure 2.3.) is viewed as a systematic method for organising institutional design and policy analysis activities that is compatible with a wide variety of more specialised analytic techniques used in the physical and social sciences (Stein, 1990). It provides a means to synthesise the work of multiple participants, including those who are directly involved in the policy situation and have an interest in policy outcomes (Ostrom, 1971). According to Nowlin (2011: 44), the IAD framework remains "*the only major policy theory or framework to be based on institutions"*; Imperial and Yandle (2005: 501–503) observe that the framework has proven "*useful in understanding a wide variety of institutional arrangements in both developed and developing countries."*

This research is investigating on unpacking different forms of institutional arrangements, for instances, *public-private, public-private-people, private-private-people partnerships*, Ostrom's (1971) study on multi-level and nested institutions that are appropriate for resource management contexts applies to this research context and purpose.

Similarly, IAD framework is "*one of the most developed and sophisticated attempts to use institutional and stakeholder assessment in order to link theory and practice, analysis and policy.*" (Aligica, 2006: 89). In Ostroms' terminology, the IAD is neither a theory nor a model but a *framework*—a sort of conceptual umbrella under which various theories and models might be deployed and tested as mechanisms for understanding or explaining 'social dilemmas' or interactions (see, e.g., E. Ostrom, 2005, pp. 27–29). However, the IAD framework cannot be completely *atheoretical*. This is because a purely conceptual, atheoretical framework might have all of the IAD's boxes with their descriptions (akin to a simple list of variables) unlike the arrows and lines linking connections to one another. Linking concepts in a relationship system requires the theory of relations.

E. Ostrom & Cox (2010: 455) defines the IAD Framework also as a *'Meta-theoretical Conceptual Map'* while developing some very useful distinctions among three different sets of propositions (1971). *Firstly*, in her view, a 'conceptual framework' identifies a set of variables and the relationships among them that presumably account for a set of phenomena. *Secondly*, the framework can provide anything from a modest set of variables to something as extensive as a paradigm. *Thirdly*, it doesn't need to necessarily identify directions among relationships, however more developed frameworks will certainly specify some hypotheses.

A '*theory*' provides a denser and more logically coherent set of relationships. It applies values to some of the variables and usually specifies how relationships may vary depending upon the values of critical variables. Numerous theories may be consistent with the same conceptual framework. A '*model*' is a representation of a specific situation. It is usually much narrower in scope, and more precise in its assumptions, than the underlying theory. Ideally, it is mathematical. Thus, frameworks, theories, and models can be conceptualised as operating

along a continuum involving increasing logical interconnectedness and specificity but decreasing scope (Schweik, 2008: 108).

The IAD framework is best viewed as a systematic method for organising institutional arrangement setting as well as policy analysis activities that is compatible with a wide variety of more specialised analytic techniques used in the physical and social sciences. It does not replace other techniques, but provides a means to synthesise the work of multiple participants, including those who are directly involved in the policy situation and have an interest in policy outcomes. The framework also helps analysts comprehend complex social situations and break them down into manageable sets of practical activities. When applied rigorously to policy analysis and design, analysts and other interested participants have a better chance of avoiding the oversights and simplifications that lead to policy failures.

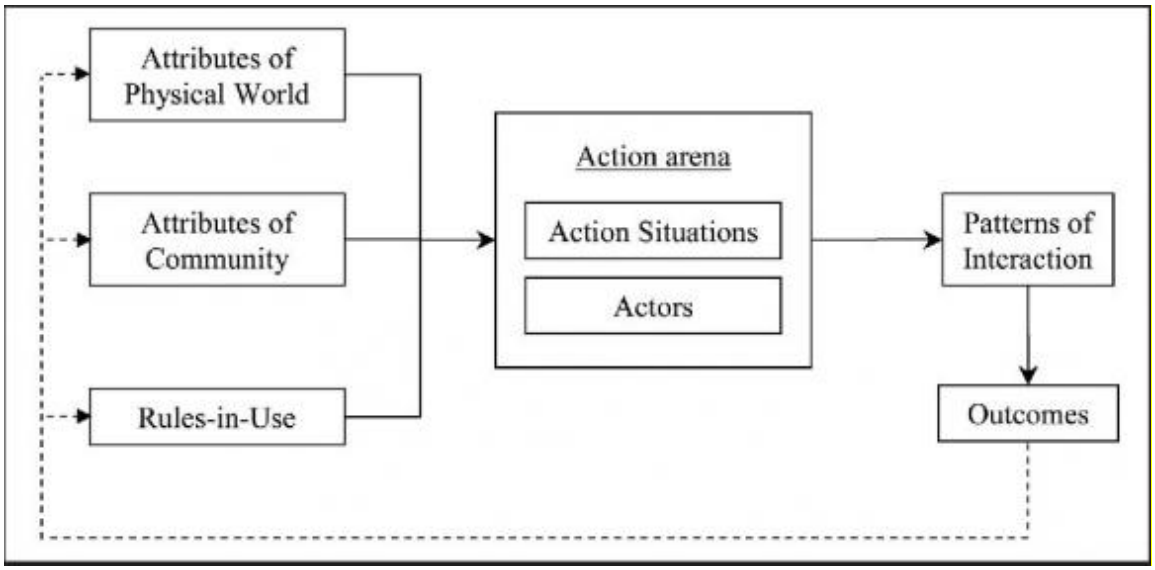

Figure 2.3: A standard version of the Ostrom's (1971) IAD framework

The framework highlights 'action arena' where the actors, their roles and decision-making situations can be studied together using a given set of criterions. These criterions can also be found to unpack the components of a given institutional arrangement and the consequent outcomes that are generated by such arrangements in combination, in particular by highlighting the role of the actors and their observed patterns of interaction involved in the process. "*An*

actor enters an action situation with her or his own position (citizen, seller, buyer, litigant, judge, etc.), information, strategy (conditional co-operator, rent-seeker, free-rider, etc.), and behaviour, all of which are to some extent shaped by existing biophysical conditions, the attributes of the community in which they live, and the "rules-in- use"." Ostrom (2010: 646)

The very structure of the IAD shows actors in positions, entering into social interactions with their own strategies, and operating under sets of rules that structure 'the game' (Cole, 1995). The 'action situation' might as well be, and sometimes is in fact, a 'decision node' in an iterated game (Cole, 1995). And in the IAD framework, just as in the theory of games, jointly produced outcomes from social interactions affect the material welfare of the actors.

After defining a policy question or problem, the focus of the analysis is on behavior in the action arena, which includes the action situation (can be understood as the 'decision node' as described above for simplification), and individuals and groups (i.e., actors) who are routinely involved in the situation (Polski, 1999).. One objective of the analysis is to identify factors in each of three areas that influence the behavior of individuals and groups in the policy situation: physical and material conditions, community attributes (culture), and rules-in-use. Two other objectives are to a) identify and evaluate patterns of interactions that are logically associated with behavior in the action arena, and b) outcomes from these interactions. This can be a very demanding task, even for very simple policy situations (Polski, 1999). Applying the IAD framework to institutional design (this being the focus of this research) or policy analysis triggers thinking carefully about a wide assortment of issues that are important aspects of a particular policy problem. The more comprehensive and precise the analysis, the better the hope of designing successful policy solutions.

To summarise, the IAD framework allows an understanding of the process of how specific outcomes are generated by actors who are involved in a given partnership or collaboration arrangement vis-a-vis allowing the research to unpack how the actors work along together (given conditions in a particular setting) – their role in a joint working scenario or partnership - and their patterns of interaction. It, also thus helps the research design because the methods are

built around an expectation on these elements presented in the framework (a bit more on this is described later in this chapter), so in other words the framework advises 'what' to look for while designing the research approach and tools (as will be explained in chapter 3 on research design and fieldwork).

First and foremost, one of the major limitations of the IAD framework is that it is mainly used for common pool resources management including forests, water resources, fishery management and also for understanding economic development issues such as fiscal policy and credit allocation (Hollick, 1993). Most studies that have used this framework look at common property resources (CPRs) and thus the way the components such as 'rules-in-use' and 'community attributes' work is very different to the context that this research finds itself in. Though the central idea and most of the elements studied under IAD are particularly relevant for this research but there are both practical and specific problems with some of the elements, this will be discussed below.

Cole (1995) observes that not all elements in the framework are yet sufficiently well developed, especially the 'rules-in-use' (a.k.a., 'working rules'). Ostrom (1990) doesn't go much in detail in regards to explaining the relations between formal 'legal rules' and 'working rules'. Cole (1995) clarifies the differences with three proposed hypothesis - *Type 1:* Some formal legal rules equal or approximate the working rules; *Type 2:* Some legal rules plus widely-held social norms equal or approximate the working rules; and *Type 3:* Some legal rules bear no evident relation to the working rules. The point in this limitation can be broadly concluded by saying that these *'rules'* and *'community'* attributes apply more in the context of 'common property resources' and also public property management than in the context of renewable energy technologies, individual or group entrepreneurial performance or exploring aspects of rural development.

Another limitation within the IAD framework are the concept of 'legal rules' and how processes appear only in the generalised and modified form of 'rules-in-use', a phrase that, as already noted, implicitly devalues formal legal rules. So, the question remains, by what processes and to

what extent are formal legal rules translated or converted into 'rules-in-use' (or 'working rules')? It is important to bear in mind that "this is not a question about formal institutions (laws) *versus* informal institutions (social norms) but a question about how rules of any kind are understood, given effect, or operationalized within a given community" (North, 1990: 3). That process of translation or 'mobilisation' itself undoubtedly involves "patterns of interaction" observed across potentially numerous and diverse action situations.

Further on the remaining elements, 'exogenous variables' really are just conditions preceding interactions whereas in reality, system is dynamic. 'Biophysical conditions' and 'community attributes' are not clearly well specified since it could mean a host of different things in a real world scenario (Duke, 2012). 'Evaluative criteria' is a 'black box' (Geneletti, 2002)), but a crucial feedback mechanism for dynamic processes. Insufficient differentiation of types of 'action situations' with different outputs so this research would consider the same as the playing ground of multiple stakeholders to ensure the use of 'action situations' in consistent with what it was originally designed for. Insufficient differentiation of – outcomes and outputs – mediated and unmediated effects of outcomes. The model also neglects the role of economic factors – relative prices, and – transaction costs which are key attributes to look into while studying a decision making scenario involving multiple actors in a given setting. In the literature presented earlier in this section, it's mentioned that a combination of resources and capabilities may not bring success to an entrepreneurial venture if the transaction costs are found to be high – so this is also an important aspect to be considered (but is missing in the IAD framework).

So, the elements that have been selected from this framework are – 'actors', 'action situations' in the specific context, 'action arena', 'patterns of interaction' and finally 'outcomes'. These chosen elements, as have been previously described and explained in this chapter also guides the research design process, as well as helped in planning the methods for data collection during fieldwork. A bit further on this comes later in this chapter.

The research has designed and used a modified conceptual framework by taking elements from both the frameworks, IAD and OECD/EUROSTAT, as discussed in this chapter. Some elements and criterion have been ignored purposefully and with reasons to overcome practical challenges that they would have arisen in the course of data collection. At the same time, a scrutinised list of criterion has been selected in order to build the new conceptual framework and these will be described below in this section.

Table 2.1: Selected items from existing frameworks that are used in the conceptual framework

Framework	**Elements selected**	Elements rejected
Institutional analysis and development (IAD)	Actors, action arena, patterns of interaction, outcome	Attributes of Physical world, attributes of community, rules-in-use
OECD/EUROSTAT entrepreneurial performance indicator	Access to capital and R&D of technologies, capabilities, knowledge creation and diffusion, and culture	Regulatory framework, market conditions

2.4. Conceptual Framework analysing institutions for solar energy entrepreneurship for rural development

The need for bringing in elements from different frameworks

Having knowledge of several different perspectives is useful to clarify differences in assumptions across frameworks, rather than implicitly assuming a given set. Multiple perspectives encourage the development of competing hypotheses that should ideally lead to '*strong inference*' (Platt 1964), or at least to the accumulation of evidence in favor of one

perspective over another. Knowledge and its application of multiple perspectives should gradually clarify the conditions under which one perspective is more useful than another. Finally, multiple perspectives encourage a comparative approach: Rather than asking if theory X produces statistically significant results, one asks whether theory X explains more than theory Y. The above is particularly relevant because this research uses a combination of specific elements from two highly focused frameworks (with their definite objectives) and comes up with a new proposed one in order to address the objective of the study.

Theoretical frameworks address a broad set of factors that political scientists usually look for in different aspects of public policymaking have traditionally deemed important: conflicting values and interests, information flows, institutional arrangements, and variation in the socioeconomic environment. The variation in the socioeconomic environment, in particular, helps a great deal in understanding the dynamics of the impact of different institutional arrangements. For example, the thesis looks at how national level organisations work with private sector alongside community level institutions and local people at the same time to achieve certain preset (development) goals. In light of the content discussed in this thesis that is largely looking at institutions with an idea of the policy processes that surround them, the policy process involves an extremely complex set of elements and actors that interact over time. Each of these actors (either individual or corporate) has potentially different values/interests, perceptions of the situation, and policy preferences. These factors make the necessity of using an analytical framework all the more important.

Most framework meets the criteria of a scientific theory; that is, its concepts and propositions must be relatively clear and internally consistent, it must identify clear causal drivers, it must give rise to falsifiable hypotheses, and it must be fairly broad in scope (*i.e., apply to most of the policy process in a variety of political systems*). Identifying causal drivers is hugely relevant for this work considering the study is investigating institutional arrangement that support entrepreneurs, and thus in order to unpack the arrangements and understand the nature of outcomes, it is vital to learn more about the drivers (*and their interplay*) behind the role. This is where the IAD framework contributes the most. Historically, each framework must be the subject of a fair amount of recent conceptual development and/or empirical testing. Both IAD and OECD/EUROSTAT frameworks have been widely accepted and tested alongside several

discussions and research work in the past years both in academic and industry. Empirical testing helps in two ways – a) maintaining the existing 'causal drivers' as well as b) highlights newer ones that are emerging with new initiatives and policies in the field.

Joining the two theoretical frameworks

The previous section in this chapter described both practical and specific limitations of the two frameworks while also reviewing the elements selected from the two that suits the purpose of the research objective of this study. While both the frameworks are originally separate with their definite roles and objectives, the selection of the carefully scrutinised elements brings them together and makes it one holistically. The modified conceptual framework is presented and described below in diagram 2.4.

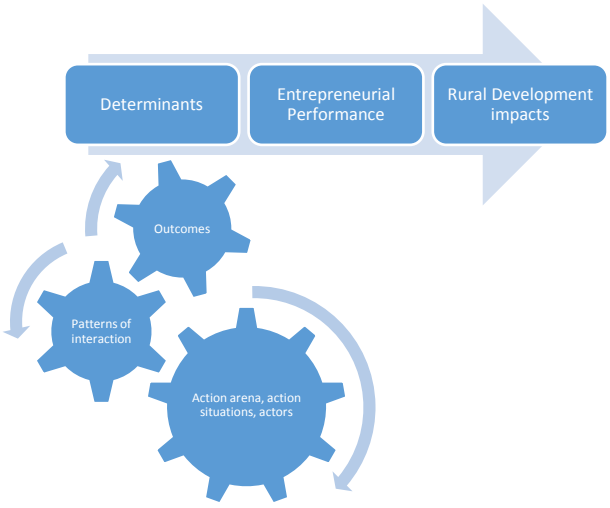

Figure 2.4: The conceptual framework developed for this research

The framework above is designed to specifically address the goals of the two sub-research questions (in the box below) and targets each one of them specifically with a particular approach powered by a set of criterion chosen from existing frameworks described earlier. At the bottom, the selected elements from the IAD framework looks at the different determining factors that shape an institutional arrangement and the consequent outcomes that are ultimately generated. At the top horizontal array, the selected elements from the EUROSTAT/OECD

framework studies the determining factors that affect entrepreneurial performance which then have an impact in the end.

There is something significantly crucial to be pointed out in the framework at this stage and that is the explanation of the point where the two frameworks comes together and becomes one. The 'outcomes' that are generated as a result of the individual and joint role of the actors, their patterns of interaction in a given action situation shapes up the way 'determinants' are created and formed to support entrepreneurs. This is vital to understand because existing studies provide us with a list of determinants, some more important than the others, that supports entrepreneurs but how those determinants are created and shaped has been elusive in literature so far. This is where the conceptual framework as a part of this thesis plays a big role, and this also informs and guides the research design, choice of data collection tools, chosen research approach using which the fieldwork has been carried out for this study.

The two sub-research questions are:

a.What current institutional arrangements support the formation of income generating RETs based entrepreneurship in India?

b. What opportunities for rural development could arise if there is an enhanced private-public partnership amongst the key RETs players?

While the elements selected from the IAD (see Table 1 above) are primarily addressing the first research question, it is important to note that the information of action arena and patterns of interactions occurring between/amongst key actors and institutions involved in the RETs industry in India will be qualitatively collected using interviews and observations. Investigating the patterns of interaction is particularly important because that would reveal a) who are the stakeholders involved in an institutional arrangement, and identifying the key ones, b) what is the role of each of the stakeholders and where they sit in the arrangement, c) how arrangements are formed and maintained, also exploring the cost of a fall out in a given scenario, d) how deliverables and terms of working together are determined in a partnership arrangement or collaboration agreement. These aspects would help unpack an institutional arrangement and

explain how a particular outcome is generated that creates an enabling environment for entrepreneurs. The factors that create an enabling environment shapes the determinants as presented and described in the conceptual framework, and this is where the second part of the framework i.e. the elements from OECD/EUROSTAT comes in.

2.5 Summary

Table 2.1 describes the elements selected from the existing frameworks and used in the newly developed conceptual framework; once again it is presented below.

Framework	Elements selected
Institutional analysis and development (IAD)	Actors, action arena, patterns of interaction, outcome
OECD/EUROSTAT entrepreneurial performance indicator	Access to capital and R&D of technologies, capabilities, knowledge creation and diffusion, and culture

Table 2.1: Selected items from existing frameworks that are used in the conceptual framework

It is important to conclude this chapter by explaining how these elements will guide the research design and tools used during fieldwork. Once the collected data will be churned through the framework, newer themes would emerge from the responses collected from fieldwork and that would form the basis of analysis and discussion of findings, this would lead to the prospective contributions made by this thesis.

The OECD/EUROSTAT framework provides the following elements that include entrepreneurial access to capital and *R&D of technologies, capabilities, knowledge creation and diffusion, and culture*. These aspects forms the basis of the questions designed for interviews meant for targeted actors and institutions during the fieldwork. It also guides the criterion set up for participant observation, another tool that is used during the fieldwork (more on this in

the next chapter). How institutions and an enabling business environment collectively provide an open access to R&D to entrepreneurs is vitally important and this would reveal whether it is the public institutions or private ones or both coming together to do so. This would reveal particular arrangements that explains how specific determinant, such as access to R&D, actually helps an entrepreneur, the tools designed for the fieldwork would also link this determinant to particular outcomes – for example, *does access to capital and R&D leads to diffusion of knowledge in a community and if so what culture is shaped from such an outcome*. The manner in which these technologies (renewable energy based, for this research) are used by the entrepreneur would clearly determine their entrepreneurial capability as well as reveal the different outcomes that they generate in communities. Findings from the fieldwork would also add new elements and features to the framework that in effect would expand the usability of the same in similar and related studies.

In the above two paragraphs, it is described how the conceptual framework helps the research design and guides the overall planning of methodology. It is also pointed out that in the process of investigation and exploration based on the foundations and elements identified in the framework, newer findings emerging from fieldwork and further analysis of the same would add back previously ignored elements in the framework. So the framework would benefit from the research as well.

Chapter 3 – Research design, context and journey

3.1. Exploratory research

An exploratory design is conducted about a research problem when there are a few or no earlier studies to refer to or rely upon to predict an outcome (Labaree, 2009; Verma, 2002). The focus is on gaining insights and familiarity for later investigation or undertaken when research problems are in a preliminary stage of investigation (Schell, 1992). Exploratory designs are often used to establish an understanding of how best to proceed in studying an issue or what methodology would effectively apply to gathering information about the issue (Stebbins, 2001). Exploratory research enables in understanding open questions to unpack the process and to clarify what is happening (Braun, 2006). This research work explores the rural development implications of RE based entrepreneurial initiatives and how the latter receive support from different institutional arrangements in India.

3.2. Qualitative method

While on one hand, the research objective is to understand the nature of composition of different institutional arrangemets by studying nested organisations, on the other the aim is also to understand the impact of entrepreneurship at both community and as regional levels as well as to understand interactions between institutions and how that supports entrepreneurship. Understanding the interaction process between institutions and how different institutions support rural development requires an in-depth analysis of existing institutions, therefore, qualitative research method is the most suitable method for this research.

"Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that makes the world visible. These practices turn the world into a series

of representations including field notes, interviews, conversations, photographs, recordings and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world… the qualitative researcher study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them" Denzin and Lincoln (2000: 3)

Qualitative case study approaches offer several benefits, such as being *open-ended, flexible* and allowing the collection of rich data for the purposes of exploratory analysis; they also offer distinctly capturing the interpretations, interactions and shared experiences and outcomes generated by the chosen actors. Similarly, the flexible nature of research design; the volume and richness of qualitative data; the distinctive approaches to analysis and interpretation; and the kind of outputs that derive from qualitative research, as defining characteristics of qualitative research (see for example Bryman, 1988; Denzin and Lincoln, 2000; Hammersley and Atkinson, 1995; Holloway and Wheeler, 1996). These are considered as benefits of choosing qualitative method and was thus chosen since it allows the researcher to be open minded on the types of data collected and participant selection. Various data collection methods have also been identified with qualitative research such as: observational methods, in-depth interviewing, group discussions, narratives, and the analysis of documentary evidence (Mason, 2002; Miles and Huberman, 1994; Patton, 2002).

However, it is important to note that practitioners of qualitative research vary considerably in the extent to which they rely on particular methods of data collection. Therefore, different qualitative methods are useful in capturing the richness of diverse institutional contexts through in-depth interviews, field visits and participant observations, when focusing on the way actors adopt their strategies according to constraints in their institutional environment. The way in which people being studied "*understands and interprets their social reality is one of the central motifs of qualitative research*" (Bryman, 1988: 8).

The qualitative method used in this research investigates the institutional arrangements that are currently in place to support RETs entrepreneurship, and the impact of RETs

entrepreneurship on rural development in India where the market potential is ripe in light of E&Y (2016) findings where they have put India to be the third most attractive country for renewable energy investment. This being the research aim, along with the components of conceptual framework that identifies factors addressing both *1) business environment and 2) institutional design,* as described and evaluated in chapter 2, guides the research design to a large extent.

3.3. Case study

Merriam (1988: 9) defines case study as "*an examination of a specific phenomenon, such as a program, an event, a process, an institution, or a social group"*, while Yin (1994: 33) defined it as *"scholarly inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used*".

Figure 1: Choosing a Research Strategy	
Strategy	*Form of research question*
Experiment	How, why
Survey	Who, what, where, how many, how much
Archival analysis	Who, what, where, how many, how much
History	How, why
Case study	How, why

Figure 3.1. Choosing a research strategy (Rowley, 2002)

Case study research emphasises detailed contextual analysis of a limited number of events or conditions and their relationships (Hamel, Dufour, & Fortin, 1993). The researcher who embarks on case study research is usually interested in a specific phenomenon and wishes to understand it completely, not by controlling variables but rather by observing all of the variables and their interacting relationships (Thomas, 2010). It is however important to

understand the theoretical difference between *a case and a case study*. Merseth (1994) defined a case as a descriptive research document, often presented in narrative form, based on a real-life situation or event and it attempts to convey a balanced, multidimensional representation of the context, participants, and reality of the situation. Case studies then emphasise the study and contextual analysis of a limited number of events or conditions and their relationships. Yin (1994) noted that case studies can also be used for both theory testing and theory building, while it has the ability to use all methodologies within the data-collection process and to compare within case and across case for research validity (Yin, 1994; Eisenhardt, 1989). It has been used in this research to elucidate findings to generate newer observations and critically showcase results from therein.

This study would use exploratory case studies of specific RE institutions in India to address the research questions. Exploratory case studies would help unpack institutional arrangements as it assisted in systematically collecting information about different actors and stakeholders, their interplay that creates an enabling environment for entrepreneurs in two regions of India, and this technique is defined by Eisenhardt (1989: 34) as *"a research strategy which focuses on understanding the dynamics present within single settings."*

Several 'cases', however, have also presented studies not only on a) *how different institutions works together, but also b) studying the impacts of RE based entrepreneurship on rural development*, to make generalisations by including more cases to study one phenomenon, i.e. the institutional arrangements that supports RETs based entrepreneurship having an impact on rural development.

3.4. Augmenting and applying the new conceptual framework

The purpose of the inquiry is to understand how actions – individually and sometimes collectively – are supporting renewable energy based entrepreneurship in India and then to see the impact of the same. The conceptual framework (diagram below), designed for this research helps in addressing the research questions drawing specific elements from the two

frameworks, i.e. OECD/EUROSTAT framework. The qualitative approach used in this research helped in designing the *method of data collection* (i.e. interviews, observation techniques, key informants), whereas the conceptual framework helped in the *research design* i.e. exploratory. The method of analysis chosen for my study is a qualitative approach of thematic analysis, the conceptual framework (see Figure 3.2.) also helps in identification of initial codes to generate themes upon analysis – this is well detailed in the section on 'data analysis' later in this chapter.

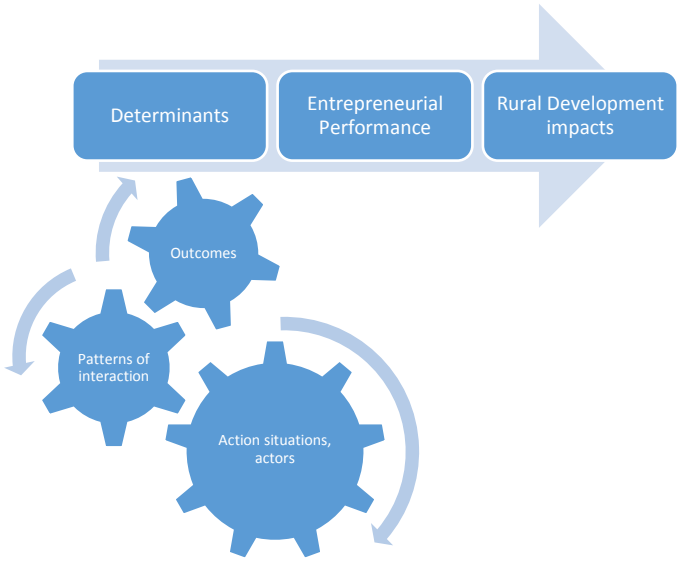

Figure 3.2: The conceptual framework

The first research sub-question explores different institutional arrangements, such as public-private-people partnership, how such partnerships are formed followed by what outcomes are generated by the current institutional arrangements. This analysis is followed by second research sub-question, which focus on investigating benefits that RETs based entrepreneurship adds to a society.

The framework was also used for the data analysis purpose as it provided a holistic view of the institutions, renewable energy based entrepreneurship and rural development impacts. Therefore, in analysing the institutional arrangements the frameworks helped in a) *developing indicators to support in designing interview questions* b) *building and identifying new codes, which*

supported in presenting themes and then results. (Please see appendix, Table 9.6 for data collection topics identified from the conceptual framework)

3.5. Research context

3.5.1. Overview of the Indian RE Context

Globally there has been an upward trend in renewable energy investment, currently worth $244 billion (McCrone et al, 2013). Developing countries alone accounted for 45 percent of investment in 2012, up 19 percent from the previous year (Sargsyan, 2011). As the world moves toward greater renewable energy production, the US and India have emerged as one of the leaders in renewable energy investment. With investment worth $40.5 billion in 2012, together the two countries account for 16.5 percent of global investment in renewable energy. Ernst and Young (2011, 2016) rated India as the world's third best investment destination in the renewable energy sector, behind China and the US (see appendix, Figure 9.7) that shows the trend of global and domestic investment in India's clean energy). This chapter informs about the range of different key actors and initiatives in the Indian RETs sector, and what arrangements do the current institutions create in order to support RE based entrepreneurs and micro enterprises. It also aims to establish the case for three institutions that are identified for detailed analysis in this thesis.

Investment in solar energy in India is expected to increase steadily with the execution of the second phase of the Jawaharlal Nehru Solar Mission (JNNSM), which lasts from 2012-2017 (UN, 2013). India has seen an annual growth rate of about 22% for renewable energy in the last decade. The production from non-conventional sources in India during 2013–2014 is about 53.22 billion units and the major contributors are wind and solar with 31.26 billion units and 3.35 billion units respectively (Barpatragohain, 2015). As stated in the National Action Plan for Climate Change (2012), deploying renewable energy is a strategic priority for India. Under India's most Union Budget 2015–2016, India aims to install 100 GW of solar energy capacity and 60 GW of wind energy capacity by 2022 (CPI, 2015).

The significance and focus on solar

The current solar-based installed electrical capacity is approximately 1.4% of the total. Most parts of India receive 4–7 kWh of solar radiation per square meter per day with 250–300 sunny days in a year (Dodic et al, 2012). Solar energy intensity varies geographically with Western Rajasthan receiving the highest annual radiation energy and the northeastern regions receiving the least. Solar Energy can be used through the thermal route or the photovoltaic route. A few applications of the thermal route are water heating, cooking, drying, water purification and power generation. Through the photovoltaic route it can be used for applications such as lighting, pumping, communications and electrification of villages.

Agriculture involves various time consuming stages in processing, and drying is one of them. Drying in the open sun is not only time consuming but also unhygienic. **Solar dryers** can be used to dry crops and other products. They come in a variety of shapes and sizes, and therefore they can be utilised for various domestic purposes as well as in agricultural processes. The disadvantages of these systems is that they are slower than the dryers using conventional fuels and that they can be used for drying only at 40–50 °C (UNDP, 2012). The Ministry of Non-Conventional Energy Sources is implementing a national programme on solar thermal energy, which provides interest subsidy in the form of soft loans, as these systems are quite capital intensive. The manufacture of specific purposes and sizes as per requirement is restricted in India and hence large systems have to be set up on project-by-project basis.

Solar photovoltaic lighting systems are becoming popular in rural areas of India. They are used in the form of portable **lanterns, home-lighting systems** with one or more fixed lamps, and street lighting systems. Solar lanterns are light and portable, normally designed to provide light for 3–4 hours of light daily. This aids in providing light in huts beyond daylight hours. They normally cost around $62–$68 depending on their capacities. Solar Home Systems (SHS) provide comfortable levels of illumination in the rooms of a house. Various models of SHS feature one, two or four compact fluorescent lamps. Small DC fans or 12-V televisions can also be run by the system. These systems are designed to work for 3–4 h daily, with an autonomy of three days, which means that they can function for three cloudy days. Different SHS models differ in cost depending on the number of compact fluorescent lamps, fans or televisions they can run. They range from a model which can operate one 9 W compact fluorescent lamp at $124 to a model which can operate four 9 W compact fluorescent lamps at $212. Solar lighting

systems are used to illuminate a street or open areas in villages. These are designed to operate from dusk to dawn automatically. The cost of these systems is about $39. The Ministry of provides financial assistance for the promotion of these, among eligible categories of users. (Radovanovi, 2012)

Rural household and remote areas are a major focus of PV programme in India. This has resulted in promotion of a large number of small PV systems, e.g. SHSs, solar lanterns, etc. PV manufacturing in India is set to grow significantly in the near future with a number of manufacturer ready to expand production capacity or establish new production lines. The leading Indian Manufacturer, Tata BP, currently has a cell manufacturing capacity of 52 MW after the establishment of a 36-MW solar PV production line in early 2007; according to a recent press release of the company, the production capacity will rise to 128 MW in 2007–2008 and to 300 MW by 2010.

Improving the uptake of renewable energy technologies in developing countries may be catalysed by certain policy measures, and market incentives, but also by entrepreneurship and local enterprise. In particular, entrepreneurship has been touted as an important solution where fossil energy utilities remain an inherent, embedded feature of the institutional status quo. The risk-taking, innovative, and institution-changing features of entrepreneurial endeavor are key ingredients needed to break the hold of incumbent fossil energies facilitates the spread of renewable energy technologies. Although entrepreneurship has been identified as an important solution for developing countries, the literature's coverage of the challenges that may be faced by entrepreneurs working in the renewable energy space has been fragmented. Indeed, the prominence, effectiveness and unique business models offered by enterprises such as Grameen Shakti, Illumination Solar, and those under the Lighting Africa programme suggest the need for a body of research that focuses on the business models, success factors and challenges associated with renewable energy entrepreneurship, specifically in developing countries. Microfinance and micro-franchising schemes, for example, have been investigated, and factors such as policy overall ease of doing business and government support have been identified as contributing to the success of renewable energy start-ups in developing countries.

3.5.2. Actors and institutions in the Indian RETs sector

In India, out of the total installed generation capacity of 243,030 MW, the private sector has contributed 82,715 MW (Barpatragohain, 2015). The Government is encouraging privatization through combined efforts of public and private sectors for the development of power generation from renewable sources so as to meet the increasing demand of electricity and to reduce the emission of greenhouse gases (MNRE, 2009). The Electricity Act, 2003 promotes competition and creates a responsive environment for investment in the electricity industry for public and private sector (Palit, 2003). Arka IGNOU College of Renewable Energy will setup a 15 KW solar power generating panel on a water body near Eco Park in Kolkata by Nov, 2014 under central government funding (Barpatragohain, 2015). This will be the country's first floating solar power generation facility. M/S Solar Town, a Chennai-based startup has been providing power to residential with innovative business model using solar energy systems. Solar Town has so far covered 70 houses to install 100 KW and is targeting 1 MW by March, 2015 (Barpatragohain, 2015).

The public sector undertakings in India have been contributing substantially in economic and social development for the nation since inception. A MoU between Ministry of New & Renewable Energy and Ministry of Petroleum & Natural Gas (MoPNG) has been signed to improve energy security along with clean energy development through investments in large solar, wind and other renewable energy projects by developing two special purpose vehicles (SPV) (MNRE, 2009). The SPVs will be formed with participation from PSUs under MoPNG and under MNRE that are ONGCL, IOCL, OIL, GAIL, BPCL & HPCL and EIL (Engineers India Ltd), SECI (Solar Energy Corporation of India) and IREDA (Indian Renewable Energy Development Agency). In an initiative of Ministry of Heavy Industries and Public Industries, Ministry of New & Renewable Energy and Ministry of Power, BHEL, SECI, Sambhar Salts Limited, Power Grid Corporation, Sutlej Jalvidyut Nigam Limited and Rajasthan Electronics & Instruments Limited have signed a MoU in Jan, 2014 for setting up of a ultra-mega solar power project with total capacity of 4000 MW at Sambhar in Rajasthan on BOO basis (Barpatragohain, 2015). OIL has also taken up a 5 MW solar power plant in Rajasthan.

Although, large players by and large dominate the manufacturers in the solar sector, there is a significant presence of small and medium enterprises, particularly in manufacturing of rural energy devices like solar cookers and solar lamps (Rai, 2002). There are evidence of strong

collaboration between different actors to promote the growth of renewable energy sources, several strategies have been formulated and implemented jointly by governments, local institutions, NGOs and private sectors. The government has brought some effective regulation in terms of providing incentives and capital subsidy for small and medium size enterprises for investment in alternative energy (Palit, 2003). There has been no import duty for import of solar cell during the last three years and the solar power developers are free to procure from foreign and indigenous sources. The MNRE (2009) has been interacting with developed and developing countries for cooperation in New and Renewable Energy. The focus of the interaction for cooperation has been to explore opportunities for exchange of scientists to share experience and for taking up joint research, design, development, demonstration and manufacture of new and renewable energy systems/devices by R&D institutions/organizations of both countries and thereby establishing institutional linkages between institutions of India and other countries. Bilateral/multilateral cooperation frameworks have been established for cooperation (Barpatragohain, 2015).

India recognizes the importance of international collaboration and interchange of technical expertise for exploitation of alternate energy resources. India has undertaken some effective measures like foreign direct investment, acquisition of modern technologies, and promotion of import/export of products associated with alternate energy. Recently, Norway has supported an electrification project for solar mini-grid plants covering 28 villages in Madhya Pradesh, Uttar Pradesh, Jharkhand and Jammu & Kashmir (Barpatragohain, 2015). M/S First Solar, a US based PV module manufacturer has planned to install a 45 MW solar power project in Telangana through Indian subsidiary and about 75 million kW h of electricity from this plant would be sold to the local utility at 6.49/kW h for a period of 20 years (Barpatragohain, 2015). In addition, a multilateral cooperation framework called Asia–Pacific Partnership on Clean Development and Climate (APPCDC) enables interaction for cooperation with USA, China, South Korea, Japan, Canada and Australia. The following sections list public and private sector institutions along with partnership models that initiates and support solar-based initiatives in India.

3.5.2.1. Public

Manslet and Martinot (2000) noted that existence of domestic regulatory policies could increase the contribution of private capital to sustainable development. Strong government support is

crucial for the development and sustainability of rural energy projects, as they control key institutional, regulatory, and financial tools (FAO, 2000: 46). An emerging role for governments is the management of technology and innovation by incorporating them as an integral part of overall economic policy (OECD, 1999). Furthermore, governments have an essential role to play in the development and adoption of new policies to encourage the private sector, and public-private partnerships, to become involved in improving energy provision in rural areas. Weingart and Lee (2000) opined, *"Successful projects reflect attractive market environment, often shaped by deliberate policy incentives"*. Strong market environments arise from supportive renewable energy policies and legislative frameworks within the context of comprehensive national plans (G8 Renewable Energy Task Force, 2001: 40). This includes effective co-ordination on the activities of different branches and levels of government.

See Appendix Figure 9.8, for the institutional structure of energy administration in India. The following snapshot captures the recent initiatives in the RETs sector in India.

Rajiv Gandhi Vidyutikaran Yojana (RGGVY) – Ministry of power, Govt. Of India
Integrated rural energy programme (IREP)
National biogas and manure management programme
Solar thermal applications in rural areas
Solar photovoltaic programme for rural areas
Remote village electrification
Village energy security program
Biomass based distributed power generation program
Jawaharlal Nehru solar mission
Introduction of feed-in-tariff for renewable energy (since 2009, but only limited in certain states only)

Ministry of New and Renewable Energy (MNRE)

The MNRE is a scientific cabinet-level ministry in charge of production, development, and applications of solar energy, including solar photovoltaic devices. It deploys strategy for

indigenously developed and manufactured new and renewable energy products and services. Besides these, it also assists the RE industry in achieving standards, specifications, and performance parameters while aligning the costs of renewable energy products and services with international standards and facilitate the industry in attaining the same. The MNRE guidelines to all state governments in India specifies policies that states should focus on attracting private sector investment and promote commercial projects in the renewable energy sector. As specific support mechanisms, it also encourages foreign investors to establish renewable energy-based power generation projects on the build-own-operate- model (BOOM) (IAEA, 1014). Exemptions and reduction in excise duty on the manufacture of renewable systems and devices such as solar collectors, solar water heaters, solar PV cells, and wind turbines are also made available. Finally, soft loans are made available on competitive terms to manufacturers and users of commercial and near market technologies through the Indian Renewable Energy Development Agency (IREDA) and certain Indian nationalised banks and financial institutions.

Funding provision by the IREDA

IREDA provides financial support to specific projects to generate electricity through renewable energy. SMEs that manufacture solar system components are supported by the refinance operations of IREDA. In MNRE'S Human Resource Development Strategies for Indian Renewable Energy sector final report (2010), the ministry states detail aims of incubating 500 green entrepreneurs involved in manufacturing of RE products and technologies by 2015, to create new RE jobs. In addition to that MNRE aims to strengthen banks, financial institutions and venture capitalists by creating awareness on potential for growth in RE sector thereby creating more jobs. Allocate specific funds/loans through IREDA and other nationalised banks to encourage new SMEs in RE and existing SMEs for scaling up their operations; in addition to that, conduct special training programs across India on green entrepreneurship, with specific focus on RE. Introduce channels and micro-financing systems to facilitate individuals to buy RE related products thereby creating a demand for higher manufacturing capacity.

"*MNRE should also organise entrepreneurship development programmes or initiating competition, a lot of things could have been done apart from providing subsidy. Subsidy is needed in very poor areas, but I think they could have done all these things in a much better way than providing subsidy and thinking that my job is done. That I feel isn't promoting entrepreneurship. MNRE was built for R&D purposes and also to promote the sector.*" - Faculty, TERI, New Delhi

The importance of State Nodal Agency (SNA) is also a key since most of the decision and initiatives taken up by the MNRE are functionally carried out by the SREDAs (state renewable energy development agencies). The objectives of these SREDAs (e.g., Karnataka Renewable Energy Development Agency, Gujarat Energy Development Agency (GEDA) and Maharashtra Energy Development Agency (MEDA) are primarily to provide technical and financial assistance to those projects that implements renewable energy, and also to assist other agencies in renewable energy R&D. Strengthening of the Ministry and its affiliated institutions is one of the key goals mentioned in the Ministry's strategy report (2013).

