Holistic Value Chain Assessment of Decentralized Renewable Energy in Developing Countries for Impact Investors: Before and Beyond Life Cycle Analysis

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ABSTRACT

As the world grapples with the idea of impact investment as one of the important ways to deliver essential services to the poor, many queries are being raised about measurement of real impact and the deriving maximum value for the money invested. Typical investments are measured purely on the basis of financials but impact investments are more complex as they also look into social and environmental sustainability.

One of the methods is to conduct Life Cycle Assessments on the products being sold in the developing countries to give impact investors a better understanding of the environmental sustainability of the products, services and systems being invested in. However, to maximize the return on investment from a holistic impact perspective, sustainability needs to be evaluated across social, financial and environmental parameters. To have a substantial impact one needs to build the corresponding eco-systems for under-served societies: thus making the measurement of impact more accurate.
The thesis focuses on the above by taking the example of Decentralized Renewable Energy enterprises in poor and underserved markets of the developing world. The project explores existing methodologies and criteria for impact investors to finance companies by balancing social, environmental and financial returns. By benchmarking and reviewing relevant approaches designed to spur sustainability and by identifying needs and gaps in the chosen methodologies the thesis proposes guidelines for impact investors to assess holistic sustainability. An analysis is provided by considering aspects across type of products sold/services provided by enterprises, type of target segments and motivations, type delivery models, type of capital and type of organizational structure and human resources. The guidelines are designed to help impact investors and enable social enterprises to look at sustainability metrics beyond Life Cycle Assessments. Finally, the importance of revising tax treatment of impact investments and the financial returns deserves serious consideration in order to effectively impact sustainable change.

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EXECUTIVE SUMMARY

The ever growing threat of climate change and dwindling sources for fossil fuels is pushing for more usage of clean technologies like solar and wind around the world. On the one hand, there are millions who still do not have access to reliable energy, and most of them live in the developing countries. Many of these countries lack the resources to put up large fossil fuel based power plants to cater to the needs of their citizens. On the other hand, fast developing countries like India plan to build numerous coal-powered plants to satisfy the needs of its 300 million un-electrified Indians. Countries like China and India, opting for large fossil fuel based resources to power households, institutes and business could tip the environment to an extent that could be irreversible. Thus it is imperative to make sure there is a rapid growth of clean technology based ventures across developing and under-developed nations. It is heartening to note a spurt of such enterprises mushrooming across the world. However serving poor segments, with sustainable energy, needs a more holistic way of running, evaluating and rewarding ventures that focus on social, financial and environmental sustainability.

More than 95% of the estimated population of 1.2 billion un-electrified people lives in developing countries. Investments in the clean energy sector focused on developing countries attracted a record $126 billion investment in 2014. Some parts of those investments have been done in the social space focused on the poor. While the growth in impact investment and social enterprises continues, measuring returns and establishing criteria for enterprise selection in most cases are no different to any private sector investment decision-making process. Sections 1 and 2, of the thesis, introduce the extent and importance of these issues, stakeholders involved and major challenges while designing solutions that are targeted towards solving some of the worlds most complex challenges. The sections also explain the significance of evaluating socio-economic and environmental impact factors across type of products sold/services provided by enterprises, type of target segments and motivations, type delivery models, type of capital and type of organizational structure and human resources.
Section 3 dives deeper into models of sustainability by providing analysis and benchmarks of different methods of assessing and measuring sustainability. Although impact investors and social enterprises can improve environmental sustainability through Life Cycle Analysis (LCA) across the different phases, exploring techniques before and beyond LCA is critical to measure social and financial sustainability. The section elaborates and discusses weaknesses and strengths of models like Social Impact Assessment, B-corporation Evaluation, Social Life Cycle Analysis, consequential LCA etc. To move to a comprehensive concept of sustainability encompassing socio-economic dimensions (which can be argued to be intrinsically linked to environmental issues) there are two types of shifts needed- shift towards including all aspects of sustainability (Environmental, Social and Financial) and shift towards moving assessments towards a handprint mode (i.e., towards what can positively be done to bridge gaps as opposed to measuring the negative aspects).

After benchmarking existing processes across holistic value chain assessment verticals, section 4 provides guidelines for each of the verticals. Developing the ecosystem for underserved communities, which include aspects of policy, finance, human resource development, technology, and related supply chains and innovation needs in developing countries rely on the approach and processes of the social enterprises and impact investors. Types of products sold and services provided include adjusting design and life cycle analysis approaches. Type of target segment and motivation includes understanding of client base and the values and motivations of an enterprise. Type of service model considers enterprise strategies on pricing, financing, partnerships etc. Type of capital refers to the ownership structure, internal rate of return and exit strategies of the organization. Type of organizational structure evaluates leadership, inclusivity and salary structures. Each of these contributes significantly towards building the ecosystem while keeping long-term sustainability and poverty alleviation as a priority.

After evaluating different assessment techniques and outlining holistic value chain assessment guidelines for social enterprises, section 5 focuses on Impact Investor User Research and delves deeper into an understanding of the current state of impact
investment and stakeholders associated with it. User perspectives, challenges, successes and failures of impact investment over the years, give a scope on ways impact investors can drive holistic value chain assessments.

Section 6 in the thesis elaborates on Holistic Value Chain Assessment, with a focus on guidelines for Decentralized Renewable Energy (DRE) social enterprises. The detailed insights into this section can be treated as an optional read, but provides the basis on which the conceptual tool for holistic value chain assessment has been recommended towards the end of the thesis. Building asset based solutions for end users, ensuring and catalyzing holistic ecosystem development for under-served populations and raising the right type of capital in order to achieve that, provides an indication to impact investors on the type of change that they need to push towards in their investments.

Considering the uniqueness of the DRE sector and the type of social enterprise structures that are needed to build it up it is key to understand the landscape of policy and regulation that impact investors and enterprises are operating within. For them to be successful appropriate policies need to be in place. Section 7 of the thesis covers relevant policies that directly influence the level of impact that social enterprises can have and the level of social return impact investors can expect. Analysis and recommendations are provided across sustainability metrics and reporting structures, specific public policy interventions, trade, subsidies, finance, tax treatments of investments and their financial returns, education and innovation- all with a focus on developing countries and social enterprise ecosystem development. Patient capital, appropriate tax incentives, type of national innovation models etc. are explored in terms of the current challenges and future strategies, which can support holistic value chain assessment.

The recommendations section provides a direction towards establishing grades of impact investment and social enterprises by evaluating the socio-economic and environmental return against long term outcome-based sustainable development efforts. The social sector needs to move away from measuring output-based financial, social and environmental impact, which cannot be tangibly linked to the overall outcome of
sustainable development. A staggering 71 percent of the world population now lives in countries with a dual-challenge: ecological deficits and lower-than-world-average income. That percentage was less than 15% in the 1960s. Holistic Value Chain Assessment puts environmental security squarely into the development equation, which is essential to ensuring that sustainable development is achieved.
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1. BACKGROUND

An estimated 1.2 billion people – 17% of the global population – did not have access to electricity in 2016. Many more suffer from a supply that is of poor quality. More than 95% of those living without electricity are located in sub-Saharan Africa and developing parts of Asia, and they are predominantly in rural areas [1]. As a key indicator for development, energy access significantly improves wellbeing, health, education and livelihood levels of communities.

Decentralized Renewable Energy (DRE) is the generation of power through sustainable sources in a manner that is closer to its application/use as opposed to centralized generation of electricity via national grid. DRE systems are implemented due to: the low carbon emissions of independent and on site generation, the significantly high efficiency due through reduced losses in transmission lines and the reliability as customers don't have to share a supply or rely on erratic power supply from large, remote, power stations. Examples of DRE can include individually owned homes, business or institute systems and community or village level systems.

In the long term, DRE offers more competitive pricing than traditional fossil based energy. Although the initial capital costs for DRE are higher, appropriate financing and DRE tariffs have created enormous economic benefits for users, especially for the poor and marginalized around the world. DRE provides a chance to push the boundaries of social, financial and environmental sustainability in the field of energy access. It demonstrates inclusivity by allowing users to own assets and become self-sustainable.

1.1 Growth in Decentralized Renewable Energy

In the mid 1980’s, a US based non-profit organization, Enersol Associates was one of the first organizations to utilize Solar Decentralized Renewable Energy for off-grid, economically backward villages in the Dominican Republic [2]. Over the past 30 years
DRE combined with appropriate service and system design has been implemented widely in developing countries in Africa, South and South-East Asia.

80% of the world’s population lives in the developing part of the world but consume only 30% of global commercial energy. As energy consumption rises with increases in population and living standards, one needs to be aware of the environmental costs of energy and the need to expand access to energy in new ways. Increased recognition of the contribution, especially in the developing world, that renewable energy makes to rural development, lower health costs (linked to air pollution), energy independence, and climate change mitigation is shifting renewable energy from the fringe to the mainstream of sustainable development. Support for renewable energy has been consistently building among those in government, multilateral organizations, industry, and non-governmental organizations (NGOs) pursuing energy, environment, and development agendas at local, national, and global levels. At the same time, commercial markets for renewable energy are expanding, shifting investment patterns away from traditional government and international donor sources to greater reliance on private firms and banks [3].

Developing countries attracted a record $126 billion investment in clean energy business in 2014 [4]. The EU alone invested $4.2 billion for sustainable energy in developing countries [5]. Out of which 62.7 million was diverted to solar businesses.

Solar Decentralized Renewable Energy remains one of key viable methods of dissemination for under and un-electrified communities. With the decrease in prices of solar PV technology from $71 per watt in 1977 to $0.30 per watt in 2016 and the shift in models from charity-driven to custom-designed ecosystem and market-based approaches [6] over the past decade, there has been a consistent increase in the number of entrepreneurs, enterprises and organizations dedicated to bridging the energy access gap via solar DRE [7].
1.2 Impact Investment and DRE

Investments, in businesses, that focus on both social and financial returns are typically called impact investments. DRE is one of the sectors that is being targeted by the Impact investors, DRE provides impact investors and funders an approach to low carbon energy provision by giving the opportunity to promote a locally provided, sustainable, competitive and smarter energy choice.

Type of Impact investors that have decentralized renewable energy as a focus area include:

- **Foundations** – e.g., Lemelson, Good Energies, DOEN
- **Development Finance Institutions (DFIs)** – e.g., Asian Development Bank
- **Government Development Agencies**
- **Venture Capital**
- **Private Equity Investment Funds**
- **High Net-worth Individuals**
- **Corporate Philanthropy or Corporate Social Responsibility Funds.**
- **Individual Philanthropy**

Today most of the research focus, in the Renewable Energy sector, is on engineering, development and techno-economic aspects. Not much attention has been paid to the private sector's investment decisions, which needs to be measured from a sustainability point of view (Bhattacharyya 2011; Kaundinya et al. 2009; Bhattacharyya 2012) [8]. Impact investors in Clean Energy for developing countries have 4 primary criteria for investment:

1. Improving the Environmental Footprint
2. Making a considerable social Impact
3. Establishing an Adequate Team Structure and Management

4. Achieving a Sustainable Financial Return

The goal is to create and grow an enterprise that focuses on social and environmental impact with balanced economic returns for both investors and entrepreneurs.

1.3 Need for Custom-Based Renewable Energy Solutions for the Poor

Dr. Paul Farmer from ‘Partners in Health’ states, “Market forces rarely serve the needs of the poor, appropriate technology means nothing for the poor.” Like Dr. Farmer there are wide spread perceptions that products, technologies and services for under-served communities are far from having the desired impacts of uplifting or serving the end user needs. Enterprises, in the name of social impact, target the bottom of a pyramid as a traditional market with expendable incomes. In the process of selling solutions and building financially-viable impact-driven businesses, these activities often end up making the poor even more poorer by facilitating transactions from non-expendable incomes. However, the better trends with the combination of Solar Decentralized Renewable Energy solutions and Impact investing challenge these misconceptions.

The motivation behind this thesis is to spur holistic innovation in products, services, and systems that are designed to impact the world by more appropriately balancing environmental and social sustainability. Decentralized Renewable Energy and Impact Investing are used as lenses and cases to put forward the example of how holistic value chain assessment would work towards reaching this goal.
2. INTRODUCTION

As the world gets more and more technological advanced, the disparity between the rich and the poor is also increasing (according to Oxfam the wealth of the poorest 50% dropped by 41% between 2010 and 2015, despite an increase in the global population of 400m. In the same period, the wealth of the richest 62 people increased by $500bn to $1.76tn). Lack of basic necessities like clean water, energy for cooking and lighting, education etc. are some of the barriers for creating the level playing field for the poor to progress up in the social and economic chain. Increased social tensions, geographical insurgencies and mass migrations are some of the unintended consequences of not able to solve the rudimentary issues of humanity in general.

Philanthropic organizations have always been at the forefront of attempting to solve many of the issues mentioned above. Even after decades of work still more than 1.2 billion people are without electricity, 2.8 billion people lack access to cleaner fuels for cooking, $663 million with no clean water for drinking [9] etc. Thus there is a push around the world to look at different ways, via alternate finance and service models, to cater to the basic needs of the under-served. The models could vary from partial to full recovery of finance from the end-users. Until 10 years ago, similar approaches have been scorned upon by traditional non-government organization, arguing that it would be unfair to charge the marginalized. While on the other hand, there are many models around the world that have successfully shown that in major development verticals (energy, housing, livelihood, water, sanitation etc.) people are willing to pay, partially or fully, provided the services add value to their daily lives.

2.1 Capital: Philanthropic to Private Equity

The excitement of the poor paying for services led to further thinking if in many of the verticals (energy, health etc.), it was time for private capital to play a larger role. The thought process has been oscillating between profiting from the poor to profiting with the
poor. Unfortunately, very few entities have truly understood the long term sustainability (both social and financial) can only happen if one took the second approach. This will be discussed in detail in the following chapters.

Numerous examples have shown that a payment from the end-users brings in more accountability and sustainability. Pure charity has led to breaking down of other parts of the socio-technical eco-system such as the non-functioning of the technology (because of lack of service). Financial commitments, in cash or kind, have led to better ownership and leveraging of resources thus leading to more people getting the desired benefits. Such examples led to a rush of private capital to fill the gaps that philanthropic capital could not fill: such as in the micro finance field [10] [11] [12] [13].

Private capital, driven by this new market of “fortune at the bottom of the market”, started to focus more on the returns than on the social and financial returns for the very end-users it was trying to serve. The partial collapse of micro finance in Andhra Pradesh and one-sided profits made by Micro Finance Institutes in Mexico begged the question if private capital was equipped to bridge the gap between the served and under-served.

Now one can see the range of capital stretches from one end, the philanthropic capital, to the other end, pure private capital. For verticals, that adds economic value to the underserved and sustainable financial models can be built around it, both philanthropic and existing private capital (with expectations of high two digit returns) will not work – thus the need to impact investment. **Impact Investment blends the social objectives of philanthropic capital and financial sustainability of private capital.** Impact investment balances, in ideal case should equalize, the benefits for all the stakeholders thus pushing for inclusivity in a much more holistic manner. The returns, in the space of impact investment should be measured both in terms of social and financial – with both interconnected at multiple levels.
A combined approach to investment is necessary i.e., layering impact investments with soft funds to strengthen conditions under which enterprises could thrive. Weak policies, lack of skilled human resources, lack of appropriate pro-poor technology solutions, regulatory hurdles in operating companies with social missions, poor infrastructure were all dis-incentivizing ingredients for anyone trying to make a dent in the social sector. Grants were crucial high-risk funds to cushion enterprises while they strengthened conditions.

2.2 Social Enterprises and Impact Investment

The answer today could lie in the combination of impact investments and social enterprises. Social enterprises develop and implement need-based innovative business models, many of which are new and thus need access to appropriate financing/funding. Building a business, which balances social, financial and environmental sustainability, while serving the needs of the poor can be a complicated process especially in developing countries where the conditions are not supportive. The complication arises from the fact that social entrepreneurs are trying to solve some of societies' most pressing social problems. To quote Bill Drayton (founder of Ashoka: Innovators for the Public), "Social entrepreneurs are not content just to give a fish or teach how to fish. They will not rest until they have revolutionized the fishing industry." For example, incomes at the base of the pyramid are highly unstable; even marginal changes in household income can change the poor’s purchasing power.

Given the nature of markets, most social enterprises have to undertake activities that are crucial for building a business but end up being time-consuming and expensive. Some of the challenges faced by social enterprises are broadly listed below:

1. Lack of reliable infrastructure (transport, electricity, telecom)
2. Lack of research and development facilities catering to the poor and subsequent transfer of solutions

3. Poor awareness among consumers, financial institutions, government about alternate solutions

4. Underdeveloped institutional capacity - human resources and policies - equipped to grow social enterprise industry

5. Limited access to flexible investment instruments particularly for vernacular speaking entrepreneurs

6. Legal structure of enterprises and corresponding restrictions on infusion of capital

7. Limited access to credit or financing based on cash flows of the poor

While social enterprises aim to be financially sustainable, the challenges highlighted above make market return-oriented investments unfeasible. Pure private-investor capital rarely supports expenditures that are required to generate awareness or develop and push new products to categories or improve supplier skills and without these vital inputs, the pace of growth for social enterprises towards sustainable business models is slowed.

2.3 Investors: Their Barriers in the Social Space

Enterprise financing is a critical catalyst needed to support an assortment of conditions required to sustain an organization. Unfortunately many investors (even in the impact investment space):

• Lack grassroots experience to infuse a creative mix of public and private investments needed for social enterprises to grow in a sustainable manner.
• Have unrealistic expectations of growth from the enterprises thus leading to failed
ventures.

This under appreciation of investors to recognize the challenges in setting up a social enterprise and hesitation of entrepreneurs to effectively communicate ground realities further drives the imbalance. This leads investors to resort to traditional business assessment/decision patterns that do not match the contextual requirements of investees (companies invested in by impact investors).

In summary, many social enterprises face challenges to accessing capital due to a fundamental mismatch between the ground level realities of building a social enterprise and investor expectations. To compensate for this, social enterprises often obtain funding from a variety of different sources in order to plug gaps however these band-aid solutions needs an overhaul if an entire sector needs support and long term growth.

The current financial system simply isn't designed to meet the needs of these hybrid organizations that are businesses serving a social mission. Donors are used to giving grants to charities. They're not comfortable with making investments in businesses and commercial funders – the army of venture capitalists and angel investors (affluent individuals who provide capital for a business start-up, usually in exchange for convertible debt or ownership equity) rarely offer the kinds of financing terms that most social enterprises can meet.

Despite their social mission, traditional philanthropy doesn't provide social enterprises with a stable, long-term source of finance. At the same time, commercial investors neither understand nor trust them, many believing that "social" means "soft" and more associated with "loss-making".

There are various ways of defining social impact investors. From the perspective of the for-profit financial investor, social investments are defined in financial terms and
range from 0% to standard financial market rates. On one hand “full financial market” returns sought by a traditional venture capitalist do not explicitly take social return into consideration. At the other extreme, philanthropic organizations seek no financial return and seek to maximize social return. Social Impact Investors came in as investors who actively seek to place capital in businesses and funds that can provide solutions at a scale that purely philanthropic interventions usually cannot reach and at least return nominal principal to the investor. This capital may be in a range of forms including equity, debt, working capital lines of credit, and loan guarantees.

Numerous reports examine the challenges and opportunities faced by mainstream financial institutions when they invest in the social sector. The reports raise concerns about modest margins, long times to scale and high risk which make finding suitable projects a tough proposition for investors [14] [15]. While there are many tools and methods to measure financial value creation, there are fewer tools to evaluate social value creation. Furthermore, there is still little consensus in the industry on how to measure social value. Because of this inherent ambiguity, investors are expected to undertake a penalty on returns, making investing in the social sector unprofitable. However, many impact investors aim to address this problem through more patient capital (long term capital where in, the investor is willing to make a financial investment in a business with no expectation of turning a quick profit) / modest financial return expectations and a better understanding of the social sector.

More recently, many funders are now joining forces in a ‘layer cake’ approach [16] to achieving greater impact. By leveraging philanthropic funds to cover the initial loss, the hope is to attract commercial investors. However, it takes creative financial engineering and specialized skills to combine foundations and commercial investors. For example, Triodos Investment Management has developed a fund that adopts this layered approach. First governments and social
investors form the base layer of the cake by providing external guarantees against default. The social investors seeking lower returns from the second layer and lastly Triodos Bank provides a final commercial credit line due to its confidence in the other layers [16]. (See the further discussed in section 5)

### 2.4 Potential for Investment in the Social Sector

A study published by JP Morgan and the Rockefeller Foundation found that the impact investment sector offers the potential for investments amounting between $400 billion - $1 trillion and a profit of $183-667 billion over the next 10 years [17]. However a review of the impact investment sector a year later found that there was a shortage of investment opportunities and many impact investors were reluctant to invest in enterprises without a successful track record [16]. Evidence from the evolution of the Acumen Funds investment profile, suggests that impact investors are unlikely to support social enterprises in their early stages. Between 2001-2004, the Acumen Fund deployed 78 percent of its capital to early stage social enterprises compared with 39 percent between 2009-2011.

On a related note, a report by Monitor prescribes philanthropy as a mechanism to fund early stage social enterprises. Philanthropic sources are vital as they are the only source that can “reliably and consistently serve long-term patient capital needs, tolerate lower than market returns and cushion scalable enterprises as they develop their business models and generate social returns in anticipation of corresponding financial returns” [18].

### 2.5 A peek into Holistic Approach to Impact Investment

In summary, impact investors are supposed to infuse a range of investments that are should be tailored to meet the growing needs of social enterprises without compromising social missions. One of the path followed by the impact investors, which
might also be termed short-term, is their focus on one part of a value chain and not end-to-end. Some would focus on purely short-term social goals while others might concentrate on providing value in one part of the eco-system without paying attention to the other parts, which might be missing.

Let us take the example of a solar lighting company that sells lights to poor slum dwellers to enhance the education of their children. The absence of teachers and school in the community would very much negate their efforts, as just providing lights does not lead to literacy or education. The same can be said about the collapse of the micro-finance sector in India; just providing loans to the poor with no attention to market linkages did not lead people out of poverty.

As seen from the above two examples, to have long-term sustainable impact one needs to assess the whole value chain. While it is understandable that one organization or enterprise cannot solve all the parts, so one needs to select appropriate partners who can solve the other parts of the chain. True end-to-end solutions with lead to long term social sustainability, preventing the poor from slipping back or being always vulnerable, true financial balance and with little or negligible impact on the environment.

The prime verticals that make up the complete sustainability chain for an enterprise are:

1. **Type of Products sold/serviced by the enterprise:** The assessment should look for the complete process from extraction to recycling.
2. **Type of target segment and motivation:** The evaluation should consider the selection of client base and creating the product/value, reason for providing the services to the clients and type of continued relationship with them.
3. **Type of service or delivery model:** Selling to a poor end-user with a product/service can be done in many ways. The traditional way is to look in isolation without paying attention to the way a product is sold or how it would impact the life of the end-user. A product that could, in some manner,
affect the client in a negative manner might impact the overall sustainability of the enterprise and the eco-system around it.

d. **Type of Capital in the Organization:** The IRR (Internal Rate of Return – a metric used in capital budgeting to measure the profitability of potential investments), pricing structures, investor exit options, management financial expectations all determine the focus and priorities of the organization. The social spirit of the organization will be determined with the financial expectations and the logic behind those outlooks. Lopsided financial expectation surely can impact the social sustainability or even some of the ones mentioned in (a), (b) or (c).

e. **Type of Organizational Structure and Human Resources:** The thought process and the future progress of the organization, in a sustainable manner, depends on the organization structure, type of partnerships it gets into, salary structures/ratio, inclusivity, and how innovation is encouraged and implemented.

Holistic sustainability means that many parts of a desired eco-system needs to be solved/implemented simultaneously, if true impact has to be achieved. Thus impact investment must have tools and a coordinated methodology to evaluate each of the mentioned verticals to ensure true impact and maximize the value of investments being made.

3. **A REVIEW OF SUSTAINABILITY ASSESSMENT METHODS**

Shared concerns about the sustainability of products and businesses has given rise to multiple concepts, tools/techniques and methods to assess, evaluate and improve on the actual sustainability verticals and metrics. Life Cycle Analysis is one such method used to gauge potential and real environmental impacts of a products/services’ life cycle involving material, energy and economic flows. Social Lifecycle Analysis, Social impact assessments, Benefit corporation assessments
and Corporate Social Responsibility metrics are methods used to gauge social, financial and impacts of products and businesses. This section goes on to review LCA and other methods to understand and outline strengths, weaknesses of existing systems and potential type and features of a holistic value chain assessment.

3.1 Life Cycle Assessment introduction

The first studies to look at life cycle aspects of products and materials date from the late sixties and early seventies, and focused on issues such as energy efficiency, the consumption of raw materials and, to some extent, waste disposal [19]. Also known as Eco-balance, Life Cycle Approach, Industrial Energy Analysis or Cradle to Grave Analysis- is the Life Cycle Analysis or LCA for products, services and systems is a concept that considers and quantifies the sum of all (or most of the primary) processes that go into the every phase of that particular product, service of system. The phases typically include- extraction and sourcing of raw materials, manufacturing and production, distribution, use case and waste management or end of life. Across all types of LCAs four stages are followed: 1. Defining the goal and scope, 2. Compiling an inventory of relevant inputs and outputs based on the scope (also called LCI - Life Cycle Inventory), 3. Evaluating the impacts associated with the life cycle inventory (also called LCIA - Life Cycle Impact Assessment) and 4. Interpreting the results by articulating conclusions and recommendations by evaluating the above three phases. Life Cycle Analysis over the years has been used for purposes such as design for environment (DFE), product development and improvement, claims (declarations) and labelling, marketing, vendor management and green procurement, annual reporting, policy making, strategic planning and decision making, deposit or refund schemes and environmental taxes. Types of LCAs can range from LCA of products, LCA of services, Economic input output LCA, LCA management, Attributional or consequential LCA, and Social LCA. Closely related to these types of Life Cycle Analysis are Greening of Supply Chain Management, Social Impact Assessment, B corp evaluations etc.which are further
discussed in this section. The levels of all types of Life Cycle Assessments and methodologies can differ between conceptual, simplified and exhaustive pertaining to the amount of detail and complexity of the analysis. It is critical to understand the application (purpose) and objectives of the LCA before choosing the type(s) and level of LCA to be used. LCA information can be used to differentiate the impacts of two comparable products, services or systems, to assess design options for the same product or service or system or to identify where in the life cycle an impact should be targeted for reduction (to avoid greater harm) or to simple assess the footprint of a particular product/business.