The Ministry also has three technical institutions functioning under its control including the Solar Energy Centre, Centre for Wind Energy Technology, National Institute of Renewable Energy. It will be important to strengthen and orient their functioning in line with the strategy of the Ministry. The MNRE specifically aims to develop entrepreneurship for rural electrification through RETs and enabling availability of banks/grant funds for the same cause besides large-scale deployment and movement towards indigenisation as already incorporated in the solar mission. The stakeholder analysis, looking at power and interest, presented in appendix, Figure 9.7. for MNRE's stakeholder analysis, shows all the relevant players that MNRE is engaged with as well as opportunities and threats coming out from them.

Jawaharlal Nehru National Solar Mission (JNNSM/Solar Mission) initiative

"*Maximum self-reliance is the cornerstone of our energy security strategy*" – Former President Abdul Kalam Azad, highlighting the key aim of the JNNSM.

In order to diversify its energy supply to achieve greater self-reliance and meet growing energy demands, the Government had embarked on a concerted effort to explore potential sources of domestic renewable energy. JNNSM is one of several initiatives under the National Action Plan on Climate Change. The mission envisions a gradual shift from dependence on conventional

sources of energy to renewable ones. The objective of the JNNSM is to harvest solar energy on a large scale in India. The mission has three phases (Table 4.1), spanning 15 years that coincide with India's 12th five-year plan period 2012-2017. The short-term objective is to ensure an enabling framework for investing in solar energy, with the ultimate goal of adding 20,000 MW of grid capacity and 2,000 MW of off-grid capacity by 2022. It is estimated that the current operational solar power capacity is approximately 2,000 MW.

Table 4.1. Three phases of JNNSM

Phase	Time period	Grid-connected power	Off-grid solar applications	Solar collectors
Phase 1	2007-2012	11,000 MW	200 MW	7 million sq mt
Phase 2	2012-2017	10,000 MW	1,000 MW	15 million sq mt
Phase 3	2017-2022	20,000 MW	2,000 MW	20 million sq mt

(MNRE, 2012)

State Governments are responsible for sub-transmission and distribution. Since the Government's short-term objective is to create an enabling framework for solar investment in India, it provides subsidies in order to provide an incentive to spur private-sector investment in solar power; the following approaches were followed in the mission:

- *The bundling scheme*, where the central government has a discretionary 15 percent quota in (thermal) power, which can be distributed to states. In this scheme, the central government purchases power from project developers at the market price. It then bundles power from the discretionary quota along with the power purchased from the project developers and sells it at a subsidised price. Companies view this as an incentive to sell power at a higher cost.
- *Generation-based incentive (GBI),* this is a price-based incentive provided to support small grid solar power projects (100 kW to 2 MW) connected to the state utilities.

- *Viability gap funding (VGF)*, this is where the Government fund to support infrastructure projects that are not anticipated to have a high financial return.

3.5.2.2. Private

The appeal of private sector approaches as a potential strategy to satisfy rural energy needs is based on empirical evidence from project implementation that indicates that market-based mechanisms provide an incentive for quality control, after-sale services, and the development of new technology (Weingart and Lee, 2000). This section would mention relevant names of private institutions that have been active in the RE initiatives and had offered social benefits. Below lists some major initiatives taken by private sector players that also highlights the focus specifically on solar projects and technology based solutions.

Table 4.2 below lists relevant other names in the private RE sector in India who have made several contributions to development in rural areas.

Institution	**Founder**	**Areas of contribution**
Auroville Renewable Energy	Hemant Lamba	1. Renting out solar products to RE based entrepreneurs 2. Innovative financial schemes to support entrepreneurs
Azure Power	Inderpreet Wadhwa	1. Delivering clean energy applications to governments, communities, and commercial customers throughout India 2. Offering information delivery and micro finance

		opportunities
Sunkalp Energy	Kanika Khanna	1. Complementary solar laboratory equipment that has been developed in house and is offered with every school project 2. Offering their clients engineering, procurement, construction, subsidy approval and loan assistance services.
Mera Gao Power (MGP)	Nikhil Jaisinghani	1. Setting its solar micro grids in different village 2. Micro grids generate sufficient electricity to run low wattage appliances more than 30 households for seven hours every evening
SKG- Sangha	Vidyasagar Devabhaktuni	1. Setting up biogas plants and providing solar RETs to rural households in Kolar, Karnataka

Table 4.2. Private sector firms and initiatives in the RE sector in India

The Commercialising Renewable Energy in India

The Commercialising Renewable Energy in India (CREI hereafter) project — jointly developed by UNDESA, Winrock International (WI) and Winrock International India (WII) — offers an

innovative approach is anchored to the proven concept of stimulating private investment in the development of renewable energy projects/enterprises by helping entrepreneurs develop projects/enterprises that link renewable energy technologies with productive use applications that generate positive cash flows. The team's upstream enterprise incubation, seed capital investment and financial facilitation services are designed to assist entrepreneurs in designing, structuring and developing such projects and complement the downstream investment interests of Syndicate Bank, Canara Bank, Infrastructure Development and Finance Corporation, and other financial institutions seeking a sound portfolio of well-prepared renewable energy projects/enterprises.

One of the distinguishing feature of this project is that it links the commercialisation of enterprises that match renewable energy technology to productive use applications with the substantial ongoing efforts to develop enterprise capacity in rural areas of India by the rural development trusts of two major national banks, *Syndicate Bank and Canara Bank*, and with the ongoing efforts of the *United Kingdom's Department for International Development (DFID, UK)* to promote sustainable rural livelihoods in Andhra Pradesh (CREI, 2014). CREI has been instrumental in developing small entrepreneurs as expert technicians for their products in rural areas by assembling a technician kit and supplying such kits to the qualified small entrepreneurs. The project is structured so as to expand the enterprise incubation services offered under the rural development programmes offered by DFID, Canara Bank and Syndicate Bank to include assistance to entrepreneurs in designing and developing renewable energy enterprises/projects that create opportunities for income generation activities and help to establish capital and service chain linkages involving local private sector entities, non-governmental organizations (NGOs), technology suppliers and financing institutions.

Aga Khan Rural Support Programme

Aga Khan Rural Support Programme (AKRSP hereafter), founded in 1984, has contributed to rural development in India by reaching over 500,000 beneficiaries in over 110 villages in the states of Gujarat, Madhya Pradesh and Bihar (AKDN, 2015). Over 4,000 village organisations

have been created. Apart from contributing to improved food security and increased incomes, AKRSP has worked on soil and water conservation, forest conservation and management, climate resilience, portable water and sanitation, community organisation; it has supported several alternative energy projects in North India. The primary aim of the foundation was to seek a solution to the drudgery of rural woman who spends 2 to 3 hrs daily collecting fuel wood, ASRSP first piloted biogas plants in Gujarat. In Bihar, where the electricity supply is usually not available (despite electric lines in place), AKRSP piloted solar lanterns that can be charged at a central charging station run by an entrepreneur. Also, to address the destruction of the *Gir* Forest because of firewood collection, AKRSP has also piloted biogas plants, solar cookers and windmills, including a low-cost windmill for water pumping. Until 2010, AKRSP had supported the installation of nearly 14,000 biogas, solar and wind systems. The ultimate aim of the programme is to reduce the consumption of biomass and non-renewable sources such as kerosene and reduce the drudgery and indoor pollution affecting rural women.

SELCO India Private Limited

"*The fundamental (premise in founding SELCO) was how to balance social, economic and environmental stability at the same level. And to destroy myths like the poor can't afford technology, the poor can't maintain, and thirdly that you can't run a commercial venture while trying to meet social objectives*"- MD, SELCO India, Bangalore

SELCO is a private US company with US, British, German and Swiss shareholders. SELCO India was founded to provide clean, reliable, safe, and affordable solar power systems to households and businesses that have no other means of acquiring electricity. Also, to provide the highest level of service to its remote and dispersed customers; combine profitable operations with sustainable social, economic, and ecological development; enhance the quality of life and improve productivity throughout rural communities in the developing world by replacing dangerous, dim, and unhealthy kerosene lamps and candles with electricity made from sunlight. In addition, SELCO home lighting systems contribute to income generation for household crafts people and enhance productive use for education and communication. For

making finance available for the RE based entrepreneurs, SELCO works with numerous rural banking networks, agricultural societies, and micro-credit institutions.

SELCO India's contribution to cheap solar power access to rural India started off by launching Solar Electric Light Company of India (SELCO) to give the poor a cheap access to electricity from solar RETs. The company received international co-operation and collaboration from E+Co who became the investment partner for SELCO and this also specialised in social entrepreneurship. The model of SELCO has proved that in rural India, solar power in cheaper than conventional energy. SELCO partnered with small banks throughout rural India to bring electricity to more than 100,000 village homes that never had any electric light. The myth that the poor can't manage a small loan and keep their power system running was broken by SELCO's model.

They also developed an innovative financial support scheme that changed the way other similar institutions support entrepreneurs in recent years. An example of how this works would be cite a small story of an Indian villager who ran a market stall and she spent Rs. 450 monthly on kerosene while the repayment rate of a solar panel costs Rs.300 every month. The case is interesting because given the villager's regular day-to-day expense; she can pay Rs.10 everyday instead of making a monthly saving of Rs. 300 for repaying the solar panel loan. So SELCO's model allowed that to happen by arranging a daily loan of Rs. 10 instead of a monthly Rs. 300. SELCO has succeeded not just for powering village households by solar panels but also commercial purposes like charging mobile phones for village hawkers/entrepreneurs. This is about syncronising payment rhythm with income patterns.

There are a few things that are a part of SELCO's product design and business model that explains how it functions. Firstly, SELCO provides customised solution to individual household energy problems and thus they have not been into product standardisation large-scale. They have tied up and have strong interdependence with local supplier and product assemblers. Secondly, it also provides door step finance to RE based entrepreneurs and to make it available, they have ties with regional rural banks as well as nationalised banks – this significantly plays a big role in benefitting the clients who wouldn't be able to afford the RETs without this financial

support from banks. They have ties with research thinktanks; both national and international, to develop and design better products over time. Instead of spending any money on marketing, the company focuses all their resources on understanding the energy demand of individual households, so they have a very highly functional technical and sale team whose members makes regular visit to their target villages and speaking to local people. In effect, the clients are a key stakeholder with whom they work in order to better understand the nature of individual household energy demand and use. In some villages, SELCO India partners with NGOs and community organisations as well to access a remote area and communicate with the villagers.

So, the range of stakeholder and the private-private partnership model that can be seen in SELCO India's case include – local suppliers, manufacturer and assemblers, banking and financial institutions, field-active technical staffs, user clients, NGOs and VOs. One point however to be noted in this particular case is that SELCO India doesn't work with either the MNRE or any SREDAs, specifically any public institution.

Till date, SELCO has sold solar lighting to more than 110,000 rural homes and to 4,000 institutions such as orphanages, clinics, seminaries and schools in the Indian state of Karnataka (Koppa and Willoughby, 2007). An impact assessment study by World Resources Institute in 2007 reported that 86% of SELCO's poor customers cited significant savings in energy costs as their primary benefit of using SELCO products, while the rest pointed to their children's education as the primary benefit. Moreover, SELCO's inclusive business model has led to the creation of employment not only for its own employees but also for several rural entrepreneurs who rent out solar lights to vendors and institutions. This institution will be looked at in –depth in this thesis.

Indian solar power industry is growing rapidly with great potential for all level enterprises. As per the latest study report by Ernst & Young (2016), India ranks (after the US, China, and Germany) third on the wind renewable index, and ranks second on the solar index. Renewable business scenario in India is moving away from policy driven to parity driven and more entrepreneurs are coming forward to with the vision to lighten India in eco-friendly way. For the development of renewable energy the Jawaharlal Nehru National Solar Mission (JNNSM) aims to produce 10 per cent of its energy from solar-20 GW-by 2022. In order to gain from

India's solar energy potential, several states have been pro-active in promoting solar by the way of separate state level policies and incentives norms. However, now a level of consolidation is taking place with several of the larger companies acquiring smaller ones and some of the inefficient players exiting the market. Entrepreneurs should consider this space only if they have a good background in the area and are ready to work in an extremely competitive environment in terms of costs and quality.

3.5.2.3. Partnership models

This section looks at a very commonly observable phenomenon, i.e. public private partnership model that are present in several RE based institutions in India. In recent literature, several institutions, including United Nations ESCAP (2015) have come up with the concept of Pro-Poor Public Private Partnerships (PPPPP) which is add on to the existing PPP considering it adds the 'people' component to it. Inclusive programme design and adding 'last mile' agents in the supply chain of implementing plan calls for such innovative approach. Although the primary role of MNRE includes a) subsidy provision and b) policy-making in the RE industry in India, but another key objective is to support the private sector to work and build themselves in the industry. The private sector firms who are RE based are practicing a far more inclusive approach involving people at the grassroots. The different institutional arrangements are thus interesting for this study in order to address the research question.

ONergy, West Bengal – India

ONergy (Punam Energy Pvt. Ltd.) provides decentralised complete energy solutions with an entire range of solar products to underserved households and institutions. ONergy's strength lies in developing high quality products, strong after sales service network, facilitating consumer financing for solar systems and developing an ecosystem for sustainable development and rural empowerment. ONergy has impacted 2,50,000 lives by providing solutions such as solar lanterns, solar home systems, solar water heating systems, solar inverters, solar street lighting, cook stoves, KW installations for households and institutions (ONergy, 2013). ONergy has also launched new and innovative products such as solar TV, solar computer,

solar micro grids and solar irrigation systems. ONergy has creates unique full service distribution infrastructure by establishing Renewable Energy Centres (RECs). It operates through a network of trained rural entrepreneurs and leveraging the existing networks of local NGOs, SHGs and MFIs. Currently, it operates across West Bengal, Odisha and Jharkhand through a network of RECs that reach out to remote areas. ONergy has also been selected as a channel partner under the Solar Mission of Ministry of New and Renewable Energy (MNRE). It has strong national and international partners that support in developing new and innovative solutions for its customers. ONergy's mission is to energise over 1 million rural lives by 2017 and impact 10 millions lives by 2023 (ONergy, 2014).

Besides investor and business partners who comes from both public and private sector, e.g., Centre for Innovation incubation and entrepreneurship, Women's interlink foundation, TERI (the energy resource institute), ONergy also have Knowledge partners (e.g., practical action), financing sector (e.g., Bank of India, Vananchal gramin bank), NGO partners (VSSU – Community development through community resources), Government/ institutional partners (West Bengal renewable energy development agency, MNRE India, NABARD, UNDP). (TOI, 2014)

In Sundarban islands, ONergy has installed solar systems in 5 schools providing lighting to thousands of school students who have suffered reading under the poor kerosene light. Students are now able to study longer into the evening without the harmful effects and smoke from kerosene lamps. With the support of Odisha Tribal Empowerment & Livelihoods Programme, ONergy has installed 33 solar streetlights in remote tribal areas of Western Odisha. Community members benefit from increased security, safely moving around at night without the fear of snakes, animals, and other predators (ONergy, 2015). Onergy has installed a 4000 litres Solar Water Heater to directly provide hot water to all the patients in their bathrooms, operation theatre and canteen at B. M. Birla Hospital, Kolkata. For B. M. Birla, the other benefits of hot water from Solar are; it's reliable and safe and is available 24x7 throughout the year.

ONergy has setup a 2 HP Solar Irrigation system at Betna village in Nadia district replacing a Diesel Pump set, powered by a 2.4 Kw Solar power plant. The farmers who were charged Rs 100 for an hour of water are now only charged Rs 70 per hour from the solar pump, the system has remote monitoring capability - that allows for the control of water supply, and also monitors the functioning of the solar pump. ONergy has successfully implemented this solar irrigation system in West Bengal charging farmers on a pay-as-you-go basis. The project is jointly funded by NABARD through the Rural Innovation Fund. ONergy is in the process of setting up another 3 HP solar pumps with water storage facility of upto 30,000 litres for vegetable farmers at Bagnan, Howrah. In addition to the above, ONergy also support entrepreneurs to set up micro businesses using renewable energy technologies, the following quote explains the nature of support. (Onergy, 2012)

> *"In Raidighi (West Bengal), Arun the owner of paper mill factory is able to work for longer hours and with more precision because of the installment of Solar powered lights and fans. Arun is able to create party strings, which he sells in Kolkata because of the reliable source of light and electricity. Like the above Paper Mill Factory, ONergy supports several other small businesses, Self Help Groups and other groups in providing reliable source of electricity and lighting and increasing their monthly income and livelihoods"* - Communications Head, ONergy, West Bengal

The Energy and Resources Institute (TERI)

The Energy and Resources Institute (TERI hereafter), established in 1974, is an India-based independent, not for profit research institution, committed to aspects of energy, environment, and sustainable development. From providing environment-friendly solutions to rural energy problems, tackling global climate change issues across many continents to enhancing forest conservation efforts among local communities, advancing solutions to growing urban transportation and air pollution problems to promoting energy efficiency in Indian industries, the emphasis has always been to offer innovative energy solutions.

Lighting a billion lives (LaBL), this TERI initiative is based on an entrepreneurial model of energy service delivery that seeks to provide high-quality and cost effective solar lanterns, disseminated through micro solar-enterprises set-up in un-electrified or poorly electrified villages. This *fee-for-service* model aims to ensure that several regions of rural India where access to conventional sources of energy and light is still a challenge gets access to clean energy at an affordable price. While the capital cost of setting up the charging station in the village is raised by TERI through government agencies, corporate donors, communities etc., the operation and maintenance cost is borne by the users of the solar lanterns in the form of the rent that they pay to the operator of the charging station (TERI, 2010). The rental is decided based on the expenditure on kerosene, the fuel for lighting in the absence of electricity. This has ensured that communities are able to afford new technologies and shift from the polluting kerosene lamps to clean and bright solar lamps. The attempt is to create a network of rural solar enterprises for enabling easy penetration, acceptance and longer sustainability of the solar technology in the rural markets. TERI also carries out extensive research to come up with latest product design and standard specifications, along with ensuring cost-effectiveness keeping in mind the field requirements.

The main objective of the programmme is to enable *a billion lives* to access clean and sustainable modern lighting solutions. Through solar lighting the initiative is contributing towards sustainable rural development in more than 1750 villages impacting more than 3,82,000 lives, across 22 states of India (GNESD, 2016). For continuous development of state of the art technology and design for solar lanterns, TERI has partnered with some of the major players in the lighting, semiconductor and PV industry to customize and develop robust and reliable solar lanterns based on the user feedback and other field related learning. LaBL-EE (Energy Enterprise) is a local level enterprise that provides after-sales service support to LaBL SCSs and is also authorized to market and sell LaBL solar products in a specified territory. Apart from providing next door, reliable after-sales support, it also aids in imparting training and local capacity building for the execution of other energy access projects in the area. They have collaboration with 60 grassroots partners has provided base to sustain the initiative and has also built the institutional capacity of these organizations towards replicating the model in other regions (Palit and Singh, 2011). The initiative has reached out to the remotest and most inaccessible areas as well, covering tribal belts and difficult terrains, with support from these grassroots organizations.

TERI facilitates access to finance for the entrepreneur through local financial institutions. Where necessary, TERI provides viability gap funding to the entrepreneur (through TERI and/or the partner organizations including government agencies). The primary emphasis is on harnessing pro-poor public-private-partnerships for delivering PV based multiple technology solutions to access energy for rural communities. A notable innovation in the delivery model was linking it with micro-finance institutions (MFIs) to augment new and existing rural enterprises. This was done by setting up solar charging stations with MFIs affiliated for funding with nationalized rural banks and state-run rural livelihood programs and promoting innovative financing of solar charging stations with commercial banks to design and implement a scale-able semi-commercial business model for financing solar charging stations. While the programme has been able to effectively collaborate with 60 grassroots partners which include NGOs, CBOs and other local government agencies, village level entrepreneurs are the main fulcrum of the interventions and they are the most responsible for ensuring the success of the programme (Palit and Singh, 2011). Similarly the users play an equally important part in decision making for the project implementation. Equity contribution from the village level entrepreneurs / operators and users makes them important stakeholders for decision related to fixing the rent, choice of site and technology etc. Village meetings and group discussions conducted after sensitizing the communities about the initiative helps in implementing the programme with local stake and participation.

TERI works under the Government of India initiative called the Jawaharlal Nehru National Solar Mission (JNNSM) and is being promoted to enhance access to clean energy in remote energy-impoverished regions of the country. The JNNSM has supported TERI in scaling outreach of the LaBL programme. TERI is also Programme Administrator for Off-grid Solar Applications under the JNNSM. In addition, TERI has received financial support for LaBL program as per standard JNNSM norms. LaBL's *fee-for-service* model has been regarded as a best practice and has been adopted by "The Planning Commission of India for solar charging stations under their programme for developing some of the under-developed districts of the country (Bose et al, 2012).

Tribal communities using solar lanterns in Odisha have witnessed increase in study hours of children and similarly villagers in Dandipadiya village of the state use the lanterns to deter animals from approaching human settlements which effectively limits prospects of human and wildlife conflict. The community members in the states of Uttar Pradesh and Madhya Pradesh have been using the clean lighting provisioned as part of LaBL program to augment their business hours post sunset. Similarly, health workers and midwives in Madhya Pradesh use the solar lanterns to deliver medical aid after daylight hours. The lanterns have also been used for safe delivery of babies in rural communities. The woman entrepreneurs of LaBL charging stations have experienced a boost in their confidence resulting from the earnings. (TERI, 2016)

TERI has been selected for further analysis in this thesis due to a host of reasons and they are a) wide network of stakeholders from pretty much all actors involved in the RETs sector in India b) provides a holistic support to energy entrepreneurs, starting from sensitising, nurturing to training and providing finance to set up RE based micro enterprise c) works closely with NGOs, community organisations and directly with energy entrepreneurs. Investigating TERI, given its long experience and wide network of partners and institutions in the sector would provide an insightful understanding about how RE based entrepreneurship is supported.

All India Women's Conference

All India Women's Conference (AIWC hereafter), a national women's organisation established in 1927, is a premiere NGO working to uplift the status of women in society as well as to empower them through education and training, enlighten them through various awareness programmes on different issues. AIWC now have over 500 branches across India with over 125000 volunteers. Their main areas of operation are literacy, health, awareness programmes, disseminating renewable energy, bringing in legislative reforms (AIWC, 2016). They run training and awareness programmes on energy conservation and energy efficiency, and also conduct programmes for poverty alleviation through solar appliances are also conducted. One

of their key areas of interest is to empower women and prepare them for taking up leadership roles.

AIWC has been the nodal agency for the MNRE for the purpose of dissemination of non-conventional energy sources and technology awareness purposes with a strong focus on empowering women to be self-dependent by setting up their own micro businesses. Training and awareness programmes on energy conservation and energy efficiency are conducted by the AIWC throughout India; they also conduct programmes for poverty alleviation through solar appliances. One of the RETs based initiatives that they have been offering women to set up micro businesses are solar dryers for agricultural produce. In addition to solar dryer, solar lantern, solar cooker and solar lamps have led to setting up of successful micro businesses in both urban and rural India. AIWC supports installation of solar charging station, providing women with solar lanterns and help in building RETs based micro enterprise. However, their programmes with solar dryers have been more widespread, they provide training to the entrepreneurs to use solar dryer and covert agricultural produce to value added products.

Besides providing these RETs to primarily women for free (funded by the IREDA, the finance wing of the MNRE), AIWC has a very big role to play in training, capacity building and nurturing business capabilities in women. Although the initiatives are done on a project basis, several case studies show that they remain in contact with their existing trainees and women entrepreneurs and in many cases help these entrepreneurs to scale up their micro businesses. Continued training is provided for assembly, installation, maintenance and repairs of solar cookers (box and parabolic), solar lanterns and solar panels to groups of women in slums as well as disadvantaged groups (e.g., rag pickers). On completion of training, the beneficiaries are encouraged to form self-help groups (SHGs) and undertake various maintenance and repair jobs. AIWC also partnered with RETs manufacturers who offer to engage the women in assembly of units in their homes. (Inforse, 2011)

The reason for selecting AIWC for further analysis in the thesis is due to a host of factors, a) it is a nodal agency for the MNRE for disseminating RETs to women and the disadvantaged in the society and have a wide coverage of areas b) works with the public institutions - IREDA for

funding, research bodies and Universities for developing and organising training programmes c) works with RET manufacturers as well as with NGOs and VOs, and d) women entrepreneurs who they help with setting up micro enterprises. Studying AIWC provides a holistic overview how the multi-partnership model works, specifically to support RE based entrepreneurs. Being one of the oldest social institutions in the country, the lessons learnt from their cases and experience can be considered valuable.

Summary

This section on general overview of the Indian RE context informs on initiatives that different RE based institutions in India, singularly or a partnership model, have taken to support entrepreneurs and set up micro enterprises. As evidenced earlier, there is a big potential of renewable energy in the Indian power sector for household, agriculture, rural, industrial and several other purposes. This is coupled with the fact that there is an increasingly great amount of investment that the country has attracted in this sector both from domestic and international institutions. The arrangements that different institutions are making involve several actors from different levels in the sector. They can be labeled as 'nested' institutions as Ostrom (1971) maintains.

The institutions discussed in the above sections shows that the RE based entrepreneurs are being supported by a range of different institutional arrangements – *private model*, wherein private firms are partnering with multiple other private firms and the latter being key stakeholders (e.g., SELCO); The *public model* where the Government initiatives are aiming at electrifying villages for rural development goals (MNRE, JNNSM). Next is the *public-private partnership model,* this is where several actors are collaborating and co-operating to support entrepreneurs (e.g., AIWC, ONergy). In addition to that, a new emerging idea of PPPP (public private people partnership) where the private sector institutions, in addition to working with public sector, are also partnering with community based/voluntary organisations in order to access remote areas, raise awareness and nurture the place before any RE based initiatives are taking place (TERI). The thesis will be investigating three different arrangements by looking at different institutions, SELCO (private model), AIWC (Public private partnership) and TERI (Public private people partnership). The following chapter investigates how different

institutional arrangements create an enabling environment for RE based entrepreneurs and micro enterprises in India.

The purpose of the inquiry is to understand how actions – individually and sometimes collectively - are supporting renewable energy based entrepreneurship in India and then to see the impact of the same. An intensive field investigation was carried out starting August 2014 until January 2015.

[Please see appendix for Table 9.7 to see the list of institutions studied during fieldwork.]

3.5.2.4. Study sites and institutions studied

The research design for this study recognises the particular importance of studying actors and their interactions in order to understand the nature and components of different institutional arrangements (Ostrom, 1980). Therefore with the focus on actors and their interactions in the process, some criterion were developed to select the study sites and the institutions: *a) presence of key institutions and partners b) scale and scope of the operations nationwide (or heavy spread in a particular region) c) number of years in the business d) the degree of impact on entrepreneurship and consequently on the community and e) evidence of multiple stakeholder partnerships and consequent institutional arrangements that they embody.* The institutions were studied in two Indian sites. Based on these criterions two study sites were chosen for this research. On top of the above points, justifying how sites and institutions were chosen, the focus was to identify how solar (specifically) entrepreneurs are supported. This will be noted in every case and institution investigated in the following sections and chapters of this thesis. Also, refer to appendices for Table 9.8.

Study site 1: New Delhi

Figure 3.3: Location of New Delhi in India

New Delhi was a selected study site since it is the hub of major stakeholders in the RETs industry in India such as from ministries, solar technology firms, and research thinktanks to Universities, solar RETs based NGOs and solar technology users (Table 3.1 below). Delhi also hosts the big solar based RETs manufacturers, for example – TATA Power Solar, BP Solar and Kotak Urja. Also importantly, it is the home of the MNRE (Ministry of New and Renewable Energy) who exercises a somewhat parental control over the RE industry via policy design and implementation as well as provision of various subsidies in the sector to promote any form of RETs initiatives in the country. The MNRE however have its own extension ministries at the state level, called the SREDAs (State Renewable Energy Development Agencies) and finance division named IREDA (Indian Renewable Energy Development Agency) that co-ordinates budgeting and grants to subsidiaries and third parties. Further details on the above listed institutions will be in the section on data sources. Table 3.1. lists the energy related institutions based in New Delhi.

Table 3.1. List of energy related formal institutions in New Delhi

Institutions	Website
Central Agencies	
Ministry of New and Renewable Energy (MNRE)	http//www.mnes.nic.in

Indian Renewable Energy Development Agency (IREDA)	www.iredaltd.com
Rural Electrification Corporation Ltd	www.recindia.nic.in
The National Small Industries Corporation Ltd	www.nsicindia.org www.techshowindia.com
State Agencies	
Delhi Energy Development Agency	
Associations	
Indian Wind Energy Association	http://www.indianwindpower.com
Indian Wind Turbine Manufacturers Association	
Institutes/ R&D	
Integrated Research and Action for Development (IRADs)	www.irade.org
The Energy Research Institute – TERI	http://www.teriin.org
Asian and Pacific Centre for Transfer of Technology – APCTT	http://www.apctt.org
Centre for Energy Studies	
Centre for Science and Technology of the Non-Aligned and Other Development countries	
National Physical Laboratory	

In regards to the sites chosen in Delhi, interviews and participant observation were carried out in Delhi suburbs with women who were running RETs based micro business sponsored and trained by the AIWC (All India Women's Conference) as well as solar entrepreneurs (both men and women) set up by LaBL (Lighting a Billion Lives, TERI). Members of the above-described actors accompanied the researcher to the field on several occasions.

Regular planned visits were made in various areas of Delhi such as *Hauz Khaz, Bharat Nagar, Saket, Nehru Place, Gandhi Nagar, Anand Bihar, Janakpuri, Darya Ganj, Vasant Vihar and* several zones in *Noida* and *greater Noida* area, where these RE based entrepreneurs were found using

the technology to run business. They were then either interviewed or participant observed or both in some cases.

See Appendix Table 9.9.

Study site 2: Karnataka

Figure 3.4: Location of Karnataka in India, southwestern region of India

Karnataka has about 30,000 MW of officially estimated Renewable Energy (RE) potential, making it one of the country's top RE-rich states, it has an installed electricity generating capacity of about 14.3 GW out of which 4.7 GW or 25% (figure 2) is from RE sources. 10% of the state's utility generation comes from RE sources. The state nodal agency, responsible for RE

development in the state- under the purview of the energy department – is the Karnataka Renewable Energy Developing Agency (KREDL). KREDL works as a facilitator between industry, finance, government, and technical experts to increase the deployment of RE in the state; this in addition to provision of 30% subsidy to RE technologies bought by households in rural areas or by companies who initiates a RE based business. The main RE resources as per these estimates are below.

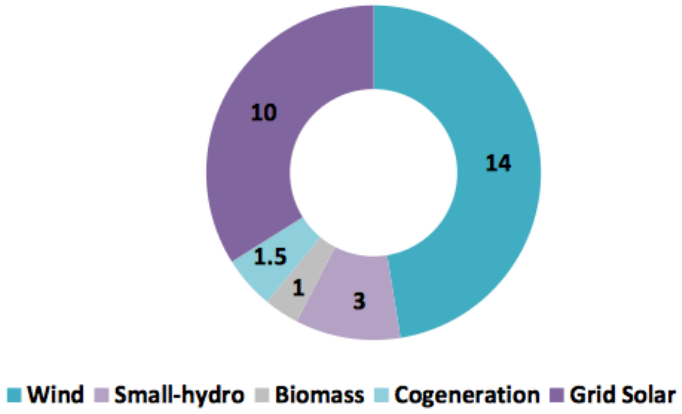

Figure 3.5: Resource-wise RE potential in GW

Karnataka was targeted as a study site, The focus was on Bangalore and on villages in northern and eastern parts of the state since a wide variety of local institutions backed by state level Government agencies work in parallel to support RE based entrepreneurship in the villages. Starting from street vendors, micro businesses and home lighting systems – RE technologies have a strong presence in this state. Therefore, making Karnataka a study site enabled in exploring the impacts of different institutional arrangements on RE based entrepreneurship and rural development. In Karnataka, Kolar district was chosen as a study site from where other villages in eastern Karnataka were commuted to for data collection. The *'taluks'* (villages) where fieldwork was carried out were *Srinivaspura, Bangarpet and Mulbagal*. Staff members from institutions, who were approached for data collection, accompanied visits to several villages and are actively engaged in RETs led rural development activities on a daily basis.

Kolar district is well known in the state of Karnataka since a decade now because of continued RETs initiatives and range of institutions actively involved in several of its villages. This district is located at a distance of about 70 kilometers (43 mi) from Bengaluru and 32 kilometers (20 mi) from Kolar Gold fields. The region is located on the southern *maidan* (plains) region of Karnataka. The Ammerallikere, a tank, forms its eastern boundary. To the north is the Kodikannur tank, the main source of water supply to the city.

Figure 3.6. Map of Kolar district, Karnataka

Kolar district has a population of 1,540,231, roughly equal to the nation of Gabon or the US state of Hawaii. Kolar has a sex ratio of 976 females for every 1000 males, and a literacy rate of 74.33%. The district, at its greatest length, reaches about 135 km from north to south with almost the same distance from east to west. The official language spoken in this district is Kannada. (Census India, 2011)

List of interviewees and methods chosen in New Delhi and Bangalore

Interview	Institution	Position	Location	Methods chosen
1	Jawaharlal Nehru	Chairman – SSS1	New Delhi	Semi-structured interview

	University			
2	Ministry of New and Renewable Energy (MNRE), Government of India	Director- General	New Delhi	Semi-structured interview
3	Jawaharlal Nehru University	Research Scholar	New Delhi	Semi-structured interview
4	Jawaharlal Nehru University	Professor	New Delhi	Semi-structured interview
5	TATA Power Solar	Vice President	New Delhi	Semi-structured interview
6	Department for Science and Technology, Government of India	Senior Scientist	New Delhi	Semi-structured interview
7	All India Women's Conference	President	New Delhi	Semi-structured interview
8	Green Grants India	Associate	New Delhi	Semi-structured interview
9	TERI (Energy Research Institute, India)	Senior Research Fellow	New Delhi	Semi-structured interview
10	Centre for Science and Environment (CSE),	Director	New Delhi	Semi-structured interview

	Government of India			
11	Indian Institute of Technology – Delhi (IIT-D)	Professor	New Delhi	Semi-structured interview
12	Light a Billion Lives (LaBL), TERI	Associate Director	New Delhi	Semi-structured interview
13-20	AIWC	Beneficiaries	New Delhi, Bangalore	Participant observation, key informant interview
21	TATA Power Solar	Technical Executive	New Delhi	Semi-structured interview, participant observation
22	AIWC	Regional Head	Bangalore	Semi-structured interview
23	TERI	Director	Bangalore	Semi-structured interview
24	SELCO India Private Limited	Managing Director	Bangalore	Semi-structured interview
25	SELCO India Private Limited	Principal Analyst	Bangalore	Semi-structured interview
26-28	TERI	Library staff	Bangalore	Semi-structured interview
29	KREDL (Karnataka Renewable Energy Development Limited)	General Manager,	Bangalore	Semi-structured interview
30-34	SKG – Sangha	Field team – vice president, supervisors and field coordinators	Bangalore	Semi-structured interview, key informant interview, participant observation

35	SKG- Sangha	President	Bangalore	Semi-structured interview
36	KOLAR unit, SELCO	Sales Executive	Bangalore	Semi-structured interview, participant observation
37-45	SELCO	Beneficiaries (silk weavers, vegetable vendors)	Bangalore	Semi-structured interview, key informant interview, participant observation

Table 3.2. List of interviewees and methods deployed

Institutions studied

Institutions that have been studied include TERI, AIWC, MNRE, and SELCO India. These institutions were chosen on the basis of 1) continuous partnership with industry, academic and RETs firms, contractual arrangement with major RETs manufacturers, multiple stakeholder partnership, policy and RETs sector planner (e.g., MNRE), 2) Range of operations, scale of reach, multiple stakeholder partnership, 'last mile' agent through LaBL initiatives, planner for major policy level planning for MNRE (e.g., TERI), 3) Works with national and local Governments, work with academic and industry, multiple stakeholder partnerships (e.g., AIWC), 4) Doesn't work with the Government, manages the entire supply chain and value chain of their products, heavy reliance on local suppliers and manufacturers, creates RETs based entrepreneurial ventures, treat customers as business clients and help them integrate with the market and banks (e.g., SELCO), 4) as mentioned earlier in this chapter that the thesis focuses on solar entrepreneurship as much as it is investigating institutional arrangements that support such entrepreneurial initiatives, all these institutions studied below are focusing on building and sustaining solar entrepreneurship at various levels, this is another reason for selection [Please see appendix for Table 9.8 that lists the reasons for selecting the four institutions for this research.]

The Energy and Resources Institute (TERI)

A pioneering organisation looking at climate policy and sustainable development issues alongside several other social protection mechanisms has been a very resourceful organisation for this research. However, since this research focused more on renewable energy the emphasis was given to 'Lighting a Billion Lives' (LaBL hereafter), a dedicated wing of TERI that has been very proactive in designing and delivering RETs in rural areas across India – their operation area covers more than 7 states and Union Territories – they are also an advisor and policy designer for the MNRE so they work closely with the MNRE in designing and delivering the policy framework which then is further supported by other actors in the industry. The recent reverse-bidding process involved in the tendering mechanism for RETs projects issued by the MNRE is also a brainchild of TERI.

TERI also came up with the concept and position of '*torchbearers*' where in young adults, University students, and young graduates can work with them as interns and become the 'last mile agents' (described earlier in the chapter). This research also presents a range of stories from the 'torchbearers' to provide an insight about how the projects are designed and maintained, how deliverables are determined, how last mile agents of development makes a key contribution to the value chain of any intervention.

Both the Delhi and Bangalore branches were approached and studied – the Program Directors, the Associate Directors, The Directors, beneficiaries were interviewed in the process alongside looking at some of their project documentations and published reports on the torchbearers and RETs interventions.

All India Women's Conference (AIWC)

All India Women's Conference (AIWC) work extensively for the progress and welfare of women and children as well as to empower women and prepare them for taking up leadership roles. Both primary and secondary resources from AIWC have been very resourceful; they have been empowering women with a range of initiatives besides helping them form SHGs using

non-conventional energy and related programmes over the past 20 years. They have also been kind to share their library resources and allowed substantial level of participation in the process. Integrating microfinance, provision of training and development (both financial and business) to women to run self-sustaining micro enterprises are a few of the many thing that AIWC has been doing for over 4 decades now. The experience of AIWC is very well recorded and documented and speaking to the current leaders and top management provided the research with a key insight about the nature of projects, agendas, current priorities, future goals.

Their focus area has also shifted over the years and this is evident from the documentation that they provided, there was a heavy emphasis on ICS (Improved Cooking Stoves) initially back in the 70s and 80s after which food processing became a focus area and towards the 90s and after 2000s, renewable energy technologies became a key part of their project priorities. They also started integrating microfinance into their programme design so along with providing training and development to the women SHGs, the organisation provided finance in the form of a start-up capital.

Both the Delhi and Bangalore branches were approached and a range of data from those interviews, review of project documentation will be shared in the findings section.

Ministry of New and Renewable Energy (MNRE)

MNRE aims to develop and deploy renewable energy sources to supplement the energy requirement of India. MNRE being at the centre and as the designer of renewable policy maker shapes the industry in a particular way unlike any other country where they don't have an entire Ministry dedicated to renewable energy. However, there is a range of limitations that it carries which we will look at while presenting the findings in the later chapters. This research looks at their strategic plans, planning process, their level of association (mainly partnerships with private sector and civil society) with other RE stakeholders in the process, their working with the banks and also how they manage the state renewable energy development agencies

(SREDAs). The Director General of the MNRE, Delhi and also the General Manager of operations and management of KREDL were interviewed. The issue of 'positionality' also came up with addressing some issues considering this is a parental figure of RETs in the country and thus the success and limitations were discussions had a one-way perspective. The research would also critically review the findings and also the interview data and address the research questions. Studying the MNRE provides a better understanding of the current RE market in India while using the theoretical framework used in this research.

Solar Electric Light Company of India (SELCO)

Solar Electric Light Company of India (SELCO herafter) Private Limited dispelled three myths associated with sustainable technology and the rural sector as a target customer base: first, poor people cannot afford sustainable technologies; second, poor people cannot maintain sustainable technologies; third, social ventures cannot be run as commercial entities. SELCO currently employs about 375 employees in in Karnataka, Gujarat, Maharashtra, Bihar and Tamil Nadu spread across 45 energy service centers. Since 1995, they have sold, serviced and financed over 2,00,000 solar systems.

Both Bangalore and Kolar branches and their operations were covered and investigated during the course of the fieldwork.

3.6. Data Collection methods

Fieldwork was carried out from August 2014 until January 2015 for conducting qualitative research. Barley's (2010: 779) work suggest that familiarity of researchers with the institutional context is an advantage; the researcher's own situational understanding and knowledge of language in one state and hiring a translator in another one reduced problems such as language barriers and difficulties in conducting research in an unfamiliar institutional context.

The study used both primary and secondary data sources for the purpose of data collection. Both of these methods complemented each other in generating in-depth information about different RET initiatives and their overall impact. For instance, primary data collection was complemented by secondary data sources, which reassured the quality and accuracy of the data collected. In addition, reference to secondary data during primary data collection allowed looking for new secondary data, particularly, statistics, figures and specific reports. In the following sections, different data collection tool is discussed along with design and procedure.

The interview process began with researchers in leading academic institutions that also participate with the Government to formulate policies and generate new initiatives in the renewable energy industry in India. These included the IIT (Indian Institute of Technology), JNU (Jawaharlal Nehru University), TERI (The Energy Research Institute) and CSE (Center for Science and Environment), DST (Department of Science and Technology) – see Table 3.2 above for full list of institutions studied.

A vast majority of the players above are engaged in designing the policies and shaping the future strategies, some of them who were interviewed and studied are also '*last mile'* action agents *(this can be defined as the final leg of the RETs networks delivering the service to the final consumers, the part that actually reaches the end customer).* It was important for the data collection to go into such depths at this stage because prior to analysing at what levels the different stakeholders participate with one another in a partnership, it is pertinent to look at their individual role first.

Primary data

The primary data focused on academic and policy researchers, Government agency officials, entrepreneurs, RETs led business managers, RETs firm and technology providers; the information collected also scooped into their nature of interactions and not only their role as independent entities in the Indian RE sector.

The primary data source included collection of qualitative data using interviews, observation and key-informant interviews. Interviews were critical for gaining a comprehensive understanding of the motives that guided key actors while influencing institutional arrangements and creating support for energy-based entrepreneurs. An important aspect of the interviews included interviewing influential experts who were well informed about institutional arrangements supporting entrepreneurship in India. The selected interviewees represented regulatory agencies, policy makers, RETs manufacturing firms, policy think tanks, government bodies and academic experts, along with representatives of other organizations and civil society members. Most of the interviewees were at senior level in their respective organizations and had considerable experience in the RETs sector in India.

A snowball procedure (*this can be defined as a non-probability sampling technique where existing study subjects recruit future subjects from among their acquaintances)* was followed in finding new data sources until a stage was reached (Katz, 2006) where there were no new information remaining to be collected, this stage of data collection had sufficient data to develop case summaries. Data was both collected and managed simultaneously. This is because the fieldwork included regular travel and to multiple institutions at the same time during a given week for example, so the quality and reliability of the collected data required revisiting interview answers and matching the same with available secondary data (if any) rather instantly (whenever that was possible) for reassurance purposes.

Semi-structured interviews

Interviews were critical for gaining a comprehensive understanding of the motives that guided key actors while influencing institutional arrangements and creating support for energy-based entrepreneurs. An important aspect of the interviews included interviewing influential experts who were well informed about institutional arrangements supporting entrepreneurship in India. The selected interviewees represented regulatory agencies, policy makers, RETs manufacturing firms, policy think tanks, government bodies and academic experts, along with representatives of other organisations and civil society members. Most of the interviewees were

at senior level in their respective organisations and had considerable experience in the RETs sector in India.

Collecting data for a case study can be performed observationally in the form of *key informant interview* as well as the *semi-structured interview* (Taylor & Bogdan, 1998). While the researcher will work to ensure that certain key questions are asked for every person interviewed, the semi-structured format allows and encourages the researcher to interject with additional questions as appropriate. The participant is asked to talk openly and freely about whatsoever he or she views as important and is thus encouraged to elaborate and even take the conversation in an unanticipated direction (Friedman et al., 2002; Friedman, Kahn, Hagman, et al., 2006; Miller et al., 2007).

Spradley (1979) views that using prompts alongside grand tour questions would be a feasible mix in semi-structured interview. He defines *grand tour question* as ones which ask respondents to give a verbal tour of something they know well. The major benefit of the question is that it gets respondents talking, but in a fairly focused way. However, one of the possible limitation is respondents may have a tendency to focus on the interesting (which may not be usual), or on what they think *should* happen day-to-day (although it actually may not) (Brooks, 1980). Prompts are as important as the questions themselves in semi-structured interviews as they serve two purposes, they keep people talking and they rescue the researcher from responses turning mush (McCracken, 1988). This method was used while interviewing the entrepreneurs and the method provided enough scope to maneuver the discussion in a more focused way as and when found necessary.

Semi-structured interviews also proved to be effective because most of the actors studied in the research have been actively involved in the field for a long time and they have a developed understanding of how the market works and reacts to any new introduction or changes. So instead of presenting a set of questions that are direct and '*too specific'*, thus allowing little space for new addition or window for exploration, the questions had more topic based discussion

embedded in them. For example, when an interview question was asked about *how success of a RETs intervention is defined* (refer to table 6 below), the answers from the participants opened up to several viewpoints and how each stakeholder perceives success tailoring to their own achievable criterion. These generic questions aren't 'too specific' and thus helps opening up the discussion and exploration further from where newer and better questions are generated and posed during the interview time.

Similarly, most of the questions were also very critical in nature, and were asked in an unbiased manner to allow some room for an exploratory discussion. Every question generated useful themes from the participant answers, for instance *how much is research benefitting the renewable energy technology application planning in rural India* (refer to Table 3.3 below), and the response ranged from talking about policy outcomes, grassroots gains to benefits for NGOs and RETs providers. This process also allowed a lot of space for the respondents to improvise their position and argument – so on one hand, *steering the interview* became important in order to ensure that the research focus is not stirred unnecessarily; but also on the other hand, to take into consideration *the new illustration of existing topics* and subjects considering the varied background of the respondents.

The respondents' individual '*positionality*' clearly mattered in a lot of cases and thus critically reviewing the findings while analysing the same became necessary and that is useful to satisfy the in-depth nature of this research. For instance, *Government officials had a different take on rural development than RETs firms who were simply contracted to set up installations and provide the technology to rural areas*. This take is surely affected by their individual personal and professional positionalities and that influenced their understanding of success and stance of RETs based interventions. The researchers' positionality also mattered because most of the initial codes and ideas were initially based on readings and field reports without exposure to field in practice.

Fieldwork photo 3.1: With Dr Harish Hande, MD – SELCO India Pvt Ltd

Prompts and grand tour questions run well if the interview can be steered carefully. For example, while interviewing the MD of SELCO (seen in photo 3.1, above) a specific question referred to the distribution of responsibilities amongst partners in regards to provision of finance, training and development and what happens when stakeholder relationship falls apart for some reason. The answer *combined a discussion that* looked at the entire organisational model and how it functions (both at the strategic and operational level) followed by specific references to deliverables of each of their key stakeholders which then linked to adverse effect of a partner fall-out scenario. Although the discussion was lengthy, a careful steering helped to *group and classify* the different codes coming out from the answer in a systematic way to generate themes in the end for further critical analysis.

Topic guide design

Table 3.3: Codes in interview questions

Codes embedded in interview questions	Concepts identified
Perception of RE sector, RE based businesses, micro entrepreneurs, perception of success, RETs interventions	Institutional structure, nature of support provided to entrepreneurs, stakeholder partnership involved in the process
Academic and industry research benefitting RETs planning	Evidence of triple helix, pattern of interaction between actors
Tangible and intangible benefits of RETs based micro enterprises	Community empowerment, women led micro business success stories,
Distribution of responsibilities of different stakeholder in a given institutional structure, consequence of a fall out	Growing indigenisation, increasing communication and connectivity between stakeholders, importance of 'last mile' agents

[Please see Annex for Table 10.1 and Table 10.2 for semi-structured interview questionnaires]

Sampling for participants

Purposive sampling technique is a type of non-probability sampling that is most effective when one needs to study a certain cultural domain with knowledgeable experts within. The inherent

bias of the method contributes to its efficiency, choosing the purposive sample is fundamental to the quality of data gathered; thus, reliability and competence of the informant must be ensured. The informant is found and chosen, the method must be reproducible in order for the results to contribute to a greater understanding of theories and phenomenon (Hones, 1990). One way of ensuring reproducibility is to have a systematic way of choosing the informant and to describe this method in detail.

This technique, also called as judgment sampling, is the deliberate choice of an informant due to the qualities the informant possesses. It is a non-random technique that does not need underlying theories or a set number of informants (Lewis & Shepard, 2006). There is no cap on how many informants should make up a purposive sample, as long as the needed information is obtained (Bernard, 2002). Seidler (1974) studied different sample sizes of informants selected purposively and found that at least five informants were needed for the data to be reliable. Purposive sampling is especially exemplified through the key informant technique (Bernard, 2002; Garcia, 2006, Gustad et al, 2004, Jarvis et al, 2004, Lyon & Hardesty, 2005) wherein one or a few individuals are solicited to act as guides to a culture. Key informants are observant, reflective members of the community of interest who know much about the culture and are both able and willing to share their knowledge (Campbell, 1955; Seidler, 1974, Tremblay, 1957).

As mentioned above that one way of ensuring reproducibility is to have a systematic way of choosing the informant and to describe this method in detail, so the participants were selected not randomly but with help from the targeted institutions. For examples, SELCO helped find samples of solar entrepreneurs in both Bangalore and Kolar and so did AIWC with their women beneficiaries in both the states. Also, in regards to the judgment sampling, at least 3-5 entrepreneurs who were doing RETs led business together in a given location in most cases where participant observation was carried out. This helped in picturing a general image of the business and entrepreneurial impact from an observer's viewpoint and able to draw a meaningful conclusion. Semi-structured interviews were carried out on one to one basis after selecting participants who were specifically targeted from academic, industry and Government; in addition to pre-selected participants, snowballing was also applied and thus the process was methodically refined during the fieldwork period and the process of which has been described earlier in this chapter. Besides semi-structured interviews, participant

observation and key informant interviews were carried out which were mainly group based meetings, interaction and learning. A key informant interview was however one to one, that was in Delhi where a woman was in charge of other women group business activities and in rural Karnataka where the participant was the eldest member of the community.

As mentioned earlier in this chapter, a relatively flexible approach was adopted, supported by semi-structured interviews that were adapted and refined over time during the fieldwork. This was useful because some of the more relevant questions (not necessarily in the list of themes prepared prior to the interviews) emerged from preceding answers of the sample respondents; this as a consequence improved the overall quality of the discussion and interviews.

Some key ideas and discussion helped in creation of useful themes that were jotted down during the data collection phase, this formed the base for discussion later in the analysis. For example, while talking about a particular RETs intervention in a given region, the participant from the formal institutions referred to a similar and comparable interventions that were implemented elsewhere. These then generated newer themes (*for example, how a particular strategy is picked amongst a few others that are available at the same time*) and thus the interviews were carried out more in-depth. If such items were found, new questions and dialogue prompts were added in order to explore these topics with later participants.

The interview process was thus in a state of continuous refinement although the fundamental questions remained the same with only ongoing specific questions added and posed to individuals when they have a particular expertise or knowledge in a given area. So essentially, the semi-structured interviews had the same list of questions and ideas but it took the form of a conversation that was steered by specific questions wherever necessary and useful.

Table 3.3.1. Interview Procedure

Stage 1 – initial contact made with interviewee and response received (via either phone, email, snowball reference, meeting on site) *Stage 2* – interviewee receives and confirms 'participation form agreement', sets an appointment *Stage 3* – interviewee met and interviewed with a time limit of 1 hour set in advance *Stage 4* – interview audio recorded with permission (when given) *Stage 5* – interview recording transcribed *Stage 6* – interview responses generate themes for further analysis or/and created emerging codes for following interview with a prospective interviewee in the similar sample description

Key informant interviews

Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community- including community leaders, professionals, or residents—who have first-hand knowledge about the community (Carter & Beaulieu, 1992). Therefore, they involve interviewing a select group of individuals who are likely to provide needed information, ideas and insights on a particular subject. (REF) Two characteristics of them are that *firstly*, only a small number of informants are interviewed who possesses information or ideas that can be solicited by the investigator; *secondly*, key informant interviews are essentially qualitative interviews based on subjective responses.

These are conducted using interview guides that list the topics and issues to be covered during a session (based on some of the key elements mapped in the conceptual framework). The atmosphere in these interviews is informal, resembling a conversation among acquaintances. This was used while interviewing solar entrepreneurs and group based business initiatives to get an overview of the (institutional and local) support that they feel they have access to. Since most of the village visits were accompanied by staff members of institutions studied, there was a need to speak directly to key informants in locations where a person(s) in particular is in a decision making power at the community level. Without these people, not many changes can be implemented in a community, and thus knowing their perspective about how RETs based

businesses run was found useful *(one lady in the photo below was a key informant in Kolar).* These community experts, with their particular knowledge and understanding, can provide insight on the nature of problems and give recommendations for solutions.

Fieldwork photo 3.2: With Banajak-amma, a key informant in Kolar, who uses solar lantern for silk weaving purposes at home, and also leads 4 other women from her neighborhood to organise and consolidate their resources together

Topic Guide design

See Table 3.3.1 above

Interview Procedure

See Table 3.3.1. above

Participant observation

Since organisations can be viewed as societies with their own peculiar customs and practices, participant observation has become increasingly popular in organisational research (Jick, 2013). This method is used in this thesis because it gave an opportunity to see the RETs led business operations, of both men and women, and also provided an insight how these entrepreneurs perceive the support that they have access to vis-a-vis how the institutions who provide the

support perceives of their functionality and success.

Evered and Louis (2001) identify two different paradigms of organisational research, and term the two approaches '*inquiry from the outside*' and '*inquiry from the inside*', whereby the former is characterised by the researcher's detachment from the organisational setting, and the latter by the personal involvement of the investigator in the research process. Knowledge of an organisation can be acquired in two ways: by examining data generated by the organisation e.g. company files, financials etc. (enquiry from the outside) or by functioning within the organisation (enquiry from the inside) and '*being there*', becoming immersed in, and part of the phenomenon under study. The authors reflect upon their own personal experience entering an unfamiliar organizational setting.

Published academic research offers little guidance in understanding the new organisational setting, whereas papers by industry practitioners appeared more meaningful and relevant. The key authors view that the knowledge acquired through '*inquiry from the inside*' is inherently more valid and relevant to the organisational actors. Management research presents challenges of its own. Managers are typically busy individuals, and are typically reluctant to allow access unless they can see some benefit to the organisation. Hence, access for fieldwork may be difficult to obtain, and, if granted, it may be subject to various conditions about confidentiality. (Evered & Louis, 2001)

Fieldwork Photo 3.3: With a biogas mason (left) and vegetable/garland seller (right) who

manages to extend their business hours after dark by 3 hrs using solar lanterns in Bangalore)

Several sites where people were using solar technologies to light up their business stalls after dark were visited during the course of the fieldwork. Participant observation took place mainly between 5-8pm because it got dark usually by 6 in the locations visited, and thus 5-8pm allowed a *capture window* before and after the technology was used. Observations included RETs providers coming in rounds in their mini van, handing out a fully charged solar lantern to the vegetable sellers who then have access to additional hours of light after 6pm. The users were also careful in handling these devices and whenever necessary felt at ease to move around the device to throw light on items that the customer would like to see and buy – this ranges from garlands, religion based ritual products, vegetables, fruits and pottery items. In most locations, a group of several users were found while also a few didn't use these technologies because they preferred to finish early and return home. So, after 6pm the participants were reduced down to an average of 5-6 out of an average of 10. It was also possible to talk to the participants and how they perceive the change in their business method, timing and their treatment of the device as an asset.

Observation Checklist
1. Business hours 2. Treatment of RET asset 3. Self-maintenance of minor issues (if any) 4. Nature of benefit derived from the RET 5. Transaction and communication with clients and business partners 6. Monitoring use of excess business hours due to the RET

Table 3.4. Observation checklist

Observation Procedure
A combination of the following: 1. Sitting with the entrepreneur during business hours 2. Sitting at a distance with the accompany from host institution 3. Taking pictures 4. Leaving with the entrepreneurs after business hours to see use of RETs after business hours

Table 3.5. Observation Procedure

Sometimes participant observation arises from an ongoing working situation, as is the case when the observer is an industry practitioner. Professional practice is a process of problem setting and problem solving. Practising managers are called upon to manage problematic situations characterised by indeterminacy, uniqueness and instability. Schon (1991, quoting Ackoff, 1979) appropriately terms such situations '*messes*'. The best professionals are able to make sense of these '*messes*', discern patterns, identify deviations from a norm, recognise phenomena and adjust their performance. Such processes may be intuitive, tacit, and unconscious. Schon (1991) terms this as '*reflection-in-action*'. The art of management is '*science in action*', so that practising managers may become developers of management science (Schon, 1991). The researcher in this position can acquire an in-depth and first- hand insight into a real-world setting.

[Please see appendix, Tables 9.9 for full list of interviews, institutions and methods used for each]

Secondary data

The secondary data was collected in order to *firstly*, complement the information shared by participants during their interview, *secondly* add background data or current statistics that were missing in observation during primary data collection. For example, (participant) observing a day-to-day managed micro business gives valuable insight into the business but in addition to that, having some past data to reflect the business performance in terms of finance and scale of operations is equally essential to know. *Thirdly*, to reassure the reliability of the data collected from primary source whenever such information is made available, *fourthly* to fill the gap in data that could not possibly by found/provided by primary data (participant is absent or can't be reached but have shared something related to one of the interview questions in writing in recent past).

Secondary data such as published materials, such as regulatory and policy documents, presentations, for example - discussions by experts during conferences and workshops, conference proceedings, reports from industry associations, firm level project reports, company websites, consulting publications and magazines were collected. These data were extracted from both public and private sector organisations, such as TERI, KREDL, SELCO India private Limited, SKG Sangha. The firm level project reports served mainly as an additional back up source for complementing insights from interviews and observation notes.

3.7. Data Analysis: Thematic Analysis

The method of analysis chosen for my study is a qualitative approach of thematic analysis. Generally, thematic analysis is the most widely used qualitative approach to analysing interviews. Braun and Clarke (2006) views thematic analysis as a method used for '*identifying, analysing, and reporting patterns (themes) within the data*' (2006: 79). The reason I chose this method was that 'rigorous thematic approach can produce an insightful analysis that answers particular research questions' (Braun and Clarke, 2006, p.97). In addition, this approach complemented the research questions by facilitating an investigation of the interview data from two perspectives: first, from a data- driven perspective and a perspective based on coding in an inductive way; second from the research question perspective to check if the data were consistent with the research questions and providing sufficient information.

Thematic analysis is a search for themes that emerge as being important to the description of the phenomenon (Daly et al, 1997). The process involves the identification of themes through '*careful reading and re-reading the data'* (Rice & Ezzy, 1999: 258). It is a form of pattern recognition within the data, where emerging themes become the categories for analysis. This study used a hybrid approach of qualitative methods of thematic analysis, and it incorporated both the data-driven inductive approach of Boyatzis (1998) and the deductive a priori template of codes approach outlined by Crabtree and Miller (1999).

The coding process involved recognising and important moment and encoding prior to a process of interpretation (Boyatzis, 1998). A *"good code"* is one that captures the qualitative richness of the phenomenon (Boyaztis, 1998: 1). Encoding the information organises the data to identify and develop themes from them. Boyaztis (1998:1) defined a theme as "*a pattern in the information that at minimum describes and organises the possible observations and at maximum interprets aspects of the phenomenon*". Crabtree and Miller (1999) advises on using a template approach wherein includes the form of code from a codebook to be applied as a means of organising text for subsequent interpretation. When using a template, a researcher defines the template (or codebook) before commencing an in-depth analysis of the data. The codebook is sometimes based on a preliminary scanning of the text, but for this study, the template was developed a priori, based on the research question and the theoretical framework.

Coding

Coding is the process of organising and sorting data since it serves as a way to label, compile and organize data. They also help to summarise and synthesise what is happening in your data. In linking data collection and interpreting the data, coding becomes the basis for developing the analysis. One of the keys in coding data, and in conducting a qualitative analysis more generally, is developing a storyline. This is the reason that thinking about the purpose of the central purpose of a given evaluation—before, during and after data collection—is so critical.

Creating Codes

Coding can be done in any number of ways, but it usually involves assigning a word, phrase, number or symbol to each coding category (CER, 2009). These are identified from interview transcripts, direct notes, and field observations in a systematic way. The ideas, concepts and themes are coded to fit the categories. The process of creating codes can be both pre-set and open.

Pre-set	**Emergent Codes**
Before beginning data collection and the coding process, it is useful to have a 'start list' of pre-set codes (often referred to as 'a priori codes'). These initial codes derive from the conceptual framework, list of research questions, problem areas, etc.	These are the set of codes that emerge from reading and analysing the data. These 'emergent codes' are those ideas, concepts, actions, relationships, meanings, etc. that come up in the data and are different than the pre-set codes.

How this research has used themes and codes

What counts, as a theme, is something that captures the key idea about the data in relation to the research question and which represents some level of patterned response or meaning within the data set (Braun and Clarke, 2006, p.82). Bazeley (2009, p.6) claims themes only attain full significance when they are linked to form a coordinated picture or an explanatory model: 'Describe, compare, relate' is a simple three-step formula when report the results. As Braun and Clarke (2006) explain themes or patterns within data can be identified either in an inductive 'bottom up' way (citing Frith and Gleeson, 2004), or in a theoretical, deductive 'top down' way (citing Boyatzis, 1998 and Hayes, 1997).

Table 3.6. Respondents, codes and methods used

Type of respondent	Workplace	Template of Codes	Tool
Researcher and scientists (Academics)	Jawaharlal Nehru University, TERI, CSE, IIT	Perception of partnership, role of research, choice of partners, concept of success	Semi-structured interview
Policy makers and Ministry staffs	MNRE, DST, TERI, KREDL	Perception of partnership, choice of partners, concept of success	Semi-structured interview
RETs manufacturers and service providers	TATA Power Solar, CSE, SELCO, SKG Sangha	Business model, inclusion of client/beneficiary in the model	Semi-structured interview
Entrepreneurs	SELCO, AIWC, TERI beneficiaries/client	Operational management, business sense, role of partners, use of business income	Participant observation, Semi-structured interview, Key informant interview
NGOs and RETs based institutions	AIWC, Green Grants, SELCO	Training entrepreneurs, perception of success and choice of partners	Participant observation, Semi-structured interview

Table 3.7 lists the respondent groups interviewed and the method used for each of the groups. The questions employed in the interviews were open-ended to begin with, followed by semi-structured questions keeping the key points relevant to the research questions and respondents' posts and positions. The main categories and codes were identified from the data by observing patterns in responses from different interviwee groups. Although the stages used in the analysis of the data look sequential, they are iterative and built up on the previous stage as Braun and Clarke (2006, p.86) puts it, '*Analysis is typically a recursive process, with movement back and forth between different phases. So it's not rigid, and with more experience (and smaller datasets), the analytic process can blur some of these phases together*.'

Stages of data coding

Stage 1: Developing the code manual and template of codes (theory driven)
Stage 2: Testing the reliability of codes
Stage 3: Summarising data and identifying initial themes
Stage 4: Connecting the codes and identifying themes (both theory and data driven)
Stage 5: Corroborating and legitimising coded themes

Stage 1: **Developing the code manual and template of codes (theory driven)** – the semi structured interview questionnaire had a set of codes embedded in the questions that were drawn both from literature as well as the conceptual framework

Stage 2: **Testing the reliability of codes** – drawing the codes from elements of the conceptual framework was useful because these codes were used before in institutional analysis in the previous studies and were thus validated. Some codes were ignored because of the purpose of this research.

Stage 3: ***Summarising data and identifying initial themes*** – following transcribing interview data, the responses were collated and the raw data was systematically summarised.
Interview transcripts were summarised separately by outlining the key points made by participants in response to the questions asked.

Stage 4: ***Connecting the codes and identifying themes*** (both theory and data driven) – the codes identified from the conceptual framework ('a priori' ones) and also 'emerging codes' contributed to a better list of responses that would provide a higher understanding. Connecting codes is the process of discovering themes and patterns in the data (Crabtree & Miller, 1999)

*Stage 5****: Corroborating and legitimising themes*** – The final stage illustrates the process of further clustering the themes that were previously identified from the coded text. Corroborating is the term used to describe the process of confirming the findings (Crabtree & Miller, 1999)

Data collected from interviews and participant observation were transcribed and prepared for data analysis by basing the discussion around themes. Data analysis followed several stages. First, each interview transcription was read carefully and themes were generated. Each story/case example provided and response was examined with respect to the nature of stakeholder, the institution that they formally belong to (the examples are all stated earlier in this chapter) - this method was initially described and referred by Lieblich, Tuval-Mashiach, and Zilber (1998). "*Participants are active constructors of meaning by presenting their subjective interpretations*" (Cassell and Symon, 1994: 188) and an understanding of their questions based on RETs interventions and entrepreneurship in India.

In the second stage, second order themes (as presented in Table 3.6) were identified and grouped together that emerged across the case stories (collected from both primary and secondary data) to carry out an analysis systematically. These themes included how a given institutional structure is formed, how many stakeholders are they nested with, their patterns of interaction and nature of involvement in the partnership. Eisenhardt (1989) view that it is important that the data analysis process is based on both *'within' story and 'cross' story analysis.* Since most of the themes were generated from collating responses that were pointing towards a common fact or a phenomenon, from a range of interview findings, an attempt was made to shift the analysis from the individual level to collective analyses. This enabled in drawing general conclusion and meaning to a given question if there were common themes generating due to repeat responses.

Some examples to demonstrate how the second phase of data analysis went on: Interview responses and generated themes enabled an understanding of the patterns of connections that entrepreneurs made between institutional support, access to bank, potential market and opportunity recognition involved in the process; these aspects and responses helped in the understanding of the RETs market, its features and potential while interviewing academic and Government officials. For example, in discussing opportunity recognition, some entrepreneurs described that they went through a process of support and training (both leadership and financial) from a particular institution and how it helped them to integrate more with the given society that they live in. Cases such as above continued during the research journey.

3.8. Research Ethics and limitations

A detailed overview and planning for the fieldwork was presented before the ethics committee to seek their approval before the field research commenced in August 2014. The general risk assessment was 'low' and my Supervisors and was approved by the Ethical Committee at the University of Sussex ER/BM86/1

Despite the strength of the chosen methods and design of the methodology, it is important to note that considering the limited scope of a PhD thesis, several other regions of India could have been looked at otherwise to showcase further similar or diverse findings and understanding of institutional arrangements. As expressed in both the literature review and some sections in the methodology, though policy framework for RETs stays the same for all the states – the implementation however varies in different states tailoring to local needs and the priority agenda of state Governments. These differences make the local action on supporting RETs entrepreneurship vary over time and regions, given some more time and work scope they can be further looked into in detail and depth. Another limitation observed upon completion of the project is an understanding of the comparison of institutional arrangements (to comment on which one is more successful/effective than others), although that has not been the focus of this PhD, but when studying the entrepreneurs and the actors supporting them in the background, the issue became relevant. This has been suggested for future research actions.

Chapter 4 – Institutions, institutional arrangements supporting solar based entrepreneurship in India

4.1. Introduction

The purpose of this chapter is to investigate three different institutional arrangements adopted by three organisations – SELCO, AIWC and TERI, supporting solar based entrepreneurship in India. The conceptual framework, i.e. part of the IAD framework (see figure 4.1 below), is used as a guiding framework to unpack the process of understanding of how different key actors act, react and interact together with their key stakeholders in the renewable energy industry, specificially solar, creating entrepreneurial environment and empowering entrepreneurs. A thematic analysis is carried out to investigate how different institutional arrangements create particular outcomes that are determinants to entrepreneurial performance. The structure followed to analyse each institution involves firstly looking at *i) actors ii) patterns of interactions iii) outcomes* generated and secondly carrying out a thematic analysis of the support provided to solar entrepreneurs. Chapter 5 would look at the rural development implications of solar based entrepreneurial initiatives.

The conceptual framework assists in the deductive method of thematic analysis because it helps to identify some of the key constructs to be investigated in detail. In addition to that, the fieldwork data assists in inductive approach as new codes emerge from findings and are considered for analysis.

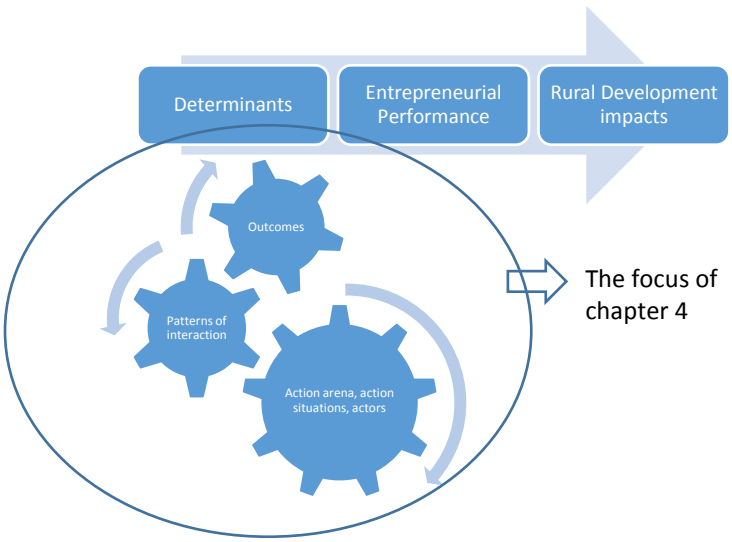

Figure 4.1. The Conceptual Framework

4.2. Solar Electric Light Company of India (SELCO)

4.2.1. Actors

SELCO works with a range of stakeholders whose roles are critical in both operational and business management aspects of their company model. In order to identify how they work with each other, it is important to firstly note who they are and what is the nature of interaction. *Firstly*, SELCO have been working with *regional rural banks (RRBs), credit cooperatives and microfinance agencies* to make necessary credit arrangements for their clients who purchase solar technologies. Bank loans can be a big challenge in rural areas because formal nationalised banks wouldn't come forward with a loan offer without satisfying the usual guarantor, mortgage and margin money requirements. This is where SELCO comes in as a guarantor and more like a facilitator to arrange funding for a solar based micro enterprises and supporting an entrepreneur. One of biggest reasons why banks would hesitate is due to the recollection mechanism, especially in rural areas where the repayment pattern and preference would be either daily or weekly and not monthly. This increases transaction and operational costs on the side of the bank. However, for most micro enterprises where an entrepreneur has purchased any solar product from SELCO, the latter have arranged for a loan via the bank. In very few cases, SELCO also provides a *bridging loan* if they identified that a particular client is so poor that they can't arrange the margin money.

Secondly, SELCO relies solely on local suppliers. The company sources all its electronic items from Anand electronics located in Mangalore, Karnataka. This is a big difference between SELCO and other large scale RET producers (e.g., TATA Power Solar), the latter's technology is designed for European conditions and more standardised (for obvious large scale sale implications). For rural India, SELCO needed electronic components that were rugged, even if that meant making tradeoff in technical sophistication. SELCO have regular meetings and discussion on design innovation with local suppliers to improvise on new and existing products.

"We go back to the drawing board with our suppliers to even make small modifications based on client feedback on our products. For example, if we could do something with the weight of the battery or to make it look more portable" – Principal Analyst, SELCO India, Bangalore

Thirdly, not all innovation (at least, product innovation) is made possible only by working with their suppliers and so SELCO partners with several NGOs and community-based organisations. For example, SELCO partners with SEWA (Self Employed Women's Association) and several community-based/Voluntary organisations in different rural areas. This is important because it would be very difficult for SELCO to penetrate into villages without local knowledge that community organisations can provide when they are partnered with. It is even more important because SELCO's products are custom-made based on clients' need and feedback so it is essential that the SELCO staff can actually speak to the prospective customers/entrepreneurs. So this is where the role of local organisations comes in as a key stakeholder for SELCO.

Fourthly, the two other groups of stakeholders that are very important for SELCO are the entrepreneurs themselves along with SELCO's sales and R&D team. As mentioned above, product and design innovation are based on feedback coming in from the entrepreneurs themselves (SELCO calls them 'clients'), so it is very important that SELCO maintains a regular communication with them and also develop different ways to support their business by improving the solar based technologies to suit a specific issue or purpose. Also, another aspect is that SELCO doesn't spend any money on marketing and advertising for their products (discussed later); instead their technical staff spends all their time talking to village clients and understanding the latters' needs and demand. So there is a constant loop of information and knowledge sharing between the clients and SELCO.

Figure 4.2: Stakeholders of SELCO India

4.2.2. *Patterns of interaction and outcomes generated*

By looking at SELCO's operational model and the extent to which they regularly interact with a broad range of stakeholders - mainly clients (end users), suppliers, sales and R&D team, research thinktanks - it is important to understand their patterns of interaction and what outcomes (benefits/externalities) are generated from the same to support solar based entrepreneurial initiatives. Codes are identified in each of these sections that would help in carrying out a thematic analysis. Looking at the range of services that SELCO offers to their clients, the following four patterns of interaction can be observed as discussed below.

a) Continuous interaction with clients and feedback loop to customise demand based products and services

SELCO services its customers from 25-service centers spread all across rural Karnataka. The lighting solution provided by SELCO's solar lights are configured keeping in mind the needs of the customers and their capacity to pay the loan installments. Thus, it is very common that the solar RETs are demand tailored and customised - this happens after the sales and R&D team understands what the client needs are by studying a household's need carefully in great detail. It can be seen from the findings (as stated below) that SELCO doesn't follow the model of offering standardised technology solution to household with a goal of saving cost as evident from the following quote. In addition to this, SELCO's regular communication with clients/entrepreneurs provides them with a strong word of mouth communication channel of 'marketing' so the company doesn't spend any money on advertising and marketing purposes. This word of mouth, a powerful communication tool to spread news in rural areas, brings in newer clients over time after the utility of the solar technologies in both household and business purposes becomes prominent.

"*We could have gone in for some one-size-fits-all system, but we didn't. When it comes to the poor, everyone wants to standardise solutions to save cost, but not us. Thus, we have a significant amount of pre-sales activity, all of which is done by the technicians because they are in the best position to understand the context as well as the solution that can meet the requirement. We do not have any marketing budget. We put all our efforts into pre sales and post sales service, which is marketing for us. All our customer service agents don the mantle of marketers when they are dealing with the customers. We encourage them to interact with the neighbors, the local community so that they have a deep understanding of the problems that the people face*"- MD, SELCO India, Bangalore

A typical sales cycle for SELCO starts with an understanding of how much money a customer can pay as loan installments every month. A SELCO technician discuss with the customer the various costs that he incurs for providing light in his home, both in terms of out of pocket expenses as well as forgone opportunities. For example, he might be procuring INR 50 worth of kerosene every month and with the additional hours of work that SELCO lights can provide the family (SELCO India, 2009). Moreover, *there will be non-quantifiable benefits in terms of better health, increased hours of study for the children as well as saving time that is spent in procuring kerosene*

or sourcing forest-wood. Adding all of these, the customer might probably be in a position to pay INR 150 per month as loan installment. This would allow him to procure a two-light system. But his need is for a minimum of four lights, one each for the kitchen, bedroom, living room and cowshed. (UNDP, 2011)

However, a deeper and clearer understanding of his lifestyle reveals that while he needs these four rooms to be lighted, the rooms need not be lighted simultaneously. His wife, who looks after the cows and cooks food, needs lights either in the kitchen or in the cowshed at one point of time. It is also unlikely that the family would need lights in the bedroom and in the living room at the same time.

Therefore, SELCO techniques will complete the wiring in all the rooms, provide four points where the lights can be fitted, but supply only a two light system that would meet both the budget and the needs of the customer. They would ensure that the lights could be easily fixed and removed from each of the four points so that the family can carry the two lights with them from one room to the other depending on where they need them the most. Sometimes, the internal structure of the house would allow fixing light at the intersection of two rooms, ensuring that two rooms get illuminated with one light.

SELCO charges INR 250 as annual maintenance contract for a four light system, which entitles the customer to two maintenance services and one emergency service on call. SELCO technicians check every solar installation twice a year to ensure that they are in proper working condition. Since the livelihoods of many customers are critically dependent on the solar lights supplied by SELCO, the technicians try to respond to every breakdown as fast as possible. This is a challenging task, given that most of the installations are in remote areas. Today, SELCO is able to respond to 65% of these calls within 24 hours and they are constantly working on measures to improve this rate. (UNDP, 2011)

SELCO has been instrumental in creating several entrepreneurs in rural Karnataka. Besides the home lights, SELCO manufactures solar lamps that can be used by street vendors to sell their products during evening times. Since street vendors will not need lights for the entire day,

SELCO identified entrepreneurs who would buy the lamps from SELCO and rent them to the vendors daily. While no bank would have been willing to cater to the needs of the street vendors, the entrepreneur was able to provide both doorstep finance and doorstep service to them.

> "*This guy (the entrepreneur) in Hasan started with 30 lamps and put the solar charging station on the roof of his house that would charge the batteries used in these lamps. He would charge the batteries daily and rent the lamps to the vendors at 5.30pm. Around 9.30-10pm, he would collect the lamps back and INR 12 per lamp that was rented out. The vendors this way would save INR 2-3 per day since they were earlier paying INR 15 to buy kerosene. Soon he purchased another 30 and then another lot of 30. Now he felt the need to purchase a tempo (a small commercial vehicle for carrying goods) to carry the batteries around and reach them to the vendors and eventually employed two people, who were below him in the economic strata, to transport the batteries on his behalf. Then one day he came back to us saying that his technicians are getting fatigued lifting up so many batteries daily – it would be of help if we could make the batteries lighter. We went back to the drawing board and designed lighter batteries – it's amazing how he made us realize a fundamental problem and led us to solve it*"- Principal Analyst, SELCO India, Bangalore

As stated earlier, there is a constant feedback loop and knowledge sharing both-ways between clients and SELCO, this helps not only in considering new design input but also building rapport between a customer and SELCO staff while supporting the entrepreneur both from the finance as well as technology fronts.

b) Partnering with banks to offer innovative financial support to clients

The financial innovation that SELCO has introduced to the RE market have changed the way banks approach RETs based businesses and entrepreneurs in rural areas. The origin of this idea can be seen as a direct consequence of the company's in-depth understanding of the household needs and capacity to pay. Considering the occupation of most of the targeted clients, be it entrepreneurs who are renting out solar lanterns on a daily basis, or street sellers and vegetable vendors who purchase/hire solar lamps/lanterns/home lighting systems, these individuals are more comfortable with daily cash repayments due to transactions occurring all day instead of saving up an amount and paying an amount monthly. SELCO tapped into this understanding and have offered loans that can be offered either daily, weekly or bi-weekly with the daily and

weekly options to be very popular at the moment. This however, involves a variety of risk in the sense that no conventional financial institution would initially come forward to offer loans to these clients of SELCO because *firstly,* these prospective clients don't have collateral, guarantor and other standard loan requirements and *secondly*, the cost and difficulty in securing the repayments on a daily and weekly basis is pretty high and unusual for any commercial bank's regular approach towards banking operations. However, SELCO earned the trust of these commercial banks that they decided to collaborate with and thus *firstly*, the villagers have now regular banking practice and *secondly*, the innovative financial model of providing energy loans becomes operational.

"*One of the best financial lessons that I learnt was from a street vendor who told me that she can afford to pay INR 10 (US 20 cents) a day, but would find it difficult to pay INR 300 (US$6) every month! This was when I realised that to sell solar lights, the poor needs to be provided with a doorstep financing that ensured that payback patterns were synchronised with their income patterns*" - MD, SELCO India, Bangalore

SELCO have been working with regional rural banks (RRBs), credit cooperatives and microfinance agencies to make necessary credit arrangements for their customers, but will not get into financing themselves however. However, there are cases where SELCO steps in to provide a *bridging loan* if they feel that a particular community or an individual is so poor that they cannot even arrange the margin money. Even in such cases, the collection of the amount that is due to SELCO is done through the agency that provides rest of the finance to avoid any situation of conflicting interest. This can be further seen from SELCO's annual reports where the operations, risk and management of these *bridging loan* financing is detailed.

c) Continuous and interactive relationship with suppliers

A solar light comprises of four key components – the solar photovoltaic module (solar cell/module), battery, charge controller, and lighting system (lamps and fan). The relative costs of these components are provided in the table below for a four-light system. SELCO secures 90-95% of its panels from TATA BP, besides being a long term partner TATA BP has been quite flexible with SELCO in terms of schedule and batch size of orders. Moreover, having a local source of supply helps SELCO reduce inventories worth INR 15 million (US$300,000) across their 25 service centers. Batteries are purchased largely from Shakti Electronics (a local source!) who work closely with SELCO to customise batteries suiting the needs of SELCO lights.