3.2 Life Cycle Analysis of Products

Product LCA refers to the environmental Life Cycle Analysis of any tangible article or substance that is manufactured or refined for users. The LCA here is relevant for industries and sectors across utilities and consumables, retail products, electronics, packaging, built environment, machines, civil construction, transportation, food etc. The basic idea behind this LCA method is to assess various environmental and health impacts across different stages of a product's life. Depending on the purpose and level of detail for the LCA a system boundary (goal and scope) is first defined. The LCA can then become a subset of the cradle to grave concept. For example- for marketing (environmental product declaration) purposes oftentimes companies commonly carry out a gate to gate assessment (the gate from which the materials came in to when the materials leave the factory), similarly there are cradle to gate (of the customer) or gate (from which materials enter the factory) to grave analysis, leaving out the actual extraction. To further manage the boundary, environmental impact metrics required through the study are specified, for example some LCAs limit their scope to assess their “carbon footprint analysis” for climate change or some may strive to assess threats to human health or ecosystems by assessment toxic chemicals, destruction of natural resources, fresh water use etc. The boundary can be defined for all or any one process and environment impact metric(s).
The goal and scope is determined by outlining system boundaries by also including geographical area, time horizons, assumptions and data quality requirements. Based on this, the Life Cycle Inventory is created by gather data in the form of inputs (energy, water, minerals etc), processes (harvesting, manufacturing, transportation etc) and outputs (emissions, waste water, minerals etc). The impact Assessment phase of the LCA (LCIA) follows elements such as, selection of impact categories and indicators, classification (i.e assignment of inventory parameters into impact categories like climate change, ozone depletion, acidification etc) and Characterization (conversion of Life Cycle Inventory results into common units within each impact category). The methods that are usually used for LCIA are for e.g., EPS (Environmental Priority Strategies), ECO (Ecological scarcity) and ET (Environmental Theme). The last stage of the LCA is interpretation which covers evaluation of the results with conclusions and recommendations based on the defined goal and scope of the study.

Most of these studies follow the unifying framework built in ISO 14040 AND ISO 14044 [20] which are a set of international standards to standardize the environmental product LCA approach on defining full-fledged or Exhaustive LCAs that are widely used in established businesses a means to review and evaluate processes as part of the decision making to make products more sustainable. However, many of the interpretations and differences between defining goal and scope of LCAs do not adhere to ISO recommendations [21]. According to Hansen (1995) [19] the degree of freedom for a designer diminishes as the level of LCA information is revealed, however an early consideration of even of a conceptual and simple form of LCA can increase the level of innovation from a design and development perspective.

Environmental Product LCA is the most commonly understood form of LCA and is used specifically for environmental sustainability decision making and is in no way a measure of overall sustainability. Depending on the level of LCA (conceptual,
simplified or exhaustive) the LCA’s can be done using internal initiatives or external experts (consultants). To carry out an exhaustive product LCA, an LCA practitioner or expert is required, you need a special set of skills, including: understanding of industrial processes in several industries, knowledge of data sources both public and private, understanding of fate and transport modeling, understanding of human and ecological toxicity. As doing an exhaustive LCA is time consuming and expensive, often external LCA consultants are companies are sought [22]. By one measure, the number of scientific publications dealing with LCA has more than doubled in the last two years. LCA tool vendors and consultants are reporting growth of 30–40% annually [23].

Keeping in mind that Life Cycle Analysis are only as good as the data and assumptions behind it, it is almost impossible to ascertain which level of and type of LCA will yield better results [24].

Referring to Dan Etsy and PJ Simmons [24]:

“Company A spends tens of thousands of dollars to generate its own primary data, while Company B uses publicly available data based on sector averages. Company A inadvertently omits a few seemingly insignificant manufacturing-related inputs from the study, but Company B meticulously includes every single one. Company A assumes that consumers will use the product about 8 hours a week for 32 weeks, while Company B assumes 7 hours a day for 40 weeks. Company A weights impacts on local watersheds 33 percent more than Company B. Now imagine the difficulty in deciding whose final numbers are “better” when they end up being different—yet this type of scenario happens all the time in real life.

Similarly, when it comes to numbers in LCAs, keep in mind the old adage that “it’s all relative.” Unless two companies’ products are verified by the same third-party certification agency, there is little meaning in comparing environmental impacts across competitors. As Deloitte has pointed out in a white paper on the subject: “Small differences in assumptions related to system boundaries or
valuation techniques can lead to radically disparate results.” The natural tendency with LCAs is to try to distill complexity down into single numbers or “scores” -- but doing so when nature is involved inevitably requires subjective judgments, which means numbers can only be trusted to a point. In this way, LCA is as much an art as it is a science.”

Most companies don’t, and shouldn’t aim for perfection or full-fledged LCA studies when it comes to analyzing product impacts. What matters most is getting an overview of the product’s main impacts i.e which are most negatively impacting phases or processes and focusing on turning that into more positive impact level. For this purpose, simple tools and approximate estimates also suffice. However, if a business wants to convey results with external stakeholders, especially for labelling or marketing they will need to plan to invest in rigorous analysis and practice complete transparency on the process of the analysis.

There are countless LCA tools and techniques ranging from simple to complex and open source to proprietary [25] [26] [27]. As researchers, scientists and companies continue to strive to find cheaper, better and faster ways of unifying Environmental LCA tools, the fact remains that LCA a method/process and not a tool and it is never too early for designers, companies and investors to start building their internal assessment capacities based on their goals. Without being inclined to any level or type of LCA, the wide array of product LCA tools and techniques are bound to advance the state of the field and the environment in useful ways.

3.2.1 Life Cycle Costing

Life cycle costing, or LCC, is a compilation and assessment of all costs related to a product, over its entire life cycle, from production to use, maintenance and disposal. It was first developed and used by the U.S. military in the 1960’s in order to assess the costs of long living goods such as tanks and tractors (Sherif, Kolarik 1981). Life Cycle Costing can address
the economic impact of a product whose environmental performance is scrutinized in a Product Life Cycle Analysis (Ref to section 3.2). Since both LCC and Product LCA build on a network of interlinked material flows over the whole life cycle of the product, the combination is ideal for financial analysis. Some of the challenges in developing a financial assessment through a product environmental assessment are duplicating calculations, i.e. double counting and streaming. From an impact investing and holistic value chain perspective product LCA and LCC (which are also known as environmental LCA) primarily cover environmental aspects and related financials specifically at the product or technology level only.

3.2.2 Relationship between Life Cycle Analysis (LCA) and Life Cycle Costing (LCC)

LCC and LCA are each designed to provide answers to very different questions. Life Cycle Analysis evaluates the environmental performance of product systems for meeting the same end-use function. Life Cycle Cost evaluates the relative cost-effectiveness of alternative investments and business decisions, from the perspective of an economic decision maker such as a manufacturing firm or a consumer. These differences in their purpose lead to differences in their scope and method. LCC analyzes the cost-effectiveness of an investment over its economic lifetime, which is related to only the use-phase of LCA. The time horizon of an LCC analysis is often even shorter than the use-phase of the investment. Additional aspects of the LCA which are absent from LCC include: physical flows which have no immediate financial consequences for the decision maker and flows into or from all the processes in a product system. LCC calculated over lifetime as compared to LCA includes: cash flows related to investments in product/process changes, costs and revenue streams which are not all proportional to, or even dependent at all upon physical flows and most importantly the timing of cash flows (costs and benefits), and the present
valuation of these flows. Therefore, fully integrating meaningful economic analysis with Life Cycle Analysis requires going beyond treating economic cost as “an additional flow,” or as another property, within LCA software. It requires the addition of a time dimension to the modeling; the ability to introduce and work with variables that have no dependence upon inventory flows; and the ability to create and work with probabilistic scenarios. Two tools are built that aim to integrate LCC and LCA: PTLaser (also used by United States, EPA) and TCAce or Total Cost Assessment. [27a]

3.3 Economic Input Output Life Cycle Analysis

Conducting life cycle assessment with economic input-output is based on the work of Wassily Leontief (1930). Leontief first used the idea of input-output models of the U.S. economy and theorized about expanding them with non-economic data. But the computational power at the time limited uses of the Economic Input-Output method that required matrix algebra [28]. The method essentially uses information about industry transactions - purchases of materials by one industry from other industries, and the information about direct environmental emissions of industries, to estimate the total emissions throughout the supply chain [29]. This type of aggregate sector-level data to quantify the amount of environmental impact is directly attributed to each sector of the economy and how much that specific sector purchases from other sectors for its inputs and outputs. Combining such data sets can enable accounting for long chains (for example, building an vehicle requires power, but producing power requires vehicles, and building those vehicles requires power, etc.), which significantly reduced the ambiguous ‘goal and scope definition’ problem of traditional product Life Cycle Assessments (refer to section 3.2, paragraph 3). EIO-LCA analysis traces out the various economic transactions, resource requirements and environmental emissions (including all the various manufacturing, transportation, mining and related activities) required for producing/manufacturing a particular product or service [30].

Although EIO LCA as opposed to LCA provides for more comprehensive assessments that allow for system level comparisons, the product assessments contain aggregate
data which makes process assessments difficult, therefore just like for Product LCA there still remains data uncertainty. Moreover, EIO LCA treats imports as products created within economic boundaries, thus is difficult to apply to an open economy (with substantial, non-comparable imports).

3.4 Life Cycle Analysis of Services

Service industries are very significant for the current economy and society, in both developed and developing countries (they constitute nearly 70% of the United States GDP [31]). Services encourage the value creation in an intangible way which leads to promoting dematerialization, a necessary strategy for more sustainable production and consumption patterns [32]. Services are intangible, but cannot be separated from consumption, they cannot be stored or owned, and are complex experiences, hence their quality is difficult to measure [33]. Backmann [32] also pointed out the differences between services and products, as shown in Table 1.

Tab.1: Differences between a product and a service

<table>
<thead>
<tr>
<th>Product</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced</td>
<td>Performed</td>
</tr>
<tr>
<td>Material</td>
<td>Immaterial</td>
</tr>
<tr>
<td>Tangible</td>
<td>Intangible</td>
</tr>
<tr>
<td>Can be stored</td>
<td>Cannot be stored</td>
</tr>
<tr>
<td>Usually without client</td>
<td>Interaction with client</td>
</tr>
<tr>
<td>Consumption after production</td>
<td>Consumption=production</td>
</tr>
<tr>
<td>Defects in manufacturing</td>
<td>Mistakes in behavior</td>
</tr>
</tbody>
</table>

There are a very limited number of researchers and studies on utilizing the LCA method to analyzing services [34]. In the existing studies and methodologies the provision of services involves a number of tangible and intangible elements, and can be challenging to separate out from products and vice versa. The major difficulty in conducting an LCA for any service base industry is outlining the goal and scope of the service provided. In the examples (case studies [35]) of service based LCA the major difference to be noted from a tangible LCAs is the definition of system boundaries which accounts for inclusion of personnel and infrastructure to the analysis.
Infrastructure determines a great part of the product share in service systems and personnel, that alone do not cause hard environmental impact, often determine a significant part of the added value. Also, the use of certain capital goods like computers are part of the analysis, while they are often regarded as negligible when physical products are analyzed.

The complexity to determine appropriate service LCAs arises from the fact that the LCA is limited to an environmental impact lens, service LCA should expand to social and financial analysis in order to design services as well as gauge and improve the sustainability of the service.

An example of a service driven LCA of a health care service conducted by University of Pittsburgh [36] demonstrates the scope of most types case studies, where in the LCI or data collected includes areas of energy and waste audit, materials and supplies (considered as inputs and outputs for specific processes with the hospital), transportation, water use etc. Similar LCAs have been carried out for food, energy, tourism etc. as service industries. However the sustainability metrics needs to go beyond only environmental concerns, especially for services. Taking the same example of the health service LCA, data collected on type of investment, internal rate of returns, types of users and employees, social cohesion, team mix etc. would provide a much more comprehensive sustainability metric from an impact perspective.

No example could be found while considering service-based LCA for service-oriented companies like Uber, Air BnB etc. For example, taking Uber as a car service apart from the environmental assessment during the "use" phase of the service a better measure of Ubers sustainability impact could be gauged by assessing employment, inclusivity, type of capital and equity metrics (refer to section 4).

3.5 Greening Supply Chain Management (GSCM)

As enterprises move towards sustainable practices, an increasingly important aspect as mentioned in the previous section 3.2 is to look beyond their own ‘in house’ practices (extended producer responsibility), into the practices of their suppliers, vendors,
manufacturers etc. from a environmental and human wellbeing by considering entire Life Cycle Assessments. Greening Supply Chain Management, just like Product Life Cycle Assessment, considers extraction, consumption and waste assessments across the enterprise supply chain to ensure a low-carbon development goal. In 1963 MSU first proposed the concept of Greening Supply Chains (GSCM) [37] to ensure environmental compliances starting from product Research and Development to End of Life. The risks of supply chain management have been further highlighted due to documentation of multiple cases that directly link endangering public health to the use of environmentally-detrimental restricted chemicals in the supply chain. Green Supply Chain Management today, demonstrates how green practices can actually save money, increase efficiency and reduce delivery time by taking sustainable approaches and decisions when it comes to logistics, packaging, vendor selection etc. It is common to find GSCM being used for environmentally improving aspects of specifically of design, material purchase, packaging and logistics. Product Life Cycle Assessment methodology is often used as a tool for measuring Green Supply Chain Management to increase certainty and quality of Green Supply Chain assessments [38] [39].

3.6 Social Life Cycle Analysis

Social and economic effects on workers and entire communities where production takes place is one of the primary definitions currently outlined by the Social Life Cycle Analysis or SLCA guidelines in UNEP STEC 2009 [40]. Although the idea of SLCA in 2003 was motivated by a consensus that “the use of LCA is hampered in developing countries [economies] clearly due to lack of expertise, data etc., but also due to the inability of LCA to engage in developing countries key issues” and the guidelines acknowledges the need to measure social economic and environmental criteria holistically in order to be able to impact sustainable consumption and production patterns, the Social Life Cycle Assessment thinking in its current form aims to add extra social dimensions and information of social impact analysis (refer to section 3.6.1) on existing environmental product Life Cycle Analysis (refer to section 3.2) method by
promoting the improvement of social conditions and of overall socio-economic performance of a product throughout its life cycle for all its stakeholders.

The general methodology as per the UNEP/SETAC guidelines mimics the Product LCA process. The goal and scope of the SLCA goes a step further than environmental impacts on human health through the supply chain by requiring that practitioners consider social impacts of the product use phase and function as well. The subcategories for SLCA are defined by “stakeholders” (worker, management, contractor etc) and impact categories (Health, Education, Security etc) as opposed to impact categories only of the specified unit or process being assessed. For the Social Life Cycle inventory (SLCIA) there data sources and collection steps and methods that need to vary between quantitative, qualitative and semi-quantitative, subjective data is considered more accurate than objective data in SLCAs and due to lack of benchmarks and data about impacts, activity variables (measure of process activity related to process outputs) are used as inventory inputs. SLCA are likely to encounter both positive and negative impacts of the product lifecycle in the Social Life Cycle Impact Assessment (SLCIA) phase as opposed to environmental/ product Life Cycle Impact Assessment (LCIA). During the interpretation phase additional information on stakeholder engagement and the difference between significant issues is presented in SLCAs. SLCA must leverage on multiple existing processes and methodologies such as designed evaluations, environmental impact assessments, social impact assessments at a site and process level, CSR evaluation (refer to section 3.6.2), Quantifying and assessing working environment related social aspects along product life cycles (the LCWE approach[41]), tools for enterprise evaluation combined with Environmental LCA tools.

Researchers and practitioners so far including UNEP guidelines have reinforced the fact that the current form and techniques for SLCA are not meant to represent a comprehensive picture, there is much scope for future research and refinement in developing tools and techniques for SLCA. Multiple issues and challenges are mentioned in the guidelines including quantifying qualitative socio and socio-economic data, missing standardization and benchmarking, developing data bases, documenting
relationships with other similar methodologies, detailing and understanding peculiarity of a stakeholder approach, develop models for data collection and interpretation and presenting findings, of which all require more research and analysis.

Although, UNEP SLCA guidelines aim to provide a basic map, flashlight or direction for further research in SLCA, the proposed guidelines and ideas require a strong benchmarking of the idea of social sustainability of which inclusivity and ecosystem building are key pillars. Assessments around the inclusiveness of the business, does it work towards bridging the inequality gap in society, do the processes contribute towards building an ecosystem for very poor and abject poverty ridden communities irrespective of the life and immediate goals of the company itself, the long term impacts of the product-service-system on development are all critical to the realm of social sustainability going beyond human employment, health and well being. For example in the stakeholder category of worker and sub category of fair wages the data sources used are ILO (International Labour Organization) Labour standards, Global Sullivan Principals and UN Rights, however, the core discussion towards social sustainability would be more about experience vs pedigree and formal vs informal education and capacity and skill building. More over the guidelines and LCA methodology does not consider the connections and impacts on neighboring communities, long term impacts on cultures and geographies, impacts other stakeholders and partners in the area which are all inter-connected. In the process of standardization of "categories", "hot spots", "sub categories" etc issues like patenting, basic rights, relationship building, culture conservation which cannot be treated as black or white are in the danger of becoming mere values. If looked at more comprehensively SLCAs with a stronger guiding principles on socio-economic sustainability indicators can also be useful in social enterprise and B-corp certifications. SLCA should have versions that are simple (feasible to execute without the presence of experts), conceptual and open source such that it can impact the developing communities it is aimed at.
3.6.1 Social Impact Assessment and Social Return on Investment

Social Impact Assessment as a term with guidelines first emerged in 1973 [42] and since then is often used to convey any or all non-financial impacts including human environmental and economic. Social Impact Assessment (SIA) is the process of evaluating positive and negative impacts of a policy, product, business, project etc on individuals, communities and the society as a whole. The Inter-organisational Committee on Guidelines and Principles for Social Assessment (1994) (cited in Glasson 2000) defined social impacts as “the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society.” [43] SIA has traditionally been used for planning interventions in development contexts, specifically for funders, impact investors, social enterprises and non profits (with the common goal of social change) to measure their social return on investments/ grants. Given the lack of global standards, tools and assessments on social impacts [44] there are several methodologies that are encompassed within Social Impact methodologies [45] and the catalog for approaches to social impact measurement. These approaches include a combination of one or more: analytical tools (stakeholder analysis, gender analysis, data review etc), community based methods (participatory rural appraisal or PRA- an interactive community engagement tool to install set empowerment, SARAR -Adult Education and Empowerment for self-esteem, associative strength, resourcefulness, action planning and responsibility for achieving a participatory approach to development. [46]), observatory and Interview tools (Participant observation, semi-focused interview, focused group discussions etc), Participatory methods (Role playing, mapping, needs assessment, access to resources, workshops etc), Monitoring and Evaluation (Controlled studies, baselines etc), Life cycle analysis methods (Product Social Impact Assessment
(refer to section 3.6), data inventory, referencing, social topic scores, performance indicators for social topics around ‘workers’, ‘consumers’ and ‘local communities’) and methods to measure Social return on Investment (method to improve performance of investments by increasing the socio-environmental returns) [47]. The tools and methodologies of Social Impact Assessment primarily consider immediate social and financial impacts to primary stakeholders. These desires to demonstrate impact has propelled the proliferation of more than 150 impact assessment methods (Foundation Center, 2015). Socially-minded assessment methodologies seek to measure “accountability”, but they are increasingly measuring the “impact” of business on social, environmental and economic vectors (Grieco, 2015: 37-38). Frameworks like Social Return on Investment (SROI) and United Nation’s Principles for Responsible Investing (PRI), which offer investors and businesses ways of measuring and conceptualizing good practices [45].

3.6.2 Corporate Social Responsibility Evaluation

According to Investopedia [48] Corporate social responsibility, also called "CSR," is an initiative taken by the corporate to assess and take responsibility for the company's effects on environmental and social wellbeing. Today, CSR widely involve short term projects that enhances the company's image in the geography it is working in. CSR was in fact created to show the kinder side of business organizations. But in todays world of social media and intense scrutiny for environmental sustainability, business organizations are progressively aligning their own business to be actually in sync with many of the objectives of the CSR itself - which is also seen as an attractive tool to increase profitability by building stronger consumer base. The phrase Corporate Social Responsibility also tends to encompass commitment by businesses to behave ethically and honestly by integrating social, environmental, and economic concerns into their values, culture, decision-making, strategy and operations in a transparent and accountable manner and thereby establish
better practices within the firm, create wealth, and improve society. American and British fortune 500 companies are spending over $15 billion a year on their CSR work [49] in an attempt to protect the environment and promote diversity. There are three approaches used to evaluate CSRs- Auditing, Facilitating and Consulting. Auditing includes conducting quality assessments based on frameworks (like International Organization for Standardization) across typical CSR elements which include: Governance, Community investment, Environment, Ethics, Health, safety, and security, Transparency and Working conditions and human rights. These are evaluated for stakeholders including suppliers, vendors, shareholders, customers etc. Audits for internal controls, assurance audits for public disclosure of CSR approach and results and third party audits give an overall opinion of the CSR controls that are developed. Internal audit activities as an ongoing measure facilitate risk assessment and CSR control improvements. External consultants are often used for project design and implementation of CSR activities.

Peter Utting, former deputy director of UNRISD put forward a discussion which questions that actual Impact of CSR initiatives with regard to social inclusion and equality. He states that,

"While the primary responsibility for promoting equality belongs to state and multilateral institutions, the CSR agenda, with is emphasis on such aspects as improvements in working conditions, community support, labour and human rights, and stakeholder participation, clearly has implications for equality and equity. Four central components of equality are considered: social protection, rights, empowerment and redistribution. It is argued that the contribution of CSR in relation to these different elements varies considerably. Most CSR initiatives focus on social (and environmental) protection. Belatedly CSR discourse has embraced issues of labour and other human rights but CSR practice associated with the realization of rights lags well behind. Other dimensions of equality related to empowerment and redistribution remain relatively marginal in the CSR agenda." [49a]
If CSR is to work on crucial aspects of equality like empowerment and redistribution, the structure of CSR itself needs to be examined. Due to its structures, company CSRs are short term by nature, all expenditure, deliverables and outputs are designed on a quarterly and yearly basis, with no imperative to long term change or regulation. Some examples of CSR initiative impacting long term change includes, Britannia in India, where in they introduced iron biscuits to help malnutrition in India as a CSR activity, but the cascading impact of iron in biscuits over time led towards a complete shift in the brand perception and market of Britannia. By its major business shifting towards distribution of nutritional foods in rural India. Similarly, iodine was introduced in salt by TATA initially as a CSR initiative before “iodine salt” becoming business as usual. When change occurs, themes and initiatives becomes part of daily life without necessarily needing CSR support in the long term. With this regard, CSRs could work on customizing their own products or services into need-based models or reaching customers that they weren’t able to due to their actual business propositions. By catering to people and taking up initiatives which they could not cater to/ take up in the first place, CSR initiatives can become a regular line of business for the company while aligning the CSR (soft money) towards building ecosystem for communities to be able to access multiple opportunities and services more sustainably.

Both, Utting and the above proposition for CSR does not in any way aim to shift existing CSR focuses from social, environmental protection or from emergency funds, but instead outlines the need to expand CSR mandates by developing buckets (areas of work/ type of communities - low income, very poor and vulnerable populations) of funding that can lead towards improving the ecosystem, basic rights and eventual redistribution.

As noble as the intention of CSR, today the evaluation often allows for companies to display their “goodness” in the form of a popularity contest. World leaders in Corporate Social Responsibility, Volkswagen ranked number 11th best in the world for its CSR work, BP with large green credentials to its CSR list and
Enron with host of CSR awards ended up with extreme corporate and environmental wrong doing, bankruptcy and fraud [50]. Companies that boast of large external cross boundary CSR programs under CSR evaluation should not be able to let their own internal standards slide, else, Corporate Social Responsibility will become a smokescreen tactic for self promotion.

3.7 Social enterprise and B Corporation (B Corp) Evaluation

A social enterprise is an organization that applies commercial strategies to maximize improvements in human and environmental well-being—this may include maximizing social impact alongside profits for external shareholders. Social enterprises can be structured as a for-profit or non-profit, and may take the form (depending in which country the entity exists and the legal forms available) of a co-operative, mutual organization, a disregarded entity, a social business, a benefit corporation, a community interest company or a charity organization. They can also take more conventional structures. What differentiates social enterprises is that their social mission is as core to their success as any potential profit [51]. B Corp is to business what Fair Trade certification is to coffee or USDA Organic certification is to milk. B Corps are for-profit companies certified by a non-profit called B Lab to meet rigorous standards of social and environmental performance, accountability, and transparency. A Benefit Cooperation, different from a B-Corp (similar transparency and accountability requirements to B-Corp but different performance, registration and reporting formats) is a legal entity classification for a for-profit enterprise, discussed further in section 6.9. B-corp (or B-Lab) online assessment, covers the company’s entire operation and measures the positive impact of the company in areas of governance, workers, community, the environment, as well as the product or service the company provides. Socially and environmentally-focused business model points ultimately are accrued in their relevant impact area (governance, workers, community or environment). Depending on a company’s industry, geographic location, and number of employees, the online assessment adjusts the weightings of the question categories to increase its relevancy. For instance, companies with more employees will have a heavier weighting
in the workers category, and companies in manufacturing will have a heavier weighting in the environment category. B-corp assessment goes through three different phases, step 1 Assess - this phase walks the company through a series of questions to help you learn what it takes to build a better business for your workers, community and environment, Step 2- Compares your answers to thousands of other businesses and see where you stack up, this gives you a simple feedback report on where you can improve within the company or a more holistic look on how your company scores with other companies. And step 3- creates a customized improvement plan for your business and provides guide to help implement it. Some good examples of B-Corporations are Etsy, Patagonia, Ben and Jerrys.

However, B corporations are severely criticized for their ownership model as the governance of B-Lab itself isn't independent and inclusive. Professor Rae Andre’ of the Northeastern University College of Business, in her research paper entitled “Assessing the Accountability of the Benefit Corporation: Will This New Gray Sector Organization Enhance Corporate Social Responsibility?” [52], concludes that:

“...the emergence of the b corporation demonstrates how some companies are determined to control the process by which businesses are held accountable, making them accountable to each other rather than to society. The research suggests that benefit corporations follow accountability practices that serve particular private interests, and because of this, the probability that they will be responsive to the citizenry as a whole, to society, is low.”[53]

Both B corporation and Benefit Corporation are extremely similar the major difference being in the reporting format, the registration and the filing body: B corporation is a private entity as opposed to Benefit Corporation which is in built into state legislation, available for corporations in about 30 U.S states and has a self-reporting performance requirement.
Marjorie Kelly in Owning Our Future mentions that although B corporations and Benefit Corporations are a vital step, they solve only part of the problem (for example they only constitute the floor or a wall, when the whole room is what is needed). Her sense is that B Lab will need to evolve over time towards a stronger social architecture requirement and evaluation of ownership model. However, the true test of B corps or Benefit corps will be tested over time once the founder or owner loses control, goes public or the management changes. The real test lies in whether the vision of these companies is engrained in the ownership design of the businesses.

Social Enterprise Evaluations are however are tuned to towards five verticals: Impact Model, Operational Model, Marketing and Sales, Management and Team, Financial Management and Growth Plan. The Sustainability levels and thought process for these however differ from one investor/tool to another or from one country to another (further explored in section 5).