Table 5.1. Cost breakdown of a Four-light system

	INR	US$
Photovoltaic module	8000	160
Battery	4500	90
4 lights @ 800	3200	64
Installation & wiring	1300	26
Total	17000	340

The sale price of the above system will be – INR 20000 (US$400)

The actors and their nature of patterns of interaction create a solid interdependency. SELCO sources all its other electronic items from Anand Electronics located in Mangalore, Karnataka *(once again, a local source!)***.** SELCO felt the need for developing a relationship with Anand Electronics when it realized that the technology available with TATA BP was designed for European conditions. For rural India, SELCO needed electronic components that were rugged, even if that meant making tradeoffs in technical sophistication. Anand Electronics was erstwhile involved in television repairing and was finding survival difficulties in late 1990s with the advent of more reliable TVs at lower prices. SELCO convinced them to become its supplier. Being a small-scale unit, Anand Electronics does not need to pay excise duties and is able to keep its overhead costs low. Moreover, their long-term and exclusive relationship ensures that they can design and produce items to SELCO's exact specification, including experimenting with new product designs.

"Our frequent interaction with the suppliers and their product design improves our delivery mechanism and further innovation of the products and service that we offer to the clients; even if the issues and improvements are minor – be it the weight of the batteries to the shape of the lamps, our suppliers are always keen to have a constructive conversation when needed and called for." – MD, SELCO India, Bangalore

SELCO has a high degree of transparency with all its suppliers and they are ready to back one another in case of constraints and challenges. Integration of stakeholders would make the

market more mature, such collaboration and business understanding between partners at both local and regional levels enhances the scope and sustainability of the business, and as a consequence benefits the clients of SELCO both directly and indirectly

d) Partnering with community organisations for new product development

It can be observed from SELCO's operational model that it engages with a variety of key stakeholder, each of them contributing to the continuous refinement and development of the product and services that the company offers to its clients. It is now important to be pointed out that the clients aren't only street sellers and vegetable vendors, but also midwives, flower pickers, manual laborers and masons, women using the technologies for both household and vendor cooking. Most women in rural India do not have access to hospitals and use the services of midwives for delivery in their homes. In their absence of grid electricity, such deliveries are often done with the help of a mirror that reflected the sun's rays to the place of delivery. This improvised arrangement was of course not possible during night or on a cloudy day when the midwife would use a kerosene lamp or a candle. SELCO designed several solar products in consultation with SEWA (Self Employed Women's Association); the latter also helps SELCO to penetrate into such regions where the latter don't have any prior experience.

This included solar lanterns for the vegetable and fruit vendors who could use it for extending their working hours as well as using it at home, head lamps for midwives and flower pickers, solar camps for laborers and masons, and a smokeless stove for cooking. One of the areas where light is needed and very less looked at is child birth delivery process in villages where the area goes dark after 6pm due to lack of electricity. SELCO designed a solar headlamp for the midwives to assist in the delivery process. The following quote elucidates further.

> *"We sat with midwives for two to three days to understand the complete delivery process. They taught us to cut the umbilical cord. People were laughing at us, but we told them that we needed to know the process well to design the energy intervention. There are usually only two women at the time of delivery – the one who is pregnant and the midwife. The midwife has a candle or a lantern, which balances with one hand during the delivery. We therefore decided to design the solar head lamp so that both her hands are free and enough light is generated for the process."* – Principal Analyst, SELCO India, Bangalore

Further on, SELCO worked with flower pickers, who collected flowers from midnight till 3 a.m. It was difficult for them to balance both the flower basket and a petromax lantern in one hand and pluck flowers with the other hand. It would slow down their efficiency. With solar-headlamps they were able to pluck double the quantity of flowers in the same time. Very often, SELCO would appoint an entrepreneur who would rent out the solar lamps to the midwives and the flower pickers on a daily or an hourly basis, ensuring higher usage of the lamps and greater income generation. SELCO estimates that today for more than 20% of their customers, SELCO lights are a direct source of increased income generation through greater productivity. And their partnership with SEWA Bank provided them with a major fillip in that direction.

The entrepreneurs, who now rent out solar headlamps, have identified a new demand in the market. Most flower pickers are workers of a vendor who sells the flowers generally in the morning market in a village. They have higher stock now while cost of paying the flower picker stayed the same. As with other solar RETs, the entrepreneurs charge the lamps during the day and rent it out after 8pm to the clients.

Till date, SELCO has sold solar lighting to more than 110,000 rural homes and to 4,000 institutions such as orphanages, clinics, seminaries and schools in the Indian state of Karnataka. An impact assessment study by World Resources Institute in 2007 reported that 86% of SELCO's poor customers (UNDO, 2011) cited significant *savings in energy costs as their primary benefit of using SELCO's products, while the rest pointed to their children's education as the primary benefit*. Being a non-polluting source of energy, solar lights contribute to environmental benefits as and when they replace the other energy sources such as firewood and kerosene. However, this impact is yet to be quantified.

Moreover, SELCO's business model has led to the creation of employment not only for its own employees but also for several rural entrepreneurs who rent out solar lights to vendors and institutions. However, success raises expectations, Harish (MD) as well as the leadership at SELCO are asked very often about their plans of scaling their business. Scaling needs

standardisation, which is antithetical to SELCO's business philosophy where solutions are customized keeping in mind the context and realities of the end customer. Therefore, they feel their business should be replicated rather than scaled. "*It is better if we focus on developing other SELCO's suited to the context where they would operate, rather than trying to grow this SELCO*" says Harish.

When it comes to scaling, SELCO has been rather conservative even if it is in Karnataka – this is because the company believes that pressure to scale might be subordinate to the social objective of the organisation.

> *"One of the obvious ways to scale is to put aggressive targets on the sales team. Such targets would instinctively make them chase low-hanging fruits – they will go after customers who will buy faster and who will buy larger systems. But are these the customers to whom we really want to sell to? SELCO exists to provide solar lights to the poor – the ones who can probably afford a small system and that too on credit. If one mixes the social objective with the commercial objective, it is most likely that the commercial objective will dominate. This is because it is usually easy to fulfill the commercial objective."* – MD, SELCO India, Bangalore

The institutional arrangements that SELCO has, as can be seen above, has led to the creation of employment not just for its employees but also for several new rural entrepreneurs who are renting out solar lights to vendors and also local businesses. There are partnership made at each stage – one could argue that at each level there is a social value that is created both intrinsically and extrinsically. In other words, at the local level, the institutions are better linked and integrated which could actually lead to developing the market maturity of this industry considering there are major players at the regional and national level where support is available but a developed framework to reach out to the rural population is missing (more on this while discussing MNRE later in this chapter).

4.2.3. Thematic analysis of support for solar based entrepreneurs

[Please see appendix for Table 9.10 for Data Analysis Structure for SELCO]

Data Analysis Structure for SELCO India

Patterns of interaction and outcomes	**First order codes**	**Second order codes**	**Themes**
1. Providing customised products and services, tapping into specific household need	1.Products are customised based on household needs 2.Continuous feedback loop and knowledge sharing 2.Word of mouth communication 3.Interaction between clients and SELCO staff 4.Faster response to RET product issues	1. Regular communication between clients and SELCO staff 2. Considering the nature of lighting needs at the household level	***Knowledge sharing, feedback loop between SELCO and clients, understanding individual lighting needs***
2. Developing a financial innovation in offering	1.Banks interacting with villagers 2.Banks offering loans to solar based businesses 3.Banks receiving repayments on daily	1. SELCO arranging bank loan facilities to their client 2. formation of clients and bank relationship	***Availability of start-up finance for solar based enterprises, developing banking practice***

solar lights	and weekly basis 4.SELCO providing bridging loan 5.SELCO connecting entrepreneurs with bankers		
3. Ongoing interactive relationship with suppliers	1.Working with local suppliers 2.Suppliers are flexible and source locally 3.Suppliers working on design innovation based on SELCO's client input 4. Experimenting with new product and design and allowing trial and error	1. ongoing product refinements tailored to client needs 2. faster response to customer service	***Faster new product development, quicker response to client issues***
4. Partnerships for Innovation and new product development	1.Identifying new needs 2.Working closely with the prospective clients 3.New product development 4. Working with a voluntary organisation 6. Working on a	1. partnering with community level organisations and VOs 2. engaging in activities that are considered sensitive to the community in an attempt to get closer to them	***Working with local communities, creation of new needs, trust building in networks***

	sensitive issue, helps to nurture trust with the community in the long run		

a) Knowledge sharing, feedback loop between SELCO and clients, understanding individual lighting needs

The very first thing that is consistently noticeable in both the themes and codes is SELCO's attention to individual demand for lighting and how important client input is for product design. References to interview quotes as well as secondary data provides an understanding that the lights are used for critical activities (not only for household lighting but also for renting out RETs which is income generating) and that would determine clients' daily lives. As a result, a great focus is laid on the quality of the products and services offered. It can also be seen that there is generation of a business model around the solar RETs that provides income to both entrepreneurs and also the street vendors (sometimes they can be the same person).

b) Faster new product development, quicker response to client issues

The key benefits of working with a local supplier and also sourcing from a small company for customisation have product development benefits. It is also essential that these relationships are maintained over a period of time, one thing that can be noticed here however is that these suppliers are not big in size and they are not in direct business relationships with major RETs manufacturers (e.g. Kotak Urja, TATA BP). Thus their association with SELCO provides a security and market edge for the latter. It would be virtually impossible to manage the same level of costs and innovativeness while delivering customised products and services if SELCO has to change and swap suppliers from time to time.

Also, the constant interaction with the supplier also keeps the contract secure between the stakeholders as well as the product quality. As evidenced in the earlier section, the feedback

collected back from the clients (very regularly) are used to improve the product design and service quality model of SELCO – this in effect have a regular impact on the supplier and technology designers at the same time. This pattern of interaction enables the given stakeholders to continuously refine their products and quality of service while also maintaining the strong relationship and interdependency between them. Another quote from the interview findings confirm the above analysis. It is also a great opportunity for the solar based entrepreneurs to refine their products from time to time upon minor modifications that SELCO can respond to speedily.

c) Working with local communities, creation of new needs, trust building in networks

From the cases and interview quotes cited earlier, there is evidence of both product and design innovation. SELCO have also worked with NGOs and community organisations because it would otherwise be difficult to penetrate the market in a rural area without any local knowledge. The example of developing a solar headlamp, in particular, is useful in this context because issues around childbirth and traditional practices are sensitive in traditional communities considering some of the regions in Karnataka are conservative and resistant to allow changes in traditional practices (midwives delivering kids). Another thing to consider is the nature of risks and amount of community involvement required in the entire process. From the results above, it can be said that the headlamps benefitted the society in many different ways and also the fact that it is welcomed in the community without much resistance. This has to do with community participation that SELCO triggered from the very beginning knowing that gathering the amount of knowledge that it needs and the technological aspect of things required in the process. In the end, this has been a big change and benefit to the society for both midwives and also flower pickers. Apart from these tangible benefits, there is also an element of trust building that was a part of this activity since SELCO worked closely with the community on a sensitive issue.

Further on in this context, in terms of the *institutional arrangements*, these innovation and changes were possible not by SELCO alone but also their partnership with a) SEWA (self-

employed women's association) and b) the community in which they introduced the solar technologies. Without SEWA, it would be very difficult for SELCO to penetrate a village area and study a sensitive topic such a child birth delivery and that too for bringing in renewable energy technologies – to this angle, SEWA's involvement in the arrangement benefitted the larger outcome of the process. Secondly, considering the end users would be the community – it benefitted the outcome further by involving the midwives into the process from the beginning. Once again, the two things can be repeatedly observed is a) targeting the end users to be a participant in the process from an early stage and b) studying the nature of demand and the need very much in-depth - these two can be applied also for home lighting systems, solar lamps, lanterns and other RE technological innovation that SELCO have offered so far.

The level of interaction that SELCO staffs have with the clients and the amount of detailed knowledge collected in the process is something of great interest to this research. A scenario where a staff is calculating how much an individual household spends on kerosene every month and calculate how many additional hours of work that SELCO light can provide for the same amount explains their level of attention to detail and willingness to go far with the '*customisation*' of the technology and also funding model. This is clearly a valued add-on over and above their measuring the non-quantifiable benefits in terms of *improving health, saving time in sourcing forest-wood and increased hours of study for the kids*. This is important for the clients who are using the RETs (solar lamps, batteries or lanterns) because they are using the technologies to increase their business working hours. Table 5.2 shows some beneficial impact of switching to renewable technologies.

Information collected on	**Switching to alternative**	**Impact/benefits of the switch**
Hours spent using kerosene	Solar lantern	No respiratory diseases, save time in sourcing forest wood
Amount spent buying kerosene	DO	Increased hours of study for the kids, saves money

Table 5.2. Benefits of switching to renewables

Each solar lantern, for example, can give an extra 3-4 hrs of light after dark and the staffs are found constantly studying how each entrepreneur uses the light, whether the latter uses it all up for business purposes or saves up an hour for using it at home for any paperwork or use by other family members. The staffs are also found to teach the entrepreneurs regarding how to service or maintain the technologies, these may seem very simple for an urbanite but getting even the basics of these technologies right could be a challenge (initially) for villagers. This connects with the patterns of interaction (between SELCO, users and clients) and outcomes generated as mentioned in the IAD framework. Clearly a) *customisation* and b) *improving health, saving time in sourcing forest-wood and increased hours of study for the kids* won't be visible in the outcomes unless the patterns of interaction is stressed, maintained and generates expected results.

The science behind the *'customisation'* of the technology that SELCO offers is through a solid understanding of the client's usage of energy and also payment capacity on a regular basis. This can be furthered by the example that we see above – the staff while identifying the needs of a household to light up four rooms while not all of the four simultaneously. This finding not only tells us the level of detail the company delves into but also the degree of flexibility to which the technology is further designed and delivered – the point here is about 'standardisation' that is deliberately missing for all its products. SELCO feels it is anti-thetical to what it stands for because they are not really after scale of sales of a one-size fit all.

Support for RE based entrepreneurship

There are a number of ways in which SELCO provides a setting in which RE based entrepreneurship can be supported. *Firstly,* the guaranteed visits (two times an year and also responding to one emergency call) but also the regular field visits to ensure that the use of the technology is made for the purpose why it was delivered in the first place. This is an important lesson because it could have two implications – one is the monitoring & evaluation of the

technologies that runs on an ongoing basis and secondly, overseeing the nature of consumption pattern of the solar technologies. It should also be noted that there's always a SELCO local office within a range of 30 km from a client's place/village. This could save them the time taken to visit the households and instead use the time to address an issue and possibly solve a problem. *Secondly*, the staff is also known for responding to 65% of the client calls within 24 hrs and that 80% of the issues are resolved within the time frame (reference needed). This is more than just assuring the fact they have a strong operational efficiency but also giving a lot of intrinsic confidence to the clients in the villages. These factors acts strongly as determinants to support RE based entrepreneurship, since the enterprises such as the one where an entrepreneur rents out the solar lamps, lanterns or home lighting systems, operates daily and there is a regular cash flow issue. So, sooner they get a technical support the better in terms of smooth continuation of their operations. Also, having a good communication and support system are always a plus for entrepreneurial initiatives irrespective of the scale. Table 4 summarises the outcomes generated from SELCO's patterns of interaction between different stakeholders.

Finance plays a major part in RE based start-up ventures, in both models of rent and ownership of the RETs**.** The arrangements that SELCO has with other stakeholders from the financial institutions market such as regional rural banks, credit cooperatives and microfinance agencies is particularly useful – on the one hand, this is the key to arranging the provision of credit to SELCO's clients without getting into financing themselves directly while on the other hand, it is developing rural 'villager – banker' interaction and relationship which was missing before SELCO came into the picture of rural Karnataka and other states where they now operate. For a village entrepreneur, having a support system that not only provides customised technology as required, responding to technical issues immediately, but also making credit facilities available from a financial institution plays a vital role in terms of security, foresight as well as confidence.

The above holds several rural development implications. Both *knowledge sharing and capacity building* can be seen from the results and findings from the field research carried out. Entrepreneurs who are using SELCO's solar technologies to build their micro enterprises benefit from the relationship with the banks – this builds their credit credibility and good

rapport for any future approach that they have to make to the banks again for either business or personal purposes. Also, the credit repayment mechanism that SELCO started, weekly or daily repayment patterns, ensures that the entrepreneurs develop a good credit habit and also business sense. From the findings of fieldwork, it can be seen the a vast majority of them ends up paying the loans on time and also sometimes paying two or three installments in one go.

This can be seen as a success, not just for the entrepreneurs but in regards to achieving SELCO's objectives of developing entrepreneurial spirit and improving villager-banker relationship in the long run. In the state of Gujarat, SELCO works with SEWA (self-employed Women's association) and the latter provides most of the loans in rural areas where SELCO's clients are. The case has been seen as a success as portrayed in their newest publication of a book (reference needed) and also the fact that the model is being replicated in other North Indian states. Knowledge sharing is a bonus in the relationship between SELCO and clients, the constant feedback loop enriches product design and applicability, and this level of user-provider integration is a support system for entrepreneurs whose livelihood depends on the technologies on a regular basis. In addition to these, the entrepreneurs being a key stakeholder and knowledge point to SELCO ensures provision of confidence that provides intangible benefits to an enterprise.

The steady and long-term relationship with the suppliers, who are mostly local, helps SELCO to design and produce items to their exact specification, and that includes experimenting with new product design. Their healthy relationship with other stakeholders, for example mainly bankers and credit cooperatives also helps the suppliers develop a solid confidence about SELCO's market and operational credibility when it's on a market development mode. This is a bonus for them on both market and non-market forces side. For entrepreneurs, it is a good sign because at most times, when they need to call SELCO staff for any repair or technical assistance, the staffs are equipped with the resources that they need to solve an issue on the spot. This could *reduce risk, time of waiting and operational costs* (e.g., visiting a site more than once, and it may not be the same staff visiting twice – the person who visits to see and review a problem, and the person who visits to solve the issue may be different due to staff time-table and scheduling issue, each one of them are following their own timeline of projects and deadlines).

The multiple stakeholder engagement and institutional arrangements that SELCO has got at various levels boosts the credibility and sustainability of the model. SELCO works with NGOs, local financial institutions, education institutions and social enterprises. These institutions can be seen as both direct and indirect stakeholders of the company, engaging, acting and reacting on a daily ongoing basis in order to ensure the continued operations and offering services to the rural entrepreneurs and clients. Each one of them has a defined set of deliverables while they work together and cumulatively adds up to the final service that the clients receive in the end. These arrangements, thus, can imply that, although the action arena and decision making process may be different for each actor but when they work together, there's one outcome that defines their collective role as *one*. This enables a deeper understanding of the outcomes generated as a result of the patterns of interaction between actors and stakeholders of SELCO supports RE based entrepreneurial initiatives in a comprehensive way.

4.3. All India Women's Conference

4.3.1. Actors

AIWC is a nationwide organisation and also have branches in other nations of South Asia besides having base in India. It is the nodal agency for the Ministry of New and Renewable Energy (MNRE) for disseminating alternative energy resources, awareness raising and empowering women via the same. IREDA, the finance wing of the MNRE also sponsors the training and pilot programmes organised by the AIWC. The organisation had worked with the MNRE (previously known as MNE) since over 25 years and have strong linkages with the Ministry's resources dedicated to RETs development and incubating green entrepreneurs. Most of the AIWC's training programmes are however designed and delivered by educational institutions, research think tanks as well as participation from NGOs and VOs. Every training and pilot programmes has several levels starting with awareness campaign, participatory meetings, taught classes to the women entrepreneurs with several facilitator coming from

different partner institution of AIWC. In many ways, without these partners, no training or incubation programme could go ahead and deliver as designed.

Besides the NGOs and VOs, the AIWC also buys RETs from private RETs manufacturers such as TATA Power Solar and Urja Unlimited; they also organise training programmes so that women in relatively disadvantaged communities can learn how to make basic RETs at home and develop micro enterprises based on it. For example, AIWC's training programmes on solar cooker, air dryer and solar lamps have had successful participation from communities and there are communities in New Delhi and Gujarat where women make, maintain and repair solar RETs. They are also trained to run their own RE based enterprises either from home or a street stall.

Figure 4.3. Stakeholders of AIWC

4.3.2. Patterns of interaction and outcomes generated

By looking at AIWC's operational model and the extent to which they regularly interact with a broad range of stakeholders - mainly clients women entrepreneurs, research bodies, MNRE and IREDA - it is important to understand their patterns of interaction and what outcomes are generated from the same for solar based entrepreneurial initiatives. Codes are identified in each of these sections that would help in the thematic analysis presented later in this chapter. Looking at the range of services that AIWC offers to their clients, the following are discussed.

a) Working with partners to facilitate training and development programmes

Some of the main challenges to any solar-based micro enterprises are the lack of basic and practical knowledge. The women and youth who are running the solar-based enterprises are not able to solve the minor problems of solar devices & maintain, repair and install the solar devices. They are dependent on external source that is a costly and time-consuming process. Thus, the aims of this training program conducted by the AIWC have been to identify and enhance the capability and capacity of low income group of women/youth from identified resettlement colonies to develop into potential entrepreneurs to assemble, repair and maintain solar devices/energy efficient devices and create a self-sustaining model and local eco-system. The model shall result into a successful demonstration that a women/youth can be successful entrepreneurs and contribute to value generating livelihood activities.

"The training programmes are easy to follow and have a good organisation of resources, we basically start from zero in terms of technical knowhow but we're familiar with the usefulness of the RETs as (NGO) colleagues have talked about that earlier. This provides a good starting point. Women are particularly focused on understanding how to make use of the RETs to run a business that can be home based, income-generating and involve other women from the local community" – Women Entrepreneur, AIWC, Kolar (Karnataka)

Each time the AIWC set up a training programme either in resettlement colonies in New Delhi or in the suburbs around Noida, there were around 15-20 trainees in each group. The time period of each training program was approximately 1 month with 20 sessions that contained

both theory as well as practical classes. Urja Unlimited provided the technical training and products (solar lanterns, home lighting system & LED devices) for these programmes. And for Global warming/climate change, solar dryer, parabolic and box type cookers; waste management, vermin compost, Biogas, self-help group formation & Peat Pot development has been taught by the experts (from the industry who were hired as consultants). AIWC were invited to cover the exhaustive syllabus for both theoretical as well as practical classes. At the end of each training programme, there was a test and evaluation session. The test was divided into three parts – Multiple choice question answer, drawing completion and viva, external experts have taken these sessions. These training programs had been conducted in the supervision of Training – convener and trainees had been selected with the help of local NGOs and the local contact person.

"One month is a less fragile period of terms of holding up to their motivation; what I am learning is less important than how is it going to affect me after the training is over is what the participants carry in their minds. So 20 sessions in one month involves quite a lot of training input and they do take these in before they are evaluated where most of the participants have been noted to get a pass…there are some really smart women who continues to stay in touch and look for further training programmes"- Ex-Chairperson, AIWC New Delhi

The above quote captures the strategy of the programme design and content, it is to be noted once again that the participants are mainly poor or from relatively less poor categories of the society, so it does make sense not to design programme that will probably going to take them off from their daily lives for a longer period of time leading to possible drop outs. In regards to selecting 15-20 participants in each group, it is highly important to note that in most of these programmes, there is often more than 1 trainer per group, there is usually an additional facilitator who also responds to individual queries and address problems encountered by the participants. The training programmes are highly hands-on, and this allows the participants to get individual attention from the trainer and the training assistants, this leads to higher efficiency and thus clearly more involvement during the process.

b) Engaging with unemployed youth/women who are potential 'solar engineers

The end goal of AIWC's training programmes is to provide an opportunity to trained women/youth to do the following.

1. Engage with solar manufacturer and service firm
2. To establish their own service centre
3. To create income by providing service as maintain, repair and installation of solar devices
4. To maintain their own solar based charging station
5. To start a sales centre

At each of these stages above, it involves a range of actors that contributes towards the final outcome. It has to be noted that the participants are usually allotted a time frame to engage in the process with a specific firm. Since AIWC is also the nodal agency for the MNRE (Ministry of New and Renewable Energy), it has got quite a commendable list of network of firms that they can closely ally with to support these individuals (youth/women). Upon completion of the apprenticeship period, the individuals are then supported to set up their own solar charging station, or a maintenance store where users can come down as a one stop troubleshoot store. These trainings are usually provided during the training and awareness campaign as discussed in the earlier section, and it has been observed that in most cases it is the women who set up the maintenance and repair shops where men are found to set up solar charging stations. While setting up repair shops requires more technical knowledge, solar charging station is about using operational management practices on a daily basis with several stakeholders. Either the AIWC staff or the NGO that they work with over a period of time systematically develops both these acumen.

Role of NGOs is key to the success of an organisation because it helps in collaborating with multiple stakeholders at the grassroots. The different levels at which NGOs plays a pivotal role in empowering people with technology transfer are the following:

Benefits of NGOs involvement in local level initiatives:

1. Going to the people and learning from them what their needs are

2. Generating awareness by demonstrating the technologies
3. People need to be motivated; this needs catalistic attitude of facilitating the process in local context after studying the local conditions, needs and the local psyche of the people
4. Once people have accepted the technologies, there will be more demand – this can only happen with bottom-up approach and that is normally followed by the NGOs.
5. NGOs can get the feedback directly from the users about the weakness and strength of the technologies.
6. While transferring the technologies, another area of vital importance is to train people in using and maintenance of these technologies.

Once these individuals are found to be set up as a solar engineer, there appears to develop a trend in the colonies or in the suburbs where neighbors of these newly built entrepreneurs try to step up and do something similar. This would involve not only to set up newer and more solar charging stations, but includes the use of lanterns and cookers to set up mini stalls and small business around their living areas. The community develops over time.

"*Rita was managing her maintenance shop for over two months and she secured around 20 clients who came on a repeat basis with their cookers, lamps and batteries, over time her neighboring family decided to use one of the lanterns given for free by the NGO to use it for selling garlands in the colony after dark for customers returning from offices after 7pm. This trend was missing before because people haven't used these technologies before and now they see the technologies are giving them additional opportunities, time and money*" – Women Entrepreneur, AIWC New Delhi

c) Working with partners in different regions to replicate the business model

AIWC tested simulation using solar lanterns and solar air dryers, these two being the most popular RETs used by their entrepreneurs. For the solar air dryers, the AWIC launched two very similar schemes in two different parts of the country in 2011. First in New Delhi followed by installing the same capacity in Kerala in South India. Interestingly, one succeeded while the other didn't and this simulation was particularly useful for building up the lessons learnt and

knowledge database. *Primary objectives* were to demonstrate the commercial viability of solar drying of fruits & vegetables on a micro-enterprise scale and also to establish its suitability for wealth creation among the poor women. *Secondary ones* were to study the market for dried/processed fruits and vegetables in general and solar dried/processed products in particular; in addition that the objective was also to *explore the various means of structuring the solar drying project* in terms of financing and asset ownership; also, to establish a set of specifications for solar dryer (hardware) and processing technology (software) for the various dried/processed fruits and vegetables. A case is presented below to clarify how the RETs business simulation ran. (AIWC, 2013)

The case is briefly presented below:

Drying of fruits and vegetables is one of the chief means of preserving the wide variety of seasonal fruits that India abounds in. Among the many techniques of drying, sun drying is widely practiced. In India, hardly 2% of the horticultural produce i.e. fruits and vegetables are processed whereas countries like Thailand, Philippines, and U.S.A process more than 70% of their produce. The fruits and vegetables processed in the form of fruit pulp constitute 50% and dehydrated products only 2.22% i.e. 33,000 tons per annum (AIWC, 2008). The traditional way the cottage industry in urban, semi-urban and rural area undertake the processing of dehydrated vegetables and fruits are unclean and unhygienic from any standards of safe food. Open sun drying has no quality control and collects contaminants like filth from birds and rodents, dusts, dirt and dead insects, etc. Solar Drying Technology offers an alternative with zero energy cost and processes the vegetable and fruits in a clean, hygienic and sanitary condition of national and international standards.

The features of a solar dryer

1. The temperature achieved in the cabinet is in the range of 40-65 degrees Celsius on clear sunny days.
2. The temperature difference between the ambient and inside cabinet is 15-30 degrees Celsius on sunny days
3. The moisture control in the product is achieved by regulation of drying time, basing on the intensity of solar radiation.
4. Thermostat control at set up temperature in mixed solar and electrical mode.
5. Closed trays provided for easy loading and unloading of a product.
6. Solar PV fan for air circulation, a special glass filter is provided to cut off UV radiation and reduce the solar intensity for special applications.
7. A clean and hygienically prepared product, meeting the cleanliness specifications of ASTA of USA and other countries, is processed in these dryers.

AIWC realised that the solar dryer technology can be utilised in small-scale food processing industries for producing hygienic quality food products while at the same time this would promote renewable energy sources in income-generating unit. They had some success with it in New Delhi in the past, so they decided to go ahead and replicate the model in Tamil Nadu. The process had two parts, firstly, training and installation of dryer in four locations and secondly, to carry out production on experimental basis. Experiments were done with different products in different locations based on available resources and demands along with the validation of technology. Mango bars, ginger powder, need powder and fenugreek powder for diabetic patients, desiccated coconut powder are few of the products.

Figure 4.4: Business process breakdown of AIWC

Figure 4.4. above shows how the simulation was carried out step by step._Training Programme included demonstration on mango bar processing in solar dryers in the selected regions. The program basically focused on preparation of mango bars. It also gave demonstration on processing of tomato, ginger, coconut, green chilies, curry leaves, and mint leaves using solar dryers. Theoretical demonstration on hygiene and sanitation practices during food processing was also imparted. In New Delhi, there were 9 participants representing AIWC and other women societies. Trainers demonstrated the use of the RET, participants found the solar dryer very good for use in the micro-level food-processing programs that are ideally suited for self-help groups. In Kerala, solar dryer training was a five days intensive training program with 13 beneficiaries, 10 from SHGs and 3 from Mahila Samagam branch. 17.3 kg of mango bar was prepared as a part of training.

Table 5.3. Marketing of solar air dryer products

Product preparation and marketing	Marketing Details
1. The products were identified on the basis of season, fruits and vegetables available in the local market and market survey. 2. The branch in Tamil Nadu experimented with tomato powder; curry lead powder, kasuri methi and bitter gourd powder. 3. Delhi pilot prepared dried tomato slices, kasuri methi, mango bars, kadi masala powder, tomato powder, amla powder and ginger powder. The members at Delhi dried basil, pudina and drumstick leafs.	1. The prepared products were sold at the calculated prices based on the production cost. A percentage of packed products were supplied as samples to retailer and canteens for testing. Till the pilot stage all the solar dryer units were promoting marketing through known linkages. 2. At Delhi, packs of Tomato slices were distributed, as samples to specialty outlets and restaurants and other products were sold through AIWC counter at main branch. Mango bars, methi leaves and ginger powder were sold like hot cakes.

Table 5.3. shows the marketing procedure. The market study at Delhi and experiences revealed that mango bar toffee can be marketed through school canteens and can fetch a good profit. Kerala unit tried to market the products through known linkages.

While Tamil Nadu pilot experimented with tomato powder, kadi leaf powder, kasuri methi, mango bar and bitter gourd powder, the pilot in Delhi tried tomato powder/slices, kasuri methi, kadi masala powder, mango bars and ginger powder. Pilot in Kerala experimented with curd green chilies, curd bitter gourd, black pepper, rice wafers and tapioca wafers. All the

products were selected carefully on the basis of availability of raw materials. But because of difference in marketing forecast and actual consumer's preference, few products faced a loss.

Results

Dried tomato slices/powder was prepared at Tamil Nadu and Delhi pilots. At Tamil Nadu about 1.7 kg of tomato powder was produced and 1.65 kg was sold which fetched 25% profit. Solar dried tomato powder was preferred in Chennai as tomato finds a very prominent place in South Indian cuisine.

Delhi pilots prepared tomato slices and powder but faced a loss of 47%. The reason was one batch got fungus infestion due to humidity in rainy season. Again consumers did not prefer dried tomato slices. These products find market in specialty stores who already had supply linkages with other enterprises. Tomato powder produced by Delhi pilot was received well in the market because consumers used the powder to make tomato soup.

Learning 1: Tomato powder is more profitable to produce in Southern India.
Learning 2: *'regional conditions and consumer preferences'* needs to be considered as a determining factor for solar air dryer food products. The choice of RETs isn't enough

Kadi Masala powder is prepared by mixing Kadi Leaf powder with red chili powder, channel dal powder, dhania powder, garlic powder, salt and refined oil. The powder is used in South Indian Cuisine and North Indians also use the same in curd to make it spicy. Delhi pilot prepared the kadi masala powder. The consumers appreciated the product and encouraged the unit by placing orders. The product was found marketable in Delhi market.

Lesson 1: Product rightly identified and marketed
Lesson 2: Regional condition and consumer's preference is after all an important determinant before setting up a RETs generated food based micro enterprises.

Summary of lessons learnt and shared from the case

The project experiences will be used in the recent future when a SHGs or individuals will use solar dryer concept in an enterprise. Project provides sufficient space for the women to use the

experiences for income generation. This will not only fetch income for the women but will also cultivate entrepreneurial ability and self-reliance amongst them. The products should be identified on the basis of cheap raw materials available in the raw market. It's better to prepare the products in the season when the local market is flushed with the raw material. Otherwise a tie up can be made with the farmers that the unit will buy a particular amount of the harvest at wholesale price.

Due emphases should be given to consumers' preference in the local area. A particular product is preferred in Delhi market but is rejected in Chennai market because of differences in food habits. Market research should be done for local market. Initially the product must satisfy the nearest market demand, as it will make the marketing easier. Each product should necessarily bear the message that the product is solar dried and hygienically prepared.

d) Develop self-sufficiency in youth/women to run energy-based businesses

AIWC runs a series of initiatives starting from running awareness and training programmes to setting up small firms installed with solar charging stations to replicating successful models elsewhere to increase the organisational knowledge database. In the process of doing so, development of self-sufficiency in youth/women to run energy-based businesses is visible. This cannot be entirely accrued to only AIWC but also the associated agencies and related actors who have a big role to play to fully implement and actualise the project design, delivery and evaluation. Self-sufficiency is however a feeling that pervades the beneficiaries as can be noted in the following quote.

"*The feeling of self-sufficiency takes a long time to develop, it starts from the training programmes when they (the participants) are informed about the prospective benefits of running an energy based businesses and that they don't have to rely on their local municipality or gram panchayat anymore to avail their social protection benefits. Women were also told that they don't have to migrate out from their base and most of the initiatives can be home-based and they can send their kids to the school. We provided adequate training to these women for over 20 years now, for various different initiatives, it started off with the simple technology of parabolic solar cooker which was new at that time, and now solar charging stations that are quite popular in the communities these days*" – Project staff, AIWC India

Two more things observed here – firstly, the concept of security and stability of women in their home area. Generally, men are more likely to migrate out than women running renewable

energy based businesses. The assurance that AIWC provides plays a vital role in securing the expectations of the women that the business can be run from home without the need to move out and leave an established set up. Secondly, the entrepreneurs are made known that AIWC starts their supporting mechanism from early awareness meetings through the process of training and nurturing entrepreneurial capacities in the entrepreneurs to guiding them till the business takes off. This is a great support for entrepreneurship at any level for both motivational, stability and security purposes.

4.3.3. Thematic analysis of support for solar based entrepreneurship

[Please see Appendix for Table 9.11 for data analysis structure for AIWC]

Data Analysis Structure for AIWC

Patterns of interaction and outcomes generated	**Codes**	**Themes**
Working with partners to facilitate training and development programmes	1. Practical training 2. Skill based test 3. Simulation programmes 4.Guided and participatory process	**Participatory training and learning, simulation opportunities**
Engaging with unemployed youth/women who are potential 'solar engineers'	1.Support from apprentice to start-up stage 2. Participatory learning support 3. Women maintain and repair solar technologies	**Comprehensive long run entrepreneurial support, women repairing RETs**
Working with partners in different regions to replicate	1. Importance of situational factors	**Situational factors of**

the business model	2. Inclusion of entrepreneurs as a part of the simulation to share learning 3. Identifying the right business to choose and grow 4. Cultivate entrepreneurial ability	**business, identifying right business and region specific, funding available for start-ups**
Develop self-sufficiency in youth/women to run energy-based businesses	1.Early awareness meetings 2.Developing sense of independency 3.Ensuring of stability 4.Support from training stage to business take-off	**Focus on awareness and knowledge sharing, entrepreneurs developing sense sufficiency**

The public private partnership model visible in the AIWC's operation is interesting. The actors that are involved with the AIWC at different levels are NGOs, MNRE, IREDA, renewable energy manufacturers, trainers and leaders from University and industry. For each purpose, starting from awareness campaigns (partnering with NGOs), sponsoring training programmes (partnering with MNRE and IREDA), providing technologies (Urja Unlimited) to building entrepreneurial capacity by development workshops (trainers and research agencies). These actors are thus vital components of AIWC's working model. In particular, the role of NGOs are undermined but the importance of awareness raising programmes are vital because the RETs and initiatives to develop women entrepreneurs requires a societal support and especially from the households where they belong to. A big part of the operational success of any such initiative calls for a well-nurtured and sensitised community where they have been made aware of the benefits and challenges of adopting a change.

a) Participatory training and learning, simulation opportunities

Examples and cases cited above shows that training and learning programmes are developed and run by a host of institutions that are partnering with the AIWC. During the training

programmes, trainer and facilitators coming in from Universities and research institutes participates and interacts with the entrepreneurs in person, shaping it like action learning and answering any questions. They are also seen taking tests that verify knowledge and understanding besides providing feedback. The opportunity provided for business model simulation enhances a higher understanding of situational factors that play a huge role in business success, especially in the case of food business where entrepreneurs are trained to use solar air dryer. The knowledge of lessons learnt ensures that the learning process is continuous both for the entrepreneurs as well as AIWC as an institution.

b) Comprehensive long run entrepreneurial support, women repairing solar renewable technologies

As evidenced earlier in this section, AIWC build 'solar engineers' who are also women entrepreneurs. In some cases, men are leading a solar charging station while women are repairing and maintaining the technologies. The process that AIWC follows to build women entrepreneurs is long. They start by awareness campaigns whereby the benefits and challenges of using RETs are explained. This includes not only explaining the benefits of using renewable energy technologies or becoming an entrepreneur but also issues such as women don't need to leave their community and the business can be based at home – this ensures stability and security. Awareness campaigns, training and development – being the initial steps, the institutions also offer finance to support a new start-up while providing business training and knowledge support. This entails the help of partner institutions as explained above. After a business takes off, AIWC also remain in frequent touch to see the progress of the enterprise and helps in further scaling up in the future.

c) Situational factors of business, identifying right business and region specific, funding available for start-ups

> *"It was important to learn what were the food habits of people in order to popularise the solar cookers and solar dryers and solar pumps while working with tribal area in Mozda, Gujarat, before any change was introduced. What kind of cattle the household has for instance norms could for a gobar gas plant is viable for 5-6 cattle. It is not always the number but also the health and the nutrition available to the cattle would be accounted for. Rigid specifications would lead to failure. Sometimes the Government officers had gone making structure for gobar gas plants without training or involving the people. NGOs and Government need to work as active collaborators to popularize these technologies and make any programmes successful. Thus, for any organisational working closely with the grassroots needs an entire set of local knowledge at various levels in order to start designing program planning and approach."*
> Green Grants Associate, India, New Delhi

MNRE and IREDA are the two other key actors that the AIWC closely collaborates with, this is firstly because MNRE had appointed AIWC as its nodal agency to disseminate technology and training campaigns on non-conventional energy in different regions of the country and secondly, IREDA provides the seed funding for all programmes and initiatives that AIWC comes up with. This also acts as a security because in several cases (as the solar air dryer case in Kerala), some of the costly initiatives may not generate expected result. The renewable energy manufacturers are however a key player in the actors list for AIWC, this is because the nature of demand has been constantly changing and thus the consequence on cost. AIWC's wide network of manufacturers considering it is a nodal agency for the MNRE brings in the best deals with guaranteed maintenance provision in the country. AIWC also brings in industry experts from both the RE industry and the Universities – and these actors can be seen providing training in their awareness programmes. These industry experts evaluate the test that the participants take to check the level of understanding and application of knowledge. They also comment on the nature of the programmes and how to develop the latter with their observations and changing demand in different communities.

In addition to the above factors, another common phenomenon noticed from most of the initiatives that AIWC have taken up, especially the recent ones (over the past 10 years) with renewable energy technology development and dissemination of the same to rural masses, is the involvement of voluntary agencies. This has clearly increased public awareness of various energy-saving devices and people have expressed a higher level of interest and perception of the same due to the fact that these voluntary agencies work closely with the communities and

households to help them understand/accept any change. This is important because in rural areas, no new change or a technology so to speak, can be introduced without an initial stage involving '*sensitisation*', and this is very much possible with the action and involvement of voluntary agencies. The initiatives and activities of AIWC over the years have set an example for several other institutions, both at the regional and national levels to develop rural livelihoods especially by targeting and benefitting women in peri-urban and rural India by providing non-conventional technologies alongside providing adequate training and business support.

In most of their programmes all the participants learned assembling, disassembling, maintenance, repair and testing of solar devices such as solar lanterns, solar home lighting systems, parabolic solar cooker, solar cooker – box type. The beneficiaries were individually able to assemble repair and test the solar devices. This helps the organisation to understand that with the help of proper training program, women/youth can learn to do these works to earn income and provide service at grassroots level.

AIWC also organised a wide range of awareness programmes on other technologies like the use and maintenance of biogas plant, solar cooker improver and other RETs sources such as wind mills, solar stills, solar drier, solar lanterns. These became a regular series of programmes under the wing of *'strategies for mainstreaming women in science and technology, policy formulation, development and dissemination'*. Since AIWC is one of the key and dominant nodal agencies of the MNRE, funding and access to resources is not a problem and thus the programmes were ably demonstrated in different parts of the country on a regular basis. This ensured consistency and regularity which kept up the motivation and interest of the growing pool of participants who became advocate on using RETs for creation of income-generating micro enterprises.

4.4. The Energy Research Institute of India (TERI)

4.4.1. Actors

TERI partners with local NGOs to mobilize rural communities around the programme. In 2007, Lighting a Billion Lives was started to deliver affordable solar light to un-electrified or poorly electrified villages of India. One-fourth of the solar entrepreneurs are poor women. 3,50,000 homes in India that are still beyond the reach of the national grid have access to clean light, because of 'Lighting a Billion Lives'. The programme is present in 22 states of India. Globally, it has reached out to Afghanistan, Pakistan, Nepal, Bangladesh, Myanmar, Uganda, Ethiopia, Kenya, Malawi, Mozambique, Ghana, Niger and Sierra Leone. This section will present a few voices of the solar entrepreneurs all across India – some from TERI's resources and my own personal communication during fieldwork.

> *"Since the Programme has seen growth and mushrooming of a large number of manufacturers who are now providing basic energy services to rural households, the focus of the Programme is now on fostering and taking forward the spirit of entrepreneurship through the setting up of a market value chain of energy enterprises across all the LaBL clusters"* – Director - Social Transformation Division, TERI, New Delhi

Such a market value chain is intended not only to provide the much-needed backup services but also making available good quality renewable energy technologies at the local level. The effort is on providing last mile delivery of technology and services. Such an endeavor would require much greater support for capacity enhancement, handholding, and financial support for enabling a viable and robust chain of energy enterprises to emerge. The effort of the programme is also on diversifying the portfolio of services that the energy entrepreneurs at the cluster level and the village entrepreneurs can provide, for instance linking them with the services of provisioning potable water supplies.

'*Torchbearers*' **-** TERI has conceptualised an unique opportunity for young students/professionals to participate in its ambitious global campaign of Lighting a Billion Lives (LaBL), which envisages to bring light into the lives of 1 billion rural people by providing

them solar lighting devices that not only provide high quality light and smoke-free indoor environment but also reduces consumption of kerosene and other fossil fuels used for the purpose of lighting in power impoverished areas.

[Please see appendix, Table 9.12 for a sample list of TERI's beneficiaries, stakeholder and RETs based initiatives undertaken]

Table 9.12 in the appendix shows TERI working in close collaboration with local vocational agencies, NGOs, Government (MNRE), RE manufacturers, banks and end users/energy entrepreneurs; this is briefly represented in Figure 4.5 below.

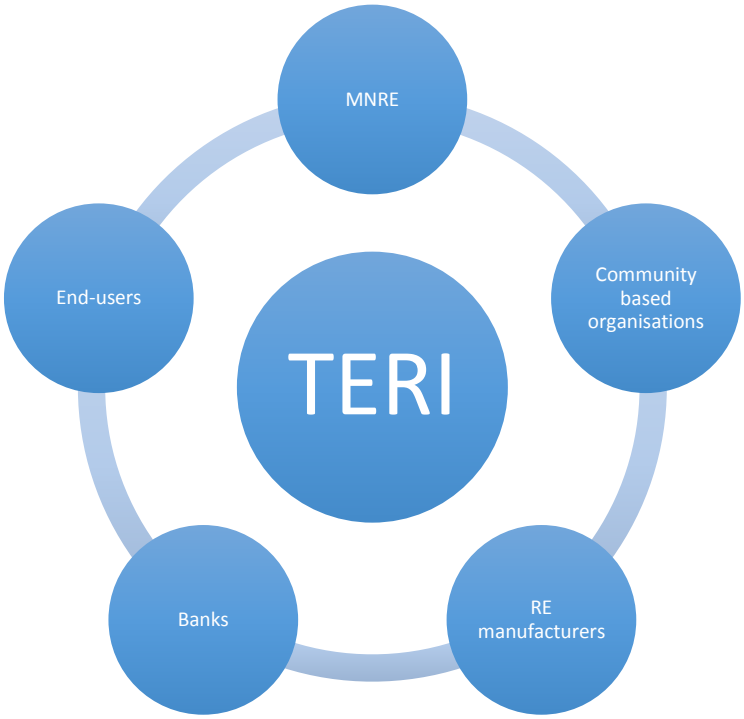

Figure 4.5. Stakeholders of TERI

While some organisations that TERI partners with, mainly banks, is to provide seed capital to the households so that the latter can buy a RE technology (e.g., solar home lighting system, lanterns, etc.); the other partner organisations, namely community based organisations, are essentially there to a) '*sensitise*' the local area about the benefits and limitations of adopting the new technologies and b) help installing the system hand-in-hand with the end users so that the latter can see the value right away and also understand the technology from the beginning.

4.4.2. Patterns of interaction and outcomes generated

a) Partnering with local community organisations as well as the MNRE

Firstly, the fact that TERI works closely with the community based organisation can be seen from two sides as highlighted in the following interview quote:

> "*In order to get a better understanding of the nature of demand and what is the nature of energy deficit in different regions and how people cope with it;* and *people are more friendly and open to the staff working for the community based organisations considering they are local and understand each other's regional perspectives, norms, cultural dimensions as well as attitude towards work and the idea of change*." Deputy Director, LaBL TERI, New Delhi

It is particularly important to note that all the three institutions studied in this thesis follow this common process of involving a local community organisation in their target villages and remote areas of their operation. This is an essential component of their planning mechanism and is vital to the feasibility of a project.

Secondly, working with the MNRE as well the RE manufacturers gives a better knowledge perspective for TERI. There is a feedback loop for product development and increasing importance on user needs. Considering the big RE manufacturers (e.g., TATA Power Solar, Kotak Urja as mentioned in one of the interviews) are profit motivated and as large scale

operators they may not be interested in entering the rural markets to help support energy entrepreneurs (although they get a 30% subsidy from the MNRE for each sale that they make). On the one hand, TERI works with the RE manufacturers to develop plan proposal for bidding and tendering process with the MNRE while on the other, use the network of RE manufacturer to provide RETs for the village level intervention that TERI makes.

Some of the several sample interview cases collected during the course field could clarify some of the above further. When TERI penetrates into a market, they have always worked with either a community based organisation or a NGO to get a clearer picture of a) the energy situation and deficit in the region and b) who are the prospecting willing participants to step up as energy entrepreneur.

> *"Two years ago, I joined hands with TERI as their TRC, servicing solar lanterns in the areas of Uttar Pradesh. Though I was satisfied with the warm vibes I got from TERI, but then they came up with the next level of services – Energy Entrepreneur. It immediately caught my attention and I liked the idea of scaling up my expertise from servicing solar products to now even procuring and delivering them to the end-user. The power scenario in the rural areas is not encouraging, especially in the 11 villages where I operate. Four to five villages have no electricity at all; and the rest and partially electrified with an irregular supply of only three to eight hours. Sometimes they even go without electricity for three days in a row. The cooking domain is still dominated by the use of wood that causes negative effects on the environment and their own health."* – Solar entrepreneur, TERI beneficiary, Uttar Pradesh

This shows firstly, the energy deficit scenario in the village and the intensity of the same and secondly, the use of wood and consequent harmful effects of using it for cooking purposes. Considering these two aspects, TERI formed an association with local NGOs to start offering solar powered home lighting and lanterns for household usage.

b) Partnering with financial institutions and offering after-sales service to clients

TERI's LaBL follows the model of public-private-people partnership and demonstrates how that can support developmental schemes and initiatives, particularly in the area of rural energy access. To finance the campaign, TERI moved from the initial grant-based model to testing an

entrepreneurial fee-for-service delivery approach, then gradually moving to a more flexible equity and investment-based model. By demonstrating credibility through results on the ground and proof of the concept, this process has helped address two key challenges: *(i) scaling up and (ii) diversification of funds*. LaBL offers financial viability to attract equity along with technology customization and an effective monitoring mechanism, and aligned its approach with the government agenda to enable greater likelihood of success. They have partnered with microfinance institutions to offer doorstep finance for energy entrepreneurs. LaBL has also linked with micro-finance institutions to augment new and existing rural enterprises, such as setting up solar charging stations with microfinance institutions that receive funding from the National Bank for Agriculture and Rural Development (NABARD) and state-run rural livelihood programs. They have also been promoting innovative financing of solar charging stations with YES Bank Limited to design and implement a scalable semi-commercial business model for financing of solar charging stations.

TERI also created a new service platform called Energy Enterprises (Uttam Urja Shops). LaBL employs a network of local-level institutions that facilitate micro-implementation of project deliverables, carry out training and capacity building, and ensure after-sales services. An Energy Enterprise (EE) is a local-level enterprise that caters to after-sales service support to LaBL solar charging stations (SCSs) and is also authorized to market and sell TERI-approved clean energy products such as solar lights in a specified area. Apart from providing next door and reliable after-sales support, the EE also assists in creating local capacities of rural youth for the execution of other energy access projects in the area.

Innovation in Delivery Model - In addition to the fee-for-service and loan finance models, TERI is harnessing public-private-partnerships for delivering clean energy and increasing energy access. Some examples to support RE based entrepreneurs include the following presented in the box below.

1. Extending mobile phone charging options through solar charging stations, in cooperation with the Department of Telecommunication, Government of India;
2. Extending stitching and sewing training to rural women at the LaBL solar charging stations, in addition to the provision of solar lanterns, in partnership with Mawana Sugars and Usha International.
3. Creating income generation opportunities for rural women entrepreneurs by training them on selling mobile telecom services locally in addition to the provision of solar lanterns, in collaboration with Uninor

Two things that can also be observed from the table above are a) the range of social benefits that the programmes are aimed at and b) multiple stakeholder interaction with clearly defined deliverables to make the programme delivery successful. There is a strong connection between the two institutions - MNRE and TERI at the planning level considering they are knowledge partners to each other, while local level institutions play a big role at the operational level.

In a village named Kudub in the district of Koraput, Odhisa – Lighting a billion Lives partnered with Rashtriya Seva Samithi (RASS), an NGO in Odhisa, which has facilitated the implementation of six solar charging stations in the Koraput district. It is primarily inhabited by the tribal population and has been affected by left wing extremism. It is highly encouraging to see one of the charging stations successfully being operated and managed by a tribal women entrepreneur. Mrs Damayanti Pangi hails from a scheduled caste community in the tribal village of Kudub in Odisha. Her struggle and dedication was first recognized when she successfully formed a self-help group, with support of RASS, which motivated other women in the village. Recognising her sincerity, leadership skills, and interest for new initiatives, RASS recommended her to act as an entrepreneur for a Solar Charging Station in the village. The charging station that was installed in her house continued for nearly over 2 years now, she has also acquired the skills to maintain and repair when there are any issues.

"*Women should take over the responsibility as far as domestic lighting is concerned because it is she who lights the lamps for the house. The charging station has brought myself closer to the women of the village and has enabled me to build a rapport with the community. I have formed a self-help group by using finance provided by ICICI (partner with TERI) and can now conduct meetings more than once a week in the evening*". As Damayanti puts it, "*The solar lantern has boosted the confidence among the women in the village. A decreased use of kerosene has in turn reduced health problems also.*" – *Women Entrepreneur, TERI beneficiary*

Further, Janmoni Borah from Assam presents an example of yet another enterprise woman who has managed to step out from the confines of her home to carve out a successful life for herself. Janmoni hails from a small village of Jaroni Gaon located in Gohpur region in Sonitpur district of Assam where TERI has implemented more than 30 SCS along with SMCF in partnership with Chaidhur Rural Development Centre (CRDC). Janmoni Borah is a successful entrepreneur who is also a major torchbearer of developments in her village. The people in her village now look up to her for financial support or otherwise. She has engaged more than 20 families in different activities that provide a means of livelihood for them. She has been chosen as one of the successful entrepreneurs of LaBL activities in Sonitpur, she is now providing lighting facilities to the village through her solar charging station. By doing this, she is not only catering to the domestic lighting needs of the villagers, but is also providing light for major community occasions, cultural events, and marriage ceremonies in her village as well as in neighboring villages.

Examples galore and more can be shared which all shows that in each of the interventions, however discussing some of these findings reveal that TERI had a few things intact all through and they are a) partnering with a local NGO or a community based organisations to sensitise and nurture the willing individuals to step up as energy entrepreneurs b) targeting women in particular because of firstly of the response rate and secondly, the nature of village women not likely to migrate out leaving her roots behind (whereas men are more likely to leave home for seasonal employment and migrate out far) and this provides stability to a new start-up **c)** partnering with banking and financial institutions (e.g., ICICI) for providing start-up capital to entrepreneurs who are willing to set up a solar charging station and d) working with the renewable energy manufacturers who at times are willing to customise the products as per demand.

"*Working with TATA power solar and Kotak Urja has its benefits because they are large scale installers so when we are asked by the MNRE to install, say hundred thousand, solar panels, in a community we usually go for the big players for the economies that they can share but when it is about individual interventions, we have also worked with local suppliers and manufacturers who are willing to customise the product as per demand as studied either by our technical staff or torchbearers when they are giving rounds in the villages and speaking to prospective beneficiaries***"** – Deputy Director, LaBL, New Delhi

c) Working with energy entrepreneurs to develop more energy based micro enterprises

> *"The focus area has been to set up a chain of energy entrepreneurs at the village level who will not only sell the clean energy technologies, but also maintain it. Our endeavor is to reach to places and expand the entrepreneurship to as many villages as possible. In this regard, we are also working with several local governments."* Project Lead, LaBL, TERI

The micro-solar enterprise called centralised solar charging stations (SCS) is setup within the target village and is being managed by the local entrepreneur. The SCS consists of solar PV modules and junction boxes, which contains multiple ports for simultaneously charging a number of solar lanterns. During the night, the local entrepreneurs rent out the solar lanterns to the households within the village at a minimal fee. During the day, the storage battery of the lanterns is charged in the SCS through the electricity generated by solar PV modules. When the lanterns are fully charged, the local entrepreneurs starts making preparation for his rental business during the evening. The rent being collected from the households goes to the entrepreneurs for managing the micro-solar enterprise and to the common fund that is set aside for operation and maintenance of the SCS and solar lanterns. The entrepreneur, trained by TERI as part of the initiative, built up their technical knowledge to operate and manage the SCS on a sustainable basis. The Campaign benefits both the user and the supplier of services.

TERI brings its training programmes with staffs from TERI University and other partner associations where 'torchbearers' can also develop training workshops with energy entrepreneur. These training provides a clear understanding of the technology as well as how to use the same to create income-generating micro enterprises. Below is a pic taken in a typical energy centre and women are seen using these solar lanterns for silk weaving purposes after dark. LaBL staff makes regular visits to monitor their progress and to see how the RETs are maintained and put to multiple uses. In many cases, when the women are not working, they use these lights for other purposes at home, e.g. kids doing homework, husband writing paperwork for gram panchayat or simply for cooking purposes in the kitchen. It has been observed during fieldwork that some of the households where TERI has intervened own/hire more than one solar RETs appreciating the multiple uses of the same.

Photo 4.1. Use of solar lanterns by women

4.4.3. Thematic Analysis of support of solar based entrepreneurship

[Please see Appendix for Table 9.13 for data analysis structure for TERI]

Data analysis structure for TERI

Patterns of interaction and outcomes	**Codes**	**Themes**
Partnering with local community based organisations as well as the MNRE	1. Partnering with local and community institutions as well as national level public institutions 2. Partnering with an energy entrepreneur	**Public-private people partnership**
Partnering with financial institutions and offering after-sales service to clients	1. Working with financial institutions 2. Door-step financing to entrepreneurs 3. Helping individuals graduate off poverty 4. Forming knowledge	**Provision of solar based start-up loans, forming knowledge partners**

	partners at different levels 5. Offering faster after-sales service and maintaining communication with clients	
Working with energy entrepreneurs to develop more energy based micro enterprises	1. Partnering with academic and industry experts for developing training and sharing learning 2. Monitoring the use of RETs for multiple purposes while keeping the core purpose intact	**Multi-level partnership, monitoring of entrepreneurial performance**

a) Public-private people partnership

As evidenced from the findings and Table 9.13 (please see appendix) showing themes emerging from data analysis, besides working with the MNRE and other public institutions TERI also collaborates with private RE manufacturers as well as local community level organisations. The partnership arrangement works at different levels. The partnership with community level organisations helps to nurture a target rural area using the local contacts and knowledge as shared earlier, these information are fed back to TERI who then comes in with the RETs and makes a development intervention. Many other benefits coming out from this arrangement is discussed more in detail in chapter 5.

b) Provision of solar based start-up loans, forming knowledge partners

The concept of torchbearer, developed by LaBL initiative, is particularly quite innovative and useful. Recruiting the members from research thinktanks, young students from Universities, local youth who are willing to volunteer, these torchbearers reach out to the target villages and

collect information from the entrepreneurs to feed back to TERI offices. The torch-bearers also works with a target community and incubate energy entrepreneurs in many cases. For provision of loans to entrepreneurs, TERI partnered with NABARD and RRBs previously, but now they have their own funding body. Entrepreneurs are given start-up loans when they commercialise the use of a RET to create a micro enterprise. Door step financing option is also made available. In combination of the above, the entrepreneurs get a comprehensive support from TERI. The local NGOs and VOs are also constantly collecting information and using local knowledge to support the entrepreneurs, they also feeds back the information of business operation and activity of these entrepreneurs to TERI who monitors from a distance.

c) Multi-level partnership, monitoring of entrepreneurial performance

Due to the presence of multiple partners in both public and private sectors in addition to energy entrepreneurs in rural areas, TERI's model can help entrepreneurs to nurture business acumen, set up and grow a micro enterprise, provide door step financing when needed, monitor entrepreneurial performance using LaBL torchbearers and community level organisations. The innovative delivery model as discussed earlier, works effectively due to a wide range of stakeholders involved in the process.

4.5. Discussion and Chapter Summary

This chapter investigated three different institutional arrangements adopted by three institutions, - SELCO, AIWC and TERI, supporting RE based entrepreneurship in India. It looked at the three elements suggested from the IAD part of the conceptual framework used in this research – actors, patterns of interaction and outcomes generated. By using both deductive and inductive approach, a thematic analysis was carried out in order to explore the determinants that support solar based entrepreneurship in India. In the end, the chapter finds that the outcomes generated from the different institutional arrangements are similar (see Table 4.4 below) and concludes by discussing a list of determinants that helps to support solar entrepreneurs. While SELCO provides an insight of a *private model* with all of their partners being private businesses, AIWC and TERI have public-private and public-private-people partnership models respectively. In summary, three institutions that have been investigated

provides an insight into three different institutional arrangements, all creating an enabling entrepreneurial environment and determinants for RE based entrepreneurship.

Similarities and differences observed in institutional arrangements across three organisations are in table 4.3 below.

Institutional approach	**SELCO**	**AIWC**	**TERI**	**Similarities**	**Differences**
Nature of collaboration	Working with local communities, creation of new needs, trust building in networks	Participatory training and learning, simulation opportunities	Public-private people partnership	*Yes*	*SELCO doesn't work with the government*
Funding mechanism	Availability of start-up finance for RETs enterprises, developing banking practice	Funding available for start-ups, Situational factors of business, identifying right business and region specific	Provision of RE based start-up loans, forming knowledge partners	*Yes*	*SELCO and AIWC don't offer institutional finance themselves, but arranges the same from a third party financial source*
Development of business acumen	Faster new product development, quicker response to client issues	Comprehensive long run entrepreneurial support, women repairing RETs	Multi-level partnership, monitoring of entrepreneurial performance	*Yes*	*none*

Knowledge management	Knowledge sharing, feedback loop between SELCO and clients, understanding individual lighting needs	Focus on awareness and knowledge sharing, entrepreneurs developing sense sufficiency	Initiation of sensitisation in communities months in advance before introducing the technologies and working with local partners, working with entrepreneurs directly at a later stage	*Yes*	*none*

Table 4.3. Similarities and differences observed in institutional arrangements across three organisations

Overall, the outcomes generated from the multinested actor partnerships and engagement are considered positive determinants for supporting solar entrepreneurial initiatives. It is interesting to see although the different components needed, in general, for all different organisations are typically the same – solar technology providers/manufacturers, suppliers, financial source/banks (private or public), local partners, community involvement in design of the projects, the nature of partnership and sectoral engagements aren't always the same despite generating similar (or in most cases, same) outcomes. For example, as seen in table 4.4, both AIWC and TERI work with the Government/ MNRE while SELCO doesn't.

When it comes to credit, both AIWC and TERI offers financial support to solar entrepreneurs by drawing resources from the MNRE however SELCO, as effective as it is alike the other two organisations, creates links for the entrepreneurs with nationalised and regional local banks in regions where they operate in without involving the financial mechanism themselves. The

general procedure followed by all the three, comparatively, are again fundamentally the same – from the stage of nurturing by sensitising the target areas first before solar technologies are introduced to developing and supporting the solar entrepreneurs once their micro enterprises are set up and ready to function. Both similarities and differences would be useful for both current and future studies. This is because while this research investigates the make up of different arrangements, it would also be interesting to see which particular setting works the best in specific regions in the long run – and in order to do so, it is important to revisit the similarities and differences of the institutional arrangements as presented above in table 4.4.

Discussion of the determinants of solar based entrepreneurial performance

The first determinant that all the three institutions share is the importance of *multi-level partnership and monitoring of entrepreneurial performance*. Through multiple stakeholder engagements and institutional arrangements that SELCO offers provide a holistic support system to an energy entrepreneur. SELCO works with NGOs, local financial institutions, education institutions and social enterprises. These institutions can be seen as both direct and indirect stakeholders of the company, engaging, acting and reacting on a daily ongoing basis in order to ensure the continued operations and offering services to the rural entrepreneurs and clients. Each one of them has a defined set of deliverables while they work together and cumulatively adds up to the final service that the clients receive in the end. These arrangements, thus, can imply that, although the action arena and decision making process may be different for each actor but when they work together, there's one outcome that they collectively create.

SELCO carries out guaranteed visits (two times an year and also responding to one emergency call) and also the regular field visits to ensure that the use of the technology is made for the purpose why it was delivered in the first place. This is an important lesson because it could have two implications – firstly, the monitoring & evaluation of the technologies that runs on an ongoing basis and second, overseeing the nature of consumption pattern of the solar RETs. It

should also be noted that there's always a SELCO local office within a range of 30 km from a client's place/village. This could save them the time taken to visit the households and instead use the time to address an issue and possibly solve a problem. Secondly, the staff is also known for responding to 65% of the client calls within 24 hrs and that 80% of the issues are resolved within the time frame (reference needed). There is a strong operational efficiency. These factors acts strongly as determinants to support RE based entrepreneurship, since the enterprises such as the one where an entrepreneur rents out the solar lamps, lanterns or home lighting systems, operates daily and there is a regular cash flow issue.

Similar support is provided by TERI as well where they collaborate with local level community organisations, the latter helps in keeping track and monitor and support entrepreneurial progress – these monitoring reports are then fed back to TERI who comes up with further action as needed. TERI's LaBL staffs also visit the entrepreneurs and train them on business incubation from time to time. AIWC on the other hand stays in touch with the women entrepreneurs all-round the year, from start-up stage till the business is in stable shape. AIWC targets particular individuals for piloting, train the individual youth or women to use a given technology and also equip them with necessary business acumen to set up a micro enterprise. This has got both intellectual and social benefits in the long run – on one hand, it helps building entrepreneurial spirit in the community and on the other, motivates the youth and women who could further refine their business skills and sustain their income-generating micro enterprise over a period of time.

The steady and long-term relationship with the local suppliers helps SELCO to design and produce items to their exact specification, and that includes experimenting with new product design. Staffs are well trained and equipped with technical knowledge and business acumen as to support the entrepreneurs when the latter calls up SELCO staff for any repair or technical assistance. Staffs usually resolve any issues on the spot. This could *reduce risk, time of waiting and operational costs* (e.g., visiting a site more than once, and it may not be the same staff visiting twice – the person who visits to see and review a problem, and the person who visits to solve

the issue may be different due to staff time-table and scheduling issue, each one of them are following their own timeline of projects and deadlines).

The second determinant is the availability of *solar based start-up loans and also forming knowledge partners* by the institutions studied. Finance plays a major part in solar based start-up ventures, in both models of rent and ownership of the solar RETs**.** The arrangements that SELCO has with other stakeholders from the financial institutions market such as regional rural banks, credit cooperatives and microfinance agencies is particularly useful – on the one hand, this is the key to arranging the provision of credit to SELCO's clients without getting into financing themselves directly while on the other hand. Their healthy relationship with bankers and credit cooperatives also help building confidence in SELCO's entrepreneurs who can see this as having a support system that not only provides customised technology as required, responding to technical issues immediately, but also making credit facilities available from a financial institution. Entrepreneurs who are using SELCO's solar technologies to build their micro enterprises benefit from the relationship with the banks – this builds their credit credibility and good rapport for any future approach that they have to make to the banks again for either business or personal purposes. Also, the credit repayment mechanism that SELCO started, weekly or daily repayment patterns, ensures that the entrepreneurs develop a good credit habit and also business sense.

TERI also provides start-up loans to entrepreneurs from nationalised banks and micro finance institutions, and this process is further facilitated by the MNRE. The MNRE subsides 30 percent of the price of solar RETs, the entrepreneur pays the difference and that too can be arranged in the form of a loan from a bank. This is where TERI comes in terms of provision of finance. AIWC, on the other hand have two sources of finance provision – IREDA that helps sponsor the RETs for dissemination to entrepreneurs or for project demonstration purposes. And the other source of finance is microfinance institutions that offer loans to entrepreneurs to start-up their enterprise as well as monitor their business finance from time to time. In many cases, these micro finance institutions in collaboration with AIWC runs workshop on finance management

while also offering several convenient loan repayment schemes. This is a strong determinant for RE based entrepreneurs.

The next strong determinant is the presence of *knowledge sharing and capacity building* opportunities that could be seen from the results and findings from the fieldwork as presented earlier in the chapter. Both TERI and AIWC *work closely with vocational agencies and NGOs* to enter a new market and target beneficiaries, while AIWC strongly focuses on semi-urban regions and TERI on rural regions in particular. In regards to creation of an enabling environment for the entrepreneurs, both the organisations have partnered with a variety of stakeholders namely local NGOs, banks and industry experts to provide training opportunities, funding and also monitoring mechanism for the newly born solar based start-up firms. These actors, together creates an enabling environment where all the basic ingredients (training, funding, staff support) needed for a rural entrepreneur to start up a new business remains available at a reasonable reach. NGOs and Voluntary organisations have played an important role for AIWC technology dissemination and sensitisation of the same in rural areas. NGOs working closely with the targeted communities of AIWC have studied what the individual household needs are, have demonstrated the use of technologies at the community level, gathered feedback from communities about the strengths and weaknesses of the technologies which could directly boost the need for further innovation, training people how to maintain and service the technologies – these are strong supporting factors that boosts entrepreneurial stability, confidence and performance.

In the state of Gujarat, SELCO works with SEWA (self-employed Women's association) and the latter provides most of the loans in rural areas where SELCO's clients are. Knowledge sharing is a bonus in the relationship between SELCO and clients, the constant feedback loop enriches product design and applicability, and this level of user-provider integration is a support system for entrepreneurs whose livelihood depends on the technologies on a regular basis. In addition to these, the entrepreneurs being a key stakeholder and knowledge point to SELCO ensures provision of confidence that provides intangible benefits to an enterprise.

The importance of knowledge of the local context and situational business factors are key considerations. Having active knowledge-sharing partners helps develop better support plans. The case studies from AIWC also strongly suggest that rigid technical specification may limit the success of the programmes, for example when Government officers tried to make structure *gobar* gas plants without training or involving the people, programmes have failed. Also, if the technologies are designed in a region specific way, it has been found that they can be transferable. Most of the programmes organised by the AIWC were also micro enterprise specific, for example the solar cooker and solar battery charger programmes was meant to train women and youth to be self-sufficient to run their charging station without external support. The idea was to engage unemployed women and youth folks to become *'solar engineers'* to cater to local energy needs, establish their own service centre, create income by providing service to maintain, repair and installation of solar devices. The training of these women and youth in context have been possible due to the help of local NGOs and the local contact person. These local actors have been the *knowledge partner* of these training programmes that had a model of a social enterprise providing solar energy solutions and service to enhance livelihood opportunity and entrepreneurship in rural areas.

AIWC provided a range of demonstration programme of solar cooking and also construction, maintenance and service details of renewable energy technologies under their '*technology and tools'* exhibition over the years – these were considered immensely useful by communities and individuals who were involved in the programmes. These individuals started off as clients and then eventually go on to advocate of the same. As a part of these programmes, ideas were exchanged on how to best utilise national programmes towards mitigating drudgery in the lives of women (e.g., long hours collecting firewood, cooking indoors using charcoal without proper ventilation). When these women entrepreneurs start their business operations they are also capable of repairing and maintaining the solar RETs. In fact, they feel more confident in doing so because during the 'technology and tools' training sessions organised by the AIWC, they were also tested on knowledge and technical understanding. A very similar setting is provided by TERI as well – these training to develop technical skills as well as build confidence in the entrepreneurs who are also the users are key determinant in running a solar based micro enterprise.

Next determinant is the presence of public-private-people partnership mechanism that is particularly observed in the case of TERI and AIWC. While AIWC and TERI works closely with the Government and MNRE in particular considering they are either nodal agencies or knowledge partners in terms of mutual relationship, SELCO works rather independently of the Government and this is supported by SELCO's MD saying:

"*The best part that Government plays in our business is by not intervening in it*" – Principal Analyst, SELCO India, Karnataka

It has got its both pros and cons, while not working closely with the Government, SELCO loses out on the 30% subsidy on its products but gains a lot in terms of efficiency (time saving from paperwork and administrative costs) and connecting closely with the market in their own way without partnering with local panchayat and village bureaucracy. TERI provides the brain behind the subsidy driven model that MNRE has been running on besides the latters' policy-making role. AIWC however, has the highest reach of all considering its age in the business as well being the Ministry's nodal agency for dissemination of RETs with a strong focus on women. In terms of scale, SELCO has a different ideology because it is not after scaling up (or per se, standardisation) but rather setting up incubation centres to create local SELCOs in every region based on a target areas' need; this has to be done by a local organisation in the selected area and not SELCO (e.g., Onergy in West Bengal – a replica of SELCO's model).

On the other hand, both TERI and AIWC work very closely with their stakeholders who are from public and private sectors along with the people and the entrepreneurs who are their targets. Including Government bodies, private RETs manufacturers, suppliers, local communities, voluntary organisations as well as the entrepreneurs develops the public private people partnership model. There is a knowledge sharing loop, capacity building and institutional growth as a consequence. Having this model of partnership can be a strong determinant for entrepreneurship because there is a regular interaction and feedback loop for

development when entrepreneurs can connect to the institutions serving them along with suppliers, RETs.

The purpose here, however, was not to evaluate which institutional arrangements have performed better than others because each of the three institutions created thousands of entrepreneurs across the country with strong social and intellectual impact at the rural level, but to investigate how these institutions have managed to create an enabling entrepreneurial environment so as these businesses to set up, survive and thrive in the long run. The next chapter would look at what are the impacts of solar based entrepreneurial initiatives on rural development in India.

Chapter 5 – The impact of solar based entrepreneurship on rural development

5.1. Introduction

This chapter aims to explore the impact of solar based entrepreneurial performance on rural development in India. The conceptual framework, i.e. constructs from the OECD/EUROSTAT framework (see figure 5.1 below) would assist in looking at the impact of entrepreneurial performance on rural development. A thematic analysis is carried out to investigate how different solar based entrepreneurial initiatives have implications on rural lives and develop communities. The structure followed to analyse each institution is i) solar based entrepreneurial performance and ii) thematic analysis of impact of solar based enterprises on rural development

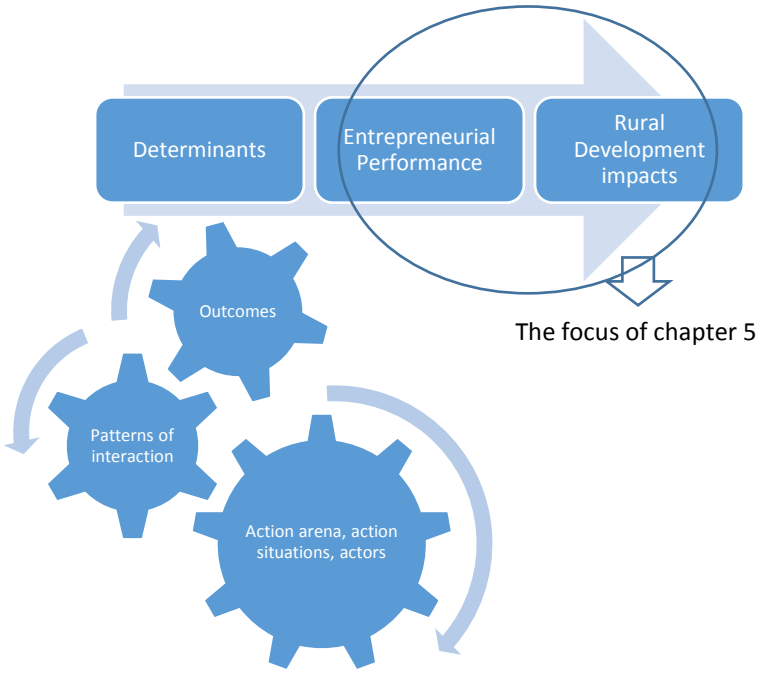

Figure 5.1. The conceptual framework

5.2. ***Solar based entrepreneurial performance***

> "*The concept of energy entrepreneur proposed by TERI immediately caught my attention and I liked the idea of scaling up my expertise from servicing solar products to now even procuring and delivering them to the end-user."* Solar entrepreneur, TERI- LaBL, Uttar Pradesh

The above quote demonstrates that the entrepreneur leveraged the opportunity given to him by LaBL to the fullest, he has also done well with marketing his products in the village, developed a feasible business model and also carry both intellectual and social implications of being an Entrepreneur. However, as a backstory one must be aware of the fact that these interventions were not made out of the blue, in order to penetrate into the market, TERI had to carry out regular sensitisation process over a period of time to cultivate the understanding that solar businesses can be income generating for both households and the community. NGOs and VOs partnered with TERI to carry out thorough and well informed sensitisation for months in advance before the solar RETs were introduced to the villagers and potential entrepreneurs. These NGOs are run by local people and have better communication with the villagers on daily basis, they organise regular meetings in an informal setting describing the benefits of adoption of solar RETs and also the subsequent process of change involved in the process. Once the stage is set and the community is fairly acquainted with the RETs, TERI comes in with the technologies (solar lantern, lamps and home lighting systems) and starts communicating with the target entrepreneurs. This remains in the backstory, however the quote cited above shows thoughts and initiatives of an entrepreneur after the business is stable.

> *"Being an Energy Entrepreneur has fostered many more opportunities, one of them, procuring a contract for Solar Street Light Installation under UP-NEDA. TERI facilitated my communication on this front and since Jan 2013, my team has been involved with installing 400 lights across the Auriya and Itawa district of Uttar Pradesh. For each light installed, I get Rs. 600. Because of this increasing business, I have now employed 12 people under my domain, and I feel this enterprise is helping me generate and light up more homes. Since my association with TERI as an energy entrepreneur, I have managed to make a profit of Rs. 100000. I am not only supporting my family now, but I am also helping others to make their ends meet."* Solar entrepreneur, TERI-LaBL, Odhisa

This participants' response also shows the number of units that he managed to secure an order for and installed in a short period of time – this can tell us that the scale of a rural micro enterprise is not always necessarily *small*. His annual return is pretty high considering his geographic location which also suggests that solar RETs based income generating micro enterprises might not always be 'micro' and limited to a particular region only. There is both scale and scope in these models. Institutional support is considered to be absolutely key in facilitating this process – these interventions wouldn't be thought of otherwise, on one hand the support is provided to the Entrepreneurs by partnering with other institutions and on the other hand, the market access is also provided to the entrepreneurs so that their scope and business confidence also can look north.

> "*Talking about awareness generation, I had distributed pamphlets places within the newspapers in the area where my enterprise was established in January 2013. This effort added around 50 customers to my database."* Solar entrepreneur, TERI-LaBL, Odhisa

Besides demonstrating the marketing skill, the entrepreneur has also generated income for community people who have joined him in his business. This, as mentioned in the literature review of this thesis, supports the fact that energy entrepreneurship can have both personal and social impacts. The fact that word of mouth is actually a powerful tool of marketing in rural communities is often ignored by formal institutions (as it was discussed earlier in the literature review) is taken valuable by both SELCO and TERI as shown in this thesis. They have leveraged this tool without spending any organisational expense on other forms of marketing, it has worked well in most regions as will be highlighted in the findings section.

> *"I have conducted meetings at the village level to make people aware about the solar products and their benefits. I put my banners across the SCs to advertise the solar lanterns. My future endeavor would be to capture customers via the word of mouth. If a customer refers the lanterns to anybody, then I plan to reward that particular customer by giving him discounts for his future purchases."* – Solar Entrepreneur, LaBL - TERI, Karnataka

It is important to mention at this point that the use of local knowledge and word of mouth has got a very powerful implication. It is nonetheless clear that this entrepreneur has managed to use the very best of the opportunity provided to him, and the fact that the local community also stepped forward in supporting his enthusiasm. He has confessedly hired local staff for his business, while also generated an overall interest in the community for the solar power business. In the same market, interestingly, exist both the consumers and employees. To conclude this point, it can be said that besides marketing, business modeling, developing a good idea to upscale the business and hiring local labor and generating income for the community, the entrepreneur have had an overall strong positive impact in his community. People have been seen to step forward and joining in and the frequency of the same seems promising for the long run, assuring the sustainable nature of the business.

> *"Women in my community about the various uses of solar lanterns including leaf plate and cup making, studying in evenings, and even cultivating vegetables in evening – which she herself has started doing with the help of the solar lantern. She is earning around Rs.600 per month by spending 2 hrs in the evening to make leaf plates; she could not have done this with the kerosene lamp."* Woman energy entrepreneur, AIWC, Odhisa

The two things that come up from the above case are *firstly*; once women have an opportunity in a community to develop vocational activities they do it in collaboration of others in the process as can be observed from the quote above and also from other findings as presented later in this section. This suggests that given the scope of the solar RETs, women while working with others can develop entrepreneurial spirit in a community – this could be a potential long run benefit for a rural region. *Secondly*, looking at Damayanti's (the entrepreneur above) words, it is evident how confident these activities have made these Entrepreneurs and the fact that they are sharing it to boost confidence and business sense of women around them in the same community. As the literature review suggested earlier in chapter 2 of this thesis, one of the ways that Rural Development has been defined is by looking at it from a community development perspective.

> *"The solar lantern has boosted the confidence among the women in the village. A decreased use of kerosene has in turn reduced health problems also"* - Woman energy entrepreneur, AIWC, Odhisa

Besides generating vocational activities, the entrepreneur also mentions the health benefits of using the technologies and thus providing another good reason why it makes sense to use such technologies in a rural household. The use of kerosene and its allied health hazards has been visited earlier in the thesis, and the fact that solar technologies actually reduce the overall kitchen related health hazards need no separate introduction here. It is important however to note that the entrepreneurs do here realise the benefits derived from these technologies and the fact that the technologies are seen to be a boon and not simply as an add-on.

Also, as discussed in Hofstede's cultural dimensions (2007) and characteristics of women, it was found that women generally prefer collective action and working with others contributing to the wider society rather than doing something alone. This, when looked carefully would reveal that working collaboratively providing long term income sustainability (individual and community) also boosts the entrepreneurial culture and positive outlook to women's involvement in entrepreneurship. It can also be backed by evidence from fieldwork that a vast majority of the women entrepreneurs did actually work with others and not alone whereas men did the opposite in most cases. Some more evidence from AIWC's women entrepreneurship established the case further.