3.8 Attributional and consequential LCA

Attributional Life Cycle Analysis (also called Product LCA, see section 3.2) as discussed, describes environmentally relevant physical flows to and from a product or a process which includes full life cycle, uses standardized and average data points and allocates emissions to co-products based on economic value, energy content or mass. Whereas consequential LCA describes how relevant environmental flows will change in response to possible decisions, which includes processes that are affected, uses data that reflects expected effects of changes and uses system expansion as opposed to proportionate allocation to quantify the effect of co-products on emissions. While Attributional assessment does not include indirect effects in the life cycle analysis, consequential assessment includes all indirect effects (or consequences) such as interactions with existing policies, impact of R&D on the efficiency of other sectors or industry process or products, changes in consumer demand, impact on state/local level economic activity, overall contribution to knowledge and values etc. For example, an electricity efficiency CLCA will define the scope and goal towards analyzing larger

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consequences of price reduction (shifts in demand), money savings (impact on economic activity) and shift in value systems (changes in knowledge). The major differences between attributional and consequential LCA is in the definition of the system boundary (while outlining the goal and scope), the complexity level (due to concepts like elasticity of supply and demand, dynamic models etc) the type of data referenced and time spans and models used in the assessment. CLCA results are dependent on descriptions of economic relationships embedded in models which generally attempt to reflect economic relationships by extrapolating historical trends in prices, consumption and outputs. Moreover, CLCA is an more appropriate method to quantify total change in emissions which result from a change in the levels of outputs of products or process. The difference in the application of ALCA and CLCA was illustrated by Searchinger et al (2008). Searchinger et al found that on the basis of a conventional ALCA US corn-based ethanol gave a 20% emissions saving compared to gasoline. However, on the basis of a CLCA of the increase in output demanded by the US Energy Independence and Security Act, they predicted a 47% increase in emissions compared to gasoline. The expected increase in GHG emissions was attributed to land use changes induced by higher prices of corn, soybeans and other grains, predicted as a consequence of the additional demand for corn starch for ethanol production [54].

As consequential LCA accounts for both direct and indirect effects it has greater relevance to policy makers and is used more commonly “unconventional” products like power plants, large infrastructure and built environment etc.

However as opposed to describing only systems that are subjective to geographic boundaries, allocations etc because CLCA describes consequences it brings with it different levels of uncertainty and instability. Efforts towards improving terminology, generating relevant information, increasing efficiency and quality of communication, ranking methodologies, increasing awareness etc are all recommendations proposed as next steps for CLCA by Ecometria press, technical paper on Consequential and Attributional approaches to LCA and Attributional and Consequential LCI modeling by
3.9 Analysis and Summarizing Methods

As discussed in the sections above, there are many competing methodologies and tools available for measuring sustainability and impacts of products, services and businesses. Before embarking on a simplified effort or a potentially time-consuming and expensive method, it is critical to know the question(s) and problem(s) that the analysis is aiming to solve. For impact assessment to move to a comprehensive concept of sustainability encompassing socio-economic dimensions (which can be argued to be intrinsically linked to environmental issues) there are two types of shifts needed- shift towards including all aspects of sustainability (Environmental + Social + Financial) and shift towards moving assessments towards a handprint mode (i.e more towards what can positively be done to bridge gaps as opposed to measuring the negative) (refer to fig 1).

<table>
<thead>
<tr>
<th>Sec. Ref.</th>
<th>Abbreviation</th>
<th>Type of Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>Product LCA</td>
<td>Life Cycle Analysis of Products</td>
</tr>
<tr>
<td>3.2.1</td>
<td>LCC</td>
<td>Life Cycle Costing</td>
</tr>
<tr>
<td>3.3</td>
<td>EIO LCA</td>
<td>Economic Input Output Life Cycle Analysis</td>
</tr>
<tr>
<td>3.4</td>
<td>LCA for Services</td>
<td>Life Cycle Analysis of Services</td>
</tr>
<tr>
<td>3.5</td>
<td>GSCM</td>
<td>Greening Supply Chain Management</td>
</tr>
<tr>
<td>3.6</td>
<td>Social LCA</td>
<td>Social Life Cycle Analysis</td>
</tr>
<tr>
<td>3.6.1</td>
<td>SIA &amp; SROI</td>
<td>Social Impact Assessment and Social Return of Investment</td>
</tr>
<tr>
<td>3.6.2</td>
<td>CSR</td>
<td>Corporate Social Responsibility Evaluation</td>
</tr>
<tr>
<td>3.7</td>
<td>SEE &amp; B Corp</td>
<td>Social enterprises and B Corporation Evaluation</td>
</tr>
<tr>
<td>3.8</td>
<td>CLCA</td>
<td>Consequential Life Cycle Analysis</td>
</tr>
</tbody>
</table>

Tab.2: Key for list of methods with section reference, and abbreviation term.
Categorizing any method into environmental, social and financial dimensions does not give a sense of the qualitative, quantitative character as well the functionality or ideal use case for different purposes. Further splitting each of them into three levels, level 1-one star, basic, simple, immediate, direct type of simple assessment, level 2- which takes into account more detailed scope and end to end analysis and level 3- which goes beyond analysis into qualitative, long term, consequential and indirect evaluations or assessments. Each of the three environmental, social and financial are broken down into three levels (refer to fig 2 below) and then correspondingly plotted in the table across environmental, social and financial. This gives better insight into the level of depth and width and potential use cases for the methodologies.

Many of the methods cover different aspects of social, economic and environmental sustainability with varies degrees (refer fig 2). As defined the degrees vary from one to three, there are two critical parts that are not covered level three, one in the social part
### Fig 2: Table and key displaying extent and limitations of existing methodologies for social, environmental and financial parameters

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Environmental</th>
<th>Social</th>
<th>Financial</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCA - Products</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSCM</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>LCC</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>EIO LCA</td>
<td>**</td>
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<td></td>
</tr>
<tr>
<td>LCA - Services</td>
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<td></td>
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<tr>
<td>SIA</td>
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<tr>
<td>SROI</td>
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<td>**</td>
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<tr>
<td>SLCA</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CLCA</td>
<td>***</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>B corp asm</td>
<td>*</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>SEE</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>CSR</td>
<td>*</td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

- **: Considers basic environmental parameters
- *: Considers basic financial analysis of products and services
- ***: Considers building ecosystems, equity and inclusivity as part of product, service and exit strategies and longterm business sustainability
and the other in the financial part. In the social part, none of the methods explicitly touch upon inclusivity and social empathy. In the financial vertical, the reviewed models do not consider expected returns, exit strategies, long term viability of the business etc. Furthermore, referring to the five parts that make up the value chain of an enterprise: Type of Products sold/serviced by the enterprise, Type of target segment and motivation, Type of service or delivery model, Type of Capital in the Organization and Type of Organizational Structure and HR, none of the models cover all the five parts (refer tab 3.)

<table>
<thead>
<tr>
<th>Products sold and services provided</th>
<th>Type of target segment and motivation</th>
<th>Type of service or delivery model</th>
<th>Type of Capital in the organization</th>
<th>Organizational Structure and HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCA - Products</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>LCC</td>
<td></td>
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</tr>
<tr>
<td>EIO LCA</td>
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</tr>
<tr>
<td>LCA - Services</td>
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<td>GSCM</td>
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<td>SLCA</td>
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<td>CLCA</td>
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<td>B corp asm</td>
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<td>CSR</td>
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</tbody>
</table>

Tab 3: Methods covering prime verticals that make up the complete value chain for an enterprise. (Refer to Tab 2 for Key)
4. GUIDELINES FOR HOLISTIC VALUE CHAIN ASSESSMENT

The 21st century has brought considerable changes to many of world’s economies and businesses. Considerable attention is being paid to the performance of stock markets, quarterly results, increased middle class incomes and rising consumerism. These are all regarded as signs of economic growth of a nation.

The growth has been followed by an increasing divide between the haves and the have-nots: a divide that is socially, economically and environmentally unsustainable for populations in the developed and developing parts the world. The overall effect is that the existing disparities are leading to turmoil, some justified others not, termed by both businesses and governments as “anti-development”. In today’s world, a truly financially sustainable business must be able to balance social and environmental sustainability. Needless to say, the greatest threat to the world today is poverty. The social sustainability that one speaks of—the basic eco-system fabric required for all businesses to flourish— is threatened by the very existence of poverty.

Businesses around the world need to look at social sustainability in a long-term and holistic manner. Amidst rising income inequality, corporations need to realize that social responsibility is essentially an insurance against social instability. Occupy Wall Street, the protests in Spain and Greece, the London Riots are some classic examples to take cognizance of and learn from. They were not one-off events. Each of them has a deeper connection to social “un-sustainability” that has crept in over decades of poor prioritization by businesses and governments in their respective countries. Profit maximization and financial sustainability are two completely different things but in the business world, they have been merged together.

There is a strong belief that existing market forces and market capital will provide the solutions. One always hears from the business world—“to increase the value for shareholders”. This is a very lopsided statement. Businesses should work towards
"increasing the value for all stakeholders”, that include end-users, employees, management and shareholders. To ensure long-term sustainability of the business and loyalty amongst users, eco-system required by the market-financing, technology, skilled human resources- must be adequately developed. The end-users' satisfaction with the value of the service provided is also equally important in ensuring this loyalty. Only if the employees and management are described qualitatively rather than purely on financial results, can one expect loyalty from them. The end result is a creation of a sustainable organization that focuses on long-term sustainability and not purely on quarterly results.

The street vendors of a country, small farmers in the seventies and eighties, Mahatma Gandhi's model of business sustainability in a decentralized manner have all conveyed modern businesses a message – society can be served in sustainable manner – without charity and in a market based fashion. Myopic attention to IRRs, incentives purely based on numbers and the neglect of social and environment sustainability are ingredients of financial disaster. In the 21st century many of the countries in the developing world can show leadership by creating market-based solutions that strive on sustainability and ethics.

Countries in the developing world have two agendas at hand. One is to make sure the economy of the country is moving forward and the second one is to eradicate poverty. Both can go hand in hand, provided the stakeholders like the government policy makers and the businesses are inclusive in their approach. The concept of inclusiveness is complex and could range from human resources perspective to design of technology and financial products.

The ecosystem required for enterprises to be socially, financially and environment sustainably consists of some critical parts.

a Enabling Policy Environment
b Mature end-user and enterprise financing mechanisms
c Skilled human resources
d Technology and related supply chains
e Environment to innovate and experiment

Each of the above has its own mature sub eco-system that require time and resources to be built. In numerous cases, enterprises catering to the underserved in the world are responsible for building the eco-system too: that requires financial and human resources. That is precise the reason why many of the enterprises in the social space cannot afford to offer the financial returns as delivered by traditional enterprises. One needs to understand that many of the traditional enterprises have been built on the basis of subsidies and incentives that were first put into build the eco-system for that particular sector: thus it is unfair to compare as the timelines and challenges are completely different. Product Life cycle Analysis and other evaluation techniques cater to small and specific parts of the sustainability. Sustainability which includes inclusivity for any impact driven business needs to be measured keeping in mins that that the ecosystem (refer to fig 3) gets built and thrives in developing countries.

Fig 3: Parts of the ecosystem that need to be developed for all types of enterprises/ products catering to under-served populations in developing countries.
4.1 Social Enterprise Structure

Social enterprises need to be carefully structured to solve the challenges they were started for. The financial needs for the enterprise is going to be different at different stages of its development. The basic blend of capital that exists today are grants, debt and equity. One can go further into types of debt and equity, which is beyond the scope of this thesis.

Grants: The territory of the social enterprise is mostly uncharted and grant monies are required to build the processes, create and implement new innovations in technology and finance, training and building human resources etc. The outputs of the grants would mostly benefit the new sector at large.

Equity: As in any sector that has angel investors, the social sector also needs to have one but with a larger risk appetite and lower financial expectations. Equity helps the enterprise to build its foundation, fuel its growth and stabilize the human resource without the pressures that normally comes with debt.

Debt: Affordable debt is needed for growth once the organization is able to show positive operational cash flows.

The founders and management of social enterprises have to carefully evaluate the needs to type of capital, expenditure for that capital and timings. Capital management if not done properly can jeopardize the existence of the company in many ways. For example, if grants are used to subsidize the capital goods and services rather than being used for building a missing part of a eco-system it could lead to financial unsustainability in the medium terms. Young enterprises also make the mistake using debt or equity for innovations that might not have immediate financial returns thus putting enormous pressure on the cash flows.
Thus as the sector of social enterprise has grown typically they could be placed in two large buckets:

1. Simple Social Enterprise with lower than market returns and owned by like minded impact investors who believe in social impacts as their primary goals.
2. Hybrid Enterprise that is a combination of a social enterprises and a foundation. The foundation takes the responsibility of building the eco-system while the enterprise part focusses on the delivering the services.

Both the above structures are not exclusive and various other forms also exist - and the sector would continue to innovate as many of the eco-system mature.

4.2 Importance of Measurement

The ever changing structures along with the complexity of eco-system makes it harder to measure the true sustainability of social enterprises [55]. In some cases short term environmental sustainability is sacrificed for the longer term goals of social sustainability and vice-versa in other cases.

Stages and corresponding metrics have to be defined accordingly for all stakeholders, investors and the company, to evaluate their respective contributions and desired impact that is beneficial to the society and the environment at large.

Rapidly changing environmental conditions, increasing social disruptions, instability of well established social norms are some of the factors that will push the governments, policy makers, investors, enterprises and other responsible stakeholders to act fast: forcing the need to have evaluation that leads to a fair and equitable society. For a holistic Value Chain Assessment tangible and intangible metrics need to be measured across five verticals:
a. **Type of Products sold/serviced by the enterprise:** The assessment should look for the complete process from extraction to recycling.

b. **Type of target segment and motivation:** The evaluation should consider the selection of client base and creating the product/value, reason for providing the services to the clients and type of continued relationship with them.

c. **Type of service or delivery model:** Selling to a poor end-user with a product/service can be done in many ways. The traditional way is to look in isolation without paying attention to the way a product is sold or how it would impact the life of the end-user. A product that could, in some manner, affect the client in a negative manner might impact the overall sustainability of the enterprise and the eco-system around it.

d. **Type of Capital in the Organization:** The IRR, pricing structures, investor exit options, management financial expectations all determine the focus and priorities of the organization. The social spirit of the organization will be determined with the financial expectations and the logic behind those outlooks. Lopsided financial expectation surely can impact the social sustainability or even some of the ones mentioned in (a), (b) or (c).

e. **Type of Organizational Structure and HR:** The thought process and the future progress of the organization, in a sustainable manner, depends on the organization structure, type of partnerships it gets into, salary structures/ratio, inclusivity, and how innovation is encouraged and implemented.

Each of the verticals can have two sub parts and further attributes as shown in tab 4 below:

<table>
<thead>
<tr>
<th>Types of Products Sold of Serviced by the enterprise</th>
<th>Design (quality, functionality, durability, use centric)</th>
<th>Environmental Impact (LCA, greening supply chains)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Target Segment and motivation</strong></td>
<td>Selection and understanding of client base</td>
<td>Value and motivations (value creation, relationships, societal impact etc)</td>
</tr>
<tr>
<td><strong>Type of Service of Delivery model</strong></td>
<td>Distribution model (pricing, financing, servicing)</td>
<td>Partnerships</td>
</tr>
</tbody>
</table>

55
Tab 4: Areas of measurement to develop guidelines for holistic Value Chain Assessment

### 4.3 Type of Target Segment and motivation

<table>
<thead>
<tr>
<th>Type of Target Segment and motivation</th>
<th>Selection and understanding of client base</th>
<th>Value and motivations (value creation, relationships, societal impact etc.)</th>
</tr>
</thead>
</table>

More than 3 billion people [56], mostly in the developing world, lack basic services: thus making them vulnerable and unable to create opportunities for themselves to move up the social and economic ladder. Over the last decade, numerous social enterprises have sprung up across the world [57] to deliver those very essential services in a sustainable manner.

Selecting the target client is one of the critical components of a viable business. Social enterprises tend to target the populations with marginal financial resources: and that is where the challenges arise. From a poor person's point of view, whether in the developed or in developing world, as in many cases the decisions are made on behalf of the poor, without actually making them partners in the whole process. The needs of the poor have been assumed and appropriate products or services have been designed from a top to bottom approach. The poor-centric or embedded approach is absent when it comes to designing or creating anything that serves the economically downtrodden. To create long term value and truly sustainable impact the approach might have to be different and more inclusive.
Today numerous social enterprise have shown potential solutions to solve the numerous problems of the poor – with the sole objective of providing equity (energy, social etc.) status to the poor thus enabling a level playing field for them to rise up the social and economic ladder. The poor need to be looked as partners, innovators, inventors, enterprise owners etc. a truly inclusive world. Creating partnerships with the poorer segments leads to enormous value creation.

Creating and enabling the poor to own assets is the true value creation. The non-expendable incomes of the poor, make it imperative for the enterprises to create services and products that leads to creation of assets for them: assets that can provide economic and social stability for the poor thus negating the threats of potential vulnerability in the future. Enabling an eco-system that inspires the poor to become owners and entrepreneurs, and that too in a decentralized manner makes the community, nation and the world a much less vulnerable to social volatility. Such an approach also helps in bridging the ever-growing divide between the rich and the poor.

4.4 Types of Products Sold and Serviced by the enterprise

<table>
<thead>
<tr>
<th>Types of Products Sold and Serviced by the enterprise</th>
<th>Design (quality, functionality, durability, use centric)</th>
<th>Environmental Impact (LCA, greening supply chains)</th>
</tr>
</thead>
</table>

As repeatedly mentioned the poor in the world because of their economic status and vulnerability lack access to many basic services like electricity; cooking fuels, clean water etc. Numerous social enterprises are trying to fill that gap and aspire to service the needs of the financially backward sections of the society in a economically and socially sustainable manner. Typically the products define companies: from value the products provide to design and ascetics. But, similar yardsticks cannot be used while designing services or products for the poor. Some of the similarities and differences could be brought out in the following manner:
4.4.1 Value

People compare products with similar end-use with the various features the chosen one has compared to others. For example, like comparing various types of agricultural machines or solar systems or even modes of transportation. The value can range from functionality (smart phones) to comfort/luxury levels (cars). The perception would vary from user to user depending on cultures, geographies, needs etc.

In the case of products that are created for the poor, they have to have a high value proposition as they, the underserved, are spending mostly their non-expendable incomes. The value, of the product, cannot be consumptive as then from a holistic perspective it is not financially sustainable and would keep economic gap between the rich and the poor ever growing. Thus it is critical for companies, designers etc. to focus deeper into the needs of the populations that are presently not served by formal markets and with immature eco-systems.

4.4.2 Pricing

For most products, pricing does matter for the end-user: except in very high-end luxury goods where the brand value and exclusivity takes a priority. Customers compare the prices of products among the competitive companies to arrive at a decision. Typically, the client tries to balance between the cost of the product and the corresponding end value it provides. For example buying a cheaper television set while letting go some features like the Internet connection etc.

While defining pricing strategies for the poor the way affordability is defined needs to be different. Many a time, affordability for the poor is related to the existing earnings or cash. The downside of evaluating is such a manner is that it entices product companies to produce ‘cheap’ products for the ‘bottom of the pyramid’ market. Cheap products either reduce the actual end-value or in many
cases do not last long – thus pushing the poor to be never ending consumers as opposed to asset owners.

4.4.3 Aesthetics

As the world is becoming more conscious about quality and design – aesthetics (also related to acceptability and aspirational value) have become extremely critical. One of the key drivers for a company like apple has been the design of its products: while balancing the obsolescence factor.

But when it comes to focusing on the poor, aesthetics is never given much attention while designing products for that segment. The interventions focus on marginal increase of quality of life from present conditions. Approach to create the products and value will have to be inclusive. Poor are very much part of society one that is culturally different across the geographies of the world – thus any intervention to that slice of the economic strata needs to be done in a partnership model: a sure mantra for social inclusivity.

4.4.4 Functionality

The decision to buy a product also depends on the ease to use it. Product designers focus on users across age groups, geographies and cultures to make the product desirable. The challenge of desirability and feasibility are further compounded in rural areas of the developing world – for example how should an ATM be designed for rural farmers where secrecy of passwords is practically non-existent.

Today many products are designed for the poor with an assumption of a preset eco-system: An eco-system that focuses on the rich or middle class and one that has taken years to build. Products are then tailor-made to meet the needs of the poor. The design approach for the poor needs to be done from a bottom to top
approach. Utilization or need of a product will depend on existing awareness levels, culture and backgrounds, stability etc. For example lack of formal education might prevent a person for using a smart phone but simple speech recognition can help overcome that barrier. Aesthetics, functionality etc. are segments that make organizations to become more inclusive in their thought process.

4.4.5 Product Durability

Lifetime of a particular product is critical in many cases like water pump for a farmer or machinery in a factory. For products in fast moving consumer goods (FMCG) sector the product needs to be designed for a short lifetime – for example cell phones. Rapid change in technology makes an existing product outdated. Repeated replacement of products also begs the question of sustainability – which will be dealt later in the thesis.

For the poor product reliability and long lasting features are critical. Products with short life spans could be socially, financially and environmentally unsustainable. For example, the perceived lack of financial resources for buying more expensive solar home lighting systems has led to some companies selling small solar lights or lanterns. Small lights or lanterns have shorter life spans, especially the batteries. Poor recycling outlets have led to disposable of batteries into the local eco-system: thus the need for products to last longer and use of local/natural materials for easier recyclability.

As the world’s get more aware of the basic problems of the developing world and encourages for solutions more products and services will be implemented which will be used/consumed by millions who were previously not part of any formal ‘markets’ before. This would mean mining of more natural resources, increased utilization of precious resources like water, potential conflict with other sectors like agriculture etc. Thus the ‘future’ products will have to look at holistic sustainability. Right from choice of raw
materials, transportation methods, utilization and inclusivity of labor, recycling techniques etc. are some of the criterion that will have to be evaluated while producing a product.

### 4.5 Type of Delivery Model

<table>
<thead>
<tr>
<th>Type of Delivery model</th>
<th>Distribution model (pricing, financing, servicing)</th>
<th>Partnerships</th>
</tr>
</thead>
</table>

To create and run a business model, which caters to the financially sensitive populations of the world with much needed basic services like electricity or clean water, has to be innovative and different from typical retail businesses. As mentioned in the previous section, selling of a service or product here is mostly based out of trust and value. The client explicitly needs the service to either enhance the quality of life or increase the base income. The financial outflow for the client, who lives on meager earnings, is comparatively substantial and perceived risk is very high: the fear that the service might not serve the purpose it is intended thus pushing them further down the economic ladder.

In a normal retail sale, most of the time, the floor sales person is lower in the economic ladder than the buyer, e.g., in the case of TV sale transaction: the financial line is upward. In the case of social businesses, the financial line is downward: meaning that the buyer is lower in the economic ladder than the sales person. Analogies for such transactions, in the more mature businesses, are those of lawyers and doctors. In both cases the services and the provider are chosen on the basis of trust. Customization and personalized service leads to deeper loyalty by the clients: the same approach needs to be taken while building up a business model for serving the poor.

As mentioned earlier in the document that the poor are not a monolithic segment. There are multiple layers of poverty and related income streams: that vary from daily wage to yearly earners. The needs and financial outflow would vary and thus the technical and financial products would be different. As delivery mechanisms would vary according to
segments, cultures and geographies — typical models like franchise mechanisms have still not been able to establish in this segment of the pyramid. Successful enterprises like SEWA Bank [61] or Arvind Eye Care [62] have both proven that eco-systems to develop an enterprise in a certain geography has to be customized and simple prototyping of models in a different region might not work and thus they have been confined to their geographies for decades. On the other hand, these models have proven that many of the process they have developed can be tweaked to suit different cultures and geographies: scaling via the concept of replication being the mantra of success.

The social sector has seen numerous business models, but the ones that are ground up with concepts that are rooted in the very core of the targeted segment have succeeded: pricing being one of them. Pricing depends on many factors and not just cost of the product plus desired profit margins: it depends on the cash flows of the client, potential financial products being available at the door-step, conceivable number of after sales service required etc. Only when the value generated should be shared in a fair manner between the client and the seller will then the divide between various economic sections of the society can be decreased. Business models in the social space will define social sustainability by pushing for fair profit margins, equal status to all stakeholders, horizontal management structures and democratization of wealth.

4.6 Type of Capital

<table>
<thead>
<tr>
<th>Type of Capital</th>
<th>Capital Structure (IRR, pricing structure, interest rates)</th>
<th>Ownership Structure (percentage, SHA and exit strategies)</th>
</tr>
</thead>
</table>

Social enterprises targeting the poorer segments of the society are defined by rules other than ones that govern a traditional businesses. Lack of mature eco-systems, varying profit margins, distinct management motivations, longer gestation periods for implementation etc. are some of the nuances that define the social sector — thus the
financial instruments or measurements cannot be the same. Focus and the growth of any social enterprise depends heavily on the type of capital it takes and the expectations of the investors/founders also chart the course for them.

Present Challenges and Mitigations with Capital Structures in the Social Sector in the developing world:

1. **Periods of turnaround**: Many investors' expectation turn around (profits) in less than 3-4 years. This is possible only if ecosystem is matured. [58]
   
   The gestation periods have to be longer and in line with the segment eco-system.

2. **Short-term Exits**: Most social enterprises are driven in the initial years by their founders and in most cases the founders are the active fundraisers and thus it becomes a costly proposition even from the perspective of intellectual time taken away from growing the business. The added complication is that investors look to exit in less than 5 years.[59]
   
   The field is new and thus exit strategies have to be looked differently: should be done only when the organization is stable and healthy.

3. **Differing views on pace of scale**: Because of the immature ecosystem which includes lack of appropriate human resources, awareness, capacity building, stakeholders etc to leverage on, companies in the social sector in developing countries have low financial returns [60]. Investors to steer the management to think bigger and therefore present a more ambitious growth plan. Projecting a high growth in immature eco-systems can be disastrous, both for the enterprise and most importantly for the end user.
   
   The management teams have to be given the freedom to slowly build the foundation for the company. Growths as seen in the technology field cannot be expected here. The pace of growth will be much slower.

4. **Misleading Internal Rates of Return (IRR)**: As a financial metric, IRR is used by investors to evaluate the desirability of investments or projects. It is essentially an
approach to weigh the magnitude and timing of cash flow returns against the magnitude and timing of cash flow costs.

Typically IRRs will have to be much lower than in other sectors with mature ecosystems. The older social enterprises like SELCO or SEWA Bank produce IRRs in low single digit. [60]

Social enterprises by design cater to the provide service to the marginalized and underserved. To achieve its goal the organization has to be structured to reflect the grassroots approach for it to remain relevant and sustainable in the long run: in other terms it has to be inclusive. Ownership structure and the shareholder agreements (SHA) become critical in determining the inclusive nature of the organization. Many social enterprises are today owned largely by the management/or some external shareholders [60] : a structure that conflicts with the very nature of a social enterprise.

Type of capital (debt, equity), corresponding terms and conditions, SHAs, management structures, management compositions etc. are some that would determine the overall sustainability of the organization: a difficult metric to define but needs to be done.

Marjorie Kelly in her book Owning Our future: Journeys to a Generative Economy, stresses on the design of social architecture and the importance of ownership in the long term sustainability of an enterprise. She refers to alternative ownership models of cooperatives, stakeholder (or employee) owned companies, social enterprises etc. with mission-controlled governance, stakeholder finance, ethical networks and rooted membership as the future of how businesses will be (and need to be) structured in order to benefit all living systems (as opposed to shareholders). She envisions through various case studies similar to the examples provided in section 4.5, ownership structures designed by prioritizing fairness, sustainability and community being much more successful socially, economically and financially.
4.7 Type of Organizational Structure and HR

| Organizational Structure and HR | Management and Board Structure (leadership, gender, inclusivity, independence, accessibility, intellectual Property etc) | Team Structure (team mix/ inclusivity, employee health and well being, salary ratios, innovation/ scope for growth) |

Social enterprises to be socially relevant in the segments they are present have to be structured in a manner that understands the needs of the clients from a grassroots perspective. The client base, the poor, needs to trust the intervention and the organization needs to be sensitive and empathetic: factors that are not part of a regular business strategy. The line between the segment that the implementation team is chosen from and the client base come from has to overlap.

The social composition of the team should be in such a manner that the client base does not feel inferior either in terms of education qualification or class structure in a particular society: a critical component in order for gaining client confidence and loyalty. The internal composition of the team should also reflect the mix of the society: in terms of gender, caste, color and religion.

The teams and the organization have to provide lots of flexibility for innovations and risk: as the sector is still in its formations stage. Importing standardized processes and products from other sectors into this might lead to very unsustainable interventions.

The other factor that needs to be considered for creating the right team is the salary structure. Typically one measures salaries and corresponding ratios within a particular organization but a social enterprise needs to compare the salaries of its employees to the average earnings of the client base. A large difference would mean, mostly, that there would be cultural and understanding divide which may not be healthy for the organization: more studies needs to be done here.
Now coming to the management and board structure. Successful social enterprises have made sure that the management and the board mix truly represent the client base. Take the example of SEWA Bank [61] a financial institution catering to urban poor (mostly women) in the state of Gujarat. Their board structure has an unique blend of clients and professionals and all of them women. They have been financially successful from 1974 by catering to poor women from the un-organized sector. Having a mix like SEWA Bank gives the organization a true understanding of its clients and making its products and processes very customized to the segment it is catering to. While SEWA Bank has set a high benchmark for management and board structures for social enterprises, it surely proven that it is a primary condition to make an institution socially relevant in the long run while being financial sustainable.

It would be interesting to note the progress of patenting laws across the world. While Social Life Cycle Assessment guideline standardize patenting norms and intellectual property’s by justifying them as instruments of stimulating innovations, on the other hand one may argue that it creates another divide between the rich and the poor (because of lack of access to services in informal sectors). The innovations of the rich, once patented has to be accessed using monetary exchange process: thus will the poor be left out of the process completely? Organizations like Cambia [63] are Lens [64] are pushing for open source innovation in an attempt to make it a level playing field and ensuring patents don’t kill innovation and hamper societal growth. Poor are already reeling from the financial and technological divide, adding stricter IP regimes would further widen it.

5. Impact Investing: User Research

The rise of Impact Investment came about due to the common consensus around the world, that philanthropic capital and aid alone cannot solve social issues of poverty and inequality in the desired time frame. Impact Investment sometime also known as “investing with purpose” actively pursues social, economic and environmental positive change. Since the 1960s, government-funded development finance institutions such as
the World Bank's private investment arm the International Finance Corporation (IFC), and U.S. Overseas Private Investment Corporation (OPIC); have engaged in one form of impact investing via private equity and debt investments in the developing economies. These trends actually led to the belief by most impact investors that financial returns need not be compromised to achieve social impact. The primary reason to believe that way is because IFC, after coining the term “emerging markets”, has achieved an annual internal rate of return of 18.3% on its investment funds portfolio between 2000 and 2011 [65]. This, along with the rise of micro-finance institutes (MFI) with its reported high return figures, made impact investors push for rigor of formal market-based models and dynamism of private enterprise (for speed of decision making, attracting superior talent, creating revenue streams etc.) into the social sector. However, IFC metrics for impact investment included large infrastructural projects with established companies in emerging markets, not necessarily catering their products or services specifically for under-served communities.

Some of the above examples encouraged a common understanding, that one does not need to compromise on financial returns to impact social change and there is no tradeoff between the two while solving the fundamental issues of poverty and inequality. Adding to this understanding, was the confidence that market-based approaches and private sector rules would help social enterprises get better returns, scale faster and thus attract larger pools of private capital.

Similar category of investors that prioritize generation of market rate returns along with some measurable, positive impact are referred to as “finance first” impact investors. However, in reality things turn’d out differently, especially in the MFI sector. In the MFI sector more than US$ 1.6 billion was lost in 2010, without even taking into account the costs of pre-investment and building eco-system [13] [68] [69] [70]. These costs are rarely taken into account while pushing for a solution as “scalable”- made practitioners (social enterprises and impact investors) rethink the idea of and approach to blended returns [66].
Investments into small and growing enterprises that are committed to providing solutions to issues in under-developed/lacking communities are ones that come under the radar of impact investments. Social issues could include access to services that can improve livelihoods, education, energy, health, housing etc. While dealing with informal, vulnerable and low income populations as end users, identifying types of capital and the structure of the investments requires more complex and nuanced approaches when compared to private sector market-based approaches. The complexity is largely due to the unstable incomes of end users and the lack of an ecosystem (aspects of technology, enterprise development, end-user financing, policy and human resources: refer to sec 4. Fig 3). The perspective and experience of impact investing firms can provide an understanding of the features and barriers that can help structuring investments for social enterprises. Over the last two decades multiple Impact investment houses have sprung up: E&CO being one of the first in the energy sector.

E&CO (E+Co), born out of the Rockefeller Foundation and the Rio Climate Summit in 1994 mobilized at-least US$ 280 million of new capital and facilitated the offset of 5 million tonnes of carbon by creating an impact investment portfolio for sustainable social enterprises in developing countries before its restructuring in 2012. In their experience, building local, stable and long-term energy access companies requires patient capital at 3-4 percent internal rate of returns. E&Co’s learnings stress the importance of having a portfolio and expectations similar to the Venture Capital space where in few failures, most modest returns and one or two market financial return entities would be expected via impact investors as well, albeit with broader timelines. [65] According to the Miller Center for Social Entrepreneurship (Santa Clara University), in the small and growing business (SGB) and social enterprise sector, this is more about setting achievable expectations than chasing developed market rates of return. They stress the importance of mobilizing capital from sources that have accurately set expectations of return to avoid failures of potential high impact enterprises. [67]

DOEN foundation, a Dutch impact investing organization, through its 20-year experience investing in local sustainability and inclusivity driven enterprises, believes in
sticking to impact first by adjusting expectations based on the social return being achieved by enterprise [71]. The Shell Foundation in its 2014 report on building inclusive energy markets in developing countries mentions the need for innovation across the value chain and the distinct lack of the patient and flexible funding needed to build inclusive markets [72]. As per the Stanford Social Innovation review on “When Can Impact Investing Create Real Impact?": Debra Schwartz, director of program-related investments at the MacArthur Foundation, summarized the kinds of capital benefits that impact investors must provide in terms of five P’s, to which Paul Brest and Kelly Bran added a sixth, Perspicacity:

1. Price. Below-market investments
2. Pledge. Loan guarantees
3. Position. Subordinated debt or equity positions
4. Patience. Longer terms before exit
5. Purpose. Flexibility in adapting capital investments to the enterprise’s needs
6. Perspicacity. Discerning opportunities that ordinary investors don’t see

Impact investments based on these characteristics can enable social enterprises to experiment, scale up and pursue social objectives.[73]

Investments, even in developed economies can be socially responsible (SRI - Socially Responsible Investing [74] ) and “finance first” impact investments, but real impact investing must fill in the gap that is needed in order to balance and actually have significant social, financial and environmental returns.

Thus, on the flip side, true impact investors or “impact first” impact investors, though extremely few and scattered, understand local and cultural challenges in developing countries and the lack of ecosystem development that entrepreneurs deal with e.g.:

a. Weak, unsupportive, changing government policies
b. Un-trained human resources

c. Lack of relevant technology and product supply chains

d. Lack of local end user and enterprise financing

e. Lack of awareness and market linkages

f. Lack of management and business planning skills

g. Lack of appropriate distribution channels

Impact investors need to learn from the failures of private capital, market-driven approaches and be willing to compromise on financial return to achieve true social returns.
Impact investment asset owners (capital providers), impact investment managers, incubators, impact investment knowledge hubs and evaluators are typical types of entities that form the impact investing space (fig 4). Other key stakeholders are social enterprises, end users, policy and advocacy entities and relevant local social, financial and technology players.

5.1 Types of Investments

Sources of impact investments include and not restricted to:

1. Mainstream investors
2. Impact funds
3. Development Finance Institutes
4. Foundations
5. Family Offices
6. Angels
7. Pension and Mutual funds

The above invest in companies at different stages (fig 5, stages and type of investment/type of support required). These sources make debt or equity investments in early and growth stage social enterprises. Selecting the source of fund for the investment defines the level of return and very often the eventual sustainability of the mission and impact. Its often healthier for impact investees (the enterprise receiving the investment) to avoid sources like hedge funds and investment bank funds, which expect between 20-40% return.

Some impact investment firms like Triple Jump [75], Oiko [76] and Grass Root Capital [77] are very explicit about the social and financial return expectations. In case their investee (the enterprise receiving the investment) returns are too high, a red flag is raised internally to re-evaluate the investment, social return. However, most impact investment companies typically look out for the higher return enterprises (who are
defined as the “winners” in a portfolio of investments) and see it as a sign to bring in more private capital into the sector.

For seed stage or early stage social enterprises equity is always preferred and in most cases can become financially sustainable if follow on appropriate growth investments are made, which can be debt or equity. Most impact investors in their shareholder agreements fix exit windows (approximately between 3 and 5 years) and return rates (can range from 18 to 24%). Longer leeway (8 to 10 years timeframe) is required specifically for sustainability driven start-ups in developing countries, in order for the social enterprises to stabilize and scale the level of social impact. Often hybrid funds (appropriate soft capital along with seed/early stage capital) are needed to spur new innovation, research and development and pilot testing requirements for enterprises before establishing an impact driven business model (fig 5).

For enterprises in the growth stage, 3-5 year exits with modest IRRs work well depending the ecosystem and the type of client(s) being catered to (low income, very poor or very vulnerable populations). Appropriate follow up on growth capital, again, given longer time frames, in most cases can also lead to recovery of pre-investment and ecosystem development costs. Impact investments also need to consider equity and benefits across the stakeholders, as social enterprises essentially aim to make profits

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Fig 5: Stages of Sustainability Driven Social Enterprise: Types of Support at different stages.
by serving the poor. An ideal impact investment would expect the similar levels of IRR on the investment to increase in “IRR” of the end user income and wellbeing levels.

Identification of companies and selection criteria for investment often reflects the investor’s commitment towards social impact. Due to difficulty in sourcing right type of “viable” investments that meet both financial and social expectations followed by lack of innovative (hybrid) fund and deal structures it is challenging for impact investors to set an exit strategy.

Typically in the traditional capital markets value or the upside in private equity investments is realized via exits. Exits could be in the form of selling shares to the management or other investors or by going into Initial Public Offerings (IPOs). However in impact investing exist strategy have to be carefully planned. In 2015, Africa had the second highest number of impact investment exits (17 percent) of the 10 geographies surveyed by the GIIN [78]. The only exit via IPO was reported in South Asia, with none in Africa. The majority of exits, in Africa, were via sale to a strategic buyer and most seeking closer to market returns. [79] The challenge of finding profitable and varied exit options stems from the fact that most developing capital markets are still at a relatively early stage of development. Staggered growth, in many developing markets can be seen as a positive way to provide services and employment in the long term; this is purely because of the immature ecosystems in these geographies.

Villgro, an early stage/ seed capital impact investment incubator in India invests in ticket sizes of USD$ 75,000 in the early stages, and follows up with growth capital of USD$ 150,000-300,000. The IRR expectation is based on an over all portfolio expectation is about 24-25%. In an analysis of Villgro’s 110 social enterprises in India, it was found that 20% of enterprises do not survive for long, 40% are in a subsistence mode and about 40% are in the thriving category i.e in the growth stage. Villgro aim’s to exit companies in 3-5 years. The team members of Villgro take board positions; provide operation support (senior advisor works very closely with enterprises, spending as many as 2 days a month). Villgro also offers funds for investees to innovate and conduct
research and development according to their needs. The cost of conducting due diligence per enterprise is approximately USD $10,000-15,000. [80]

5.2 Balancing social and financial sustainability

The idea of mimicking private sector and corporate expectations to ensure efficiency and scale for social impact needs be further analyzed. Broader discussions around the issues that need that solved have to be achieved through these investments. Problems of poverty and inequality are complex and cannot be simplified via financial profitability. Although many of the processes do improve social business from a financial standpoint, there are beyond business approaches that can ensure that social impact metrics being met. Current tool and factors for evaluation of social metrics are a testimony for sticking with good quantitative metrics based on outputs. The reasons being that these are easy to understand by the typical investment community and thus there is no need to define metrics that could be more complex. [81] [further discussed in section 5.3]

Balancing social and financial returns also follow simple processes in order to follow private sector processes and norms. As explained by one of the impact investors [80], “100% of impact times 0 is still 0”: i.e driving an enterprise to the ground because of its struggles with financial sustainability is not always the best approach. Therefore, hybrid models (to serve different segments of end users) can be acceptable to impact investors in order to meet expected returns. One of the approaches could be to serve higher income customers or diversifying with non-impact driven products (while building their capacity to serve impact driven products) until they stabilize financially. Some investors are willing to accept similar hybrid structures, even up to 60-70% [80]. Social impact clauses are pre-defined in shareholder agreements and as long as a company reaches defined type of social impacts, number of end users within a period of time: typically accepted by impact investors. But if the percentage (mix of end user types) or impact levels get beyond comfort levels, investees (the enterprises receiving the investment) are liable to return the investment with predetermined IRRs. For example: A
smart irrigation controller company raised money to cater small holding and marginal farmers. Over a short period of time, the management realized that the farmers could not afford the equipment’s: thus they diversified their segment base by reaching out to richer farmers. The team also in parallel raised research and development funding to develop a low cost affordable version for small holding farmers. Their impact investor encouraged this deviation as long as they would go back to their original mission. This trade off however, poses multiple threats to social returns:

1. Mission and goals for social impact (i.e. the theory of change) has to be built into the underlying structure and practices of the company. It is very challenging to reorient companies to supply to a new target customer base with very different socio-economic backgrounds. The team composition, partnerships, distribution channels etc. have to be completely different.

2. Building profitable businesses with typical ‘green washing’ can be counter productive.

3. Typically companies that compromise on social impact find it difficult to balance and in the process making it challenging to measure the overall financial and social return on the impact investment.

Even if it is still possible to balance social goals and expected financial profitability and achieve the organizations theory of change, it is important to make that explicitly clear so that the investors expect the returns from the diverted business to go into “value creation”. Transparency and shared value between the enterprise and the impact investor is critical internally and externally, so that the expectations of future impact investors are in line while investing in social enterprises.

Key aspect to achieving balance, between financial and social, is not only in the processes of the impact investment firm but also by the composition of its team. Individuals need to have:

a. Passion for social impact

b. Have significant knowledge of the domain
c. Have an understanding of investment and business

The team needs to have broad and multidisciplinary skill sets in order to work efficiently and effectively. A multi-disciplinary impact investment team can leverage the organization's intellectual capital and networks to assist the investees (the enterprise receiving the investment), while also giving the team an informational edge relative to “conventional” investors who do not have the same degree of specialized domain knowledge [82].

In an interview with Tony Sheldon, Executive Director of Yale School of Management's Program On Social Enterprise, he mentions that - “Most investors are unable to compromise on financial returns as many impact investment managers aren't able to break down the argument over 10% versus 40% returns. A few probably can, but maximum numbers of social enterprises and impact fund managers have tried without much success. The industry itself on the financial or social front does not have the levels of transparency needed to achieve a productive balance.”

5.3 Selection criteria and evaluating returns

Financial and social return expectations (quantitative and qualitative) of impact investors directly results in the design of the screening process or selection criteria that portfolio managers use when evaluating social enterprise investment opportunities. The criteria includes:

1. Issue(s) the enterprise is trying to solve:
   • Is it a deeply felt need?
   • Does it bridge gaps and bring about positive change in social, economical or environmental realms?
2. Team mixture, background and motivation: What is the core competency of the team and passion levels?
3. Traction and Achievement: Is it feasible, demonstrated end-user desirability and impact?
4. Evaluating if the solution really for bottom of the pyramid or can really bring about significant environmental change: what are the chances of success?

Impact investors or firms based on their fund size and capacity oversee number of companies. Time and resources spent on due diligence however is similar for investment managers but different for more hands-on incubators. To provide an example of a shortlisting/due diligence process: one of the early stage impact investment firms interviewed gets about 1200 requests out of which, through an online scoring rubric about 800 are automatically rejected. 400 enterprises have some interaction with junior team members in the firm and are filtered though a scoring tool (with 12-13 parameters), about 120 of these with good scores a deeper level of due diligence done with the entrepreneur (along with inputs from the oversight team) and are presented to an internal investment committee. 40 of the chosen enterprises go through a 4-6 week detailed due diligence process where in the oversight team speaks to all the stakeholders. 20-25 of selected enterprises are presented to an external investment committee out of which 15-20 finally funded. Need based support of different types and levels is provided for a minimum of 1 year by the firm.

Impact investors provide information of a very high level of criteria externally, but the exact bench marks selection remain internal. For the most part, maximum number and sizes of investments are made into exclusive, proven, profitable business models which are ready to achieve massive scale.

From a return evaluation stand point, what passes for social impact data is typically very low quality, the true impact of what impact investors are funding isn’t really captured. For example for an education-based enterprise reporting on number of students is common, the next level would be to determine the number of students are from low-income families. Going even deeper, the evaluation should include the level of education improvement in terms of knowledge base, skills etc. Once this data is collected then
social impact per dollar invested is calculated with variables and constants. Constants can be level of health improvement, CO2 displaced, price of alternatives etc. and variables can be number of people, amount of awareness levels etc.

In an interview with P.R Ganapathy, India President of Villgro, he mentions, “Evaluation is a major challenge as far as companies and impact investments are concerned, they are very weak in capturing and reporting impacts. Most enterprises get by, with providing “pretty” pictures and anecdotes. In the next 3-5 years, impact investors will be much more demanding in terms of social return evaluations and data reporting.”

IRIS [84] or GIIRS [85] metrics (an outcome of GIIN, Ande, Acumen, Blab and Rockefeller Foundation) are very similar to Social Life Cycle Analysis (refer to sec. 3.6) efforts, with the aim to standardize the social and environmental impact language. The rise foundation catalogs other methods for impact evaluation [93]. The performance metrics used and accepted, archives and provides impact measures through management databases and processes for various sectors. Most of these are however, are output based impact metrics with very low tolerance to contribute towards measuring the social impact outcome. Out of 100s of metrics only about half a dozen are outcome-based metrics that can give a measure of social impact [81]. This again, is a result of catering to private sector norms, so that everyone can calculate and understand the impacts.

Firms believe that IRIS standards of evaluating impact metrics still have long way to go for them to become universally acceptable as basic financial evaluation techniques. In the initial years of IRIS it started with the aim of becoming acceptable to business and investments but focused mostly on outputs and not outcomes. Their goal was to add in the outcomes once they got mature. However almost 7 years down the line, in-spite of strong advisory group pushing for outcomes based metrics (which has been overruled [81]), IRIS remains an extensive platform of measuring outputs.
Lauren Delucia  
Age: 52  
Relevant Experience: 5 years  
Founder and CEO: Delucia Ventures  
Impact Investment:  
"Unless and until impact investment compares to near market returns, social enterprises cannot be sustainable."

Impact evaluation:  
"While assessment and evaluation is important - scale matters the most - reaching most number of people defines the entire level of impact."

R G Viaykiran  
Age: 48  
Relevant Experience: 8 years  
Senior Manager: Impact Fund Managers  
Impact Investment:  
"Early stage capital is extremely had to raise. Investors needs to build portfolios, instead of investments."

Impact evaluation:  
"In cases where the investors have time and resources to carry out extensive evaluations well and good, else there is very little done on evaluating social return."

Richard Cardif  
Age: 65  
Relevant Experience: 35 years  
Senior Manager: Impact Fund Managers  
Impact Investment:  
"Entrepreneurs are in a desperate situation and will agree to or present higher returns and numbers in order to raise capital."

Impact evaluation:  
"It is critical to analyse, quantify and document social metrics to streamline and improve efficiency and develop a common language - one set of parameters."

Taskeen Hamid  
Age: 35  
Relevant Experience: 7 years  
Founder: Better Life Efficient Stoves  
Impact Investment:  
"It is rare to speak with impact investment managers or consultants with realistic field or operational experience."

Impact evaluation:  
"Evaluation that needs to be documented is expensive and we need funding to do it - also maintaining our mission when cash flows are at a very critical situations. Is very challenging."

Figure 6: User Personas of Impact Investment Stakeholders
Another challenge is the rigor, time and resources required to collect and analyze these data points. Villgro believes that any company with intent to have impact, should be able to internally measure (the outputs specifically) with reasonable degree of accuracy. For example: basic evaluation metrics for a cook-stove company was included in their customer sign up form itself. This was done by added a few more fields such as:

a. How many staff members does the end user hire?
b. How many patrons do they receive etc.?

With very low cost and incremental effort, on an ongoing basis, this allows enterprises to use that data for further investments and grants. Further more, with cloud devices, it is becoming easier and cheaper to capture output data than to engage in expensive and invasive impact assessments methods, with reasonable level of depth and accuracy.

An organizations theory of change can only be evaluated through outcomes. But even foundations and impact investment firms that have that rigor and the money to do extensive evaluations are structured towards outputs.

In the Interview with Tony Sheldon he also mentions that, “while monitoring social impacts- there is a lack of effort when it comes to thought processes. Most impact investors make claims but have no real metrics.” The lack of effort in thought process is also demonstrated while quantifying outputs itself. For example: While preparing metrics, a saving in 3 hours of time for the woman was translated and quantified into her being able to start a business in the 3 hours of extra time. An actual evaluation on analysis showed that in the extra 3 hours women would rest. The question then became how would one quantify the value of those 3 hours of rest. Another example of a cook-stove company evaluating fuel savings by translating them into saving time and expenses without realizing that these weren’t priorities for the end users, as their collection time and activity was used to socialize and the fuel was free. On a call with one of the impact investment manager, two impact investors wanted to split the social impact into half.
The impact investment space however is not going to reassess the metrics and approach unless there are some big failures. Taking the example of the micro finance sector failures and learnings [13] [68] [69] [70], things are now changing, many voices in micro finance are now advocating for deeper understanding of what social impact is and what's appropriate to expect in terms of returns. Social performance task force is one of the examples, in the micro-finance space, advocating the changes needed [85]. However, the approach of holistically evaluating based on goals has been met with resistance by multiple people, especially the segment of stakeholders that believe in scale = success = maximum social impact [further discussed un sec 5.4].

A Dutch based impact investment initiative, DOEN [71], is also an example of a goal oriented impact investor that compromises on financial returns based on the mission and social impact of the organizations they invest in. One of their ways to capture social impact is by qualitatively capturing the highest possible social impact story through the investment. They believe that the social sector needs to becomes sustainable even if the business doesn’t and this is possible by investing into high risk, big impact projects with patient long term capital. By highlighting the most significant change they look at impact investment as a means and not the goal itself. It is interesting to note that DOEN is a foundation who went into impact investing to ensure the self sustainability of their beneficiaries, as opposed to most impact investors who are regular investors that come into impact investing, definitely without the same flexibilities that DOENs investments possess. Most socially focused funds tend to be most transparent, but are also the ones who have the hardest time raising capital. The issue arises mainly due to the market-based return investments claiming high level of social impacts through anecdotal evidence and surface-level output based metrics. With better transparency, it is possible to map types of investment sources to stages and types of enterprise needs. Even without mapping, almost all the impact investment reports outline a gap in early stage, patient/ flexible capital and better evaluation metrics to build inclusive markets [65] [72] [73]. With clean energy enterprises in particular, it is widely accepted in the social investment sector that a blend of catalytic subsidy and tailored finance is needed to build a strong, global energy value chain to serve the energy poor. While investors talk
about single-digit financial returns with robust triple bottom lines and applaud the discipline required in such a model, the pool of interested dollars is too small and attention shifting. The International Energy Agency projects that $756 billion of additional financing, or $36 billion a year, is needed to achieve universal energy access by 2030 [86]. While the need is immense, the current investments in the space are meager—only approximately $10 billion in developing countries. The Pacific venture study asserts that most of what constitutes 4b$ impact investing market expect market IRRs. [65]

5.4 Scope for Holistic Value Chain Assessment guidelines for Impact Investing

In an Interview with Philip LaRocco, Columbia University [87] he opined “Impact Investing is still more a phrase and slogan rather than an actual asset class or sector... it is a watered down successor phrase to "balanced scorecard", "triple bottom line", "People, Planet, Profit"... impact investing will be real when there is agreement that investors will trade off financial return, or take more risk or be patient (or all three) in return for social or environmental benefit.” In the same interview, Philip LaRocco, emphasized on a triangle with the three sides being business, environmental and social. The business side being viewed as “the greedy ones” by the other two, the environmental side was being viewed as “the tree huggers” by the other two and the social side being viewed as “the bleeding hearts”. Unless there is an understanding between the three, actual impact that solves issues though impact investment will be difficult.

At the heart of the debate over different approaches and indicators are not only different disciplinary approaches but also different views of development (similar to the debate on sustainability metrics and indices [88]). Some indicators reflect the ideology of globalization and urbanization while others reflect the ability of cultures to maintain their traditions within their eco-systems. Other approaches focus on the process of evaluating based on the requirements of the impact investor, directing stakeholders towards ensuring mission and outputs alignment, reporting schedules and reporting
parameters and process with investors while structuring the deal [94] [95] [96]. Vinod Khosla, of Khosla Ventures who has put in over 200 investments into climate change for developing countries pushes private and public leaders to support/ underwrite cheaper capital, 3% return rates, that are feasible, predictable and practical via investments in local clean energy enterprises [92]. Jed Emerson, the co-author of the book, Impact Investing: Transforming How We Make Money While Making A Difference, believes that “Mission First. And Last,” holds the key to the much more sophisticated, blended approach to value creation in the 2.0 era of impact investing [91], as it clarifies how successful funds actually behave with regard to the pursuit of their larger goals and objectives.