See Annexure case study 10.3 for a project report on gender differences in running a business, the case demonstrates a male and a female with equal level of household assets and shows how a woman manages a SME when compared to a man. Firstly, though the female wasn't as enterprising but her long-term goals possess more far-reaching consequences. Educating children could lift an entire household/family out of a particular underdeveloped setting. She wanted her kids in school and not sent for household work or factory work from an early age, whereas men were found to be expecting their sons to follow their footsteps. *Secondly*, women are less likely to migrate out given their sense of security while living in a suburb/village with people to reach out more quickly and easily. The above presents a mixed case – if looked at financial output maybe the male counterpart wins in the short run but for a change to come in the long run, women are better managers (even if they just provide a supervisory role, not an operational one) as evident from the case study. *Secondly*, as observed from most studies, when it comes to running a business or even maintaining the cropping pattern of a land, the women are more likely to hire

other women from the community to assist her in the process and also often lease out the land instead of managing it on her own. More examples from fieldwork to follow.

> *"I have engaged more than 20 families in different activities that provide a means of livelihood for them. TERI had chosen me as one of the successful entrepreneurs of LaBL activities in Sonitpur. I am now providing lighting facilities to the village through my solar charging station. By doing this, I am not only catering to the domestic lighting needs of the villagers, but also providing light for major community occasions, cultural events, and marriage ceremonies in my village as well as in neighboring villages."* Woman entrepreneur, TERI - LaBL, New Delhi

A classic example of an energy entrepreneur where the entrepreneur has not only used the technologies for household or business income generation purposes, but also for cultural community occasions. This brings in people together and also raises community awareness. The multi-facetted benefit of the renewable energy can be realised using this example highlighted by the entrepreneur in her interview. It is important for the readers to note that for any rural community, a cultural occasion or a social event is merely not a social gathering but an enabler for bridging and collaboration of families for a common purpose of unification. These activities helps in bonding, some references to social capital can be made here but the objective of the discussion is to point out that these events also allows the awareness of the benefits derived from solar technologies. As emphasised earlier, word of mouth is a powerful tool for marketing and in several occasions it has been observed (as will be presented later on in this section) that community households slowly take up solar technologies after existing users talk about the multi-facetted benefits.

> *"I am responsible for providing lanterns to 40 households and now earn an additional monthly income Rs. 1600. I am even quite happy to provide the service at minimal rent. The reason is quite understandable. Me along with my other villagers can now protect the crops from wild animals and they had even extended the harvesting time till evening during the previous summer."* Solar entrepreneur, LaBL- TERI, Bangalore

This throws light to a new discussion that is another use of the technology, which is not directly business or household related uses of the existing technology. The scale of operations of a solar based entrepreneurs can be seen – 20 to 40 households are covered in a range and it would be prudent to comment that each of those households makes an individual use of those solar lamps and lanterns – either for household or business purposes. This in essence could suggest that not only the micro enterprises are a source of income and confidence for these entrepreneurs but also the receivers/user of the technologies (i.e. the individual households) are also benefitting from the solar light for different purposes. Protection of crops from animals by putting up solar lights in the field is an innovative use of these technologies, the *multi-facetted use of the technology* is emphasised here as well as the new ideas generated by the entrepreneur allows the technology provider and supporter to design new products based on the new uses.

> *"With the protection of the crops, I was able to earn a profit of Rs. 5000 unlike before. With greater income it has become possible for me to diversify cultivation on the same piece of land by growing additional crops of cashew and turmeric. The solar lantern has been the only source of light to conduct the village development commitment meeting at night, which was not possible with kerosene lamp before... Rental income from the Solar Charging Station may not be much, but the solar lanterns have been instrumental in enhancing my income level. The lanterns enabled me to adopt new livelihood options; not only for me, but also for my fellow villagers"* - Solar entrepreneur, LaBL – TERI, Bangalore

It is also important to note from this interview that it is not just about managing technology or running a micro enterprise or looking at the tangible and intangible benefits drawn from the solar technologies but the fear from wild animals in some villages are also addressed. This is something new because it is empirically understood that these solar technologies are used for electrification purposes or to run a micro enterprise but here it is established that these are also used for protection from wild animals that may come and go after dark in the regions where people live or set up their regular stalls for business (selling vegetables, fruits, garlands, etc.). These aspects are most often overlooked but have key things to take away – for example, most of these activities are done jointly and collaboratively, villagers working together, and thus using these technologies as a community is likely to bring them together in terms of building social capital.

The multiple use of the solar lantern as emphasised earlier in this section can be highlighted once again, and this can also be labeled as an indirect use of the lantern for income generating activity. *Firstly*, the crops are protected from the animals due to the solar lamp set up in an otherwise dark plot of lamp after 6/7pm and *secondly*, the entrepreneur also found ways to diversify his cropping pattern leading to an enhanced income generation opportunity. Finally, the realisation of the entrepreneur that the solar business in itself is instrumental to the success and turnaround of his livelihood is a sign of development. These aspects of a solar business are most commonly ignored in the literature and previously highlighted case studies; this is where another contribution of the thesis comes in.

"Most of the lantern users were satisfied by the quality of light it gave. 'Earlier there was a lot of difficulty for me to operate on patients using a kerosene lantern, now I feel at easy while treating the patients', said a doctor who operates out of a small clinic in the village. While treading across the village at night, I came across a group of fishermen for whom 'life has become much easier' with the use of solar lanterns. It is no more difficult for them to stay on the boats during the night while catching fish." - Solar entrepreneur, LaBL – TERI, Odhisa

The strong light of the solar lanterns poses a challenge in catching fish as they do not fall prey easily. But as a solution to this challenge they wrap a cloth around the lamp while catching fish – this is very innovative and demonstrates good understanding and approach towards the RETs.

From the case studies presented from interviews and secondary data collected from AIWC, it is revealed that women aren't only just managing and running the RE start-ups that is initiated out of PPPs, but they are also found manufacturing, servicing and selling solar energy technologies – this is reemphasised in the interview quote below.

"I don't need to buy the finished product from AIWC or the local NGO anymore, because I learned how to make them using the right inputs and technique that was taught by a training team in an RE awareness week in my community by AIWC – now I can make and sell these technologies to other women in the village as well as other customers in village haat and regional expos in my nearest town", Women Entrepreneur, AIWC, Kolar (District in Eastern Karnataka)

This firstly confirms their level of autonomy and confidence in expanding their business know-how and scale of existing operations but also the absorption capacity of women in rural areas that are often under-estimated/represented in popular literature. This also confirms that the training teams that AIWC organises by collaborating with research and technical skills team from Universities and research institutes are highly effective. Most organisational models, including those of SELCO and AIWC do not have plans for their own operational expansion in terms of scale but set up incubation centres and knowledge transfer mechanisms in place. For both SELCO and AIWC, these have been immensely successful.

Moving forward and before concluding the section, it is important once again to remind the reader that the findings above corresponds closely to the elements prescribed in the OECD/EUROSTAT framework. The diagram below shows the connection and relationship, this would clarify *firstly*, the nature of the findings and how theoretical valid it is and *secondly*, the application of the theoretical framework is not limited only to for-profit business but also social enterprises (as one would see in the cases from SELCO and AIWC).

[Please see appendix for Table 9.14 for data analysis structure]

5.3.Thematic analysis of impact of solar based enterprises on rural development

Drawing on the themes generated earlier in Table 9.14 (see appendix), following discussion coupled with fieldwork data would elucidate the impact of RE based enterprises on rural development

First order codes	**Second order codes**	**Themes**
- Marketing products	- Scale up in role from	

- Idea of scaling up a business - Hiring additional employees	procurer to becoming a last mile agent - From entrepreneur to managing a business	**Business acumen**
- Idea of lighting up more homes Support community families	- Financial motivation to social impact - Hiring local labor	**Entrepreneurial community impact**
- Choice of door to door pamphlet distribution - Putting up marketing banners	- Rewarding an introducer for product reference	**Wider application of business acumen and networking**
- Women making leaf plates - Hiring other women from the same community	- Additional use of RETs on hand made and home produced products	**Women-led vocational activities and social impact**
- Engaging several families in solar businesses - Use of RETs in *community occasions, cultural events, and marriage ceremonies*	- RETs application in non-business activities	**Community bridging and empowerment**
- Use of RETs to protect crops - Keep away animals	- Practical daily applications of the RETs	**Intangible personal and social benefits of the technology**
- Buying supplies and raw materials to self-make RETs - Self–servicing and maintenance of technology	- Training other members of the business to make and maintain RETs	**Business incubation** **Knowledge sharing and transfer**

Table 5.4. Identification of themes

a) Business acumen

> *"Selling fruits has been my business for the past 17 years, previously my Father used to run the business. My small stall as you can see gets a regular demand, can make a total sales of 1200 a day of which 200-300 is profit which I then re-invest. The lantern allows me to have another 3-4 hrs of extra light; I mainly use it in the winter season because I sell vegetables and flowers as well in addition to my fruits. So, I can run the business until 9.30/10pm every day"* – RE based street vendor, Karnataka

The idea of reinvesting the money back into the business is productive and shows understanding of management and maturity. Also, the idea of the entrepreneur about business hours, his products that are perishable in nature and that winter could be an useful season to use the lanterns in the evening demonstrates fair level of business acumen.

> *"Solar entrepreneurs earn anywhere between Rs. 1500 to Rs. 3000 per month. The programme has engaged over 1600 solar entrepreneurs across the country. The programme has engaged 1600 solar entrepreneurs across the country"* – LaBL Torchbearer, Bangalore

This is a good income because the difference in income before and after the use of lantern is significant as presented in chapter 5. It also boosts additional entrepreneurial opportunities, this is a good sign and would lead to greater general engagement in the sector.

b) Wider application of business acumen and networking

> *"I have now two solar lanterns. My mother and wife share one after dark to teach my kids and also to weave silk products, then they sell it in Village mandi that comes once every month. This is a good economic activity because they create new contacts in the mandi and sometimes gets to know new buyers who are interested in repeat purchase. My mother's friend in the neighborhood uses the other lantern and that gives us Rs. 2 every day as rent. We all charge the lanterns at a central station where the staff is trained to do so. I would like to buy more to rent it out more to our neighbors, but since last year people are buying their own and the rent concept is vanishing in this area." Solar entrepreneur, Karnataka*

Activity diversification is another key component of solar run businesses based on solar charging stations and solar lanterns, the lanterns have got multiple usage and when the demand for similar products become higher, these entrepreneurs are noted to rent/buy more of these technologies. For example, an entrepreneur who was supported by TERI started running tuition classes after dark, became quickly aware that the lanterns can be put to other usage in his neighboring community – so he rented 5 more from Lighting a Billion Lives foundation and then further rented it out to his neighbors who needed it either for cattle-feeding, cooking after dark or for women engaged in handwork or silk weaving.

"We have 17 members in our family and first of all, my wife felt that she can properly see the ingredients while cooking. Our 3 years old daughter fell ill very frequently and we were very concerned about the food at home because we don't eat outside. So, that has improved now and my daughter is much better. The lantern also helps my son to study more hours and do the homework. He is in 6th grade and good at Mathematics, I want him to study more and go to town and find work. My wife also weaves silk products on a regular basis, she cannot do it until dark because the entire day she has to look after the livestock, feed the family members, go to the market and buy things for the household, meet relatives and in-laws for chat or for any occasion." – Villager, Karnataka

The impact of the use of lantern can be seen both in households as well business capacities. The trend of increasing home based activity, for example weaving silk products is interesting and demonstrates the use of lantern at home for income generating activities.

c) Community bridging and empowerment

"Janmoni Borah is a successful entrepreneur who is also a major torchbearer of developments in her village. She has engaged more than 20 families in different activities that provide a means of livelihood for them. She has been chosen as one of the successful entrepreneurs of LaBL activities in Sonitpur that has added one more feather to her cap. She is now providing lighting facilities to the village through her solar charging station. By doing this, she is not only catering to the domestic lighting needs of the villagers, but is also providing light for major community occasions, cultural events, and marriage ceremonies in her village as well as in neighboring villages." – LaBL Torchbearer, Bangalore

The intangible impact of the solar RETs is visible in this case. It also brings in people together. In chapter 1 of the thesis, a review of seminal and contemporary literature of social capital was presented while discussing rural development. The quote represents that community

gatherings in a village bring people together where the population lives in a pretty tightly-knit social structure. Some of them are entrepreneurs, rest are a mix of users and non-users of solar RETs, social gatherings provide a good platform to share and discuss experiences. These experiences include realisation of the phenomenon of how solar technologies makes an impact on daily lives, both at household and for business reasons.

d) Business incubation, knowledge sharing

> *"Sunita had a talent for sewing and stitching, she decided to open a small shop at the back of her house. She used to help her mother and sister-in-law with the household chores during the day and in the evening she would rent a solar lantern and sit at her shop. Due to the lantern she was able to stitch and sew till late hours at night and complete her work on time. Slowly, with more and more customers she expanded her work and now owns her own shop. By teaching other women stitching and providing them with employment, she has encouraged them to earn a living from this activity."* – LaBL project staff

This is a trend that benefits the community and not only a particular household or one individual entrepreneur. Knowledge sharing that leads to business incubation is a positive move towards empowering communities from where additional micro enterprises are emerging. Also, by way of such sharing and learning interaction between a trainer-trainee a better understanding of the business and the management of it is generated. In addition to that, the activity in context (i.e. sewing and stitching) can also be done in a flexible time format due to availability of the solar lantern.

e) Intangible personal and social benefits of the technology

A lot of RE based entrepreneurs, especially women, are initiating activities that not only generate household income but also involve many others from their own community. This is leading women to gradually developing significant voice in the panchayat and local bureaucracy – and they are using this voice to add value to the community, for example proposing to build toilets and better hygienic environment in the community.

"The lantern comes handy during medical emergency, the light is very useful and my work as an entrepreneur is being appreciated a lot by everybody including the Panchayat. In the weekly meetings, I'm pushing for building proper toilets for the community as no work has been initiated on this so far, other women are also in favor of this." LaBL beneficiary, Odhisa

This is particularly important because, in most villages that are lying un-electrified for different reasons do not have sanitation facilities and the fact that these places go totally dark after 6 or 7pm doesn't give a good picture of development for a community. These places now, are growing up, because these women who are well identified due to their energy based businesses and community involvement, are using their voice to bring about a change. This is a welcome change in many regions. Also due to additional available lighting at home after dark, when the lanterns are not used for business, this is leading to better education for kids who can use the light to read and write. There are cases of evening school and tuition centres being run using solar lanterns and have received great amount of support. Solar lanterns or lamps used in the kitchen also reduce chances of respiratory illness as well as providing the ability to see the ingredients while cooking these lead to multiple health benefits and also less hours spent in the kitchen.

These aspects are very important for rural development considerations.

f) Women-led vocational activities and social impact

This, is in addition to other community development projects that can be observed in the villages where the fieldwork was carried, and the fact that women led micro enterprises also generally brings in other women from the community is also a reality. Be it silk weaving, hand painting, handicrafts products, running tuition centres, women entrepreneurs are involving other community members in their business.

"Self-help groups in Odisha, can stitch sal leaf plates with ease at night" - LaBL Torchbearer, New Delhi

This research, to stress again, is not studying gender dimensions in entrepreneurship but investigating rural entrepreneurship that are based on renewable energy. However, in the process, it has been unavoidable to note that nearly 1/3rd of these emerging entrepreneurs are

turning out to be women, and in many cases, for example TERI targets women in particular due to a host of reason. It is thus necessary in this section to highlight what are the rationales behind choosing women as targeted beneficiaries. The diagram above looks at a list of observations; of these a few can be highlighted given their nature to repeat in the study. This is also a key contribution of this thesis, in view of the fact that no academic work has been systematically done to highlight this aspect of women led energy based rural enterprises.

"Arati now charges and rents 50 lanterns for an additional income of over Rs.1500 per month. According to her husband, the demand for conventional electricity is no longer felt due to the presence of solar lanterns under the LaBL programme. While recalling her earlier days, she articulates that hardly anybody in the village was close to her or concerned about her and her family. The charging station has brought her closer to the women of the village and has enabled her to build a rapport with the community. Now she tells the women in her community about the various uses of solar lanterns including leaf plate and cup making, studying in evenings, and even cultivating vegetables in evening – which she herself has started doing with the help of the solar lantern. She is earning around Rs. 600 per month by spending 2 hrs in the evening to make leaf plates; she could not have done this with the kerosene lamp. Her SHG group can now conduct meetings more than once a week in the evening. As Damayanti puts it, "The solar lantern has boosted the confidence among the women in the village. A decreased use of kerosene has in turn reduced health problems also." RE based entrepreneur, Karnataka

"My income fluctuates depending upon the number of sarees I can weave and sell. But now that I run a solar charging station, I have a stable source of income" - Solar entrepreneur, Madhya Pradesh

These findings point out to new dimensions of women led solar businesses. In addition the above points discussed, the fact that women are less likely to leave the community than men have been now well established. It has been seen that men often decide to swap a stable business (e.g., a village stall or a trading vendor in a rural area) for highly-paid seasonal jobs in town centres, mainly in the construction industry. This disrupts income generation and also the repayment pattern if the business is run on installments payable to organisations that initially handed the beneficiary with any given technology. This has been found highly unlikely in the case of women, who would rather stay, hire other women from the community, attempt in scaling up the business and build social capital during the phase of business growth. The phase of business growth is the difficult phase because in most cases, these women may be running the enterprises by themselves considering their husbands work in town (and may send income) and they also have to do household work – however, with the help of other women from the

community, and in some cases men too – these business find a way to find stability and growth. Once it is more stable, women tend to diversify their operations as well – this gives additional venues for everyone involved in the business.

A number of interesting findings and discussion suggest that women led solar RETs based businesses is a phenomenon that requires more in-depth analysis and study in future research. Besides the benefits derived from solar micro enterprises, both tangible and intangible, it is pertinent that institutions are now targeting women ownership of the businesses more than men. A number of factors contribute towards this growing trend, requires more exploration. This, however, is not one of the aims of this research while it does both illustrate and to a great extent explore this scenario.

g) Entrepreneurial community impacts

> *"Rental income from the Solar Charging Station may not be much, but the solar lanterns have been instrumental in enhancing my income level. The lanterns enabled me to adopt new livelihood options; not only for me, but also for my fellow villagers."* Solar Entrepreneur, Odhisa

Madhusudhan who was unemployed and had studied upto VIII, was selected to work as an entrepreneur for a Solar Charging Station. The driving force behind his willingness to manage a charging station was to provide lighting service to the community and earn some income by way of renting solar lanterns. He is responsible for providing lanterns to 40 households and now earns an additional monthly income Rs. 1600. He is even quite happy to provide the service at minimal rent. The reason is quite understandable. According to him, he along with the villagers can now protect their crops from wild animals and they had even extended the harvesting time till evening during the previous summer. As a result, he was able to earn a profit of Rs. 5000 unlike before. With greater income it has become possible for him to diversify cultivation on the same piece of land by growing additional crops of cashew and turmeric. The solar lantern has been the only source of light to conduct the village development commitment meeting at night, which was not possible with kerosene lamp before. His sincerity and interest led him to be selected as the secretary of the village development committee. He now sends two

of his children to school and ensure they study at night. He and his wife have already started lead-plate making in the bright light of the solar lantern in the evening. He says,

> *"The lantern helps me make my ayurvedic medicines even in the night"* – Village Vaidya, from Chakulia, Odisha

The impact of the lantern can be felt when individuals can carry on practising their indigenous knowledge and share the fruits with the community. *Vaidya* is a Doctor in India. This also provides health care during emergency times, coming directly from a practitioner who is well versed with the science.

h) Entrepreneurship and social value creation

> *"…in the condition of mere nature, where all men are equal and judges of the justness of their own fears, he which performeth first, does but betray himself to his enemy; contrary to the right (he can never abandon) of defending his life, and means of living."* Thomas Hobbes, 1651 (from Van Mill, 2001)

Most large firms now have explicit public sustainability policy statements and claim to apply a '*triple bottom line'* that considers a firm's financial, environmental, and social performance (Elkington, 1998). All manner of waste reduction and resource substitution are rewarded as symbols of good corporate citizenship (see Clelland et al., 2000). In many circles, the term 'corporate sustainability' has become a synonym for 'corporate social responsibility'. How much 'green' (i.e., profits, ROI) there is in 'going green' (i.e., adding to ecologically sound resource use). As with so many scholarly efforts, measurement often predetermines outcomes, and the empirical evidence is mixed. Nonetheless, in an overview of the pays-to-be-green literature, Ambec and Lanoie (2008) suggest that environmental responsibility presents a number of unique 'opportunities for increasing revenues'. They identify the following financial benefits from sustainability investments*: (a) better access to certain markets; (b) differentiated products; (c) revenue from selling green technology; (d) better risk management and relations with*

external stakeholders; (e) lower cost of material, energy, and services; (f) lower cost of capital; and (g) lower cost of labor (Ambec and Lanoie, 2008: 45).

In the context of this research, work of Levinsohn (2013) can be drawn where he states that SMEs play a key, but under-researched role, in contributing to the sustainability of local communities. Zu (2014) points out that sustainable entrepreneurship gained momentum in recent years as a global movement that aims to encourage businesses to pay closer attention to their social and environmental impact. Special issues of Journal of Cleaner Production (Volume 19, issue 8, 2011) and Journal of Business Venturing (Volume 5, 2010) devoted to sustainability and entrepreneurship show that many authors employ the term 'sustainable development' to refer to the positive contribution of entrepreneurship to society. The transition toward a more sustainable system is a complex process that requires interactions between technology, policy/power/politics, economic/business/markets, and culture/discourse/public opinion and requires a multi-level perspective analysis (Geels, 2011). Farinelli et al. (2011) states that green entrepreneurs are of crucial importance to the economy as they make significant contributions to job creation. They are also recognized as engines of change and have been credited for introducing innovation, adapting to new ideas and responding to changes more rapidly, flexibly and efficiently than larger companies.

And while entrepreneurial activity has been an important force for economic, social and environmental sustainability, Pacheco et al. (2010) points out that its efficiency is dependent upon the nature of market incentives that must encourage sustainable practices. This is specifically true for the emerging economies where entrepreneurs primarily think of how to survive the open market competition. Thus, the institutional, structural, social and economic factors play a critical role in whether entrepreneurs invest in new business ventures associated with natural resources (Nikolaou et al., 2011). Pacheco et al. (2010) discussed over different models of collective actions that proved to be successful in improving competitiveness of sustainable behaviors, including partnership with the industry and civil sector. Ashraf et al. (2014) showed that networking has had a positive effect on carbon performance carbon performance of companies in emerging economies. Lorek and Spangenberg (2014) stress the role of non-governmental organisations, suggesting their ability to stimulate bottom up action

and mobilise the pressure necessary for institutional changes through networking and advocacy.

While discussing the boundaries of RE based entrepreneurship and rural development in chapter 1, it was noted that these complex and multi-thronged concepts will be measured specifically by looking at personal, community, intellectual benefits. The following Figure 5.2 connects these four benefits with the thematic findings. Also, the discussion sytematically shows the interconnected nature of these four dimensions, for example, how progressive impact on personal attributes can boost community benefits which then propels business and intellectual gains overtime.

Figure 5.2. Impact of solar based entrepreneurship on rural development

5.4. Summary

In light of findings presented in this chapter, it can be stated that the impact of solar based entrepreneurship has been measured by more than the three highlighted in the original OECD/EUROSTAT framework. In fact, the impact are found to be multi-thronged and multi-approached than the short list that empirical literature provides (job creation, economic growth, poverty reduction). It is more than these factors that can define the impact of energy based rural entrepreneurship as evident from the analysis of findings of this research. It is important to highlight that some of these impact are intangible by nature and have strong long term repercussions. The framework helps in understanding the relationship between entrepreneurial performance and the impact that it has on rural development while the thematic analysis reviews the outcomes. In appendices 6.1 and 6.2, figures represents the connection between the conceptual framework and thesis findings. In the process of this research and thematic analysis presented, a list of additional variables can now be considered in the conceptual framework on top of the ones presented by OECD/EUROSTAT in existing framework. This will be useful for future research.

Voices of the energy entrepreneurs

"Solar entrepreneurs earn anywhere between Rs. 1500 to Rs. 3000 per month. The programme has engaged over 1600 solar entrepreneurs across the country. The programme has engaged 1600 solar entrepreneurs across the country "- Laxmidhar Naik from Simdiha village, Odisha

"After installing the solar charging station my income has improved. Now I own a small flour mill and have also extended my grocery shop." Rajesh Patel from Kachauan, Madhya Pradesh

"My income fluctuates depending upon the number of sarees I can weave and sell. But now that I run a solar charging station, I have a stable source of income" - Jawaharlal Kohli, a weaver and now a solar entrepreneur from Chanderi, Madhya Pradesh. The villagers pay a daily rental of Rs 2.00-Rs 5.00 to the entrepreneur to use fully charged solar lantern

"I am fortunate to be the entrepreneur for this village. This helped me save more money than I could in the last seven years. I can now fulfill my dream of setting up a grocery shop." - Prafulla Khandai, a solar entrepreneur from Chandrapur, Odish

"In Jagdishpur, small shop owners have stopped using kerosene and paraffin lamps. They pay Rs 5.00 for 5 hours of solar light every evening."

"Bharati was introvert in nature. But after becoming the village's entrepreneur she has become a confident person" - Mr. Tripathi, NGO worker, Sambandh – Bharati Naik, Laxmipshi, Odisha, she uses the light for stitching sal leaf plates

"The lantern comes handy during medical emergency. The Arati Mahanta from Tentala, Odisha villagers feel that the light is very useful and my work as an entrepreneur is being appreciated a lot by everybody including the Panchayat." –Arati Mahanta, Tentala, Odisha - The lantern comes handy to move around the village after dark

"Now I can see the ingredients clearly while cooking"- Gudiya Baiga from Rakhi, Madhya Prades"

"The lantern helps me make my ayurvedic medicines even in the night" – Village Vaidya, Niranjan Danakuliya from Chakulia, Odisha

Chapter 6– Conclusions and implications

6.1. Introduction

The two research sub-questions that this thesis started with were:

a. What current institutional arrangements support the formation of income generating solar based entrepreneurship in India?
b. What opportunities for rural development could arise if there is an enhanced private-public partnership amongst the key RETs, specifically solar, players?

The conceptual framework helped as an organising device that directed the collection and analysis of data. The thematic analysis carried out in chapters 4 and 5 respectively helps to show how different institutional arrangements create an enabling environment that supports solar based entrepreneurship and the consequent impact of the latter on communities and rural development. Initially the codes were drawn from the constructs identified in the conceptual framework as well as fieldwork data in order to generate themes. One of the core findings of the thesis contributed towards the wider application of the conceptual framework in order to understand how institutions work together in partnership to support RE based start-up initiatives, this in addition to the recognition of the fact that the impact of entrepreneurship can be understood from various indicators and not a limited series of results as presented in existing literature, per se job creation, income generation, poverty reduction; these will be highlighted in this chapter along with pointing to the research gaps for future research.

6.2. Contributions of the research

Both the empirical and theoretical contributions will be discussed in the following sections. Figure 6.1 shows the different contributions that emerged from the analysis of thesis findings.

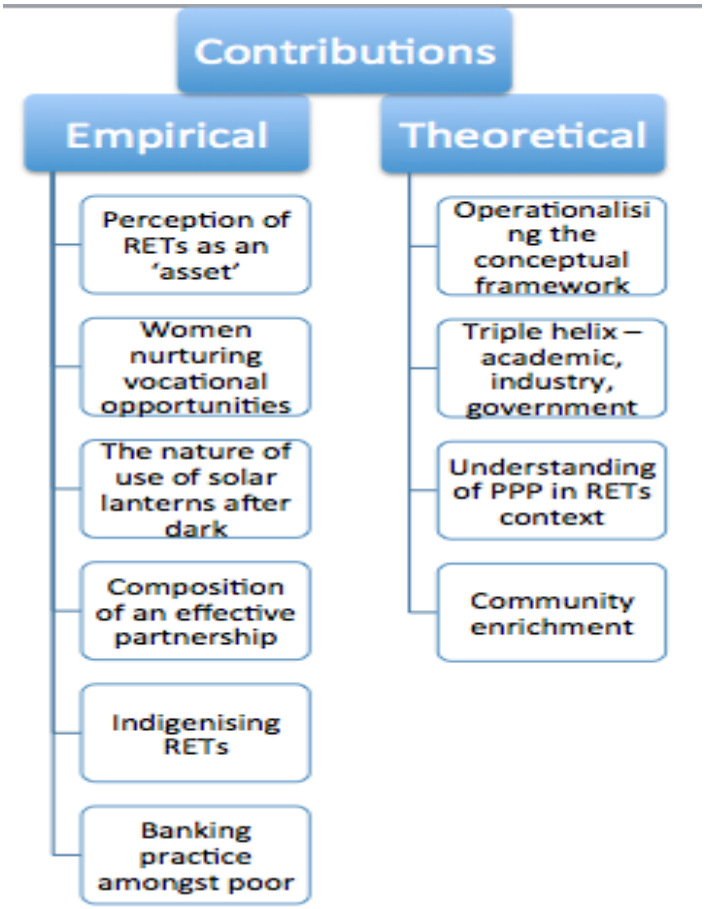

Figure 6.1: Empirical and Theoretical contributions of the thesis

6.2.1. Empirical contributions

The discussions coming out from the thematic analysis has presented newer insights into the following:

1) Solar RETs are perceived to be 'an asset' by the users and not simply an add-on energy option
2) Women led solar based micro enterprises are creating and nurturing vocational opportunities in the communities of their operation.
3) The nature and purpose of use of solar lanterns after dark
4) Providing an insight into the general composition of an effective partnership amongst the key stakeholders for a solar RETs based firm

5) Indigenising solar RETs and the subsequent benefits to both solar actors and communities
6) The development of banking practice amongst the poor (i.e. repayment pattern matching income rhythm)

Perception of solar RETs as an 'asset'

Analysis of findings from the fieldwork shows that following the period of sensitisation and introduction of the solar RETs in rural areas, mainly by NGOs and VOs, the users found the technology to be an asset and not simply an add-on energy option. It is important to emphasise that the sensitisation period is very important since rural areas are generally resistant to change. This is true even in the state of Karnataka where the capital city Bangalore, which is also known as the 'silicon valley of India', the rural areas remains underdeveloped. The process of sensitisation carried out by NGOs and local community organisations involves sharing potential benefits and also the costs of using solar RETs to the potential users in the community. Considering most of the rural areas where the fieldwork for this thesis was carried out have no other source of electricity after dark, solar RETs became preferable as an energy option mainly due to a) the ease of maintenance and different applications of one product b) availability and accessibility of solar RETs, and having solar based enterprises around to support solar RE based initiatives.

> *"All our SELCO service centres are located in the range of less than 60 km from the target village which gives us the flexibility and time to cater to market needs and also maintenance requests. The users are also initially trained how to use and maintain the product, considering the technologies are simple to manage on a day-to-day basis, this phase is relatively quick."* – Principal Analyst, SELCO Foundation

In addition to the fact that the technologies are delivered to the users followed by training about its use and maintenance, it is also important to understand how the users perceive these technologies on a daily basis. In the villages where the fieldwork had taken place the households had three options:

A) Having a free meter at home provided by Rajiv Gandhi Vidyutikaran Yojana (if that given village was covered in the list of target areas), this is a national level initiative and involves both state level and local level Governments

B) Use of Kerosene to light up village street business stalls as well as using the same source of light for kitchen use at home

C) Buy cheaper lamps 'made in China' - there is no activity after 6/7pm and all community members retire to their home or sometimes go out together to have a group chat.

Option A is often a cheaper and preferred option in many states but it can also be seen as a mixed blessing. ***Firstly,*** the spread of Rajiv Gandhi Vidyutikaran (electrification) Yojana is very dispersed and slow to reach out but when it does the households do get a free meter. In terms of monthly bills, the cost is much lower than the price that a household would pay for a/any solar RETs (for example, solar lantern), however it is not flexible and the users cannot customise the lights in order to cater to their specific needs (for example, SELCO's four point solar home lighting system is far more useful in this matter) while saving both energy use and cost. ***Secondly,*** since the meters are <u>not 'mobile'</u>, the use of electricity is only limited at home and not for village vendors or street hawkers who wish to run their business after dark and away from home. ***Thirdly***, another big issue with the meters is the fact that there is zero monitoring or maintenance carried out once installation is complete; there are leakage issues as well where users are found to be fiddling with the meter to draw additional chords and damaging the life of the meter in this process. Furthermore, since there is no maintenance (either from the Government or the companies that the former had outsourced the installation to) and once it stops functioning the meters lie useless – this brings the households back to square one when they don'tnot have any other sources of light.

"The meter readings are correct as long as they have not been tampered with, these meters usually give two to three power points, one for TV, fridge and the other one for light in the kitchen. However, people also need to charge their mobile phones and for related electronic items and they try to hatch out additional chords to set up more plug points without fully knowing the science and capacity of the meter given to them", Country Advisor, Green Grants India

Option B would refer to the economic and health consequences of using kerosene. The use of kerosene harms lives and induces respiratory and related ailments in a household. They also cause the formation of dark skin patches, these are formed over time due to long repeated reliance and use of kerosene in the kitchen, below is a photo of a woman (Mrs. Banjakamma in Kolar Village, Karnataka) who has endured the same (note the dark skin patches).

Photo 6.1. Researcher with a key informant in a study site in rural Karnataka

There is no rational argument today in support of Kerosene use at home. Besides the respiratory and skin diseases, there is also the burden of collecting firewood, which is done usually by the women at households leading to other negative health implications (plus the time away from home and kids). In several states, communities have switched to either solar or wind or hydro powered RETs as an option against kerosene. Some state Governments from *Gujarat, Uttar Pradesh, West Bengal and Karnataka* have been very proactive about this replacement of kerosene. More details on how kerosene leaves a harmful impact on the households was discussed earlier in the thesis.

Option C, cost-wise Chinese made lamps are way much cheaper compared to solar lanterns/lights but the former requires repeat purchase and there are associated performance issues due to the short life cycle of the product. Villagers however, in several interviews have expressed their dissatisfaction towards these lamps and have also shown their understanding of

the value of solar lanterns and how these are seen as a long term 'asset' and at times worth having more than one or two at the same time, the following quote elucidates on that.

> *"I have two more lanterns. Both my mother and wife use one after dark to teach my kids and also to weave silk products that they then sell in Village mandi once in every month. This is a good economic activity because they create new contacts in the mandi and sometimes gets to know new buyers who are interested in repeat business. My mother's friend in the neighborhood who gives us Rs. 2 every day as rent uses the other lantern. We all charge the lanterns at a central station where the staff is trained to do so. I would like to buy more to rent it more to our neighbors, but since last year people are buying their own and the rent concept is vanishing in this area."* - Vegetable vendor using solar lantern, Kolar (Karnataka)

Photo 6.2: A group of solar lantern users

The fact that solar RETs are perceived to be an 'asset' is particularly important because this is largely missing in the current literature that does not provide any understanding about the perception of the users of these technologies. The interviews elucidated that the users – entrepreneurs, vendors, home users, don't perceive the solar technologies simply as an add-on option over and above what they already have, or as a short run solution to their energy problem, but see buying/renting a solar lantern with a long-term orientation. This value is not only a*) **Tangible*** – increased business hours, income generation on an on-going basis, reaching out to new markets, mobility of the lanterns allow the users/entrepreneurs to shift the location of stalls and not stick to the nearest place close to the lamp post offering light installed by the

gram panchayat, b) ***Intangible*** (see photos below) – increased hours of children studying at home with light, women cooking *and able to see the ingredients* (which is a big concern with kerosene use), other household members are able to do paperwork and other handicraft work (also bringing in other people from the same community) as required using the same light – these bring in a wide range of intangible benefits to households and also the local community.

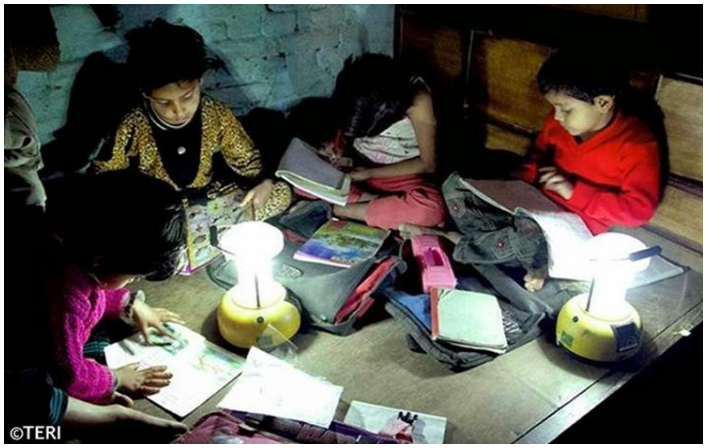

Photo 6.3 and 6.4: Solar technologies providing multiple tangible and intangible benefits

"I used standard lamps before which are run by battery and they are good for a few months. They cost something around Rs. 300-500 but they are unreliable and run out once in a while. Battery replacement is also an issue – especially if the batteries go off on a Sunday when the shops are closed.

Researcher intervened, saying – you could always buy more in advance)

Some shops don't sell more than 2-4 at one point in time thinking that the buyer might sell them elsewhere at a slightly higher price. So, usually I have two spares and the light also grows dim with usage. It is not a good investment because in the long run and on an average, I have to buy 3 lamps in a year which is nearly the cost of one solar lantern, the latter being more sustainable in the long run and there's always staff to help us out if there are any issues." - Women entrepreneur, Kolar (Karnataka)

Photo 6.5: Solar lantern charging station

Women led solar RE enterprises and generation of vocational opportunities

Women led and managed solar based micro enterprises generate further ripple effects on the society and not just at the household level. While the impact of women led businesses at the household level is loosely touched in the current literature but those studies have not addressed the same when it comes down specifically to solar businesses. In addition to this gap, the study of community benefits of women managed solar businesses is missing in contemporary literature although there are studies on gender differences looking at how businesses are run and managed. On the basis of findings and analysis of this work, it can be seen that the benefits of women led solar micro enterprises have strong impacts both at personal, community and intellectual levels.

Firstly, as observed in chapter 5 that women led businesses generally involve other members (mostly women) from the community and not self-run and managed at most times. Apart from having well-developed business acumen as established in chapter 5, most other women have a good sense of *'what to do with the income'* and that includes sending off their kids (both boys and girls) to school and also reinvesting the money into the business and generating other income-generating vocational activities that would involve other women from the community. *Secondly*, a key thing to be mentioned here is that the chances of women leaving the village or the area of

operation is more unlikely than in the case of men (who often terminate a stable micro enterprise and leave the place in search of a higher 'seasonal' income in sectors like *construction and contracting work*). This point is important because women entrepreneurs/solar users ensures that both *income* and the *work involvement* stays and sustains itself over time. This is also the reason why several RETs businesses, research thinktanks and institutions (e.g., TERI, AIWC) have specifically targeted women as their clients/beneficiaries/service users.

A range of vocational opportunities have been generated by women in the villages and observed from the fieldwork findings. Some key ones, drawing from all the institutions studied as a part of the research, can be found in Table 9.15 in the appendices.

In Table 9.15 (see appendices), some of the key activities generated by the RETs' users have been listed and also the impacts generated are listed alongside. They involve making and selling *a) incense sticks, milk b) Stitching sal leaves together to form 'Kholi', a plate made out of leaves c) poultry breeding d) 'Chikan' embroidery design and d) selling dry fish and shrimps* – these all involve more than one person to run and manage the business. In all the cases closely inspected during the fieldwork confirms that these women-led ventures involve other women from the community as well as their interaction with a wide range of stakeholders on a daily basis. Analytically speaking, some of the activities above are more than just 'income generating' if looked at carefully, but also carry substantial impact in the community – for example, making 'kholi' plates and designing 'Chikan' embroidery are nearly a lost form of artwork considering the rapid urbanisation and fast replacement of these traditional forms of hand-made items. They make good sales which reflects the fact that there is still a demand for these products.

So, on the one hand the lanterns are reaching out to corners of Indian villages given the involvement of institutions studied in this thesis while also the use of the lantern is not just to a) generate income, b) involve and employ local people (women) <u>but also</u> c) saving lost forms of art and d) creation of vocational opportunities, this is essential because these regions where these individuals live have still got the (nearly extinct) skill but without light they cannot make the final product. One final thing to be noted is that, looking at the table above, one of the unavoidable observations that can be made is how the main RE actor works closely with local level NGOs and VOs in order to bring in the desired result. This is also where the concept of public private people partnership (PPPP) is emerging from.