With all of the above issues surrounding definitions and alignment of impact investment, clean energy social enterprises and impact investors need to differentiate between success and scale. There needs to be success first in order to scale - and the space (time and flexibility), type of resources and transparency required for achieving that success, isn’t being provided to all sustainability driven social enterprises. The industry is clustered around finance first investors, who typically conduct a social screen (through severely lacking metrics) and then send in their standard financial due diligence team to ensure they get those modest to high returns.

The true power of data comes from conveying the “so what” behind the numbers, inspiring people to probe new questions, and using it for rigorous statistical inquiry. Joanna Radeke in the Stanford Sustainability Review writes that, “it’s not easy for companies to conduct impact assessment, and it all boils down to purpose. Traditionally, the primary purpose of the corporate world has been to maximize profits; it’s been up to charities and other social sector organizations to generate social impact. So while the social sector has long debated how best to capture and measure impact, businesses haven’t been part of that discussion.” As a result, only a few impact investors are set up to assess more than the outputs of their investments, and the corporate/ private sector thinking overall, has only limited impact measurement experience to share. That means that even if a business as usual or market driven initiative wants to start measuring
impact at their company, they often end up thinking nobody is doing it, that it can't be
done, or that impact isn't measurable [89]. And in current cases, trends lean towards
converting all impact into exhaustive, quantifiable outputs, so as to bring rigor and
efficiency into impact measurement.

The lack of acknowledgement that the current evaluation metrics aren't really
substantial provides further clues on how holistic value chain assessment needs to be
redesigned in order to be adopted. User profiles (personas) of a typical

a. Impact Investment asset owner,
b. Impact Investment fund manager or incubator and
c. Impact Investment Evaluator, Networker or Knowledge Hub
d. Social Entrepreneur

in figure 6 can provide a direction towards recognizing the barriers and perceptions. The
four personas provide further insight into how holistic value chain assessment needs to be
approached within the impact investment space.

Table 4 translates phrases and comments captured in reports and interviews into
characteristics (or needs) for the design of holistic value chain assessment. (Further
discussed in section 8: Recommendations)

<table>
<thead>
<tr>
<th>Statements captured</th>
<th>Needs to..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metrics need to be internalized at different</td>
<td>be part of day to day thinking and due</td>
</tr>
<tr>
<td>levels</td>
<td>diligence.</td>
</tr>
<tr>
<td>Evaluations are expensive and can only</td>
<td>be open source, accessible and relatively</td>
</tr>
<tr>
<td>be conducted by resources that have the</td>
<td>easier to adopt</td>
</tr>
<tr>
<td>funds, time and flexibility to do it</td>
<td></td>
</tr>
<tr>
<td>Need to be more accurate than just plain</td>
<td>reflect the theory of change of the</td>
</tr>
<tr>
<td>numbers and outputs</td>
<td>enterprise/ sector</td>
</tr>
<tr>
<td>Have to embody the goals of the particular</td>
<td>be sector specific</td>
</tr>
<tr>
<td>organization</td>
<td></td>
</tr>
<tr>
<td>They need to be outcome based (actual</td>
<td>be connected to the overall impact</td>
</tr>
<tr>
<td>impact driven) not output driven</td>
<td></td>
</tr>
</tbody>
</table>
Standardization is not the best way to measure social impact as social impact cuts across areas and sectors. It's too complex and will not be understood by most investors. Cross-sectoral or multidisciplinary teams needed for evaluation. No space for innovation. Not enough transparency. No evidence to show that the product/service provided to the family has actually contributed to removing them from the cycle of poverty. They glorify very short and medium term sales targets and “feel good” stories.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardization is not the best way to measure social impact as social impact cuts across areas and sectors</td>
<td>embody social sustainability across human, economic and environmental boundaries</td>
</tr>
<tr>
<td>Its too complex and will not be understood by most investors</td>
<td>be simplified and inspiring for investment asset owners to adopt</td>
</tr>
<tr>
<td>Cross-sectoral or multidisciplinary teams needed for evaluation</td>
<td>be able to be applied and conducted by individuals from any discipline with little or no knowledge about the sector</td>
</tr>
<tr>
<td>No space for innovation</td>
<td>encourage innovation</td>
</tr>
<tr>
<td>Not enough transparency</td>
<td>encourage and incentivize sharing of failures, shortcomings and learnings</td>
</tr>
<tr>
<td>No evidence to show that the product/service provided to the family has actually contributed to removing them from the cycle of poverty</td>
<td>discourage temporary interventions and demonstrate proof of effectiveness or contribution towards poverty alleviation</td>
</tr>
<tr>
<td>They glorify very short and medium term sales targets and “feel good” stories</td>
<td>lead to concrete long term change</td>
</tr>
</tbody>
</table>

Table 4: Table translating the comments about existing issues in measuring impact/impact investing into needs and characteristics that Holistic Value Chain Assessment needs to be designed for/with.

For impact investments, especially in clean energy in developing countries, the evaluation goal needs to shift from providing services to as many people as possible in the quickest way possible to providing it to as many people as possible in the quickest and in the best way possible: the best way being

- Listening to the challenges
- Adapting solutions
- Designing innovative investment and enterprises structures for long term, goal oriented impact

While the impact investment sector works towards defining and embodying the basic characteristics of impact investing. One critical way impact investors can consider or
adopt holistic value chain assessment guidelines is if they are based on:

a. Outcomes, Goals and Grass-root evidence
b. Replicability
c. Relatively understandable, accessible and adoptable (i.e. needs to be part of the criteria setting)
d. Mission alignment (or open discussions on real impact between investor and investee)
e. Adopted within internal evaluation methodology of enterprises and investment management firms.

It doesn't make economic and social sense to enforce impact investment stakeholders towards more extensive, exclusive and expensive tools as the effectiveness can only be determined by making Holistic Value Chain Assessment "business as usual" (wide spread and by default- part of day to day thinking) for the impact investing community.

When a social enterprise fails one of the primary reason is due to the investor and investment type failing [90]. Although this is rarely recognized, in the social enterprise space given the challenges and context of the issues, investments and evaluations need to be designed accordingly. Most failures are still to come and these are expected by experts primarily in the sustainable energy access space [81].

6. Applying Holistic Value Chain Assessment to Clean Energy Enterprises

In the previous sections 4 and 5, guidelines for social enterprises, the present day eco-system and the corresponding stakeholders that exists for impact investment were discussed and analyzed. This section dwells into the value chain for clean energy enterprises – especially for the underserved populations in the world, by bringing in the various DRE specific nuances that were discussed for enterprises in general in chapters 4 and 5.
Impact investors and local clean energy enterprises have a common goal to alleviate poverty through sustainable energy access. Social, Financial and Environmental sustainability are interconnected and dependent on one another. Having an environmentally positive supply chain while doing harm to human health, having a financial profitable business without positively impacting society or having a highly sustainable technology that is implemented inefficiently are all weaker models of sustainability. Clean and specifically Decentralized Energy Solutions implemented by evaluating sustainability across the product, user segment, delivery mechanisms, business models and organizational structure can yield much greater equitable returns for all stakeholders socially, financially and environmentally.

<table>
<thead>
<tr>
<th>Types of Products Sold of Serviced by the enterprise</th>
<th>Design (quality, functionality, durability, use centric)</th>
<th>Environmental Impact (LCA, greening supply chains)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Target Segment and motivation</td>
<td>Selection and understanding of client base</td>
<td>Value and motivations (value creation, relationships, societal impact etc)</td>
</tr>
<tr>
<td>Type of Service of Delivery model</td>
<td>Distribution model (pricing, financing, servicing)</td>
<td>Partnerships</td>
</tr>
<tr>
<td>Type of Capital</td>
<td>Capital Structure (IRR, pricing structure, interest rates)</td>
<td>Ownership Structure (percentage, SHA and exit strategies)</td>
</tr>
<tr>
<td>Organizational Structure and HR</td>
<td>Management and Board Structure (leadership, gender, inclusivity, independence, accessibility, intellectual Property etc)</td>
<td>Team Structure (team mix/ inclusivity, employee health and well being, salary ratios, innovation/ scope for growth)</td>
</tr>
</tbody>
</table>

Section 4 discusses guidelines for the above parameters and is a prelude for overarching evaluations across any sector. This section delves deeper into designing an assessment specifically for local decentralized clean energy enterprises.

6.1 The Need: Lack of Energy Access

The light bulb was invented in 1802 [98], more than 200 years ago and with numerous other progress happening in the overall energy sector more than 1.5 billion people still do not have access to electricity and many more to cooking fuels. Instead these
households use very expensive and low quality sources of energy such as batteries, kerosene or diesel for basic needs such as operating radios, lighting their homes or running their businesses. Today more than 1.2 billion people in the world have not yet being served with electricity [99].

As the world makes breakthrough advances in telecommunications, internet etc. the energy and development sector is faced with finding solutions to the vast energy divide that still exists between urban and rural areas in developing countries. One option is to further extend the electrical distribution grid where the extension of this infrastructure is cost-effective. In many areas, however, the cost of extending the grid is prohibitive. Distributed power generation has emerged as a popular option, with photovoltaic (PV) technology and other renewables taking an increasing role in recent years. Multiple organizations have researched and come to the conclusion that distributed renewable energy are least-cost, by looking at populations, especially the poor, at various distances from the grid and comparing which methodology makes sense. For simple household loads, like lighting and cell phone charging, the analysis depends on the number and density of households, as suggested in the sample graph below.

![Graph](Fig 7: Grid Extension vs. PV)

Rural electrification projects designed by many governments, multi-laterals, and bi-laterals now look at DRE as a critical option or an alternate to centralized grid to provide
greater impact. A typical distributed DRE system, such as that shown in the diagram below, could serve basic electrical energy needs for lighting, entertainment, communication, and refrigeration for households and businesses such as those shown below.

Fig 8: Examples of a decentralized solar energy systems with components including panels, charge controllers, batteries and loads. (Image credit: anterbox.com)

6.2 Type of Target Segment and Motivation

<table>
<thead>
<tr>
<th>Type of Target Segment and motivation</th>
<th>Selection and understanding of client base</th>
<th>Value and motivations (value creation, relationships, societal impact etc.)</th>
</tr>
</thead>
</table>

A vast untapped need exists for environmentally, and financially beneficial energy services that enhance livelihood or quality of life for low income households in developing countries. There have been efforts to expand access to energy services but they have primarily been confined to heavily subsidized and ineffective efforts to extend the largely fossil powered grid to rural areas. Unable to capitalize on the benefits of convenient, safe and reliable energy a vast majority of people continue to struggle with dangerous, heavily polluting, and expensive alternatives. Recognizing the limitations of this approach, there have been concerted efforts to shift the focus to integrate different
energy sources and apply the most suitable solution based on the context and nature of the problem.

For those who have attempted to deliver energy services in innovative ways, there has been a marked lack of understanding in relation to the range of energy needs, appropriate products, the mode of energy delivery, and the financial mechanisms that can make these services affordable to poor households. A surge of attention focused on reducing energy poverty in recent years has often failed to view the poor as partners but rather as beneficiaries stemming from a mindset of financial gain that sees a “fortune at the bottom of the pyramid.” As a result there is a tremendous lack of innovation as well as emphasis on designing products and services from the lens of a poor end user, which leads policy makers, businesses, and even civil society to continue to utilize ineffective and inefficient methods for overcoming energy poverty.

However, it has been proven in recent years that energy service providers that do incorporate poor consumers into business and product design can be highly successful at delivering energy services. As a result a range of innovative business and financial models that efficiently and economically deliver these services exist. However, their success has remained isolated and energy poverty continues to persist due to:

- Misplaced assumptions that the poor are a homogenous group and solutions can be superimposed from the wealthier urban context.
- There is a misfit between needs and products stemming from the inability to capture the needs of the poor identify weak links and develop appropriate solutions. Low emphasis on a financial ecosystem that enhances affordability for the poor and access to capital for local enterprises that can deliver energy services.
- Dearth of human resources that can appreciate the challenges in developing solutions for the poor and in building the appropriate enabling conditions for the same.
- A lack of focus on the inclusion of the poor as partners rather than beneficiaries including the creation of local supply chains and local partnerships both of which are critical to spreading the reach of energy services.
The poor, as mentioned before, are not a homogeneous segment. They have been, over the years, bracketed as one sector and have been named as part of the ‘bottom of the pyramid’[100]. Within the category of poor, I would divide it further into three parts – Low Income, poor and vulnerable/abject poverty (figure 9). The segments differ because of income streams, livelihoods, and level of access to related basic services like health, education etc. The divide is large even with the people under the vulnerably/abject poverty category struggling to get basic food on a daily basis. Decentralized Renewable Energy (DRE) has an opportunity to intervene in all the three segments of the poverty category. One can innovate financial products for the poor while there has to be a deeper linkage between DRE and income generation while implementing it for the very poor and abject poverty. The business models, value proposition, financial justification, access to markets etc. will vary and there is where the opportunity lies for sustainable energies.

Figure 9: FORTUNE AT vs FORTUNE FOR the BOP. Left triangle- typical treatment of Bottom of the Pyramid, Right triangle- ideal approach to bottom of the pyramid where BOP cannot be treated as standard market due to non-expendable incomes and lack of ecosystems. (Data taken from Suisse Global Wealth Databook 2015)
6.2.1 The Opportunity

Previous approaches have barely skimmed the surface of what’s possible in terms of delivering sustainable energy services to bottom of pyramid consumers. However, in order to deliver on this promise it is critical to build an enabling ecosystem of support. By creating multiple local centers across the developing world to create innovative and replicable processes that address the diverse needs of world’s poor it is possible to develop segment tailored sustainable energy service solutions. Given diversity among the poor these processes can then be adapted to similar segments around the world but within a contextual ecosystem conducive to the region’s target customer base. Using this method, it is possible to create an approach that entails using experiential learning to design solutions that boost poverty alleviation.

What is required are immersive centers, Energy Innovation Centers located across the world that capture the diversity of problems affecting the poor which develop innovations for technology, finance, process, market linkages, entrepreneur development, enterprise creation— all with an aim to provide sustainable energy solutions to the poor. The potential mitigations offered by the localized innovation solution centers will be:

- Misplaced assumptions that the poor are a homogenous group and solutions can be superimposed from the wealthier urban context.

  Various immersive centers, working out of different geographical locations with poor with various income streams and behaviors will help policy makers, and other stake holders understand the heterogeneous nature of the poor. The diversity of the locations and the corresponding solutions will also further enlarge the differences between the various segments of the poor across rural, tribal and urban locations.
• There is a misfit between needs and products stemming from the inability to capture the needs of the poor identify weak links and develop appropriate solutions. Low emphasis on a financial ecosystem that enhances affordability for the poor and access to capital for local enterprises that can deliver energy services. Immersion of multiple stakeholders into the daily lives of the poor and encouraging the innovators among the poor to come up with appropriate solutions will help in better capture of problems and needs. Focused definition of the poor will help in creation of better solutions. There will also be a push to push for better financial products that will enable to the poor to afford DRE products that can provide them with higher value.

• A lack of focus on the inclusion of the poor as partners rather than beneficiaries including the creation of local supply chains and local partnerships both of which are critical to spreading the reach of energy services. Localized operations, right from innovation to implementation, will refocus the positioning of the poor in the stakeholder chain for DRE applications. Numerous organizations like SELCO [103] and BOOND [102] in India or Solar Sisters in Africa have shown that inculcating the poor in the decision-making will lead to long-term social and financial sustainability[101].

6.3 Types of Products Sold of Serviced by the enterprise

| Types of Products Sold of Serviced by the enterprise | Design (quality, functionality, durability, use centric) | Environmental Impact (LCA, greening supply chains) |

The energy access field, especially in the DRE sector, has seen numerous products over the last two decades. The products have ranged from lanterns, torches, small portable lights, small and big home lighting systems, street lights etc. The various components of the DRE systems have also changed as technology has evolved over a
period of time. For example in the lighting sphere the transition has happened from CFL to LEDs – that too in a matter of less than a decade.

The critical need is to create affordable products – as one is targeting the economically deprived part of the populations. Unfortunately, the perceived confusion among designers and implementers is between creating affordable products versus cheap products. An upfront expensive product made accessible via financing can also be perceived as affordable at the doorstep of the poor: unfortunately this is not the stance taken by numerous developers around the world. The push for more sales, with little attention to developing an eco-system for long term sustainability, has led to mushrooming of short life-span products around the world that have been implemented in the rural areas of the developing world. One can evaluate the need and choice of products depending on various factors and circumstances:

6.3.1 Value

DRE products need to be designed from the perspective of what the end-user shall utilize the product for and with any social or economic benefit. The value proposition and pricing strategy needs to go hand in hand. The value the DRE product delivers, quality of life or increased incomes, should be substantially better than the substitutes (kerosene for lighting etc.) There are numerous organizations in the world that supply cheap lighting products on the notion that it is notionally better than kerosene, thus compromising on life time and non-recyclable materials etc. DRE systems are installed in the households of the poor in far flung areas of the world. They have to be rugged and long lasting. The raw materials used for producing the products, be it lighting or income generating, it would be very sustainable if local materials are used or ones that will not harm the local environment when disposed.

6.3.2 Pricing
As mentioned earlier that pricing of DRE products that are targeted towards the poor have to consider many factors, including the initial cost vs the life cycle cost. The model that pushes for ‘as cheap as’ possible is surely not a sustainable one for numerous reasons. In many cases a marginal increase of prices might bring in more value to an end-user. For example in the case of a solar powered sewing machine. An expensive option with more features that could potentially earn multiple times more for the end-user might lead to a better financing model than one with a cheaper sewing machine with less features. Or a more expensive solar light, with a slightly over-designed solar panel, that can last longer might be cheaper in the long run as would not require as frequent replacement of batteries. Enormous pressure from investors is actually pushing many of the DRE companies to go on a sales mode with cheaper product leading to the poor getting a more expensive option in the long run: socially an unsustainable model. Policy makers, funders and investors have to relook at this point or else the DRE space would be marked with numerous failures in the near future.

6.3.3 Aesthetics

Many of the DRE related products, now sold around the world, are mostly manufactured out of China. There is very little attention to aesthetics that is segment and geographic specific: because of the mass scale production facility far away from actual usage points. There is little consideration of the type of habitation and the actual end-use of the product in most of the DRE systems: mostly the end-users have to customize according to the product and not vice versa. End-users should have a definite say in the design and aesthetics of products especially ones that cater to their basic needs. There have been numerous instances of product failure because of poor aesthetics: like insect into the electronics of charge controllers and lights: or in another case reluctance of snack vendors in a market to adopt the same system as the vegetable vendors. DRE systems cater to varied segments – students, doctors, domestic rural households, urban slum migrants, religious institutions, public health centers, educational institutions, etc. Today very few variations of DRE products exist and that needs to be broadened by innovation and user interaction.
6.3.4 User functionality

As mentioned repeatedly, user needs assessment has been one of the weakest points in the promotion of DRE systems around the world. There is a basic lack of understanding of user needs beyond lighting and cell phone charging. DRE in the near future will play a critical role in advancing the sectors of education, livelihoods, health and livelihoods. A school projector in a remote un-electrified school has no other option but to be powered by a DRE solution – solar, biogas or pico-hydro etc. The features that the particular projector needs to consider the need of the local school, educational content that would be taught via the projector, technical qualifications of the teaching staff etc. will help in creating a set of input parameters for the manufacturer. Local financial institutions to popularize their products to the poor could use the same projector with slight modifications.

There have been considerable advancements in the DRE for lighting space, as one gets deeper into the economic strata DRE would have to expand its product portfolio to income generating sphere: this would require more financial and human resources for understanding the user needs and consequently production of the selected products. Linking DRE to income generation will bring in more options for the poor to get out of poverty: an important component for social sustainability of the society.

6.3.5 Product lifetime

DRE systems cater to the basic needs of the poor who have limited resources: thus it is critical to design products that are rugged, long lasting and made of materials that have minimal impact on the local environment after the lifetime. Many of the DRE systems those are popularized today around the world lay little or no emphasis on the longer lifetimes as it increases the cost of the system. It is true that increases the initial cost of the system but on a life cycle basis it would be lower and thus cheaper for the poor. Many companies like D Light [106] or Green Light Planet [107] pushes from small
products because they are cheaper. While companies like SELCO [103] or SOLUZ [105] push for products that more expensive but last much longer. Repeated replacements followed with poor after sales service has hampered the diffusion of DRE like solar in many countries and has also discouraged numerous financial institutions to finance DRE products. [108]

In many parts of the energy underserved world eco-system to build DRE products is nearly absent. Take the example of countries in Africa. Most, if not all, parts of the solar system are imported from China or in some cases from India. While DRE promotes the use of sustainable energy but there are sustainability questions related to production of its parts, materials used, long distance transportation etc. On top of all these issues related to supply chains and Life Cycle Analysis (LCA), many of the developing and underdeveloped countries do not have end to end mature systems for recycling thus leading to further environmental issues at the local level. There are numerous parts of the DRE systems that can be manufactured locally, encouraging the following:

- Utilization of local materials that are sustainable and easily recyclable
- Better designs as involvement of end-users
- Creation of local jobs

As one goes deeper into each of the above points it becomes very clear as DRE become more popular for the poor - product designs, user functionality, material utilization etc. all become very critical for environmental and financial sustainability. DRE can truly show the concept of ‘cradle to cradle’ and social inclusivity; there is huge potential to replace ‘mined’ resources by local raw materials and reutilization of products after its lifetime for other needs or uses.

Life cycle analysis of solar home lighting systems have been done by numerous organizations around the world [110].

The issues with many of the LCA’s are very technically and product specific. The parameters do not consider the local eco-system and the impact of it on the LCA.
Building of local capacities with local materials, manufacturing along with better recycling methodologies will help in re-looking at LCA in a truly inclusive and holistic manner.

Localization, especially in the DRE sector will lead to multiple innovations that will lead to further impact on LCA. For example, by creating access to electricity will lead to more income generating activities by the poor – like working using various types of machines. These machines like water pumps will have to be better designed and thus can change the way efficiency is perceived around the world. The supply chains will be forced to look at efficiency and that can happen because of DRE in the developing world.

Even from a carbon perspective it is assumed that the net CO2 saved from a typical 2 light solar system in around 7 tons in its lifetime of 20 years [111]. Again, it only considers the environmental benefits in the use phase, displacement of existing fuels like kerosene but does not consider environmental impact across the supply chain and related social impacts because of better lighting and quality of life.

6.4 Type of Service of Delivery mode

<table>
<thead>
<tr>
<th>Type of Service of Delivery model</th>
<th>Distribution model (pricing, financing, servicing)</th>
<th>Partnerships</th>
</tr>
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</table>

Creating a DRE focused social enterprise is a challenging one: right from setting the pricing strategy to setting a stable service delivery model that is effective and economically viable. There are numerous constraints to delivery of improved energy services to the poor and especially that live in the remote parts of the developing world. Some of those very barriers are:

- Poor access to affordable capital for DRE businesses
- Poor access to long term low interest rural credit for the end-users
- Lack of pool of human resources in the DRE sector
- Lack of financial and technological innovations
- Lack of ground-up policies
• Vulnerability to subsidized grid

DRE companies operate in an interesting and challenging market. Their primary objectives is to improve access to energy services for poor people, typically in remote areas. It is the realm of poverty, and usually one where aid organizations, NGO’s, public utilities and departments and government subsidies hold sway. However there is demonstrated potential to operate real businesses in this environment, either independently, or in public private partnerships where government or other funds are used to deliver services in a business like manner. Ways need to be found to stimulate and nurture growth, and perhaps most importantly to render such companies attractive to second and third stage finance, while taking cognizance of the social context and the development objective.

6.4.1 Example of Decentralized Renewable Energy in India

In India, 70% of its population lives in rural areas. 23% of villages in India and about 55% of rural households are as yet not electrified. There is a huge disparity in the per capita energy consumption between rural and urban areas. For e.g. 75% of rural households depend on firewood for cooking, 10% on dung-cake and about 5% on LPG as against 22% of urban households depend on firewood for cooking, 22% on kerosene and about 44% on LPG. Similarly for home lighting, while 50% of rural households depend on kerosene and another 48% on grid electricity, 89% of urban households depend on grid electricity and 10% on kerosene [112].

For the nation’s overall development access to energy is critical as it is required in almost all our daily activities – cooking, access to clean water, agriculture, education, transportation, employment generation and environmental sustainability.

Today in India, about 80% of the rural energy used is derived from biomass. This puts additional pressure on the already increasing deforestation in rural India. Further more use of inefficient stoves often increases the drudgery of women and children who are primarily involved in collection of fuel wood. Moreover, the smoke generated during
indoor cooking from these stoves severely affects the respiratory health of women and children.

India has over 140 million rural homes out of which more than 85 Million still use kerosene as the primary fuel for lighting. Kerosene as fuel is dangerous, dirty, and - despite being subsidized - consumes nearly 4 percent of a typical rural Indian household's budget.

Artisan activities and small-scale industries are an integral part of village life. Previously, villagers practiced a wide range of artisan activities and agro-industries, catering to the everyday requirements of village populations. Over the past decade, these activities have gradually reduced due to rising levels of education and expectations (leading to migration to urban cities), as well as increased competition from cheaper factory-made goods. These changes have forced the local artisans to now concentrate on providing services, rather than products, to local populations. In some cases, however, artisans have addressed the problem of competition by clustering together to exercise collective power in procuring raw materials and to command a wider market. As a consequence, their energy-use patterns have changed significantly over the years. While artisans still rely on traditional forms of energy, village industries have turned to both diesel and grid electricity for motive power.

The most common forms of occupations at the village level are tailoring, carpentry, barber saloons, blacksmith, goldsmith, and pottery. Most of them depend largely on manual and animal labor for a large part of their energy use. Traditional fuels represent a significant part of energy supplies in a limited number of occupations, including carpentry, pottery, and weaving. Coal and charcoal are major forms of energy for blacksmiths and goldsmiths where high, controlled temperatures are needed.

The most energy-intensive activities are ones that goldsmith and blacksmith do, baking in kilns (whether for pottery or bricks), and stone-crushing. In many cases, energy is used in a primitive, thermally inefficient way. The major rural industries, such as flour
and rice milling, are agriculture based industries and grid electricity is a primary requirement to run these units. Diesel fuel based electricity is used mainly as a backup to grid electricity. Many industrial operators and some artisans are aware of energy-efficiency possibilities, but most consider them too expensive to implement.

Access to energy in the rural areas is critical

- For better quality of life.
- For productive use thus uplifting the income levels.

To achieve the above two in a sustainable way increased energy conservation, improved energy efficiency and enhanced energy production from renewable sources are definitely required.

Presently in rural India, there is little evidence to indicate that modern renewable energy play a significant role. The government programs have mostly concentrated on implementing pilot projects, subsidy driven targets, and "free" systems. Today most renewable energy technologies have moved beyond the product-testing phase and doing pilots to prove the technology is not needed anymore. There is an urgent need to shift polices and program towards creating of sustainable enterprises that can promote the diffusion of energy services in the rural areas of the country. There is need for broadening the scope of support for development of businesses involved in renewable energy technologies and adopting a market-oriented approach to the creation of a supply chain for renewables in rural areas.

6.4.2 Types of rural energy services

Few of the most required common rural energy services usages are:

- Cooking
- Lighting
- Water heating
- Household devices for entertainment and drudgery reduction
- Transportation
• Income generating activities
• Rural Industries such as flour mill, rice mill etc.
• Energy requirements of institutions such as schools, hospitals etc.
• Water pumping for domestic and agricultural purpose

6.4.3 Barriers to the provision of rural energy services

Primary barriers in rural energy service provision are:

• Lack of access to appropriate technology primarily due to limited awareness and poor supply chain
• Ability to afford technologies due to lack of access to affordable financing
• Poor access to technology know how and financing leads to un-favourable conditions for entrepreneurs to undertake businesses
• Lack of access to market linkages
• Lack of access to value added products
• Poor service provision by technology suppliers in rural areas
• Need for sufficient research and development in technologies that are applicable to rural areas
• Assumption in standardizing designs and solutions for the rural households
• Shortage of skilled human resources at prices that make sense to decentralized energy projects. Limited focus on providing training to rural people in developing skills related to rural energy service provision
• Shortage of proven technology and devices at the right scale.

6.4.4 What needs to be done?

To provide better rural energy access going forward the above mentioned barriers need to be addressed. Some of the ways are:
• Explore low-cost and clean technology options using renewable energy based
distributed power generation that will also helps achieve the national goal of
electricity access for all.
• Access to clean cooking energy and other social and economic infrastructure are
limited in rural India. Providing these are very critical, and this step would go long
ways in ensuring energy equity, while still mitigating significant quantities of
greenhouse gas emissions in addition to the health benefits.
• Electricity access should be linked with productive end use that will uplift the
income of the poor families. Income generation also ensures their ability to pay for
access to electricity. A deeper understanding of the local economy and exploring
innovative ways in which energy generation can be coupled with better livelihoods
that are locally relevant and feasible would help catalyze the energy generation
ecosystem.
• Developing local energy markets based on available energy resources, needs,
capacities, strengths and constraints, and adopting appropriate delivery
mechanisms and organization structure suiting to local needs.
• Strengthening supply chains and service centre in rural areas for small energy
devices - solar lights, improved stoves, other efficient lighting and cooking products
such as CFL, LED, pressure cooker etc.
• Decentralized energies such as biogas, micro-hydro require local skills that are not
readily available. There is a need for setting up training opportunities where
generalized broad based technical skills related to renewables is provided.
• Appropriate market interventions to render energy affordable while ensuring
financial viability.
• Involving local financial institutions to finance energy products and technologies.

6.4.5 Technologies for rural energy service provision

List of technologies applicable for rural energy service:
• Solar photovoltaics for
  o Lighting for rural households
- Lighting for rural businesses and institutions
- Energizing motors and looms
- Water pumping

- Solar thermal for
  - Water heating
  - Cooking
  - Drying

- Improved cook stoves for
  - Rural households
  - Institutional cooking in government schools, SC/ST hostels
  - Rural SME’s requiring heating for agro processing, dyeing etc

- Biogas for
  - Cooking
  - Lighting
  - Power generation for water pumping and driving motors

- Biomass gasification for
  - Thermal application – for institutional cooking, heating in SMEs etc
  - Power generation to electrify households

- Bio-fuel for
  - Power generation
  - Running motors
  - Transportation

- Small Hydro for power generation

- Wind for
  - Power generation
  - Water pumping

- Other technologies such as:
  - Net metering to feed excess power generated at households and institutions to the grid
  - Batteries for storing energy
Inverters as other electricity back up source and for converting DC energy stored in batteries to AC
- Light Luminaries for different lighting requirements and
- Hydraulic Ram for water pumping

6.4.6 Type of Interventions

As one can see from the above, there are numerous technology options that could be available from a DRE perspective. The type and way of intervention needs to be customized according to the site, geography, people behavior, income streams, type of incomes etc.: all leading to different business models, service mechanisms and related services. For holistic and truly inclusive approach, the models of intervention have to be different when catering to the poor. Sustainable enterprises in this sector are those who involve the poor in all parts of their intervention: right from being an end-user to being the service providers themselves.

Common mistake entrepreneurs and enterprises make, is to adopt the sales strategy and the business models that have succeeded for populations with expendable incomes (higher incomes user segments). Selling a typical retail product, e.g. like selling a TV, is an upward sale. Most of the time the person selling the product would be lower in the economic ladder than the end-user. In the case of DRE applications the scenario is reversed. The person ‘buying’ the system is earning less than the sales person – a downward sale. Downward sales strategies occur in the cases of doctors and lawyers: where the client choses according to reputation and human trust: same analogy needs to be implemented while choosing an intervention for the poor. That is the only way holistic sustainability can be achieved in the DRE space.

The interventions at the individual level or institutional level should lead to the following:

1. Leverage local resources: from materials to finance.
2. Up-lifting of local economy and human resources.
3. Creating of processes, organizations and institutions that are more dependent on local values, cultures etc. and would be more resilient to external shocks.

Thus it is not only important to look at sustainability from an intervention or product perspective but also from a service delivery mechanism and especially when one is dealing with populations that are vulnerable from various angles: financial, social and environmental.

6.4.7 Importance of After Sales Service

The DRE products and services for the poor enhance dramatically people’s quality of life and increased incomes. Thus it is critical that there is very less scope for failure else would directly affect the lives of the poor. It is imperative to make rugged products that last long with an effective after sales service: both critical for gaining the confidence of the poor.

An organization needs to map out the After-Sales Costing evaluate real cost of the DRE application. The costing also helps design the pricing structure. Some of the basics of looking at after sales service are:

1. Cost of service with or without material
2. Contribution to cost of service
   a. Operational and overhead expenses; technical and non- technical roles
3. Average costing of materials (subject to products or technology offered)
4. Average number of services completed by technician per month, average installations by technician per month, average technician salaries, office administration costs per service, technician travel.
After-sales servicing has to be looked at holistically, as a marketing opportunity to better know the client and their needs, attract new customers and build the brand. After-sales service will bring in the trust of financial institutions and partners.

Poor after sales service can kill markets and demoralize the future for DRE in a particular country. Example of SHELL Solar as a company abandoned the thousands of DRE systems, which lead to non-payments to the local financial institutions [109]. Not only did the financial institutions lost faith in DRE but also the end-users, mostly the poor, felt it was not a viable option for them. Numerous such examples exist around the world, where projects were done to maximize financial returns in a short time frame – leading to enormous long-term repercussions – unfortunately not for the large corporations but to the poor clients.

The importance an organization puts on after sales service also lays down the philosophy of the organization and its commitment towards the clients on a long-term basis. Also as an organization keeps growing over time, the service structure needs to grow with the maintenance and repair needs of its growing client base, and its ranks should include local experienced technicians. The price per service and actual cost should be flexible and customized to diverge due to customer’s ability and willingness to pay, as well as strategy company interests, such as mission or positioning priorities.

6.4.8 Pricing

Pricing strategy while selling services or products to the poor is a challenging one. Numerous factors have to be taken into consideration while creating a product-pricing list. The end-user pricing has to be dynamic and depends on:

a. The value the client is deriving from the intervention and is there a fair pricing allocated to the desired value.

b. Perceived potential market in the selected area and related transaction costs.
c. Existence of other parts of the eco-system like finance and after sales service.

The enterprise should decide on the profit margins and compare it to the value the end-user in benefitting from: a critical way to maintain financial equality. Such approach will help the organization gain loyalty of the end-users and not perceived to be monopolistic.

There are instances\[113\] where the product is fairly priced but the financial product is expensive. The newer models promoted by companies, especially in Africa, called the pay as you go capture higher percentage of profits from the financing part of the equation: there is financial sustainability for the companies but not for the end-user.

The pricing structure is normally also decided on the basis the overheads of the organization and the salary structures. The thinking basis also has to shift by bench-making the overheads and salaries on the basis of the pricing than vice-versa: putting the end-user at the center of discussion.

### 6.4.9 End User Financing

Access to affordable finance can transform poor's lives, as they can access to modern energy services. The combination of energy services and finance can work together for the benefit of the underserved. And to do this, one needs to understand the needs of the rural energy consumer, as well as the potential for, and limitations of financial institutions and energy service providers in meeting these needs.

It is critical to understand that the energy consumer does not need energy per se, but the service that energy provides, be it electric light, energy for pumping water and sewing machine, or electricity for running home appliances like fans and televisions, etc. Energy service providers and finance managers need to keep this in mind when designing products and financing packages.
The poor use energy can be used for various purposes.

a. Productive uses for income generating activities
b. Household uses involves utilizing energy inside the house for cooking, lights, and running home appliances like televisions and fans
c. Community uses are schools, hospitals and health clinics, community center.

The financials products need to tailor-made into the above three categories.

a) The barrier of capital costs:

The majority of rural people cannot afford the initial capital costs of investing in energy technologies. The financial product needs to be tailor-made to the savings (from existing sources like kerosene) or should be created according to the perceived cash flow.

b) Down-payments on loans can also be expensive:

Even if a rural individual or household has access to credit, the initial down-payments on the loan can be as high as 25-40% of total costs, which itself can prove to be very expensive. There are guarantee funds that could help mitigate this risk for the end-users.

c) Terms of credit may not match income patterns:

Rural earnings are often not in the form of a constant amount every month. Income can, for example, vary according to changes in agricultural market prices, and be earned in few lump sums at times of crop harvests. Such variations in income are often not compatible with fixed, regular loan payment schedules established by rural credit agencies. A good
People with no reliable energy access have no motorable roads, from where they travel by foot for days to reach market places, energy services, and financial services. Not only do these people have a difficult time accessing services, but servicing their needs is a costly and difficult proposition for energy service providers, and finance agencies: but true inclusivity is needed to solve this problem.

To make finance inclusive for the poor the terms of finance should include considerations such as payment schedules, interest rates, down-payments and collateral. Energy service providers mostly offer standardized packages only, which does not always match the needs and purchasing power of the poor. Products and services that enable income generation is an obvious area of finance for Banks and other financials institutions.

6.5 Type of Capital

<table>
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<tr>
<th>Type of Capital</th>
<th>Capital Structure (IRR, pricing structure, interest rates)</th>
<th>Ownership Structure (percentage, SHA and exit strategies)</th>
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The establishment of a business operation requires adequate amounts of venture start-up capital, which can be a combination of equity and debt. While entrepreneur equity is always required, external capital is also often necessary, particularly with capital-intensive offerings involving consumer finance or rental.

Several new mechanisms, including various types of impact investments, have emerged within the energy sector to facilitate investment into small- and medium-size enterprises. These channels, however, have had steep learning curves, resulting in small to medium but complicated transactions, typically $50,000 to $2.5 million. As a result transaction costs have been very high, 10-20% or more of the capital raised. The cycle time (The time from preparing a business plan to raising capital) for closing these investments has
been long, typically ranging from two to three years.

Experience of organization like SELCO and other similar entities have shown that DRE operations, with significant investments in consumer financing, cannot be financed on straight venture capital. Also the most complicated area of financing for a pioneering DRE companies is the lack of financial resources to cover early business development and innovation in the very immature markets operating in difficult environments. While a good deal of soft funding has been spent by bi-laterals and multi-laterals, it has generally not been effectively availed by private players in the field of DRE. It was very difficult to attract development funds as a private DRE player; the cash flow from the rural poor is the last option and a non-starter.

6.5.1 Subsidies

Some form of public-private collaboration is optimal to assure that delivery services can be established within a reasonable policy and support framework. A pure private commercial approach to delivering energy services to the rural poor is today being touted as the primary option, but experiences of players like SELCO and SOLUZ [90] [104] suggest that in practice it is not viable. The other critical lesson that many pioneering DRE social enterprises have faced the brunt is that of heavily subsidized government programs can totally destroy the market for them in the rural areas.

As Richard Hansen, founder of SOLUZ [105], narrates his experience of how a government project destroyed his efforts to build a social enterprise because of competing programs.

"Soluz’s experiences have shown that a public-private planning linkage is critical to avoid overlap and working at cross purposes. In the Dominican Republic, with 300,000 unelectrified households, Soluz has operated with 2000 PV rental units financed by funds sourced from the World Bank (IFC), the InterAmerican Development Bank (Multi-Lateral Investment Fund) and USAID, all under private-sector approaches. In 2003 the Dominican government’s Secretary of
Industry and Commerce established a project to electrify 1000 households nationwide using PV technology—100-watt systems with no cost recovery from the end-users. Some of these units were allocated to the northern region where Soluz Dominicana operates. Installation was by a firm located in Santo Domingo, four hours away. In signing up customers, the program in some cases targeted Soluz customers, who were paying for rented 30- to 50-watt PV systems and services from Soluz’s local zone supervisor.”

This example shows how limited resources get wasted, markets distorted, and social enterprise activities undercut due to conflicting approaches of major institutions while rural areas remain in need of service.

DRE enterprises will succeed only if all parts of the eco-system is in parallel developed. Once a government and now inexperienced impact investors are involved it then vested interest takes over: the poor’s impact is the last priority. In the case of governments it is politics and in the case of investors it is short term capital gains.

6.5.2 The cost of raising capital for DRE enterprises

Over the years several funds by multi-laterals, bilateral, funders etc. have put in place to buy down risk, and improve access to resources for rural off-grid electrification and energy service delivery. However, the costs and risks associated with accessing this sort of capital are of the order of 10 to 20% of the capital raised. Criteria and funding policies have not always been well worked out in advance, thus applicants have paid a heavy price in working through proposals and business plans while the funders develop the models. Grant funded investment assessment processes allow financiers to take their time and carefully analyze over issues, while the applicant does not have the luxury. Bureaucracy and layers of decision makers create delays, hurdles and decision reversals that cost companies dearly in terms of lost time, false hopes raised, and contingent investors stalled.
Strategies to streamline financing and share the transaction costs include:

- Standardization of application and assessment procedures
- Pre-qualification processes, and staged investment decisions, with the costs of later stage application efforts being partially or fully reimbursed, even if the loan/investment/grant is finally not approved
- More direct access for companies such as ours to the key decision makers/funding institutions
- More direct and speedy allocation of resources such as the REEF off-grid funds to acknowledged companies capable of delivering the results.
- Quicker turnaround times for funders, with a more commercial approach to the decision making process. This could include the establishment of target timescales for decision making, with penalties accruing if these are not met.

6.5.3 Progress in DRE Across the World

Significant progress to develop the distributed PV opportunity has been made across the world. A number of trailblazing private DRE players have emerged around the globe such as SOLUZ and TECHNOSOL in the LAC region, SELCO and SIMPA in Asia, and MKOPA and OFFGRID in Africa. The World Bank and IFC has initiated a number of rural electrification projects that include distributed PV within enabling environments such as the Light up Africa and ASIA programs. Business models including mobile payment based, credit or rental and related enabling environments, have being developed in various parts of the world with varying degrees of success.

Africa is seeing successful mobile payments based business models. The most visible example is the experience in Kenya of MKOPA, a Financial institutions that offers systems paid via mobile payments PV system purchases. The SELCO experience in India includes working with financial institutions that offer affordable financing to the underserved households.
One of the more complicated aspects of the lessons learned by SELCO involves the prevailing intervention model established by various actors in the rural energy space. During the 1990s, with the euphoria of the stock market, an investor-centered approach evolved for models to catalyze private-sector energy delivery in rural areas. A number of organizations believed that the only barrier to expanded rural use of renewable technology was access to capital in the form of equity and debt. They expected that companies would emerge based simply on the financial rewards of revenue flows from rural customers as equity and debt financing became available.

In reality, broad DRE-based rural energy delivery is a low-margin, high-risk business, a combination that obligates developmental support if any substantial business infrastructure is to be developed. A better eco-system would adequately consider and mitigate the costs and risks of all players so that greater positive impact can be made. The most effective intervention models for encouraging sustainable rural energy delivery would seek to support innovation—technical, finance and social. For lack of trust and creativity more than any real legal or operational reasons, DRE developers have generally been expected to operate totally without access to soft funding.

6.5.3 Internal Rate of Returns (IRRs)

Over the last couple of decades there has been a rise in the number of Social enterprises that are cutting across different sectors like energy, agriculture, education, livelihoods etc. The eco-system that they are start with and continue working is extremely challenging. Irrespective of working in different sectors, these enterprises have very similar learning’s in terms of balancing social and financial objectives and facing the same challenges in terms of high transactions costs, lack of skilled man-power, dearth of innovation monies, pressures of scale, immature supply chains etc.

One critical aspect while building an enterprise financing, other than the ones mentioned above is the balancing the socio-economic sustainability, fair pricing and
sustainable growth is benchmarking the Internal Rate of Return (IRR). Today there is a considerable difference in the expectations of the investor community and what the enterprises can pragmatically offer (discussed in section 5). The market, because of the immaturity of the eco-system, is not ready to provide the returns that one expects in other mature sectors like Information technology.

To take a cue, from the DRE sector itself, of why the expectations are so varied and how higher expectations are not socially, financially or environmentally sustainable. As mentioned before, in the thesis, that there are more than 300 million people in India living without electricity. Thus the market defined by enterprises, investors and lenders is between 50-60 million households. Numerous managements of enterprises and investors aim to reach a certain percentage of the defined market in a particular time frame, typically 3-5 years. The IRRs are then set – with the assumption that the market growth can happen fast as the people would be lining up to buy DRE systems for lighting. There is a fundamental flaw in the assumption. Implementing DRE systems among poor communities and households requires considerable financial and human resources to build the other parts of the chain like awareness, financial products, market linkages for the extra production done because of DRE intervention etc. These efforts chip away at the profits and thus the IRRs. Many of the enterprises in the DRE space pragmatically peg their IRRs at low single digit.

To counter the low IRRs and slow space of growth, enterprises have started to market very cheap shorter lifetime products to the poor like solar powered torches, lanterns and other low wattage systems. These are extremely short-term temporary solutions, which are socially and environmentally unsustainable with very poor LCA numbers. The companies look at these markets as one time sales assuming the poor to be consumers, not producers or asset owners: a very short term sales strategy which will lead to long term environmental consequences: as many of the products with shorter life spans will not be properly recycled in the remote parts of the developing world.
Till the eco-systems get developed, it would be ethical and practically right to expect low single digit IRRs: organizations like SELCO [103] have proven that they can be sustainable socially, environmentally and financially.

6.6 Organizational Structure and HR

Dearth of human resources that can appreciate the challenges in developing solutions for the poor and in building the appropriate enabling conditions for the same. Localization of solutions and decentralization of problem seeking centers will help in also encouraging local innovators and entrepreneurs. Availability of finance and innovation capital at the grassroots level will help in creating a large scale human resources that will focus right from innovation to implementation: thus creating true social sustainability.

Type of personal that manage and run social enterprises need to have the passion to solve a problem. The problems are complex and sometime unique thus will take time and out of the box thinking to solve it. The team has to have the patience on one hand to solve the problem while trying to grow and on the other hand needs to manage the expectations of other stakeholders in the system: financiers, investors, end-users etc.

With India solar targets itself, for instance, of 2000 MW by 2022 and thousands of more enterprises of off-grid solar applications and millions of solar home lighting systems to be deployed and serviced in the next decade, there is a dire need to build up the human resources in the sector for all capacities that would help in building the organizations.

The eco-system for various organizations, for profit or not-for-profit, need the following:

(a) Technicians
(b) Service providers
(c) Sales staff
(d) Grassroots entrepreneurs or associates
The seven parts make up the HR eco-system for an enterprise that wants to deliver energy services to the poor in the underserved households. While today there are no concrete channels that could be dipped into for the upcoming energy enterprises, human resources are picked up from other sectors. The reason being that the primary focus today is mostly on finance and the assumption is that the industry will take care of the human resource.

The nature of the business is about understanding the needs of the poor and executing it in a manner that leads to increased quality of life and increased incomes. People in the organization, from top to bottom, need to be inclusive in their thought process as well as in their actions towards other colleagues. Truly inclusive and successful organizations are those whose employees are from the very client base they are trying to serve.

The salary structures are also very critical in such organizations. Today the salary ratios are compared within the organization structure but one of the true ways of looking at equality would be by comparing the ratios with the average client earnings: lower the ratio better the connection of the enterprise with its target segment. Higher the ratios mean the overall social sustainability is questionable.

DRE organizations promote grassroots jobs creations. For example the role of local technical support in the maintenance and long term functioning of DRE systems is invaluable- particularly given the number of remote, rural and inaccessible households that become dependent on such energy. Enabling training of such technicians would add tremendous value in the creation of employable resources at the various levels.
At present, the human resource requirements for the DRE industry is viewed primarily as the need for manufacturing and not for innovation in supply chain, local entrepreneurs etc. Consequently, there is a lack of understanding about the requirements of systems integrators- that extend beyond technical expertise to marketing, sales and operational aspects. There is often an assumption that the existing human resource base for the above-mentioned tasks would fit perfectly into the DRE sector. However, experience has shown that the skill-sets required to effectively operate in the decentralized clean energy sector, while catering to low income end-users, are very different and would need appropriate training. There is also a dearth of field coordinators to thoroughly understand user needs and facilitate the interaction between technology players, financial institutions and the end user. There is, thus, an urgent need to turn our attention to the neglected demand for skilled manpower in system integration in the off-grid renewable energy space.

The management and the board of social enterprises have to be inclusive in terms of gender, caste, creed, etc.: in line with the demographics of the client base it is striving to serve. Experience and management skills should triumph over educational backgrounds: as many potential managers would have had the opportunity to get a formal degree because of lack of financial resources.

Thus as one can see from above, DRE is not only a powerful tool to prove the sustainability in term of energy access but also can create newer models of organizations and structures within them.

This section was a deep dive on the DRE sector and the appropriate eco-system required for it along with the necessary parts for all the stakeholders to create holistic value. But for all of the pieces to fall in place and the DRE sector to come together there are appropriate policies needed to encourage it. The following chapter gets to the core of what types of policies are required in order for the DRE sector and holistic value chain assessment to flourish in developing countries.
7. Policy and Regulation

The previous sections covered the eco-systems required for social enterprises and impact investment before specifically getting deeper into the DRE sector. After understanding the uniqueness of the DRE sector and the type of social enterprise structures that are needed to build it up in section 6, this section analyzes appropriate policies that need to be in place in order for them for be successful.

Global access to clean energy is one of United Nations 17 Sustainable Development Goals [114] that directly impacts almost all other goals including climate action, reduced inequalities, good health and well-being, quality education, decent work and economic growth etc. To achieve these goals the world needs to triple its investment in sustainable energy infrastructure per year, from around $400 billion in 2016 to $1.25 trillion by 2030 [115]. Most of this growth is needed and will occur in under-developed and developing nations. Thus analyzing policies surrounding sustainability and inclusivity in these parts of the world becomes critical so that appropriate ecosystems and development models emerge and are replicated.

Despite the well-understood link between access to energy, improved quality of life and increased incomes, many developing countries struggle to form the necessary infrastructure to address their basic energy needs, specifically for the poor. Lack of energy not only affects productivity but also places a huge economic burden on households and local enterprises [116]. There is a high correlation between economic growth and increased energy consumption. For example, in India the growth of 77% resulted in 60% increase in electricity consumption [117]. Globally, 1.2 billion people (22%) live on less than $1.25 a day. Among the poor living on less than $1.25 per day, just under half have electricity, the un-reliability levels (electrified areas with long consistent power cuts and low voltages) being much larger. Today there is an urgent need to bridge the gap to provide the platform for the poor to move up the social and economic ladder. As repeatedly mentioned and justified in the thesis, before that one needs to move away from traditional modes of business and conventional model of dissemination.
of energy through large-scale centralized models, because traditional modes have not been able to reach the poor. Social Enterprises could be the answer of solving the problems of the energy poor via sustainable energy. But many of the governments, especially the ones in the developing countries, are still focused on centralized solutions, grid interactive technology, large power plants that would supplement ongoing grid extension programs or erratic power supplies in urban areas. The poor are still neglected un-economic markets that do not warrant significant investments in infrastructure, resulting in not getting the grid or even if they do it would be very unreliable.

These significant infrastructure gaps in government interventions, in part, have been recently addressed through innovative social enterprise-based approaches that are designed to bridge the gap of providing critical services for under-served communities. However, none of the social enterprises have gone on to achieve the level of scale and replication needed to address the energy needs of the poor and under-served. A key barrier is the absence of a local supportive eco-system (Refer to Section 4, Figure 3, which includes appropriate policies and regulation), which is necessary to stimulate and sustain long-term sustainable energy solutions.

In order to create and implement a stable socio-technical eco-system, where Decentralized Renewable Energy (DRE) focused social enterprises can thrive and grow, following are the objectives that policy makers should have in mind:

- Encouraging and Incentivizing sustainable energy enterprises that strive for last mile delivery
- Supporting delivery of quality after sales service to the underserved populations
- Spurring new innovations in technology, finance, and market linkages at the grassroots level
- Increasing awareness on feasibility and viability of clean and decentralized energy solutions across various stakeholders (government, end users, investors, researchers, technology developers, financiers, academics etc.)
Referring to the socio-technical ecosystem approach (that covers aspects of technology, enterprise development, end user financing, policy and human resources: refer to sec 4. Fig 3), this section aims to understand the status of sustainability related policy and regulation within the scope of sustainability reporting instruments (based on sustainability metrics), policy interventions for clean energy social enterprises, trade and local production for Decentralized Renewable Energy (DRE), fossil fuel subsidies, public policies related to DRE, human resource development and education and innovation, ‘research and Development’ and Intellectual Property Rights. Each of the sections are analyzed specifically from a ‘developing country’ and ‘holistic value chain perspective’ for DRE [section 4.2, table 4].

7.1 Sustainability Metrics and Reporting Instruments

Overall, Sustainable Development Indicators (SDI) are measures of sustainability, that are able to quantify efforts beyond the concept. SDIs can be related to resource depletion, biodiversity, toxic pollution, climate change, peace and security, economic inequality, employment etc. While the concept itself evolves and improves, sustainability indicators, indices and reporting systems have gained increasing popularity in both the public and private sectors. However their effectiveness in influencing actual policy and practices often remains limited [118]. It is the role of Government to measure societies’ progress towards sustainability by developing and maintaining metrics and reporting formats- this in turn should facilitate integration of sustainability into the overall management of organizations and the national economy [119].

Ban ki-moon, Secretary-General of the United Nations said “Eradicating extreme poverty, promoting sustainable consumption and production, and managing the planet’s natural resource base for the benefit of all are the overarching challenges of sustainable development.” The Sustainability Development Indices (SDIs) inform and/or influence the implementation of various reporting instruments that are largely issued by Governments (around the world 223 sustainability reporting instruments have been issued by governments, 69 by financial regulators, 44 by stock exchanges, 15 by
industry regulators and 32 by other various institutions [120]). These reporting instruments are in the form of regulations, codes of conduct/guidance, standards etc., and the most commonly used instrument being regulation. **Regulations either target general sustainability metrics, environmental-specific metrics or social metrics.** Although indicators of sustainability should be developed in order to take into account the concerns of environmental protection, economic and social development and at the same time to provide to government officials a tool for policy choices and policy design, almost one-third of sustainability reporting instruments around the world (even in developing countries) apply exclusively to large listed companies and of these around three quarters have been introduced by financial market regulators and stock exchanges. The remaining two thirds are generally applicable either to all companies or to specific types of companies such as state-owned [120].