The nature and purpose of use of the solar lanterns

It has been revisited in chapters 4 and 5 that the lanterns are broadly used for *a) household purposes b) running a micro enterprise c) nurturing vocational activities d) running a solar charging stations e) other indirect benefits of using the lanterns (e.g., protection of crops against wild animals).* Discussing the above more in-depth would highlight some other implications.

a) *Household purposes* – from education for kids to household cooking at home, one of the key considerations that several women during their interviews expressed is they need to *look at the ingredients of the food* while cooking, this is particularly quite a big challenge while using a kerosene light. The lanterns provide clear light (see photo below) without any negative health (respiratory, dark skin patch, gas emission, ventilation) implications. The solar lanterns are also easy to maintain and manage by the users. If the total number of hours that the lantern is used for is consistent then the hours spent on charging it also remain the same. If the lanterns are a) bought by the household, then they charge it themselves while also maintaining/cleaning the panels, or b) rented from the nearest solar charging station, the lantern goes back to the station for charging for approximately 6 hours and then the user picks it up before dark to resume the solar RET usage at home.

Photo 6.6. a solar entrepreneur in his own charging station

b) Running a micro enterprise – Micro enterprises can take several forms, whether it is about selling vegetables, fruits, flowers and garlands at a village 'haat' or 'mandi' or using the lantern to run a tuition centre at night, sculpting hand-made idols of God made of clay, making incense sticks, silk weaving or 'Kholi' plates and designing 'Chikan' embroidery – the solar lanterns and lamps have established their multiple use in different regions of rural India. It has been reviewed in the thesis that these businesses can be further classified into *a) man or woman managed b) engagement of community members and c) a business model having an association with other indirect stakeholders (NGOs, VOs and other community level organisations).* However, one of the most important observations made during the fieldwork that these lanterns are generally used in places where people don't have any source of electricity after dark (starting from 6 or 7pm) - the solar RETs are the only source of light for these micro enterprises and the individuals/groups who own or manage it.

It is thus important to learn how the additional 3 to 4 hours of light are used after dark. Firstly, during normal day time business hours, the vendors, for example selling vegetable, fruit or flowers have got an ongoing business operation with their customers because the latter can 'see' the products that they are buying. However, sale of fruit and flowers shrink as evening approaches since the 'freshness' of the products can't be observed right away by the buyers. So, as a solution, the sellers often try to position their 'mobile' van or stall closer to the street lamp that provides a dim light as it helps to see the quality of the products sold. However, in many places both in the villages of Karnataka and New Delhi some of these street lamps have very low light and may function on and off several times during the weeks and seasons. These lamps are known to be 'community managed' rather than by the local government in order to avoid delays and instead have a quick-fix approach. This also brings in additional responsibility and hassle to these small business owners who would rather avoid the same. For those who have either a) rented or b) bought a solar lamp/lantern have a different story however. Their products can clearly be seen in the dark and it runs for 2/3 hrs in full power without any problems.

Having a solar lantern provides the following to a rural business:

a) The extension of business hours by 3 to 4 hrs in the evening

b) A new 'market' is created because previously there was no business after dark, but having a lantern brings in new/existing customers who can come after daylight and still see the stalls are operational and ready to sell

c) No dependence on street lamps, and

d) No need to move their stalls close to street lamps or change position every day - this includes time to set up their stall/rearrange decoration/ good positioning, these activities take time away from actual business and selling operations

d) An increase in their income, the money coming in from the evening market was previously not there

c) Nurturing vocational activities - Two business operations that need emphasis in this section with respect to the vocational activities are a) idol making and painting and also b) designing '*chikan*' embroidery. These two are particularly important in this context due to the fact that besides offering longer business hours and income-generation sources, a solar lantern can also save a variety of art forms that would otherwise be lost or inaccessible although the skills/ resources are currently available. Idol making and painting involves a big percentage of the rural youth engaged in the process and working day and night, and from home. These involve an intense level of handwork and the different stages in the making process that is particularly a time issue. Looking at the time issue and how solar lanterns are a blessing in this case, the idols require several stages of dry and wet phases that are very 'hour specific', putting it simply. In other words, if the basic construction is done during the day in 4-5 hrs, then it needs to stay wet for another 3-4 hrs before it dries and can absorb color painting. If the painting is not done on time and is saved up for later, then the longevity and the glow of the idols will suffer consequently. With the advent and use of solar lanterns, the users can now schedule their 'activity-time' accordingly and not wait until the following morning's sunrise before they can commence their work again. A similar line of activity goes on for *'Chikan'* embroidery as well, and the production line suffers due to timely unavailability of light unless there is an arrangement of light after dark.

Some of the community based initiatives involve stitching *'Sal'* leaves to form *'Kholi'*, a plate made out of leaves and also poultry breeding – these home based micro enterprises are popular in several rural regions in Karnataka, West Bengal and Uttar Pradesh. These activities also bring people together and communities to rely on each other's skills and abilities leading to a stronger

sustainability of the business and the place. Solar RETs have played a unifying force in this regard and this has been previously ignored by studies in the past.

d) Running solar charging stations - In rural India, the idea of setting up solar charging stations has mainly been made possible by the initiatives largely taken up by SELCO and TERI in light of the growing needs and increasing dependence of these lanterns by solar based local businesses. Usually these stations are run either by one person or a family with someone in charge of finance and decision-making, also there is evidence that these businesses grow over time. A normal schedule of the business involves the owner (or an employee) of the charging station retrieving the lanterns from users/households/business stalls in the morning and bringing it back to the charging station to get them charged for 5-6 hrs before the users collect them again from the station at around 5pm to use it between 6-10pm. There are also some cases where disabled individuals have been able to run this business and have expanded their societal scope.

> *"The task itself is pretty motivational, I have a defined number of working hours, I know the names of most of the clients and I meet newer ones, the need for this lanterns are growing in the community more and more, SELCO staffs come regularly and I am very familiar with them which helps me to upscale my operations and they help me to approach the local banks for small loans. I can also finance my law degree that am studying at IGNOU (open University) and can use my time in the evening doing my studies."*
> Physically challenged RETs based Entrepreneur, SELCO

e) Indirect benefits from the solar lanterns - Some indirect benefits as described earlier in chapter 5 that a) farmers have used the lanterns to protect the crops from wild animals and b) a fisherman using the lantern to attract the fish towards the boat – these are innovative use of the technologies and show an understanding of the use of technology by the users. These activities also however generate results. The example of the fisherman can be found in the region of Sundarban in India, the farmers in this region have now got full availability and access to light due to installations of solar RETs by WBREDA (West Bengal Renewable Energy Development Agency) and WWF made in recent areas. These fishermen and farmers are also trained to maintain and now 'make' solar lanterns from the participatory training workshops. This has been:

a) Making the community self-dependent

b) Indigenising technology in the region and country, and

c) Reducing the community's dependence on other solar technology provider.

Protection of the crops against animals is also another use of the lanterns, much less discussed in current studies, but highlighted in one of the interviews of a farmer (presented in chapter 5). Besides these, the lanterns are also used for maintaining the cattle and the cow shed after dark, and the women in particular benefitted a lot due to this initiative, it saved a lot of time and also ensured their health and safety after dark.

The general composition of an effective partnership

While revisiting the institutional arrangements reviewed in chapter 4, the conceptual framework was a constant guide to organise the findings and systematically present the same. The unpacking of the components of solar RE directed institutional arrangements and various other forms of partnership leads to a higher understanding of how the support to solar entrepreneurship is provided and sustained.

It is relevant to mention here at this point, that all the institutions studied for this research – SELCO, AIWC, MNRE and TERI have been working with a wide range of direct stakeholders. These stakeholders range from *a) research thinktanks b) government organisations (national, regional and local) c) NGOs d) VOs e) Suppliers f) RETs manufacturers g) users/ clients/ beneficiaries h) banking and financial institutions i) international donors and funding bodies.* The interconnectedness between these stakeholders ultimately decides on the performance of an institution and the arrangements that are in place.

The partnership in this context of RE industry is more than just a paper 'contract', it is about working *together* towards a desired objective. For example, as discussed substantially earlier in chapter 5, the function and model of SELCO would fail if its close association, interaction and relationship with suppliers, banking institutions, RE manufacturers, user network management are not maintained regularly. There is a tendency for these institutions to refine their ways of doing things, customise the products and services that they offer so it is essential that this

refinement loop keeps on involving the key stakeholders/partners in the process to make it effective and operational. Similarly for AIWC, it is essential that being a state nodal agency of the MNRE for RE dissemination and to help build women led micro enterprises, their partnership with IREDA (Indian Renewable Energy Development Agency), MNRE (Ministry of New and Renewable Energy), NGOs and Universities are maintained and sustained on a continued basis. While IREDA provides seed capital and regular funding opportunities to promote AIWC's initiatives, the role of MNRE is nonetheless as a parental figure guiding and directing the RE policy and also the way forward. It is also interesting to observe that they complement each other at various levels as well, for example a scenario where AIWC is aiming to hand solar lanterns, solar air dryers, solar pumps to women in certain regions, the MNRE helps to organise the training programme and awareness campaign for the beneficiaries in association with its partners in research thinktanks and also Universities, this further strengthens the relationship while also ensuring the end desired goal is achieved realistically.

"We draw strength from a wide variety of partners, Industry experts and University students help in developing training materials and assessment of tests during training and awareness campaign programmes; funding provided from MNRE and IREDA are mostly without much bureaucratic delays since we have been working since nearly 20 years now. Local NGOs help us get into the veins of the community and help in targeting women beneficiaries. We also work with both large-scale and small-scale RETs manufacturers. The organisation underwent several leadership changes but we also call upon existing leaders as advisors during any particular project planning and design process." – ex-Chair of AIWC, New Delhi

TERI, on another note performs a very similar function like AIWC and SELCO but from a different level and operational efficiency. Besides reaching out to rural areas and incubate RE based entrepreneurs, TERI also designs planning tools, research papers and also tender bidding arrangements for the MNRE. In addition, TERI developed its own programme called Lighting a billion lives (LaBL) that has succeeded in bringing in light to nearly 100,000 Indian villages already. They work with solar manufacturers (TATA Power Solar, Kotak Urja), NGOs, VOs, international donors, Universities and also directly with the targeted beneficiaries in rural areas. Previously, they have also worked closely with CSE (Centre for Science and Environment) to enable banking and financial institutions (both regional and local) to recently come up with their own energy loan options and to support energy entrepreneurs setting up their businesses. This has been very important because at the national level, it has mainly been NABARD (National Bank for Agricultural and Rural Development) with the RRBs (Regional Rural Banks)

catering to rural bank loans. These institutions have also been a key partner with the MNRE, so in effect TERI has circumscribed all the key players and actors in the RE industry for their own planning, design, implementation and operational strategy. Without these players, the model of the institution would be dysfunctional. The fact that TERI works closely with community based organisations and the energy entrepreneurs directly helps in the understanding and importance of the public private people partnership PPPP model, especially in the context of RE.

These relationships are major contribution in this section because it explains the actors, their patterns of interaction and how particular outcomes are generated. This provides an understanding of how institutional frameworks are designed and maintained and then it is possible to see the impact made on rural lives.

Indigenising solar RETs and the subsequent benefits to both RE actors and communities

It has been well established in the cases and discussions previously provided in earlier chapters that most of these institutions – SELCO, AIWC and TERI are helping in indigenising the solar RET manufacturing, selling, servicing and marketing. This trend is a contrasting one compared to a few years ago when most of the RETs came from Sweden, UK, Germany and USA but now these technologies are a) made by local companies like Ananda electronics as used by SELCO b) domestic large scale manufacturers (TATA Power Solar, Kotak Urja, Urja Unlimited) used by all major RETs' service providers, c) local men and women who are both buyers and sellers (and makers in some cases) as examples cited in cases from AIWC and TERI d) developed and further refined in research thinktanks considering the emergence of the triple helix relationship (University, industry and Government working together).

The above have been a) making the communities more sustainable and self-dependent, b) making the RE sector resource rich in terms of training new people and transferring a) boosting regional economics and the labor market in the sector in context b) allowing continuous refinement and customisation of the technologies that have helped boost domestic innovation for both local and national level RET manufacturers.

While large-scale RETs manufacturers are contracted out for big projects and large-scale deployment of RETs, local level RETs manufacturers have been equally effective in reaching out to individual households and also entrepreneurs whose needs and aspirations change and develop over time. Due to the number of actors and institutions emerging, growing and refining the sector the support provided out to RETs based entrepreneurship is also both accessible and available. However, stress is needed in this contribution since there is a large amount of literature looking at the big players in the market while ignoring the small and local ones – if looked at impact wise, SELCO's successful cases can exemplify the need and importance of local RETs manufacturers. This may need further research in many others states a) where SELCO has incubation centres and a small business like Onergy (based in West Bengal) has emerged out of SELCO's model b) Entrepreneurial needs and aspirations will vary and so will the design of the products and services.

The development of banking practice amongst the poor: banking practice tailoring to income ryhthm

As evidence both in the case of AIWC and mainly SELCO, one of the new observations made during the fieldwork is the growing banking practice of the poor. This is a sea change in the past mainly because a) the poor do not have collateral and a guarantor making their partnering with banks nearly impossible b) micro finance loans offered out of local co-operatives and banks which were found to be dysfunctional in several cases (examples can also be found where the co-operatives apparently had closed down without notice along with the deposits of its clients). SELCO's example is stressed here once again, as above, because of the financial innovation model that they came up with which carried risk and also generated initial friction from the rural banks. However, eventually the latter could see the market prospect of such customised loans proposed by SELCO. This is a key empirical contribution since this has been largely overlooked in the contemporary literature although there are cases of successful RETs based entrepreneurs who benefitted from SELCO, however these studies didnot unpack the framework in which SELCO functions.

Firstly, it's the banking habit and secondly the nature of loans and the relationship between the clients and the financial institutions. The banking habit of the rural population is more active than ever due to *a) the loans are now either paid daily or weekly instead of monthly or half yearly b) the clients of SELCO see the bank as their key partner due to this increased interaction and trust generated over time.* It is vital that the nature of the loans and the relationship is understood because this is a new form of innovation as well, the loans provided to SELCO clients are not enormous but the repayment collection cost is high for the bank. While appreciating the reality, the banks did however decide to proceed because there is a good market and statistically speaking from SELCO's reports, the repayment rates and ratios are very highly satisfactory leading to a further increasing level of interest in the business. The loan beneficiaries in this context are mainly individuals or families a) running solar charging stations, buying solar lanterns, lamps and air dryers b) installing solar home lighting systems c) buying solar pumps/dryers/ rooftop heaters.

6.2.2. Theoretical contributions

The role of the conceptual framework in the thesis was vital in designing the research design and tools for data collection. In addition to that it also provided a list of constructs on which the thematic analysis was carried out. While it helped by identifying the variables to look for during the organisation of fieldwork findings, the latter also added several components to the conceptual framework to be used for future research. Understanding the type and role of institutional arrangements was the core focus of chapter 4 which addressed research sub-question 1; the analysis identified the presence of a triple helix connection where government, industry and academics work together in the Indian RE sector to support RE based micro enterprises. This observation had remained elusive in studies carried out in this field so far.

A. Operationalising and augmenting the conceptual framework

The conceptual framework developed and used in this thesis borrows selected elements from two well-established theoretical frameworks, i) IAD and ii) OECD/EUROSTAT entrepreneurial index. It helps in unpacking how institutional arrangements are formed and works to support solar based entrepreneurs in India as well as to explore the wider implications of the latter on

rural development. The framework helped to shape the research methods as well. Drawing on the analysis carried out in the thesis, the conceptual framework also benefits from the additional components that the thesis offers. These components would be useful to develop a better understanding of how the impact of RE based entrepreneurship on rural development can be better measured in future research. In addition that, the components provided in the OECD/EUROSTAT were not designed for measuring the impact of entrepreneurial performance in firms that are 'not for profit' by nature. However, the additional components identified in the thesis while exploring the second research sub-question (chapter 5 to be particular) show that the framework can be used to study micro businesses and social enterprises as well.

Given the nature of nested organisations that were studied as a part of this research, the purpose was to better understand the composition and nature of partnerships that exist (and not to compare which ones work best) while creating an enabling environment for solar entrepreneurs to develop their business. In this process, the determinants that were identified and used to study expanded the scope of the framework. For example, existing literature shows that components such as regulatory framework, market conditions, finance, culture are the conventional determinants of entrepreneurial performance – the findings of this research however shows that additional components, for example - knowledge of local markets, regional demand conditions, close ties to direct stakeholders (e.g. suppliers) are also key considerations to be made. The framework can thus be used for future reference when research looking at RETs, no only solar, would ask similar questions on entrepreneurial determinants.

Not only the conceptual framework has benefitted from the additional components, but it acted as an useful tool for the data analysis. Themes generated from the findings could be classified and critically discussed following the codes that emerged from a pattern of responses. The design of questionnaires, research approach was guided by the elements provided in the framework. For example, complexities associated with studying nested organisations including elements such as how different partners act, react and interact with each other which then leads to a certain pattern of interaction. These patterns of interactions carried out overtime leads to a specific outcome which then creates an enabling environment/ determinants for effective entrepreneurial performance. The components utilised from the IAD framework in particular

helped in fragmenting the nature of partnerships that exist within all the organisations that have been studied for this research. The conceptual framework addresses both wings of the research questions effectively, guiding the research design and approach while finally benefitting at the same time, from findings and added components that the research analysis provided.

B. Evidence of triple helix connection – Industry, academia and Government

While answering the first research sub-question in chapter 4, and studying the patterns of interaction to learn how particular outcomes are generated the evidence of a triple helix connection has been noted. In all the three institutions studied (SELCO, AIWC, TERI), the partnerships that are in place namely public-private and public private people partnership (PPPP) demonstrates how the triple helix connection has emerged in India especially for institutional arrangements designed to support solar based entrepreneurs. It has been reviewed earlier in the thesis that without the interconnectedness and partnership arrangements amongst the stakeholders, the operational model of the institutions won't function. Recognising the presence of the triple helix and the support it provides to solar RET based initiatives in rural India is a particularly important factor. This would help in developing a better understanding of the institutional arrangements comprising nested institutions that are working towards creating an enabling environment for the solar entrepreneurs in future research.

"Triple helix – Industry, Government and Academia is emerging in India. This connection is not taking off faster as it should in India; many people are talking about this. The process is not automatic… Germany in 2010, they made this industry university relationship mandatory. So to hope that this kind of relationships would emerge out of market conditions, profit motive, I don't think so. A lot of institutional arrangements need to be there before any concrete, solid meaningful relationship emerges. There are examples, in EU and USA, I can cite 2 dozens such acts who were moving and forcing the relationship to move into this direction. It's not automatic, the Government has not made any institutional arrangement for these interactions, emphasising access to the network, however several recent PPP models observe the triple helix kicking off in the renewable sector in India" – JNU Chair for SOSS, JNU – New Delhi

Previous studies largely ignores this multi-play and interactive relationship that exists among the three sectors. Importantly though, this research suggests that stronger the connection and frequency of interaction the effective the responses are, for example TERI's model stands on constantly functional triple helix model without which the idea of LaBL wouldn't run. Similarly, while noticing the involvement of TERI with local partners and then on another level, the entrepreneurs provides a general picture of the final result but not the process that it has embedded. The triple helix is necessary for the solar based initiatives to fully materialise since this is where the idea conception stage exists followed by reaching out to potential beneficiary regions and then contact begins with local partners and entrepreneurs (the last rung in the supply chain). Understanding the triple helix better would give a higher understanding of which actors are involved and their individual plus group role in the process. This element, when considered, would provide a solid base to start an enquiry during future research.

It is interesting to note however, that the findings leading to the existence and importance of triple helix wouldn't emerge without the elements suggested by the conceptual framework. It is only during the process of studying the different actors and the action arena when the triple helix became a pattern identified in most interview responses and observations made. Although the partnership component is often well understood in paper, but the role of the three sectors, important simulataneously, has not been made known before in this area of research investigation.

C. Understanding PPPs in RE context

The analysis shows how strongly tied mutiple institutional arrangements are when it comes to working together towards either a) tailoring technological output to an individual/household need, or b) developing training resources by one actor, delivering the training by another, project funding by another actor – a glimpse of AIWC projects elucidates on this with great clarity, or c) working closely with suppliers, banking organisations and clients at all times where constant feedback loops is believevly improves the business model – the case of SELCO projects the same, or d) reaching out to local partners with the necessary resources alongside training entrepreneurs to run solar based micro enterprises – the cases provided by TERI.

This understanding of PPP, not merely conceptual but also functional is an important contribution considering the limitation of the concept, conventionally used rather loosely, in financial partnership and project partnership references/contexts only. The idea of PPP, as identified and explained in the thesis shows that the idea 'working together' is a constant process in most scenarios where actors are developing a solar based initiative for a community, household or an individual. During the course of the fieldwork, a couple of responses from academic sector questioned the definition of partnership used in this research. This was good for clarity considering in most recent case studies, the idea of PPP is often representing a case of 'contracting' or 'outsourcing' rather than working 'together'. This is a key understanding to be considered in future research because the level, frequency and purpose of PPPs need to be clearly understood and established before any determinants of entrepreneurship is investigated in depth. As an add on, while delving into the PPPs concept the research also came up with an indicative future ideas (for example, the role of the MNRE needs to be more hands on rather than solely being a regulatory or facilitation authority) as discussed later on in this chapter.

6.3. Limitations and future research

Although three institutions have been studied in detail in order to gain a higher understanding of how institutional arrangements are formed and support solar RE based entrepreneurship, the limited scope of the research (and allocated time period) did not allow me to study several other regions in India where firstly institutional arrangements might vary in regards to their composition and nature as well as the degree of impact on solar entrepreneurs. In addition to the sites where the fieldwork was carried out, several other states of India where similar work is being carried out to support solar entrepreneurs would have been good to inspect. This research aimed at how different institutional arrangements are formed and support solar entrepreneurs, and it would be interesting to investigate different arrangements by comparing and contrasting them to evaluate which arrangement works the best. This would then carry policy implications as well, in addition to any empirical contributions that it is likely to offer. Also, in terms of methods and research design – applying observation techniques to a large number of solar based micro enterprises in addition to conducting interviews with entrepreneurs would bring in more understanding of the impacts of such entrepreneurship in communities. This would also lead to an enhanced understanding of the determinants of

entrepreneurship and identifying the ones that are most strong and in under what specific situations.

Chapter 4 also concludes by demonstrating the similarities and differences across the three organisations studied. It can be suggested that while generating similar (and in many cases, same) outcomes, several aspects of multiple stakeholder partnership are similar but contain some significant differences as well. For example, some organisations may not prefer to engage directly with the Government (and thereby checking the triple helix possibility) while others are constantly in the process of developing the working relationship and triple helix with the Government. Although there is a possibility of research concluding the fact that the different institutional arrangements end up generating similar positive/ enabling environment for solar entrepreneurship to flourish but a critical review of how composition of multinested institutional arrangements differ (and whether they may/do change and evolve over time) would provide a higher understanding of the study. This would be to gain a further insight into the process of partnership and not the final outcome *per se*. Finally, the gender aspect looking at firstly why women led solar businesses are thriving and secondly why institutions are now specifically looking for women owned plus managed solar businesses – this could be looked into further. This research did however illustrate as well as explore the areas of women led solar businesses, both in chapter 4 and 5, where future research can focus on with greater detail and applied qualitative methods.

In light of the thematic analysis and the improved conceptual framework, further research is needed to explore the gaps that this research points to. As mentioned earlier, the conceptual framework can be used to study solar based micro enterprises by adding components identified and described in this thesis. Future research needs to provide a higher understanding of the nature and composition of different actors who are joining together with a shared goal as well as studying the nature of a partnership in a more planned way; investigate the nature of particular outcomes generated by different institutional arrangements and who benefits (user, provider, indirect stakeholders); an entrepreneurial research investigating the nature of initiatives and operations started by the entrepreneurs and the benefits generated from it.

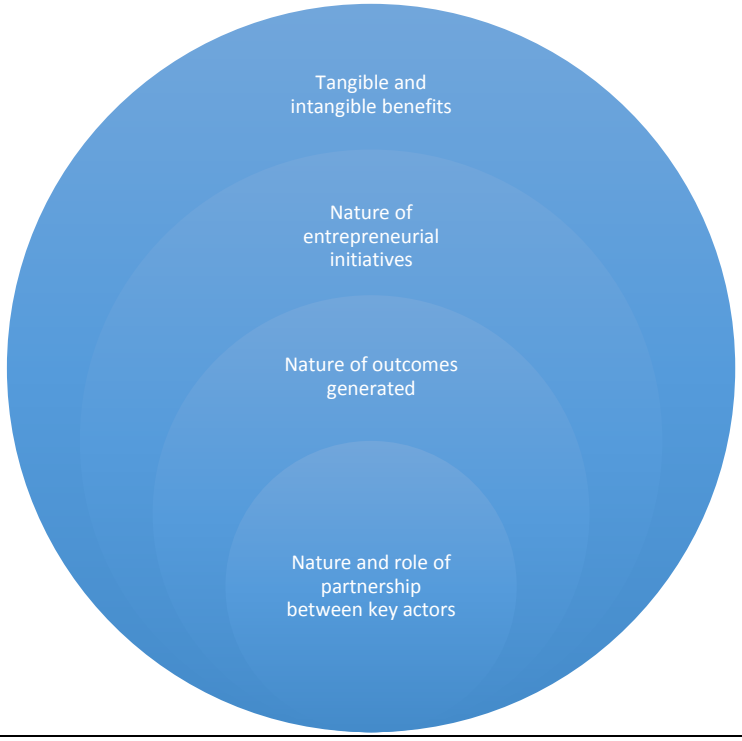

Figure 6.2. Indicative future research

Indicative Future Research

There were responses received from interviewees during the fieldwork that this research couldnot entirely address partly because a few of them werenot a part of the research goal and some were beyond the scope of this thesis. Specifically two things that kept coming back from the interviewees were a) that they are optimistic about the ambition and direction that the RETs sector is taking in India, and b) a concern that MNRE is being looked upon only as a subsidy provider and policy maker with no other business or operational decision making to do. The latter is a concern and raises different questions in this context. Firstly, a) limiting its abilities only to being a subsidy provider and policy maker also connotes that they depend heavily upon other related partners and close stakeholders, this is important as highlighted in the thesis, b) heavy dependence on other partners also raises questions on monitoring and evaluation (M&E) co-ordination and accountability (and who is burdened with it). For example, if the MNRE is deploying a large scale solar panel installation on several acres of land in a region and

it contracts out to a private RE manufacturer, there may or may not be a quality assurance and maintenance checkups much later, and this goes unnoticed. The question is of accountability and this is why more research needs to be done to understand the nature of certain partnerships and contracts. Another reality would be when the MNRE is expecting to provide a huge number of solar dryers, pumps and lanterns to all women in a targeted region, and this will be via the AIWC – the results of this measure is expected to ensure more success by looking at the statistics historically. So, on the one hand the question is one of choice and the on the other hand, efficiency and quality control. These need to be addressed by the policy makers and further research is also needed.

Secondly, the issues around monitoring and evaluation need to be systematically studied for proposing feasible solutions in the future. Several reports and interviews have confirmed that there have been numerous cases where the solar PVs have been lying de-laminated for a long time, demanding attention, while nobody came to replace it. It is often another third party, for example, a local NGO who walks in and addressed the problem as a 'quick-fix' rather than a formal measure, which is actually the job of the solar manufacturer who had it installed and guaranteed it for a minimum of 2 years. This has raised questions about the sector that requires an investigation both policy-wise and research-wise.

The next thing is the slow emergence of the *triple helix connection* across the government, industry and academic sectors. Although this has been generally treated in a positive way for both operational efficiency and strategic drift gains of the sector, it is still however at its inception stage so focus should be given to the quality and consistency of the work rather than heavy participation at all levels in this sector. To a great extent, careful partner selection, reviewing collaboration terms and conditions, a holistic approach towards the support provided to the solar entrepreneurs, a strong monitoring and evaluation process that the MNRE needs to set up and not sticking purely with the subsidy provision and policy making are needed.

As a way forward, another growing concern as experienced by several prominent figures is the varying nature of state policies not entirely in accordance with the national level MNRE set ones. This is a concern, for example, while the feed-in-tariff is legal in Karnataka (considering the initiatives from Karnataka Renewable Energy Development Limited - KREDL), this isnot

considered legal in several other states like Gujarat or West Bengal. The point here is about policy level consistency, the SREDAs are meant to be state nodal agencies of the MNRE and thus carrying out state specific policy modifications for a geographically diverse country like India would mean a) generating inconsistent result in the future and b) even more difficult to monitor progress and identify challenges. This is because lessons learnt from one part of the country can be applied in another context with some minor induced change since they are in the same sector. Varying policy making and practice might destabilise and perturb expectations set from the next MNRE strategic report, which promises to more than double its area of operations and the consequent result generation. These indicative thoughts for the future apply only for the part of India that this research looks at.

Finally, looking at how the institutional arrangements have been effective enough to support RETs based rural entrepreneurship, it is also very important to develop an indepth understanding of the concept of PPP in this sector. Clearly from the findings, it can be said that the traditional public-private partnership where *'contracting'* has been more popular than *'working together'* is not applicable in India's RETs sector considering the nature of the nested institutions working together for quite some time, while also supporting the RETs based entrepreneurship as evidence from the chapters in the thesis. However, the key thing that has gone unnoticed is the increasing formation of cases where partners are forming a PPPP model – Public Private People Partnership, that most of the institutions in the RE sector in India have been following. Looking at the initiatives carried out by TERI, it is observable that in nearly all of their projects they have a local partner, a NGO or a VO or a community organisation, this has been instrumental to Lighting a Billion Lives' success stories and effectiveness. Without the intervention and participation of these community organisations and NGOs, the process of sensitisation wouldn't begin and thereafter the constant contact that organisations like TERI keep with the region to monitor progress and refine their future design of projects and strategy formulation. More research in this area is essential to enable a higher understanding of the partnership arrangements formed between key partners and how results can differ from one setting to the other given the varying roles and deliverables of these partner institutions.

In light of the above discussion, it can be stated that future research needs to explore three important aspects emerging from this thesis. Firstly, the nature of tangible and intangible

benefits drawn from the entrepreneurial performances – this thesis has highlighted several of them but further research is needed to mainstream them to generate systematic studies and cases for reference. The examples cited in this thesis, for example women exploring vocational opportunities and involving the community while running an energy based business and also the fact that the rural users are perceiving the technologies as an '*asset*' can be key themes for future study. This can be taken up in the interest of extensive qualitative research work to measure how this perception develops and what are the determinants of it. The scope of the conceptual framework, as stressed earlier, is now much more enhanced in terms of applicability in this given genre of research. Following the empirical and theoretical contributions, the work ends here with key suggestive future research indications.

"Ring the bells, that still can ring, Forget your perfect offering,
There is a crack in everything, and That's how the light gets in"

Leonardo Cohen, 'The Anthem'

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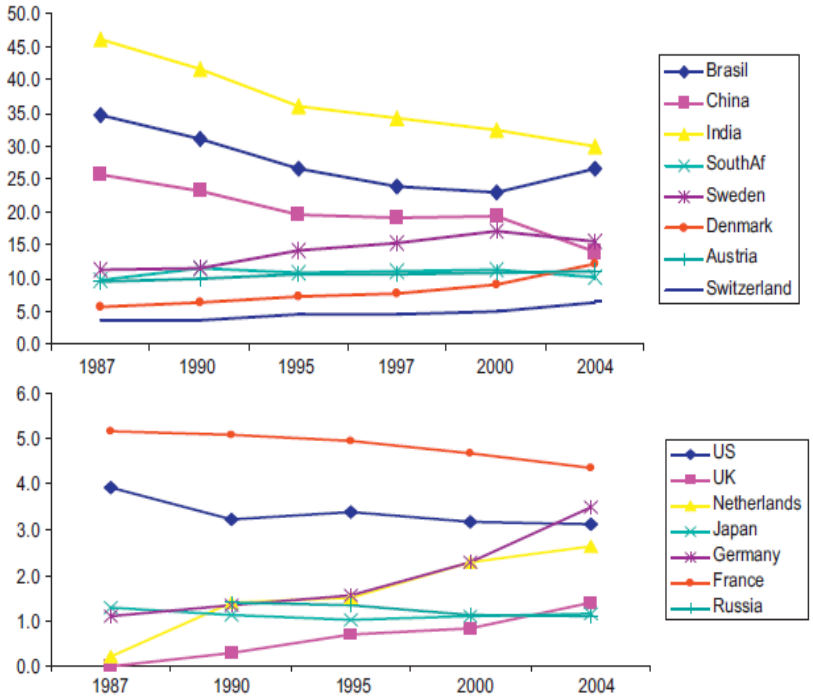
Appendix: Figures and Tables

Figure 9.1: Share of combustible renewables and waste on total energy in the BRICs and some developed countries (World Bank, 2005)



Graph 1. Share of combustible renewables and waste on total energy, in the BRICS and some developed countries, 1987–2004.
Source: World Bank Indicators. *Note*: Combustible renewables and waste comprise solid biomass, liquid biomass, biogas, industrial waste, and municipal waste, measured as a percentage of total energy use.

Figure 9.2: Ranking of the world leaders in existing renewable energy capacity and production in 2006 and 2008 (REN21, 2007; 2009)

Table 2
Ranking of the world leaders in existing renewable energy capacity and production in 2006 and 2008.
Source: REN21 (2007, 2009).

Top five countries										
	1		2		3		4		5	
	2006	2008	2006	2008	2006	2008	2006	2008	2006	2008
Existing capacity										
Renewables power capacity	China	China	Germany	United States	United States	Germany	Spain	Spain	India	India
Small hydro	China	China	Japan	Japan	United States	United States	Italy	Italy	Brazil	Brazil
Wind power	Germany	United States	Spain/ United States	Germany	Spain/ United States	Spain	India	China	Denmark	India
Biomass power	United States	United States	Brazil	Brazil	Philippines	Philippines	Germany/ Sweden/Finland	Germany/ Sweden/Finland	Germany/ Sweden/Finland	Germany/ Sweden/Finland
Geothermal power	United States	United States	Philippines	Philippines	Mexico	Indonesia	Indonesia / ItalyMexico	Indonesia /Italy	Italy	
Solar PV (grid-connected)	Germany	Germany	Japan	Spain	United States	Japan	Spain	United States	Netherlands/ Italy	South Korea
Solar hot water	China	China	Turkey	Turkey	Germany	Germany	Japan	Japan	Israel	Israel
Annual production										
Ethanol production	United States	United States	Brazil	Brazil	China	China	Germany	France	Spain	Canada
Biodiesel production	Germany	Germany	United States	United States	France	France	Italy	Argentina	Czech Republic	Brazil

Figure 9.3. Installed capacity for different sources of power (IBEF, 2015)

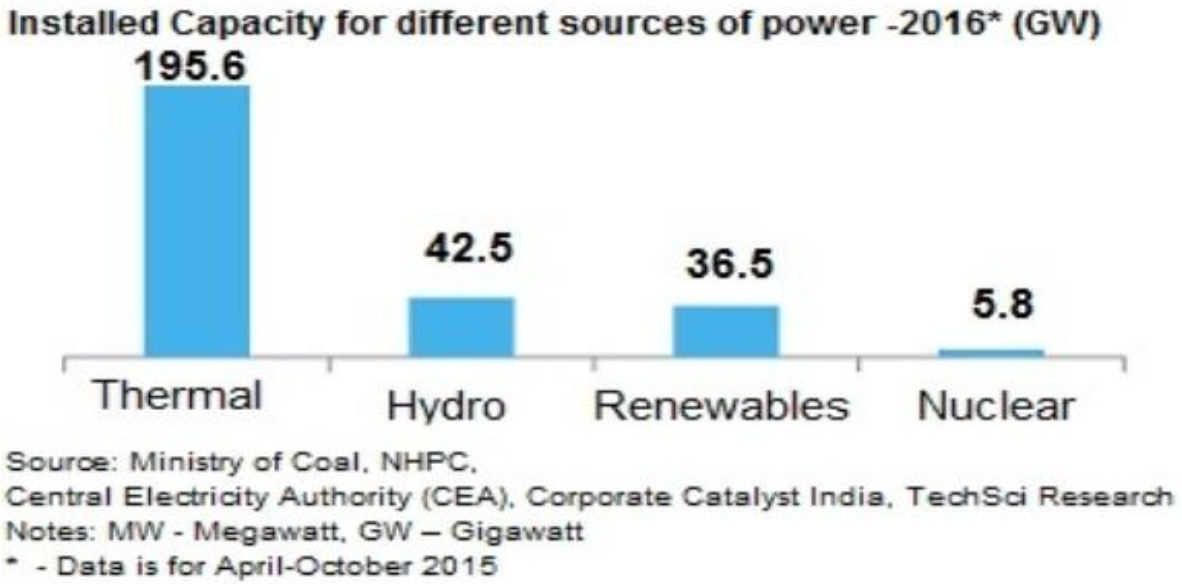


Table 9.1. Effects of Entrepreneurship: Interventions on Wealth Creation in rural areas – Intellectual, Social, Individual, Natural, Built, and Financial Capital

Intellectual	Social	Individual	Natural	Built	Financial
• Increased creativity and innovation among entrepreneurs • Creation of knowledge networks within the kitchen incubator • Building local knowledge of sustainable development practices • Creation of learning laboratories for preservation-based development in the region	• Increased trust among players new to sustainable development • Facilitation of new partnerships • Creation of a broader, more diverse leadership pool • Collaboration of people, businesses, non-profits,	• Increased skills for entrepreneurs, community members in collaboration, leadership, preservation, etc. • Enhanced opportunity for community gatherings and celebrations • Increased pride of craft associated with selling to an expanded market • Increased pride of place associated with regional branding • Increased individual empowerment	• Increased use of local produce • Expanded use of organic or sustainable processes • Increased stewardship of the natural environment • Preservation of the natural environment through nature tourism • Preservation of unique regional assets through regional branding	• Creation of a 12,000 sq. ft. kitchen incubator • Restoration, rehabilitation and reuse of historic properties • Expansion of water treatment facility to keep up with demand associated with business expansion • Expanded infrastructure at community college	• Increased financial investments by entrepreneurs • Increased value of entrepreneurial ventures • Creation of grant and loan pools to assist business clients • Capturing wealth transfer through community foundations • Enhancing the performance of existing

• Enhanced pool of leadership capacity • Built pool of knowledge about innovative practices in community development • Transforming individual farmer knowledge into "community property" through sharing strategy for standards' compliance • Strengthening knowledge and innovation through coaches and mentors network	and governmen t, many of whom were once competitor s • Intentional service provider network created • Creation of cooperative with both bridging and bonding social capital. • Building coaching relationshi ps based on trust Building relationships between youth and community elders	associated with building financial and business skills • Increased hope for the future being developed in and passed on by youth			CDFIs through entrepreneur education and coaching

(Stark,2008)

Table 9.2. Summary of potential energy sources in India and their future outlook

Energy Source	Key constraints
Solar	• High upfront cost • Intermittency due to weather conditions
Coal	• Pollution, rising costs, mining and transportation infrastructure bottlenecks • Energy security (i.e. import dependence) and detrimental effect on balance of payments of rising import of coal
Nuclear	• Makes India dependent on the Nuclear Suppliers Group (NSG) (The NSG is a multinational agency tasked with stopping nuclear proliferation by controlling the trading of materials that could be used in nuclear weapons and mitigating risks involved in the civil nuclear industry) • Security concerns (e.g. Fukushima) • Environmental concerns around waste disposal

	• Very long plant gestation period. Commissioning of nuclear plants is fraught with protests causing delays. For example, the Kudankulam nuclear power plant in Tamil Nadu was delayed by seven years (Nuclear Power Corporation of India Limited, http://bit.ly/1mXevCz) • History of under achievement (targets for new capacity additions in all five year plans were missed by a long margin)
Wind	• More than 95% of India's wind energy potential is concentrated in just five states in the South and West: Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, and Gujarat, giving rise to transmission issues (Tamil Nadu, which has the highest installed capacity of wind in the country, is unable to evacuate all the wind power generated, as the grid's current infrastructure lacks the strength to evacuate the peak generation. In 2013, 2.1 billion kWh was wasted due to insufficient evacuation infrastructure. Source: Indian Wind Power Association, 2014: http://bit.ly/MPlnBf) and grid management issues due to the variability of wind power • On-shore wind potential estimated at 100 GW by MNRE (C-WET, http:// goo.gl/IGolTB)

	• Wind plants have high intermittency due to unpredictability of wind availability • Not suitable for distributed generation • Off shore wind options not yet explored
Hydro	• Limited potential (149 GW OF WHICH 40 GW has already been tapped) (Source: Review of greenhouse gad emissions from the creation of hydropower reservoirs in India", World Bank, 2008, http://bit.ly/1capFzp) • Social and environmental concerns with respect to largest projects involving dmas • Long project gestation periods are often further delayed due to protests • Infrastructural challenges such as access roads and power evacuation with respect to remote sites
Gas	• The dependence on imports is rising. India is currently the sixth largest LNG importer in the world and is expected to move up to third place by 2020 (Petronet LNG: http://bit.ly/N6Cnns) • Significant infrastructure improvement required, including

	transportation and port infrastructure • As per current data, India has only limited technically recoverable shale gas reserves (96 tcf). These are less than 10% of the recoverable reserves in China or the USA. ("World Shale gas and oil resource assessment", US Energy Information Administration, published June 2013, http://bit.ly/1f08C2k)
Biomass	• Seasonal power source • Only waste biomass can be used in India (conflict with food production) • Limited overall potential of around 18 GW ("Energy Statistics", Ministry of Statistics and Planning, published 2013, http://bit.ly/1n0YOoL). The Indian Biomass Atlas (India Biomass Atlas, http://bit.ly/1eZlTs5)by the Indian Institute for Science estimates that 145 million tons can effectively be used for energy generation

Table 9.3. Projected capacity addition to each renewable energy source (TATA Power Solar, 2014)

Categories	Definition
Solar Bees	Under this scenario, India installs 8.3 million solar rooftop systems of an average size of about 3 Kw to achieve a total of 25 GW by 2024.
Solar Pigeons	Under this scenario, India installs 100,000 systems of an average size of 250 kWp to achieve a total of 25 GW by 2024. These will largely be industrial and commercial installations.
Solar Horses	Under this scenario, India installs 1,250 utility scale power plants with an average size of 20 MW each to achieve a total of 25 GW by 2024.