Out of 378 sustainability-reporting instruments (65% of which are mandatory), only 9 are specific to small and medium-sized enterprises. Sector-specific reporting instruments target primarily finance and heavy industries. Given the significant social problems faced by many emerging markets, one might expect a greater focus on socially-themed reporting instruments in these countries. However, in the 2016 ‘Carrots and Sticks’ publication jointly produced by KPMG International, GRI, United Nations Environment Programme (UNEP) and The Centre for Corporate Governance in Africa (at the University of Stellenbosch Business School), it is suggested that currently most sustainability reporting instruments in developing countries are more likely to apply only to environmental reporting or a general sustainability reporting. They also mention South Africa as one of the emerging economies where a special interest in the social agenda can be noted. The country has laws related to the reporting of procurement, social and labor plans, as well as employment equity reports that have to be submitted to the government [120] [121].
7.1.1 General Sustainability Reporting Instruments

Many general sustainability-reporting instruments are limited to guidelines that ensure companies produce Sustainability Reports or Corporate Social Responsibility (CSR) reports. For instance, the CSR Legislative Acts of Philippines and Pakistan outline potential few areas of work and reporting requirements. A few examples of specific regulation of mandatory General Sustainability Metrics (GSM) reporting instruments or Environmental, Social and Governance (ESG) related reporting metrics in Developing Countries that go beyond the requirement to submit a sustainability report are:

- Johannesburg Stock Exchange Listing Requirement 2010, South Africa [122] and The Securities and Exchange Board of India (SEBI), Business Responsibility Reports, India 2015 [123]:

  **Johannesburg Stock Exchange (JSE),** which lists 450 companies are required to produce an integrated report in place of their annual financial and sustainability reports. The integrated report gives a view of a company by including social, environmental and economic performance along with the company’s financial performance. The FTSE/JSE Africa Index Series complies with the recommendations made by the International Organization of Securities Commissions (IOSCO) [124], as laid out in the Principles for Financial Benchmarks published in July 2013 (the IOSCO Principles).

  Similarly, **The Securities and Exchange Board of India (SEBI),** Business Responsibility Reports, 2015 mandates listed companies to submit Business Responsibility Reports, describing measures taken along the key principles enunciated in the ‘National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business’ framed by the Ministry of Corporate Affairs (MCA). The requirement, presently, only applicable to the top 500
companies in terms of market capitalization. Its Clause 55 requires companies to engage in a thorough environmental and social reporting process.

Both, Johannesburg Stock Exchange Listing Requirement 2010 and SEBI reporting encourages all companies to abide by disclosure (or transparency) requirements and are based on a ‘comply or explain’ principle. [121]

- **Department of Public Enterprises (DPE) Guidelines on Corporate Social Responsibility and Sustainability for Central Public Sector Enterprises in India, 2013.**[125] [126]

  The annual Memorandum of Understanding (MoU) between Central Public Sector Enterprises (CPSEs) and Government Ministries defines the targets and objectives for a CPSE, in which a fixed percentage is defined for CSR and Sustainable Development. The DPE Guidelines have been developed for CPSEs in committing to and achieving their respective targets in a manner that is beneficial to them and their stakeholders. These guidelines were revised and entered into force in April 2013, to better promote transparency in disclosing strategies and activities. India, does mention OECD guidelines for multinational enterprises, Millennium Development Goals etc, only as non-binding recommendations.

- **Nigerian Sustainable Banking Principles (2012).**

  Issued by Financial Regulators as a code of conduct or guideline, a group of representatives from leading commercial banks adopted environmental sustainability and respect for human rights, which was enforced by law when the central bank directed all financial institutions to adopt and implement them. The Principles require banks to respect human rights in their business activities, to promote financial inclusion and women’s economic empowerment, and to integrate environmental and social considerations into all bank
decision-making processes. Banks are required to measure and report their progress toward implementing the Principles on a regular basis. This is implemented at a national and federal level. [121]

7.1.2 Environmental Regulation

Beyond the discussion of general sustainability policies being primarily implemented for large listed companies in developing countries, in the past environmental regulations always created a North-South divide between developed and developing countries. Developing countries sometimes had restricted market access in developed countries for not being able to meet the latter’s environmental or product safety regulations. Multiple actions by developed countries overrode the boundaries of domestic regulations and invaded national sovereignty [127].

Currently, many governments remark that unilateral environmentally friendly measures might even create environmentally harmful competitive advantages, such as pollution havens [128] in developing countries, where only through multilateral agreements, ecosystem building into sustainable regulation and infrastructure could developing countries be brought up to international standards of environmental protection.

Thus very few significant laws and regulations are found in developing countries specific for environmental protection. This is largely due to the fact that developing countries often prioritize catching up from an economic, trade and employment perspective as opposed to environmental sustainability. A few examples of mandatory environmental sustainability standards in developing countries include:

- Venezuela legislation 1995-current, DECREE 883,638 -N° 1.257 that establish standards for improving air quality and the prevention and control of air pollution from stationary and mobile sources. [121]
India Environment (Protection) Act, 1986-current [129] The Environment (Protection) Act was enacted in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991. [121]

Much of the research into failures and delays of up-to-date and need-based environmental regulation in developing countries have been attributed to implementation issues, enforcement problems (a result of poor governance in developing countries) and badly designed regulation. The existing environmental regulations are currently based on northern environmental law developed from restrictions on emission/effluent limit values, often been described as “command- and-control” legislation [207], and is criticized, perhaps unjustifiably, for its static and dynamic inefficiency [206]. This, it is argued, Which means that although this approach imposes detailed restrictions and provides for stringent administrative and criminal standards if breached, it does not guarantee that operators will strive for an optimal reduction of emissions. One way to achieve better adherence would be to provide financial incentives to reduce emissions to the greatest extent possible.

However, Michael Faure, Morag Goodwin & Franziska Weber in ‘Bucking the Kuznets Curve: Designing Effective Environmental Regulation in Developing Countries’, outline the limitations of flexible or economic instruments that provide these financial incentives through environmental taxes and tradable emission rights. Principle 16 of the Rio Declaration, United Nations Environment Programme (UNEP), United Nations Framework Convention on Climate Change (UNFCCC), The World Bank and IMF, among others frequently promote the use of such economic instruments as the best means of achieving environmental objectives within developing governance structures [205]. However, critical voices are to be found [208]. Hybrid instruments (combination of “command and control” and financial incentives) are often found with much-praised
flexibility for environmental regulation in developing countries. However, moving away from “command and control” legislation does not negate the need for “command and control” capabilities. Even a financial incentive or hybrid instrument requires strong administration for allocation, trading or rights, monitoring and enforcement mechanisms, which are not in place in most developing countries.

The best way to improve environmental quality apart from poverty deduction (Kuznets Curve [206]) is also to improve institutional structures and the quality of regulation (Esty and Porter). Environmental regulation for a given country needs to be designed based on the legal, cultural, and institutional contexts and capabilities within that country [206].

A UNEP, Cleaner Production Programme publication 2010, ‘Governmental Strategies and Policies for Cleaner Air Production’ [208] outlines both incremental and radical changes, a custom approach to targeting, staging and phasing-in and phasing-out of policies and the transformed roles of stakeholders needed towards achieving environmental sustainability in developing countries. The publication acknowledges the difficulty of importing developed countries’ regulatory structures into less-mature economies, and emphasizes the importance of technology transfer and assistance, rather than economic instruments.

The Organization for Economic Co-operation and Development (OECD) provides a full list of useful initiatives, tools, links, networks, indicators and regulation guidelines for sustainable manufacturing and Life Cycle Analysis which is adopted in member countries only (35 developed countries).

7.1.3 Social Sustainability Reporting Instruments

A staggering increase in income inequality over the past two decades has been accompanied by rising concerns over the impact of the vast and increasing gap between rich and the poor. In recent years, and especially since the onset of the economic downturn, these debates have moved to the top of the policy agenda in many
As discussed previously, social sustainability includes dimensions of social protection, rights, empowerment and redistribution.

The UNDP paper on Humanity divided: Confronting inequality in Developing Countries [130] states that:

“The complexity and multi-dimensionality of the drivers of inequality call for a complex and multi-dimensional response. In fact, only a genuinely holistic approach can fully address the multiple factors that cause inequality and create the conditions for a truly inclusive society.”

Most social policies however, are focused on employment, wages and health of employees. Even of these, very few are mandatory examples of social sustainability reporting that can be found in developing countries, these include:

- The Employment Equity Act, 1998 and its Amendment Bill, 2012, South Africa [131]: The Act seeks to eliminate unfair discrimination in the workplace and implement affirmative action for “designated groups”: black people, women, or people with disabilities. Annual reporting on progress is required. All designated employers, including those with 150 or fewer employees, have to submit annual Employment Equity reports. The Act is not, however, a major driver of comprehensive reporting. [120]

- Amendment to the National Black Economic Empowerment Act, 2003, South Africa [132]: The amendment aims to amend the Broad-Based Black Economic Empowerment Act, 2003, so as to insert certain definitions and to amend others; to clarify interpretation; to provide for the remuneration of Council members; to promote compliance by organs of state and public entities and to strengthen the evaluation and monitoring of compliance; to include the creation of incentive schemes to support black owned and managed enterprises in the strategy for broad-based black economic empowerment; to provide for the cancellation of a contract or authorization; to establish the Broad-Based Black Economic Empowerment Commission to deal
with compliance of broad-based black economic empowerment; to provide for
offenses and penalties; and to provide for matters connected therewith.[121]

Both of the above are introduced via legislation and are mandatory.

OECD recommends Social Life Cycle Assessment guidelines (discussed in section 3.6) and OECD guidelines for multinational enterprises, again considered largely for developed economies, still has a long way to go to be introduced into legislation. Issues with the sustainability reporting instruments in developing countries lie in the fact that most of the regulations are not designed based on local needs and capacities of middle and low-income sectors at various levels (local, state and national), but more for top listed companies. The ones specifically for the informal sectors lack in operationalizing, monitoring and evaluations and ownership and consistencies of policies. Examples of these would include pro-poor policies, such as cash transfers [133], fuel subsidies [discussed further in section 7.4], access to skill development [134] etc.

The inherited legacy of environmental, social problems, current environmental, social and economic instabilities will not disappear with the mere passing of laws and regulations. Success in environmental and social protection can only be achieved through implementation, administrative care and ethical practices, cross-sectoral collaboration of ministerial institutions, capacity building for appropriate personnel, sufficient financial resources, and coordinated development practices of local and foreign investors.

A large and still growing number of attempts continue at a broader level to create aggregate measures of various aspects of sustainability that provide a more nuanced perspective on development that can be achieved as opposed to aggregated economic metrics such as Gross Domestic Product (GDP). GDP and GNP have extreme limitations to measuring “real” development, even economically [135].
Some of the most prominent attempts include the Human Development Index (HDI) of the United Nations Development Program (UNDP); the Ecological footprint of Global Footprint Network and its partner organizations; the Environmental Sustainability Index (ESI) and the pilot Environmental Performance Index (EPI) reported under the World Economic Forum (WEF); or the Genuine Progress Index (GPI), the GINI coefficient etc calculated at the national or sub-national level. Parallel to these initiatives, political interest in producing a green GDP that would take at least the cost of pollution and natural capital depletion into account has grown [118]. The implementation and relevance of these alternative metrics for policy making however, is held back by the reluctance of policymakers and statistical services arising from concerns about conceptual and technical challenges. Moreover, the weakness of sustainability regulation at a global level (international sustainability agreements), mostly lack mandated commitments (for example legally binding consequences as opposed to an effort to keep promises) [136] [210] [212]. A review of most international sustainability driven treaties reveals that they tend to use vague language and side step the issue of real capacity building [209]. Subsequent negotiations have been unable to produce agreement on the penalties for failure to meet the goals.

7.2 Policy Interventions for Clean Energy Social Enterprises

Social Enterprises, relatively a new phenomenon, bring in the concept of true sustainability by encompassing all the three dimensions: social, environmental and financial. Distributed renewable energy (DRE) also needs to be diffused in a similar manner in the rural areas of the developing countries for them to be socially sustainable in the long run. Social enterprises in the DRE sector have to be treated in a manner very differently from regular development or growth enterprises for multiple reasons. These enterprises are trying to solve difficult and complex problems in a sustainable manner and in very immature eco-systems: unlike regular companies, which work in fairly
established eco-systems. Thus comparing Social Enterprises in the DRE sector to standard enterprises will unfair to them and to the potential investors.

The policy structure and the corresponding policies have to change a bit in order to encourage the growth of the social enterprise sector in the DRE arena. Some of the critical points that one needs to look out for immediate policy changes are:

7.2.1 Credit rating: Current systems of credit rating mechanisms do not take in to consideration the unique nature of social enterprises and the absence of a stable eco-system. As mentioned before, peer-rating comparisons of social enterprises with traditional for-profit companies is not a fair comparison for mission driven businesses. Scale, pace of growth, IRRs, potential exit strategies, etc. are very much different for social enterprises and managers at credit-rating agencies are typically not trained to evaluate them. On the other hand, today the social enterprise face competition from traditional enterprises in the terms of marketing their social impact. Traditional enterprises are claiming social impacts by marketing their products to some of the low-income households, thus leading to debates about consumption based marketing versus asset based value intervention.

To avoid being lumped together with traditional enterprises many of the impact investors have started to request the social value from their investments. Clara Barby, head of impact at Bridges Ventures (a social investment company), encourages social enterprises not to write off impact measurement as being too complicated.

"Think how long it took for the accounting industry to standardize. We're still at early stage with social impact accounting. Don't just think it seems too unwieldy and complicated, we need to do it" [137].

While there will always be debates about how to grade types of enterprises based on their social impact, some baselines need to be created with a set of indicators for all stakeholders to measure. These measures will not only help the social enterprises
differentiate themselves from regular enterprises but also more importantly help achieve the social goals they had set out to achieve in the first place.

1. A robust **standardized matrix to capture the quantitative and qualitative** measures must be developed. These parameters will increase accountability, reduce the due diligence costs of investors and drive investments in to the sector. Social Enterprises should clearly demonstrate the social issue they are aiming to solve (such as education, health, energy access, etc.) along with the type of targeted community in order to achieve more **transparency and accountability** in the sector.

2. For better evaluation of social enterprises, Credit rating companies should hire more practitioners. For example in the DRE sector, there are various complex mechanisms while establishing the last mile delivery systems, which only the practitioners can evaluate.

7.2.2 **Legal and Tax Status:** Social Enterprises in the DRE sector need a mix of financial instruments (grants, debt or equity) depending on various parameters like type of segments, stage of growth, geography, type of expansion plans etc. In the early stages of the organization, when significant resources need to be spent to build the ecosystem (being early market entrants or even when targeting a new customer segment or product), there might be a large need for grant funding. However, due to the legal ambiguity of a social enterprise, many of the philanthropic institutions are hesitant in partnering with for-profit social enterprises. Strengthening some of the legal issues both from the social enterprise and funding organization’s side will ease the legal tensions of such entities absorbing grant monies. These grants are needed by similar social enterprises to create the appropriate the eco-systems. There are needs to various flexible mechanisms to infuse patient capital at various stages as one needs to take into account the long term gestation periods of similar entities, especially in the DRE sector. Any legal definition for social enterprises should allow for **hybrid approach to investments.**
• As repeatedly mentioned before, it is important to recognize that returns of social enterprises (under many tax schemes) will be lower than market defined returns for regular enterprises. Social enterprises in the DRE sector spend considerable financial and human resources in developing a long-term sustainable eco-system, which for many years erodes away the margins and thus the IRRs. To sustain the growth, infusion of patient capital is necessary for a social enterprise to effectively function: reality investors need to become aware of in order to create long-term enterprises in the DRE sector.

• Social-enterprises must have smoother and affordable processes for registration with suitable exemptions with regard to taxation, accelerated depreciation, investment in R&D, tax benefits to investors for investing in social enterprises etc.

• Many countries are still trying to differentiate social enterprises from regular enterprises in order to create a clear tax structure that can be applicable only for social enterprises. Countries like the US have created a separate entity in the form of Benefit Corporation [155] and India has allowed for the creation of section 8 [156] companies. Creation of both entities still does not full capture the complete gravity of why entities need to be encouraged to balance social, financial and environmental sustainability. Section 8 companies in India while can take monies in the form of grants and debt but cannot repatriate or distribute profits or dividends to its investors: a huge disincentive for impact investors. Also long term-sustained profits could jeopardize a section 8 company in India to lose its status to receive grant monies: critically needed for the development of the eco-system. The Benefit Corporations do not provide for tax exemptions and thus might discourage from philanthropic organizations from investing into them. Taxation of social enterprises in the DRE arena have to be re-examined in order to encourage more investments in this sector. For example, in India social enterprises promoting solar among the poor are taxed at normal corporate rates, which can be considered unfair.
The reason being, that these enterprises are encouraging the poor to avoid kerosene, by using solar. Kerosene in India is imported and highly subsidized: thus by replacing it the country in saving a lot on foreign exchange.

Non-uniformity of legal structures, especially in the developing world, has put many of the local social entrepreneurs at a disadvantage. Flexibility of corporation and hybrid laws in the developed world has given entrepreneurs from the developed countries a greater advantage than local ones. For example, having a hybrid structure in the US or Europe helps the entrepreneur avail both soft loans and grants which then can be used to either pay the top management salaries or invested into companies in the developing countries as long term patient equity. On the other hand a local entrepreneur, from the particular developing country, will have to avail equity at much stricter terms leaving less chances for survival. A common mechanism, cutting across country boundaries, to rate social enterprises is the need of the hour to make it a level playing field.

7.2.3 Strengthen the Role of Incubator Vehicles: Incubation centers are critical part of an eco-system that encourages the growth of the DRE sector by helping in the creation and growth of multiple social enterprises. The Incubation centers can serve as an intermediary role between investors and practitioners. The Incubation Centers can help the budding enterprises with all the necessary help in order to negotiate with potential social impact investors. The personal in these centers can also serve as mentors for the social entrepreneurs during their start and growth phase: a critical need for many of the enterprises.

7.2.4 Public R&D programmes and laboratories also play important role in the development of the eco-systems in the DRE sector. They should be encouraged to support the commercialization and deployment of socially relevant innovative
technologies and solutions: via the numerous social enterprises. A more developed patent regime and facilitating platforms to patent innovations especially those developed at the grassroots. [further discussed in section 7.8].

According to Marjorie Kelly (2013), “As long as businesses are set up to focus exclusively on maximizing financial income for the few, our economy will be locked into endless growth and widening inequality. But now people across the world are experimenting with new forms of ownership, which is generative: aimed at creating the conditions for all of life to thrive for many generations to come. These designs may hold the key to the deep transformation our civilization needs.”

Effective policies will encourage more social enterprises in the DRE sector, increased investments into the sector, spur innovation in terms of services and products and grow employment in the lower income strata of the society: all the necessary ingredients for an inclusive and sustainable society. Equality among all the stakeholders in the society will help create opportunities for the poor to own assets and on the other hand encourage the upper strata of the society to become more sustainable in consumption.

7.3 Cross Border Trade versus Local Production in DRE

As the world is moving towards large-scale deployment of decentralized energy systems, there will a multi fold increase in the manufacturing of renewable energy bases end-user products around the world. Today with the betterment of technology leading to faster communication and transportation competition between local products and imports from other countries will increase. Distributed renewable energy, by localizing the services, will promote indigenous innovation promoting local materials: but still will face stiff competition in terms of cheaper products from countries like China. Localized production could also face other barriers like the WTO law: a case in point being the India versus USA in the solar panel case [138].
Under its solar mission [139], India has stipulated the utilization of only locally manufactured panels to benefit from subsidies. The USA had approached the WTO to object the ‘localization’ stipulation and won the case. It was interesting to note that numerous environmental groups in the US opposed the US government’s taking India to the WTO. They believed that by doing so the United States was discouraging India of transforming from a coal based economy to a sustainable energy economy [140].

Recycling also is another issue in many of the developing countries, especially in the continent of Africa. Lack of specific rules and regulations in terms of quality and recycling, cheap products using un-sustainable materials have been imported into many countries of Africa: leading to creation of tons of plastic and used batteries. Import of products is a temporary solution and does not enhance the building of the local eco-system. The African poor are been considered as consumers and not as asset owners, or potential entrepreneurs. Social Enterprises in the DRE sector can create local employment in the areas of re-manufacturing, financing, after-sales service and innovation.

Chinese companies get cheap debt financing from their government [141], which gives them an unfair advantage over numerous local companies across the world – discouraging local production and innovation. The move has forced countries like the US to apply the anti-dumping rules, but many of the poorer countries in Africa cannot afford to do it, a worrying sign for many of the potential grassroots entrepreneurs in Africa and much of the developing world. Unfortunately in the poorer countries both the financial resources and products are external and socially un-sustainable in the long run.

Local and international policies have to work in tandem to encourage the localization of solutions. The poor cannot be victims of various trade laws, which discourage them from becoming innovators and entrepreneurs: a sustainable way to grow the local economy. On one hand it has to be ensured that the end-user, poor being the main ones, should avail themselves of high quality affordable products while on the other hand an eco-
system has to be created to encourage local entrepreneurs and innovators: thus leading to true creation of local wealth and employment.

7.4 Fossil Fuel Subsidies and DRE

It is estimated that the subsidies to fossil fuels amount to 550 billion annually, which is four times more than for renewables [142]. According to the World Energy Outlook, in 2014, with the present consumption of oil, gas and other fossil fuels the world is on track for an increase of temperature by 3.6-degree Celsius: an increase which will cause droughts and floods. Subsidizing fossil fuels encourages inefficiency and discourages innovation for alternate and cleaner forms of energy generation that is more harmful to the poor as they are presently bearing most of the brunt to climate change [143].

The International Energy Agency (IEA) report on 2014 further goes on to say “the Middle East is a region where fossil fuel subsidies are hampering renewables.” It said that 2 million barrels per day of oil are burned to generate power that could have otherwise come from renewables, which would be competitive with unsubsidized oil.

According to the report published by the Nordic Council of Ministers [144] reform of fossil fuel subsidies is a policy tool that governments have at their disposal that will lead to emissions reductions as well as government savings. The report has done modeling across 20 countries to find that early phase-out by 2020 leads to average national emissions reductions of between 6 and 11%. It also recommends that by investing a modest portion of savings back into renewable and energy efficiency measures, emissions reductions can be increased further to a national average of around 18%: resulting in attracting the attention of numerous countries. The Nordic Council Report further notes that on average the rich get six times more in subsidies than the bottom quintile, and that for transportation fuels 97 out of every 100 dollars of subsidy “leaks” to the upper strata of the societies across the world.
In 2014, UNEP published a report [145] that mentioned kerosene subsidies for lighting kerosene lamps undercut solar-lighting systems in many parts of the developing world. Kerosene not only being harmful for the eyes but also was the cause of respiratory diseases. The report notes that hypothetically redirecting one year’s worth of kerosene subsidy (at 40%) toward kerosene- free lighting systems (e.g., solar) would eliminate the need for all subsequent subsidies for the service life of those new DRE systems: a huge incentive to promote DRE across the developing nations. It is fair to say that subsidies on fuels like kerosene are extremely unethical and unfair for the poor, providing them with no options.

India recently introduced a tax on extracted and imported coal [146]: Rupees 400 ($5.8) on every ton of coal extracted or imported. The money is parked in a fund called National Clean Environment Fund (NCEF); the purpose of which is to invest in implementation of renewables in the country. The DRE sector could largely benefit from this pot of money. Countries like the Philippines and Jordan have removed and even taxed fuels; while investing in renewables.

Countries need to realize that subsiding imported fossil fuels harms the nation and especially the poor in the long run. Focusing on development of renewables at the decentralized levels not only cushions them with the vagaries of the international energy markets (foreign exchange issues) but also helps them come up with models of true sustainable development.

7.5 Financing and Impact Investment in DRE

Over the last decade numerous Social enterprises been incubated across the globe to cater the energy access issue. Many of these organizations operate in challenging environments. These enterprises work in different geographies, cultures, needs etc. and are trying to balance social and financial sustainability. As mentioned before in the
thesis, the challenges faced are very similar: lack of income generating products, trained human resources, flexible capital, long term polices and affordable end-user financing; but they still need to balance social and financial sustainability. One of the most critical aspects for social enterprises to be started and grown is to access flexible financing. There has been a spurt of impact investment but still there is a wide gap in understanding the needs of the enterprise and the expectation of the impact investors [as discussed in section 5]: one that has prevented large scale sustainable diffusion of energy access across the world. There is enormous push for pure private capital to move into the sector, but this might not be conducive for the poor either as entrepreneurs or end-users.

Grant monies or hybrid mechanism could be used to develop Social Enterprises in the DRE sector. However, in Technology, Globalization, and Sustainable Development: Transforming the Industrial State, By Nicholas A. Ashford and Ralph P. Hall explains that, “Also, although developing countries have usually been able to acquire funding for the initial formulation of a sustainable development program or strategy, it has proved more difficult to secure donor financing for the ongoing processes of monitoring and review. The difficulty is to persuade donors to provide financial support for a recurrent process that has no predetermined outputs.”

Experiences of organizations SELCO [147] and impact investment vehicles like E+CO [148] have shown that investments have to be mixed between grants, soft loans and long-term equity. These there variable instruments will help the management to focus on building the necessary process for the long-term sustainability of the organization rather than focusing immediately on scale and growth. Immediate focus on growth and higher rate of returns has forced companies like SHELL Solar, an organization focusing on DRE, to collapse [149]. Numerous solar systems installed by SHELL solar in India and Sri Lanka have become defunct thus bringing a bad name to technology and leaving numerous poor families in the dark.
Companies like SELCO in India, Soluz in Honduras, Grameen Shakti in Bangladesh have to pay for the transaction cost of building the eco-system which has to be borne out of the softer funds and not from expensive equity. In the case of DRE because of vast difference in the needs of the poor, there is effectively no first mover’s advantage. The time and human resources needed to build the eco-system, necessary for one’s survival and growth, lowers the profits, thus affecting the internal rate of return.

In summary, DRE focused social enterprises tend to have the following characteristics:

- Have longer gestation and exit periods
- Focus initially on process building than focus on scale and growth
- Have Internal rates of return (IRR) much lower than traditional businesses
- Have higher cost of raising the right type of capital
- Need a blend of grants, equity and debt

Also reiterating from earlier chapters, in order to have a pragmatic and sustainable portfolio an impact investor in the DRE sector should focus on the following points:

- Easy and shorter processes of due diligence
- Standardizing the due diligence documents
- Having team members with practitioners experience
- Understanding the eco-system and the management
- Personal who can be long term mentors and advisors to the investee companies

Given the nature of the DRE market and the related eco-system, pioneering enterprises have to undertake non-revenue generating activities that are crucial for building a business that are time consuming and expensive and some of them are:

- To help in the creation of favorable physical, legal, regulatory, and political environment.
- Create appropriate products and services for the poor. The needs and expectations of different segments are unique and solutions need to be tailor made.
• To custom designed end-user finance that is tailor made to the cash-flow and needs of the poor.