Solar Elephants	Under this scenario, India installs 13 ultra-mega scale solar power plants of size between 1 to 3 GW each to achieve a total of 25 GW by 2024. These power plants can either be individual projects or they can be clusters of projects in one location (akin to a solar park).

Table 9.4: Institutional arrangements for receiving Renewable Energy Technologies (a look at different stakeholders involved in the process)

Institutional Basis (receivers)	**Characteristics**	**Pros and Cons**
Central Government	Financed and constructed through national budget	Funding takes place outside market places, political priorities can change
State Government	Financed and constructed through national budget	Compete for political priorities, lack expertise to arrange project financing, arrange construction

Local Government	Smallest formal unit concerned with basic infrastructure development issues	Lack expertise to demonstrate need besides inadequate resources to arrange construction
Rural areas (villages)	Non-formal governing system	No formal legal entity with which to negotiate, limited ability to plan, limited skills
NGOs	Financed through contributions or third party	Limited financing available
Private Companies	Invest in projects with adequate return on investment	Must have commercial potential and be attractive or capital investment, often managed by elite for profit
Rural households/families	Basic unit of society, basic unit of production in agricultural societies	Low capital, low skills

Table 9.5: Fourteen dimensions of the difference between the model of the entrepreneurial and the managed economy

Category	Entrepreneurial economy	Managed economy
Underlying forces	Localization Change Jobs and high wages	Globalisation Continuity Jobs or high wages
External environment	Turbulence Diversity Heterogeneity	Stability Specialisation Homogeneity
How firms function	Motivation Market exchange Competition and cooperation Flexibility	Control Firm transaction Competition or cooperation Scale
Government Policy	Enabling Input targeting Local locus Entrepreneurial	Constraining Output targeting National locus Incumbent

Figure 9.4. Framework of entrepreneurship policy areas.

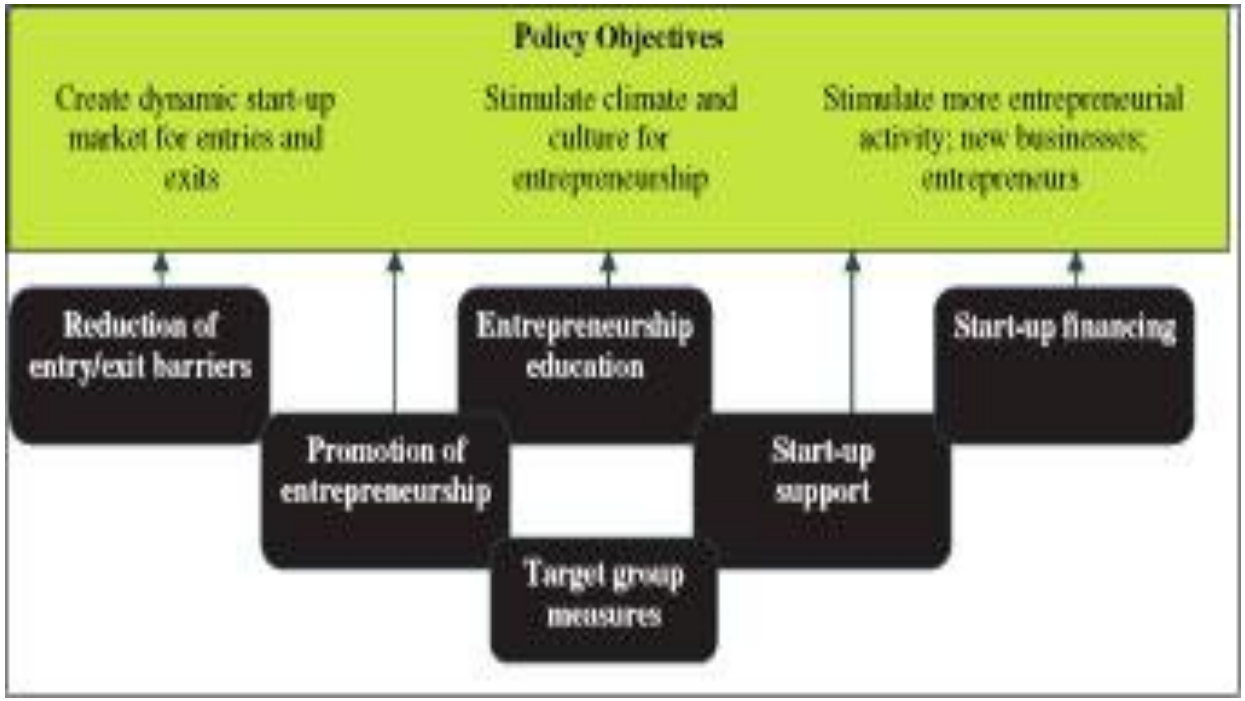


Figure 9.5. Factors of significance to entrepreneurial performance

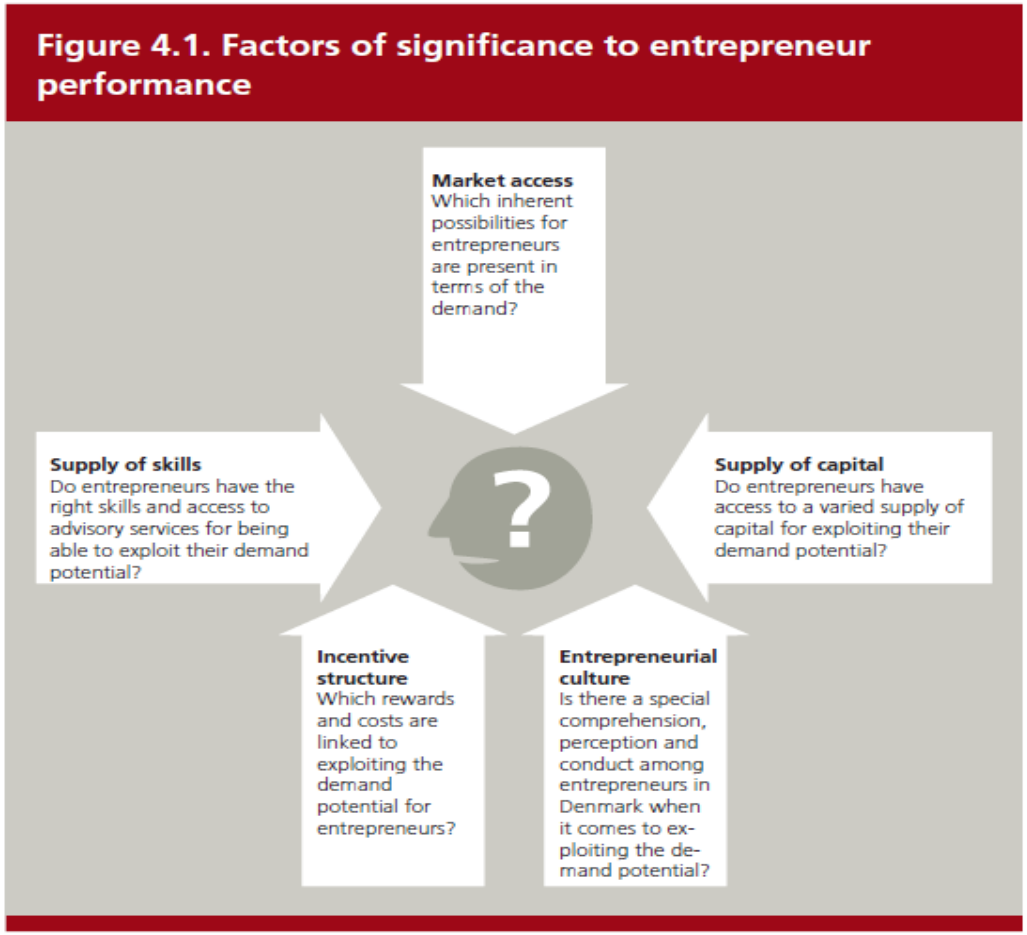


Table 9.6. Codes identified from conceptual framework

Elements in the conceptual framework	Code(s) generated
1. Actors – selected public and private sector players in the RE sector in India 2. Action situation – in what setting do the different actors perform 3. Patterns of interaction 4. Outcomes	1. Nature of interaction, deliverables, role and functionality, nature of operation 2. Role of MNRE, state level RE agencies, relationship with RE based entrepreneurs 3. Nature and role of partnership, project deliverables 4. Results of working together, how collaboration of actors help support entrepreneurs

5. Determinants	5. Role of credit, training and development, regulatory agencies, marketing and business knowledge, capacity building

Table 9.7. Institutions studied during fieldwork

Institution	Name	Location
1	Ministry of New and Renewable Energy, Government of India (MNRE)	New Delhi
2	Centre for Science and Environment (CSE)	New Delhi
3	The Energy Research Institute (TERI)	New Delhi, Bangalore
4	Jawaharlal Nehru University (JNU)	New Delhi
5	Lighting a Billion Lives (LaBL), TERI	New Delhi, Bangalore
6	All India Women's Conference (AIWC)	New Delhi, Bangalore
7	Indian Institute of Technology	New Delhi

	(IIT)	
8	Department of Science and Technology (DST)	New Delhi
9	TATA Power Solar	New Delhi
10	Solar Electric Light Company India Private Limited (SELCO India)	Bangalore
11	Vendors and energy based micro businesses	New Delhi, Bangalore (villages)

Table 9.8: Reasons for selecting the institutions studied

	TERI	AIWC	MNRE	SELCO
Founded in	1974	1927	1992	

Based in	New Delhi, Bangalore	New Delhi, Bangalore	New Delhi	Bangalore
Organisation	Private	Mixed	Government	Private
Organisational aim	Research for sustainable development of India and the global south	Empower women and prepare them for taking up leadership roles	Energy availability, access, affordability, equity and security	Empowering clients by providing a complete package of product, service and consumer financing through micro-finance institutions
Focus	Clean energy, water management,	Emancipation, education and empowerment of	Cost competitive, reliable new	Creating products based on end user

	sustainable agriculture, climate resilience	women	and renewable energy supply options	needs, incubation of other firms
Initiatives	Works with the Government, acts as a 'last mile' agent, wide network of local partner institutions in several states, possess triple helix functionality	Nodal agency for the MNRE for dissemination of RETs led women managed micro businesses, promotes and trains women in running RETs led businesses, sponsor programmes	One of a kind ministry in the world, provides 30% subsidy on RETs at all levels, supports building green entrepreneurs hip, provides funding through IREDA and	Largest reach in Karnataka villages, builds and sustains green entrepreneurs, increasingly growing partnership with suppliers and local manufacturers,

			functions through extension ministries through SREDAs, works with private RETs firms, academic and industry expert on a continued basis	
Key reasons for selection	Range of operations, scale of reach, multiple stakeholder partnerships, 'last	Works with national and local Governments, work with academic and	Continuous partnership with industry, academic and RETs firms,	Doesn't work with the Government, manages the entire supply

	mile' agent through LaBL initiatives, planner for major policy level decision making	industry, multiple stakeholder partnership	contractual arrangement with major RETs manufacturers, multiple stakeholder partnership, policy and RETs sector planner	chain and value chain of their products, heavy reliance on local suppliers and manufacturers, creates RETs based entrepreneurial ventures, treat customers as business 'clients'

Table 9.9. List of interviewees and methods chosen in New Delhi and Bangalore

Interview	Institution	Position	Location	Methods chosen
1	Jawaharlal Nehru University	Chairman – SSS1	New Delhi	Semi-structured interview
2	Ministry of New and Renewable Energy (MNRE), Government of India	Director- General	New Delhi	Semi-structured interview
3	Jawaharlal Nehru University	Research Scholar	New Delhi	Semi-structured interview
4	Jawaharlal Nehru University	Professor	New Delhi	Semi-structured interview
5	TATA Power Solar	Vice President	New Delhi	Semi-structured interview
6	Department for Science and Technology, Government of	Senior Scientist	New Delhi	Semi-structured interview

	India			
7	All India Women's Conference	President	New Delhi	Semi-structured interview
8	Green Grants India	Associate	New Delhi	Semi-structured interview
9	TERI (Energy Research Institute, India)	Senior Research Fellow	New Delhi	Semi-structured interview
10	Centre for Science and Environment (CSE), Government of India	Director	New Delhi	Semi-structured interview
11	Indian Institute of Technology – Delhi (IIT-D)	Professor	New Delhi	Semi-structured interview
12	Light a Billion	Associate Director	New Delhi	Semi-structured

	Lives (LaBL), TERI			interview
13-20	AIWC	Beneficiaries	New Delhi, Bangalore	Participant observation, key informant interview
21	TATA Power Solar	Technical Executive	New Delhi	Semi-structured interview, participant observation
22	AIWC	Regional Head	Bangalore	Semi-structured interview
23	TERI	Director	Bangalore	Semi-structured interview
24	SELCO India Private Limited	Managing Director	Bangalore	Semi-structured interview
25	SELCO India Private Limited	Principal Analyst	Bangalore	Semi-structured interview
26-28	TERI	Library staff	Bangalore	Semi-structured interview
29	KREDL (Karnataka	General Manager,	Bangalore	Semi-structured interview

	Renewable Energy Development Limited)			
30-34	SKG – Sangha	Field team – vice president, supervisors and field coordinators	Bangalore	Semi-structured interview, key informant interview, participant observation
35	SKG- Sangha	President	Bangalore	Semi-structured interview
36	KOLAR unit, SELCO	Sales Executive	Bangalore	Semi-structured interview, participant observation
37-45	SELCO	Beneficiaries (silk weavers, vegetable vendors)	Bangalore	Semi-structured interview, key informant interview, participant observation

Table 9.10. Data Analysis Structure for SELCO India

Patterns of interaction and outcomes	**First order codes**	**Second order codes**	**Themes**
1. Providing customised products and services, tapping into specific household need	1.Products are customised based on household needs 2.Continuous feedback loop and knowledge sharing 2.Word of mouth communication 3.Interaction between clients and SELCO staff 4.Faster response to RET product issues	1. regular communication between clients and SELCO staff 2. considering the nature of lighting needs at the household level	***Knowledge sharing, feedback loop between SELCO and clients, understanding individual lighting needs***

2. Developing a financial innovation in offering solar lights	1.Banks interacting with villagers 2.Banks offering loans to RETs based businesses 3.Banks receiving repayments on daily and weekly basis 4.SELCO providing bridging loan 5.SELCO connecting entrepreneurs with bankers	1. SELCO arranging bank loan facilities to their client 2. formation of clients and bank relationship	***Availability of start-up finance for RETs enterprises, developing banking practice***
3. Ongoing interactive relationship	1.Working with local suppliers 2.Suppliers are flexible and source locally 3.Suppliers working	1. ongoing product refinements tailored to client needs	***Faster new product development, quicker response to client issues***

with suppliers	on design innovation based on SELCO's client input 4. Experimenting with new product and design and allowing trial and error	2. faster response to customer service	
4. Partnerships for Innovation and new product development	1.Identifying new needs 2.Working closely with the prospective clients 3.New product development 4. Working with a voluntary organisation 6. Working on a sensitive issue, helps	1. partnering with community level organisations and VOs 2. engaging in activities that are considered sensitive to the community in an attempt to get closer to them	***Working with local communities, creation of new needs, trust building in networks***

	to nurture trust with the community in the long run		

Table 9.11. Data Analysis Structure for AIWC

Patterns of interaction and outcomes generated	**Codes**	**Themes**
Working with partners to facilitate training and development programmes	1. Practical training 2. Skill based test 3. Simulation programmes 4.Guided and participatory process	**Participatory training and learning, simulation opportunities**
Engaging with unemployed youth/women who are	1.Support from apprentice to start-up stage	**Comprehensive long run entrepreneurial support,**

potential 'solar engineers'	2. Participatory learning support 3. Women maintain and repair solar technologies	**women repairing RETs**
Working with partners in different regions to replicate the business model	1. Importance of situational factors 2. Inclusion of entrepreneurs as a part of the simulation to share learning 3. Identifying the right business to choose and grow 4. Cultivate entrepreneurial ability	**Situational factors of business, identifying right business and region specific, funding available for start-ups**
Develop self-sufficiency in youth/women to run energy-based businesses	1.Early awareness meetings 2.Developing sense of independency 3.Ensuring of stability 4.Support from training stage	**Focus on awareness and knowledge sharing, entrepreneurs developing sense sufficiency**

	to business take-off	

Table 9.12. TERI'S beneficiaries, stakeholders and list of RETs initiatives

Location	Types of RETs	Actors	Activities generated
Village: Mahmuda; District: Nalanda, Bihar	Solar lanterns, solar charging stations	TERI (provision of finance), Lighting a Billion Lives (training and delivery of tech)	Incense sticks, milk, tuition centre
Village: Panchagarh; District: Thane, Maharashtra	Solar lanterns	TERI (training and tech delivery), ICICI (provision of finance)	Renting out lanterns, 'Worli' paintings

Village: Tentala; District: Mayurbhanj, Odisha, Orissa	Solar lamps	Lighting a Billion Lives	Stitching 'sal' leaves together to form 'Kholi', a plate made out of leaves, poultry breeding
Village: Mirgimundi; District: Mayurbhanj, Orissa ;	Solar lanterns	Lighting a Billion Lives with partner organization: Sambandh, TERI's funding support	Extended hours of cycle repairing in the village
Village: Kamlapur; District: Unnao, Uttar Pradesh	Solar lanterns	Lighting a Billion Lives with partner organization: Humana People to People India (HPPI), New Delhi	'Chikan' embroidery designer
Village: Sorispadar; District: Koraput, Orissa	Solar lamps	Lighting a Billion Lives partner organization: Integrated Tribal Development Agency (ITDA), Koraput + gram panchayat's participation	Schooling, tuition, home lighting
Village: Sorispadar;	Solar lanterns	Lighting a Billion Lives	Schooling

District: Koraput , Orissa		partner organisation: Integrated Tribal Development Agency (ITDA), Koraput	
Village: Tentala; District: Mayurbhanj, Orissa	Solar lanterns	Lighting a Billion Lives partner organization, Social Organization On Various Aspects (SOOVA)	Selling dry fish and shrimps

Table 9.13. Data analysis structure for TERI

Patterns of interaction and outcomes	Codes	Themes
Partnering with local community based organisations as well as the MNRE	1. Partnering with local and community institutions as well as national level public institutions 2. Partnering with an energy entrepreneur	Public-private people partnership
	1. Working with financial	

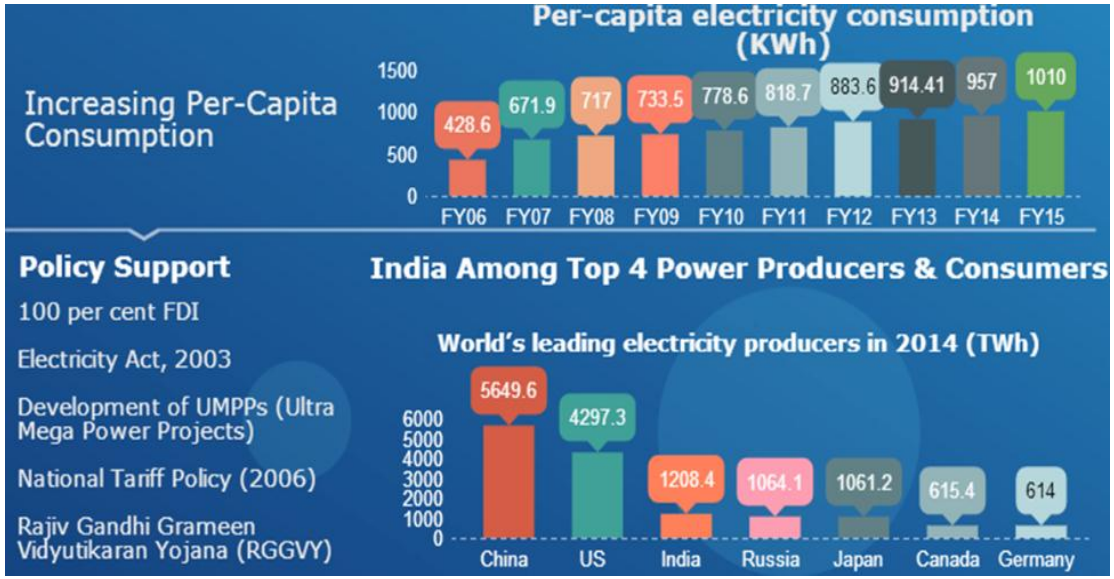
Partnering with financial institutions and offering after-sales service to clients	institutions 2. Door-step financing to entrepreneurs 3. Helping individuals graduate off poverty 4. Forming knowledge partners at different levels 5. Offering faster after-sales service and maintaining communication with clients	Provision of RE based start-up loans, forming knowledge partners
Working with energy entrepreneurs to develop more energy based micro enterprises	1. Partnering with academic and industry experts for developing training and sharing learning 2. Monitoring the use of RETs for multiple purposes while keeping the core purpose intact	Multi-level partnership, monitoring of entrepreneurial performance

Table 9.14. Data Analysis Structure

First order codes	Second order codes	Themes
- Marketing products - Idea of scaling up a business - Hiring additional employees	- Scale up in role from procurer to becoming a last mile agent - From entrepreneur to managing a business	**Business acumen**
- Idea of lighting up more homes Support community families	- Financial motivation to social impact - Hiring local labor	**Entrepreneurial community impact**
- Choice of door to door pamphlet distribution - Putting up marketing banners	- Rewarding an introducer for product reference	**Wider application of business acumen and networking**

- Women making leaf plates - Hiring other women from the same community	- Additional use of RETs on hand made and home produced products	**Women-led vocational activities and social impact**
- Engaging several families in solar businesses - Use of RETs in *community occasions, cultural events, and marriage ceremonies*	- RETs application in non-business activities	**Community bridging and empowerment**
- Use of RETs to protect crops - Keep away animals	- Practical daily applications of the RETs	**Intangible personal and social benefits of the technology**
- Buying supplies and raw materials to self-make RETs - Self–servicing and maintenance of technology	- Training other members of the business to make and maintain RETs	**Business incubation** **Knowledge sharing and transfer**

Figure 9.6. India's position as a global energy producer and consumer



(IBEF, 2016)

Figure 9.7. MNRE's stakeholder analysis (MNRE, 2013)

(Please see next page)

Table 10: Stakeholder Analysis

	Power		Stakes	
Group/ Individuals	**How can they help us?**	**How can they block us?**	**What would they want from us?**	**What do we want from them?**
Research & Development (R&D)/ Technical Institutions	- Engaged in technology development/ indigenisation efforts - Manpower development	Misuse of assistance/ subsidy	- Skill development - Financial support	Incubating new technologies
Equipment Manufacturers and Technology Providers	- Product marketing partners - Technology innovation - Awareness creation among users	Misuse of assistance/ subsidy	Financial support	Providing high quality products
State Governments	Promotion of renewable energy programs at the state level through conducive policies	- Lack of adequate support for RETs - Lack of appropriate fund allocation - Inefficiency in delivery	- Financial support - Timely releases - Skill development	Facilitating effective implementation of RE programs & schemes
Regulators (CERC, SERCs)	Formulating conducive regulations that would support the RE policy initiatives of the Ministry	Through regulations that have inadequate enforcement measures	Cooperation	Working together at the time of formulation of policies and regulations
Different Ministries of Government of India	Promotion of renewable energy programs in complementary programs	- Lack of adequate support for RETs - Sectoral interests can block/hamper growth	Convergence for inclusive growth	Facilitating large scale off grid applications such as SWH, solar cooking, solar street lighting, solar air-conditioning, kitchen waste processing,

	Power		Stakes	
Group/ Individuals	**How can they help us?**	**How can they block us?**	**What would they want from us?**	**What do we want from them?**
Indian Renewable Energy Development Agency (IREDA) and other Financial Institutions/ Partner Banks	Concessional financing for RE projects	By not financing RE projects through high cost of finance	Financial support through for instance guarantees	Large scale financing of RE projects through concessional funds
International Financial Institutions	- Source of low cost funds - This would be particularly helpful for development of large solar power plants with storage.	Lack of support		Helping particularly off grid initiatives and rural electrification efforts by providing debt funds at low cost
Developers/Investors (including foreign)	- Implementing RE projects & programs - Innovation in business models for inclusive growth	- Availing financial support from the Ministry but not implementing projects - Unfair practices - Sub-optimal monitoring of projects	- Financial support - Conducive policy & regulatory framework	- Implementing RE projects & programs - Innovation in business models for inclusive growth
Non Governmental Organizations (NGOs)	Spreading awareness	Fictitious NGOs Spreading of misinformation	Financial support	Awareness generation
End-users	Large scale use of RE devices	Non cooperation towards usage of RE devices on account of: - lack of awareness - high cost - utility factor	Awareness creation Cost of such devices being made available at same cost or lower cost than conventional systems	Increased usage and promotion of RE systems and devices

Figure 9.8. Institutional structure of energy administration in India (OECD/IEA, 2012)

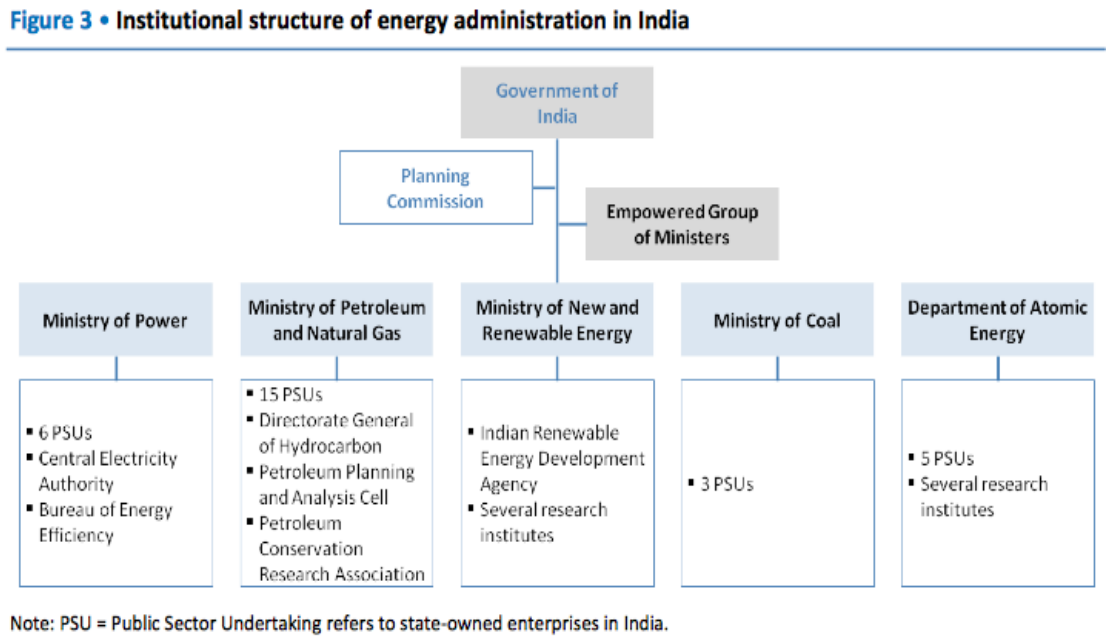


Figure. 9.9. Interplay between the conceptual framework and fieldwork findings

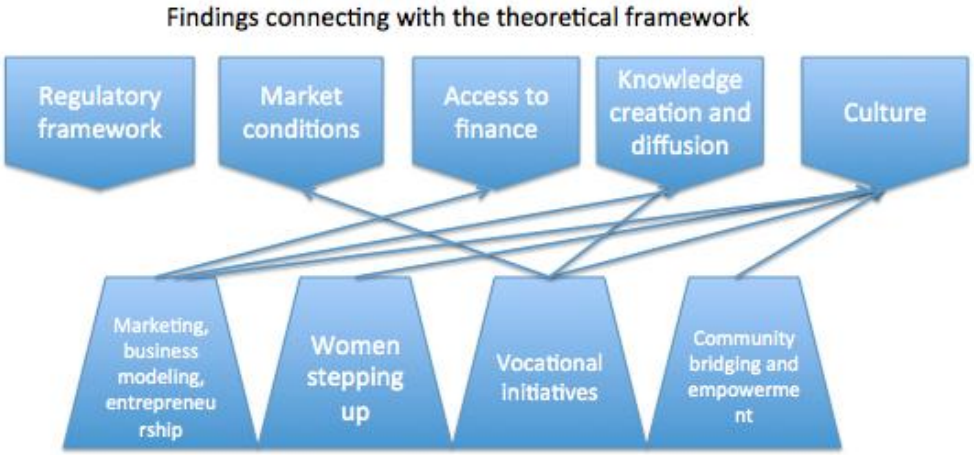


Figure 9.10. Rural Development opportunities arising RE based entrepreneurial initiatives in rural areas.

Table 9.15. RETs based creation of vocational opportunities

Beneficiaries identified	Location	Types of RETs	Activities generated	Rural Development Benefits
Baby Devi, Rinku, Shabir	Village: Mahmuda; District: Nalanda, Bihar	Solar lanterns, solar charging stations	Incense sticks, milk, tuition centre	Local income and job generation, children's education, community safety and bonding
Kishore	Village: Panchagarh; District: Thane , Maharashtra	Solar lanterns	Renting out lanterns, Warli paintings	Income generation, community bonding (returns in kind), preserving a dying art, man-animal conflict avoidance
Hinsi Hazda	Village: Tentala ; District: Mayurbhanj, Odisha , Orissa	Solar lamps	Stitching sal leaves together to form 'Kholi', a plate made out of leaves,	Community bonding, income and local job generation, entrepreneurial spirit, women

			poultry breeding	empowerment
Somnath Singh	Village: Mirgimundi ; District: Mayurbhanj , Orissa ;	Solar lanterns	Extended hours of cycle repairing in the village	Education, income generation, health
Kamlesh Devi	Village: Kamlapur ; District: Unnao , Uttar Pradesh	Solar lanterns	'Chikan' embroidery designer	Income generation, children's education, market access
Benudhar Sahoo	Village: Sorispadar ; District: Koraput , Orissa	Solar lamps	Schooling, tuition, home lighting	Education, school attendance rate, school savings (dedicated to building medical stock to spending on kerosene), health
Alaka Rautaray	Village: Sorispadar ; District: Koraput , Orissa	Solar lanterns	Schooling	Enhanced study hours, vocational training opportunities for adults

Arati Mahanta	Village: Tentala; District: Mayurbhanj , Orissa	Solar lanterns	Selling dry fish and shrimps	Access to three weekly markets, can maintain and service the lanterns, income generation, entrepreneurial spirit

Annexures

Table 10.1 Overview of interview questions for participant groups 1, 2 and 3

Participant groups	Questions
1. Researcher and Scientists 2. Policy makers and Ministry Staffs 3. RETs manufacturers and service providers	1. Given the current priorities of the MNRE slated out in its 2012-2017 strategic planning report, and the involvement of a variety of private players in the renewable market and the multi-facetted benefit it carries for rural entrepreneurs who uses the RETs to form income-generating micro enterprises, what is your take and understanding of it? 2. What are the different forms of institutional support provided to RETs based rural entrepreneurs? How do these models work (being critical is okay)? Please use any reference of an example, a case or case studies. 3. When do you say that a success has taken place from a RETs intervention made in a rural area? How do you define success? 4. What rural development implications do these interventions carry in the long run?

	5. Looking at the different layers of costs involved in these programmes and support, do you think that these are affordable and can be sustainable for the same reason? 6. How much is research benefitting the renewable energy technology application planning in rural India? 7. Do research institutions work closely either with the MNRE or SREDA or other private actors in the renewable sector? 8. What are the factors that support the formation of public-private partnership in the renewable market given we have the MNRE at the top?

Table 10.2. Overview of interview questions for participant groups 4 and 5 only

Participant groups	Theme based questions
4. Entrepreneurs 5. NGOs and	*1. What tangible and intangible effects do these RETs based micro enterprises formed by the entrepreneurs have on households and their livelihoods?* *2. Do the entrepreneurs migrate out of their communities or they stay back*

RETs based institutions	*after their business has succeeded?* *3. Do most entrepreneurs have another supplementary source of income or these micro enterprises are the sole activity they depend upon for their livelihoods?* *a. Can you refer to some particular cases?* *4. Who takes up most of the loans every year? Women or men?* *5. Whose repayment rate is the highest? Women or men?* *6. If men/women, what are the prime reasons? Entrepreneurial or personal factors?* *7. What form of social security do they have?* *8. What are the effects of the distribution of responsibilities in regards to provision of finance, training and development have when stakeholders fall apart in participation?* *9. How does having MNRE at the national level support your activities? Is there any level of participation involved?* *10. How can your institutional model or the programme delivery mechanism be further developed? Are there any future plans currently being put in place?*

10.3. Case study: Gender differences in managing household based businesses

From the project files of AIWC

The following case study compares and contrasts skill and acumen of Shyamlata (female entrepreneur) and Jaljeet Yadav (male entrepreneur).

Profile 1 – Shyamlata

A woman in her 30s, she lives with her four minor children and old *Saas* (mother-in-law) in a suburb in Delhi. Her husband has emigrated to Mumbai where he works as a factory worker. In the absence of any adult male in the household, she takes all necessary day-to-day decision. But all major decisions are taken by her husband. Her *Saas,* being quite old, does not take any interest in household affairs. Shyamlata maintains *ghunghat* (a cover for her head), because her *Saas* is still alive (part of custom and tradition).

Household assets: She has 4.3 acres of cultivable land, of which 3.3 acres she has leased out and the remaining one acre she herself cultivates. She does not have a bullock and plough, but does have a sickle, a spade, a harrow and other small agricultural implements. For ploughing purpose, she hires them often from the one whom she has leased out land. She keeps a cow and two she-goats. In addition to this, she (along with 5 other women from the same community) was provided with a **solar lantern** for her children's education purposes by a private company. Shyamlata rents the lantern out to another household in her neighborhood community, where her sister-in-law lives (and uses it for making handicraft goods) and earns Rs. 4 per day from the same. However, Shyamlata doesn't use the lantern for any productive activity in her home because she is busy raising four kids pretty much alone given her

husband is mostly away (mentioned above). She also has some consumer goods like a watch, a bicycle and coats besides owning some jewelry as well. She lives in a small and partly *kuccha* house with two rooms and one kitchen with a separate cattle shed as well.

Sources of Income: From her own cultivation she could get a net income of Rs. 1200 and from the leased out land she received rent of Rs. 3300. She cultivated paddy on one acre and wheat on 0.25 acres. She also grew potatoes and other vegetable which she sold. The cow remained dry for most of the parts of the year. From goat rearing she could get Rs. 300 by selling goat-kids. Besides, she received remittances of Rs. 6000 during the year. But money order always comes in the name of her *Saas*. Thus, the total income from all sources that she received during the reference year comes to approximately Rs. 11,000. In addition, she earns Rs. 80 from renting out the solar lantern for 20 days a month which her sister-in-law uses for productive purposes.

Daily routine (during agricultural season): In the suburb, a typical day starts at six in the morning. If it is the agricultural season, she immediately starts making arrangements for the day's work, including on the leased out land by supervising them. Otherwise, she will first go and take out the cattle-shed and feed them. She cooks and prepares the children for school. She will then go to the field during forenoon hours otherwise she will take her meals and then rest. In the afternoon, she starts preparation for the night meals after which she will sit with children and teach them wherever possible, as she has been educated upto 8th standard. After eating around 8-8.30 all of them will go to sleep.

Consumption behavior: Her food consumption includes adequate quantities of pulse, vegetables, oil/ghee/masala, besides rice and wheat. She also spends on education of her children, social and religious ceremonies and medicals. For clothing, her husband will bring clothes from Mumbai for everyone in the family. He comes twice in a year and stays for 10-15 days.

More about her: She is educated upto 8th standard and is not an 'ignorant woman'. However, she does not participate in any of the village activities, even if it is among females. This is because, she thinks, people indulge in. She expects her children to complete college and University education. She does not have any

complaint to make either against her *Saas* or husband or anyone else in the village. In times of emergency, she takes help from her neighbor which she readily gets as and when required. She never wanted more than 2 children. But, because of her husband's indifference to family planning she has 4.

Profile 2 – Jaljeet Yadav

Jaljeet is 25 years old belonging to the Yadava community. He lives with her wife, three children, aged father and mother. He parents chose to live with him rather than with his brothers. He has inherited 3.6 acres of land. Except for 0.4 acres which he has mortgaged, he cultivates all his land. He keeps two bullocks and two buffaloes. Besides, he has some goats as well. He also keeps all necessary agricultural implements like ploughs, sickle, harrow, etc. He has also irrigation facilities like well and pumpset. Besides the above, he was provided with a solar lantern for using it for productive purposes but he uses it to run a tuition centre at home twice a week teaching community kids in exchange of a *very* small fee. Jaljeet is educated upto 9th standard and one of the most literate individual in the particular community, for education and health issues, other people often visits him.
Jaljeet grows crops like wheat (2 acres), paddy (1.3 acres), gram (0.3 acres), potato (0.2 acres), and green peas (0.2 acres). He produced 15 quintals of wheat, 8 quintals of paddy, 0.5 quintals of gram, 3 quintals of potato and 0.6 quintals of green peas. The total value of these comes to roughly Rs. 7500.

He has utilized HYV seeds, fertilizers, and irrigation, technology for all the crops, but more prominently for wheat and potatoes. He could generate an income of Rs. 4800. From dairying he could get an income of Rs.3500. They did not engage in wage employment, not because of any social restrictions, as may be the case among Rajputs and Brahmins but because of sufficient work opportunities available on their own farm. While the males, including his father engaged in cultivation activities, female folks looked after the live stocks, including buffaloes. Their children were attending school as well.

Conclusion

It may be observed that both Smt. Subita and Harjeet Yadav are from the same socio-economic strata, as both of them belong to the upper caste and have land holding between 3-4 acres. But, the two differ sharply in the survival strategies, as well as the utilization of existing resources.

Firstly, Smt. Shyamlata prefers to lease out land whereas Jaljeet cultivates all his land himself.

Secondly, Shyamlata could not utilise her land as much as Jaljeet could as may be seen from the crop intensity and cropping pattern of the farm households.

Thirdly, Jaljeet was more enterprising in as much as he used both intensively and extensively all the available modern HYV seed, fertilizer, irrigation, technologies. But, comparatively Shyamlata wasn't enterprising at all. In addition the use of solar lanterns also adds to this conclusion.

The reason perhaps was that while for Jaljeet land was the only resource which he could utilise to get a living for himself and his family of seven. But, Shyamlata had her husband to remit regularly.

Fourthly, while Shyamlata did not have to work so intensively, except giving supervisory services, the females of Jaljeet's household had to work from dawn to dusk to assist their males in making out a living from the limited services they had at their command.

Fifthly, the priorities in the case of Shyamlata was giving education to their children even upto University level, for Jaljeet education of children was not important and he wanted his children to be cultivators only.

Note: though the female wasn't as enterprising but her long-term goals possess more far reaching consequences. Educating children could lift an entire household/family out of a particular underdeveloped setting. Secondly, women are less likely to migrate out given their sense of security while living in a suburb/village with people to reach out more quickly and easily. The above presents a mixed case – if looked at financial output maybe the male counterpart wins in the short run but for a change to come in the long run, women are better managers (even if they just a supervisory role, not an operational one)

Note 2: as observed from most studies, when it comes to education of girl child both the types of households are the same, as neither of their believe in educating the girl, as they think that the girl would go away to another house after marriage, so any investment in their education would be a waste.