• To create a channel for personnel with expertise in the field of DRE: technical staff, service providers, holistic planners, innovators and policy formulators

The space of Impact investment has been taken over by multiple private philanthropic institutions like Acumen or Rockefeller Brothers Fund and multilaterals like GEF, ADB and IFC. IFC has multiple programs like PVMTI [150] or Lighting up Africa [151]: both programs have encourage the evolution of private sector in Asia and Africa. Impact investors and social enterprises in the DRE space need to work in tandem to develop it for future enterprises and more importantly for the poor who need the energy services to go up the social and financial ladder: very critical for the overall sustainability of the world.

7.6 DRE and Public Policies

The dominant development model prevalent in most parts of the world today emphasizes endless economic growth as an end in itself and around which all other social and ecological concerns revolve resulting in many of the developing countries like China, India not willing to compromise from Coal as their dominant fuel for the coming decade [152]. Sajai’s article [153] in 2015 (India Is Now World’s Fastest-Growing Major Polluter): “In per capita terms, India is neither one of the world’s major polluters and nor was its emissions growth rate in 2014 the absolute highest worldwide. On the other hand India is set to grow faster than any other major economy, propelled by a massive, coal-fuelled, Chinese-style industrialization drive.”

Thus there are two distinct positions – North and the South. The North, mostly consisting of the developed countries who already have the luxury of financial resources and do not have the constrains of large sections of poor populations, cautioning the rising developing countries (the South) of utilization of fossil fuels. The South counter
arguing that they could speak about true clean energy only after taking care of the poor [154]. For true social development of the world, there needs to be a different solution and not one that seemingly looks like a compromise between the South and the North. Growing viable decentralized (country-independent) energy systems can be a force that neutralizes country positions and gives the power to the hands of citizens of the world.

The last 5 years has seen considerable rise of DRE based technologies and enterprises mushroom across the developing world. While these are signs of change, still lots needs to be done by respective governments around the world.

The COP 21 in Paris has been hailed as a success and whether still yet to be seen if DRE gets the same attention it deserves: though many countries around the world have started to announce large programs but the link to Paris agreement would be difficult to make. According to Rachel Kyte, CEO of Sustainable Energy for All, which sums up the present lacuna in the DRE world “Policy and Finance have to catch up with Technology”. According to REN21 report numerous governments have come up with new targets for their deployment of renewable energies. According to the report, Kenya, Rwanda, Sierra Leone and Tanzania all removed VATs on solar products. According to the REN21, Rwanda approved a policy that 22% of its population would have to be DRE by 2018, while Tanzania announced a target of 1 million solar installations by 2017 and create 15,000 additional jobs. Meanwhile in West Africa, Ghana and Sierra Leone launched DRE programs to provide electricity to 100,000 and 250,000 households respectively. Today, the Indian rooftop market is currently growing at over 100%. Another larger DRE initiative is being pushed by USAID in Africa: with 600-million people living in sub-Saharan Africa without access to electricity, a new $36-million initiative by USAID and President Barack Obama’s Power Africa initiative aims to inspire entrepreneurs and investors to connect 20-million homes in the region [157]. India has its own program to electrify 18,000 un-electrified villages using DRE. While most of the mentioned programs have created considerable interest among investors, financiers and entrepreneurs – the questions that needs to be answered whether the push is going to be truly inclusive. The programs should make sure that the poor become part of the
planning process.

Some of the notable policies around the world that have helped DRE diffusion in a true sustainable manner are:

a. Solar Water Heater Financing Mechanism In India

Unreliable electricity and rising costs of electricity have forced numerous households and commercial establishments in India to look for reliable and cheaper ways to heat water for bathing, solar being one of the primary options. Solar water heating has scaled up in India primarily encouraged by the low-cost financing provided by numerous commercial banks in the urban and rural parts of the country.

The Ministry of Non-Conventional Energy Sources (MNES), Government of India subsidized the regular interest rates, offered by state owned banks. The financial institutions offered loans for solar water heaters at 5% instead of 13% [158]. Till the early 1990s, there existed a capital subsidy on the solar water heaters. These subsidies were monitored by the nodal agencies of MNES in the different states of the country. The bureaucracies of the processes of availing capital subsidies, with the lack of appropriate financing deterred the growth of the market. Numerous companies sold the water heating systems to the end-users after deducting the subsidies. Many of these companies had to wait for months before getting reimbursed by the government for the subsidies, thus stunting their growth and also discouraging the new players from entering the solar water heating markets. The change from capital subsidy to interest subsidy in many ways saved the solar water heating industry in India.

The interest subsidy enticed the numerous banks to finance solar water heating systems and that in turn led to the growth of a number of manufactures. The involvement of banks (both commercial and rural) ensured the sustainability of the program -- as now solar water heaters are being viewed as any other
consumer product. The manufacturers have to collaborate with the financial institutions in order for their systems to be qualified under the solar water heater program. This has ensured quality and service to the end-users. Non-performance of the system would lead to non-payment of the loan -- thus leading to the disqualification of the supplier. The financing program has led to installations of solar water heater in households, hotels, hospitals, small scale businesses, medium enterprises, sugar mills, milk processing plants, food processing units; all places where there is a requirement for hot water.

Similar changes (of shifting from capital to interest subsidy) brought about the desired change and same should be applied for all other renewable energy technologies. The key to success of similar technologies is flexible and site-specific financing. One key change that could be made is to make the interest subsidy back ended one. The end-user could get the difference in subsidy only if the loan is completed: thus ensuring a sustainable program.

b. Small and Medium Enterprise (SME) Program by International Finance Corporation

In 1995, a program was created to promote SME financing in the DRE sector. It was the first non-grant SME financing program targeting the private sector and the first Global Environment Fund (GEF) and IFC led program designed to receive capital reflows. One of the main successes of the program has been the start and growth of Grameen Shakti [159] in Bangladesh. Grameen Shakti has installed more than million systems [160]. The IFC program was designed to provide loans to very early stage DRE focused enterprises in countries like Dominican Republic, Vietnam and Bangladesh. Low interest working capital coupled with R&D grants was one of the critical components of the structure. Soluz in Dominican Republic was one of the other recipients that benefitted from the program.
A similar program was conceived by the IFC, funded by GEF, known as the Photovoltaic Market Transformative Initiative (PVMTI). The program was focused on three countries – India, Kenya and Morocco. Approximately 9 companies were financed in these three countries and approximately 70,000 solar home lighting systems were installed. Overall the program was considered a failure because of the large transaction costs and very little impact in the countries of Kenya and Morocco. The program should have taken more risks but the managers were not aware of the existing eco-systems in the selected countries. The financing periods were also small (between 3 to 5 years) and should have been between 7 to 10 years.

The overall failure of a GEF funded program of IFC has been well captured by in "Financing Development": Technology, Globalization, and Sustainable Development: Transforming the Industrial State, By Nicholas A. Ashford and Ralph P. Hall [214], where it is mentioned GEF has been long recognized for its length and complexity of its project cycles: same was the issue for PVMTI. Grassroots level entrepreneurs found it difficult to access or even communicate with the IFC managers on the reality of the ground. Ashford further goes on to say “environmental funds such as the GEF can make a difference in tackling global environmental problems, but only if all major stakeholders involved are truly willing to strive to resolve their conflicts and differences and to agree to more precise, practical, and meaningful definitions of the focal problem areas, as well as the means to strive to resolve them.” In the case of PVMTI the stakeholders were the IFC, local financial institution, local governments and entrepreneurs. There were too many layers of due diligence managers that made getting money from PVMTI an extremely tedious policy.

c. IDCOL Program of Bangladesh

IDCOL program was started in 2003 [161] to promote solar home systems in rural Bangladesh. Till date more than 4 million households have benefitted from the program. It started with a loan and grant from the World Bank but has
subsequently leveraged monies from USAID, JICA, DFID etc. The program has brought together all the essential stakeholders in the eco-system of diffusion of energy access: implementers, manufacturers, end-user financial institutions, SME finance institutions and policy makers. By providing financial incentives at different levels it has helped Bangladesh become one of the top installers of Solar based DRE systems in the world.

As mentioned earlier numerous countries have announced similar programs but it is too early to judge the success of those both in terms of financial and social sustainability. The US government’s has created a large initiative for Africa called the Power Africa [162]. The signals are still mixed about how much of the thrust is going to be led by large corporations, pushing large solutions, or by creating grassroots infrastructure that can encourage local innovations and delivery models via decentralized energy access. The Indian government, in 2010, started a program called the National Solar Mission [215]. Under this program the Government intends to electrify the existing 18,000 un-electrified villages using solar energy. The program is in its 6th year but many of the incentive programs under this are yet to be deemed successful. The solar mission should replicate the success of the solar water-heating program by providing interest subsidies via its numerous financial institutions in the rural areas.

7.7 Human Resource Development and Education

Human resource development and education plays a key role in building the ecosystem for sustainable development. Especially for developing countries, with the need and scale of impact-driven clean energy solutions discussed, the requirement for future social entrepreneurs, innovators, champions, technicians, bankers etc, is key. This section provides insights into the scope that future social entrepreneurs and impact investors can expect with the capacity building and trained personnel. According to World Bank 2014 census, India alone has over 20% of the world’s poverty i.e., 58% of the population lives on less than $3.10 a day.
Human Resource Development as national policy (NHRD) is growing exponentially as countries worldwide grapple with sustaining and growing economic development. NHRD plays a major role towards the sustainable development of nations.

“Studies by Haq and Kirdar (1986)[163] reaffirmed the correlation between education and human resource development. If human resource development is “a process of development” (Swanson & Holton, 2001, p. 227) then education is the acquisition of human capital (intellectual and experiential) that allows the implementation of methodologies that put learning into action within the human resource development framework as part of a country’s national policy.”[163]

As the world continues to become extensively global and competitive various country-specific definitions of NHRD emerge to address a multitude of issues. Education and NHRD policies go beyond capacity building and knowledge to include issues like health, culture, safety, environment and community.

In developing countries the poverty and political weakness of rural populations are cited as main causes of rural neglect in UNESCO’s International Research and Training Centre for Rural Education Report [164]:

“... governance in developing countries bypass [sic] the politically voiceless – those who suffer multiple deprivations on account of their income, ethnicity, gender, religion and because they live in rural areas ... The poor in general and religious, ethnic and cultural minorities, in particular, bear disproportionately the burden of deprivation from essential public services including education [...]. The facts clearly are that the social sectors, especially the priority items of human development and education for the politically inarticulate and invisible rural poor, have been crowded out from government budgets by such items as heavy military expenditures, keeping afloat loss-making public enterprises in urban areas, subsidies that do not often reach the poor and external and internal debt-
Consequently, the provision of basic education for youth and adults, as well as out-of-school children, has been left largely to NGO and private initiatives. Over the years policies such as mid-day meal program in India (provision of one nutritional mean for primary schools in rural areas), community based child care centers in Malawi, Second Chance Government School program in Morocco, Tamil Nadu (India)’s total literacy campaign, Functional Literacy Program of the Philippines, Outsourcing Literacy to NGOs in Senegal etc. have attempted to improve education and well-being levels in under-served communities of developing countries. However the, prior disappointing experiences [164] [165] with state education and adult literacy campaigns in poorer parts of developing nations, raise legitimate questions about how best to proceed. For instance, how can curriculums be made relevant to local needs and conditions? What kind of adult literacy and vocational training programs will be most effective? There is divide between preferred future of globalization and the current realities of most developing countries, where industrialism, unemployment, subsistence living and vast informal economies define day to day life for most of the population.

Beyond essential literacy and first steps of basic knowledge, education and HRD has to be improved in terms of content and quality. While recognizing limited public resources, wide spread poverty and unemployment, extensive informal economies, rigid bureaucracies and corruption being the fundamental challenges [166] of improved knowledge and skills development in developing nations, ‘sustainability driven HRD’ can be one effective way demonstrate a stronger link between HRD and economic development and local wellbeing. The current situation and trends connected with globalization and climate change and the changing rural scenarios call for new responses.

For example of Industrial Training Institutes or polytechnic institutes in India, often based in rural areas provide training in technical field constituted under Directorate General of Employment & Training (DGET), Ministry of Labor & Employment, Union
Government of India. While being developed around the time of the green (or agricultural) revolution in India [167] and including courses on motor winding, water pump repair, agricultural machinery etc., has been upgraded to cater courses which train rural youth and adults on becoming employees or filling the needs by getting trained on joining various service industries for affluent communities for example supermarket employees, beautician courses, basic computer literacy etc. There are two folds to be considered here: First being the false sense of complacency that arose when the famous green revolution appeared to offer limitless science-based solutions to the production of staple grains, especially rice and wheat. To an extent, the policy maker felt that agricultural education had solved the problem of food production and turned its attention to other seemingly more urgent challenges.

However in lieu of the state of the declining agricultural sector itself [168] [169] [170] building capacities for sustainable practices (not just in agriculture, but technology in general) is an urgent need to make positive strides in the next few decades. The second being, inverting the dialogue of ‘type of HRD required to employ the poor’ into ‘type of HRD required to make the poor, employers’ i.e ensuring a path to equal opportunity by also offering entrepreneurship, leadership, business and technical skills offered in more affluent or urban sectors of developing economies. Tackling both environmental and social sustainability concerns simultaneously within curricula is critical while addressing sustainability development goals (for both rural and urban HRD or education institutes) in developing countries.

Another example of HRD policy that directly impacts operational and financial issues of public (or state run) schools, such as teacher absentees, drop outs, in developing countries is, sub-standard quality of education techniques and linkage of education to eventual livelihood generation. Taking the case study of National Education Policy Act of 1996, in South Africa [171], which aims to provide for a uniform system for the organization, governance and funding of schools.
It seeks to ensure that all learners have right of access to quality education without discrimination, and it makes schooling compulsory for all middle and high school candidates. Referring to current patterns of enrollment and low graduations rates, particularly in the fields of mathematics, science, and technology, in OECD review of national policy in South Africa [171], it is apparent that the higher education system is still far from fulfilling its function in terms of producing the high quality human capital needed to propel and sustain the social and economic development of South Africa.

In view of this, beyond other ethnographic/qualitative studies needed to improve student performance, in terms of high attrition and poor completion rates, introducing additional learning platforms on hands-on invention based education, audio visual content and aids and well as middle and high school curricula on relevant context-based local environmental and social issues could peak student and teacher interest. These types of efforts empower students to enjoy learning, increase curiosity levels and inculcate a thought process that leads to a sustainable future for their communities.

Both of the above examples require content development and teacher training and acquisition, particularly tailored for local needs in local languages (One of the primary conclusions of United Nations Dialogues at the World Economic and Social Council around for lacking education [172]) and collaboration between public, private, NGO and civil society to disrupt sustainability and well being levels.

In both of the analysis above, I would like to specify that in no way does the analysis or recommendation question the value, opportunity and timeliness of the ongoing efforts, but is more of an effort to outline the need a more relevant sustainability driven thought process being added to existing educational and HRD legislation systems.

Human capital theory regards education as an investment “like any other”, and as a generator of externalities. For example, individuals make individual choices concerning their education, but this choice has a strong economic impact through the resulting increase in total factor productivity of the country and well being of the planet humanity
as whole. Hence the sustainability driven thought process is a key towards strengthening institutional capabilities for sustainable development.

The UN Conference on Environment and Development in Rio de Janeiro, in June 1992 with unmet goals and worsened conditions after 10 years was re-evaluated in the World Summit on Sustainable Development in Johannesburg. The outcome being the need for an effective institutional framework for sustainable development, which should include:

- Strengthening of coherence in implementation, including in particular through integration of the economic, social and environmental dimensions of sustainable development in a balanced manner;
- Enhancing participation and effective involvement of civil society in implementation of sustainable development; and
- Strengthening capacities for sustainable development at all levels, particularly in developing countries. [172]

7.8 Innovation, 'Research and Development' and Intellectual Property Rights

The pace and pattern of innovation and Research and Development (R&D) in developing countries and more specifically innovation and R&D targeted towards sustainable development in developing countries strongly influences their ability to catch up (or define) current social, technological and environment progress in the world. While innovation and growth in general are central for addressing social challenges, climate change and improving economic performance, the impacts are not always necessarily “socially” inclusive, because they can increase inequalities in income and opportunities, access to services and vulnerability to climate change for different groups in society.

As per [173], “Innovation dynamics and policies have impacts on “industrial inclusiveness”, which is the extent to which firms differ in their innovation and productivity performance.” Developing countries often have low-performance Research and Development (R&D) methodologies, institutions and substantial informal population co-existing with leading world class R&D capabilities in terms of technology within the same country. This is primarily due to the offshoring of R&D in developing-country
locations of internationally known Transmutational Corporations (TNCs) such as Ericsson, GE, IBM, Intel, Microsoft, Motorola, Nokia, Oracle, Texas Instruments and SAP [174]. Industrial inclusiveness along with geographic dimensions of industrial and social inequalities has potentially important impacts on social inclusiveness. Well-designed "place-based" policies seek to build on the opportunities for development based on the economic and social realities in different locations of a country, be it a capital city or a remote rural area, by ensuring the needed public goods and services are available to people and firms (OECD, 2013). OECD 2013 review paper also explains that although few and largely in the private grant or early stage capital realm R&D efforts appropriately channeled and design have produced innovation not only in technology but also in pricing and financing strategies and business process innovations to serve lower-income markets.

Five types of innovation models, first, second, third, fourth and fifth generation innovation models widely referred to ‘technology push’ (1950s-1960s), ‘demand pull’ (1960s to 1970s), 'Coupling or Interactive Models' (1970s), ‘Integrated models’ (1980s) and ‘Systems Integration and Networking Models’ With first, second and third innovation systems having their limitations due to linearity the fourth and fifth are most commonly practiced in leading firms and institutions in developed economies.

Most existing innovation models implicitly assume firms with leadership status (or ambitions) and most are oriented towards large firms (e.g. with R&D departments and elaborate organizational divisions of labour), rather than medium or small firms that might operate with more informal processes (with perhaps no official R&D or engineering department). Most of the models deal with R&D-centred activities, where innovation is defined in the strict sense as a product or process new to the world or market-place.

Because developing economies have different types and patterns of innovation model requirements, there have been very few attempts to link traditional market-based innovation models to developing and sustainability lenses. The expert meeting

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proceedings at UN council of trade and development 2005: Globalization Of R&D And Developing Countries[175], emphasizes on the need for this work not only for understanding past patterns of innovation in developing economies but also for guiding and improving current and future processes of innovation as local latecomer institutes, firms and champions increasingly reach the frontier, perform R&D and compete as leaders.

7.8.1 Potential Innovation Model for Developing Countries

Sustainable Development brings into picture the need for improved environmentally and economically sustainable (or stable) production and consumption patterns based on which, innovation models, from a need-oriented technology perspective, can be re-framed in contexts of developing nations as:

- **Direct application**: Implementing appropriate existing technologies from other parts of the world into developing contexts by working on supply chains, servicing, system design, business model innovation etc. E.g. A portable projector typically designed for education purposes in both contexts (where one is replicating it from and purpose being replicated for).

- **Re-purposed applications**: Contextualizing an existing technology from a application perspective to complete a solution. E.g. A Direct Current (DC) Television designed for high-end automobiles contextualized to solar systems for better efficiency etc.

- **Modifications and Customizations**: Physically or technically modifying an existing product of technology to be used for specific user segments. E.g. An ATM machine designed for rural farmers modified with eye scanners as the culture of disclosing passwords to all and due to the fact that most farmers (because of years of manual labour) don't possess clearly identifiable or distinguishable finger prints.

- **Pure Inventions**: Developed for scratch specifically for need-based lacking communities. E.g. Water purification system for communities living in Arsenic heavy geographies.
To effectively translate into a solution, the above technology-based innovation types will need to be combined with appropriate processes, service, finance and business model innovations, each of which can also be categorized into direct replications, shifted applications, tweaked or hybrids and completely new processes, services, business models etc. The innovation paths and models will be varied for each of the above four types of innovation. One can define the innovation landscape as a puzzle or a lego set that can use existing pieces of lego (from different parts and sectors in the world), change applications of specific legos (fit them to varied need-based application), modify or tweak the lego (to perform better) and some cases work on developing new (missing) lego pieces from scratch.

R&D initiatives to avoid reinventing wheel and maintain high levels of efficiency must work on developing innovative game-changing solutions to issues of their own economies and of the world as opposed to focusing on inventive/innovative products alone. This becomes all the more critical an innovation approach to consider when relevant patentable inventions solving sustainability issues need to be dispersed and scaled around the world to different socio-economic, geographic and cultural categories of populations. Disciplines of management, finance and service also need multiple innovations to be able to serve all of humanity as opposed to only technological systems. This method can be used as a guide to measure R&D and innovation in developing countries.

Freemans unpublished paper (1982), is where the the term and idea of ‘national innovation system’ appeared for the first time. Referring to Friedrich List, Freeman echoed the concern that applying Adam Smith’s Invisible Hand [178] and ‘cosmopolitan’ strategy [177] would leave countries that were less developed increasing behind. The need for governments to actively build knowledge infrastructure and invest in knowledge with the aim of promoting economic development and international competitiveness is reinforced in List (1842) and Freeman (1982). However since then, development economic scholars have criticized List over the years by arguing:
that while building technical capabilities and promoting learning were conceivable, “innovation” in less developed countries is setting the goal too high,

there is no ‘full-blown’ system of innovation in a less developing countries that can be studied,

about the analysis issue between micro and macro analysis i.e the possible dramatization in national innovation systems, due to differences in national or regional innovation systems and economies and

that developing nations will always be a diffused learning system and never an actual innovation system, i.e only developed economies can introduce innovations that are new to the world. [179]

Lists argument in 1842 over the same concern states that “the most important form of national capital was neither ‘physical’ nor ‘financial’, it was ‘mental.’” Today we would call it intellectual capital. The scholars criticizing Lists hypothesis did not consider sustainable development, production consumption patterns or 'intellectual’ and experiential potential advantage that local innovation systems would possess from an ‘issues’ perspective. In developing economies, due to the inherent innovation required for lack of appropriate private and market based solutions that fit issues, can be the intellectual think tanks for some of the worlds most pressing sustainability issues.

Despite of the lack of ‘national innovation system’ infrastructure policies and reporting/evaluation instruments, the Innovation and the International Diffusion of Environmentally Responsive Technology[179] research states that environmental patenting rates in developing countries are fairly high, reaching over 2% in many years in Brazil. Innovators in developing countries obtained a non-trivial number of patents, most of which appear geared towards adapting imported technologies to local conditions.

The patent system and the World Trade Organization’s 22-year-old Agreement on Trade-Related Aspects of Intellectual Property Rights, known as Trips was devised in order to reward inventiveness, encourage technical progress specifically and foster the dissemination of innovations. The restriction to the free movement of ideas that the
granting of a patent entails has been justified under different theories, namely natural rights, moral reward, incentive to invention, encouragement to innovation. [180] The idea that patents are necessary to allow the investor to recover their investment in R&D and the societal benefits of incentivizing pipelines of ‘new’ patentable technologies has dominated Intellectual Property discussions across the world.

Though the development and exploitation of numerous contributions to technology have been closely linked to, although not necessarily determined by, the possibility of obtaining exclusive rights to exploit inventions (Archibugi and Malaman, 1991), the patenting system is today, is far from fulfilling its intended objectives. The expansion of the subject matter of patentability from inanimate to living forms, the admission of broad claims encompassing vast fields of technology, the dilution of the patentability requirements, and shortcomings in the examination process, have led to a profound distortion of the system (Jaffe and Lerner, 2004). There is a proliferation of patent applications and grants, in great part motivated by a variety of defensive and offensive patenting strategies (Granstrand, 1999).[180] Trips, the world’s first enforceable contract to protect patents at a global level, gave developing countries the perception that it would promote their access to innovation by increasing selling or licensing of new technologies, which in-turn would encourage foreign investment in local research and development. Margaret Kyle and Yi Qian in their working paper in 2014, Intellectual Property Rights and Access to Innovation: Evidence from TRIPS [181], studied the impact of Trips across 60 countries concluded that the deal encouraged access to technology, although new medicines were unlikely to be introduced until they were covered by patents. They [181], also concluded that while patent protection did increase research and development in high-income countries, it did nothing to foster more investment for treatments that combat diseases like malaria that affect the world’s poor but have no market in the rich world. Tight intellectual property protection can backfire, stopping locals from piggybacking on foreign inventions and discouraging indigenous innovation in less-developed countries.
The lack of interest of the pharmaceutical industry, which generates huge profits protected by a web of patents enforced around the world, raises a few important questions:

- Do we need a different way to spur innovation and disseminate new technologies quickly around the world?
- Are patents, which reward inventors by providing them with a government-guaranteed monopoly over their inventions for many years, the best way to encourage new inventions?
- Does it create another divide between the rich and the poor? The innovations of the rich, once patented has to be accessed using monetary exchange process: thus will the poor be left out of the process completely?
- Would the above concerns be relevant across sectors like medicine, clean energy, bio technology etc?

The contention with drug patenting was a primary feature of the Trans-Pacific Partnership trade agreement [182]. The Obama administration, spurred by the drug industry, insisted that patent protections should be tightened further around the world. But several other countries argued that they raised excessive barriers for poor countries, costing lives. In India, for instance, more than 97 per cent of the HIV programs use generic medicines from India [213]. India's patent law sets a high bar for what deserves a patent. This allows robust competition among generic producers, which has driven down first-line HIV treatment prices by 99 per cent. But India is faces immense pressure to roll back its pro-health patent policies – which place people's lives above corporate profits – especially from the United States, backed by its pharmaceutical corporation lobby. Other countries, such as the EU, along with Japan and South Korea, are preparing or actively pursuing trade agreements with India that would restrict the country's production of affordable medicines in the future. Should India be forced to change its policies for these trade agreements, it could pose a serious threat to affordable medicines production in India [213].
The same argument is now being echoed in the climate debate and was the most contentious issue in the international climate negotiations leading up to the summit in Paris in December 2015 [183]. Even if one ignores the abuse of the patent system, according to Professor Ambuj D. Sagar, professor of policy studies at the Indian Institute of Technology Delhi, it depends on where you sit: one could make an argument of the pipeline of new technologies versus diffusion, but diffusion is the more substantial point today, especially given the time scale in which we need to make substantial progress. As per other experts, finance and know-how are bigger obstacles to the spread of clean energy systems in poor countries than technology intellectual property rights.

Eduardo Porter in the NYT [183] states that,

“Nonetheless, patents are probably here to stay. Rich countries will end up one way or another paying to spread clean energy technology among the world’s poor. Why not create a government-supported global fund to buy intellectual property on behalf of poorer nations? Another idea: Finance prizes to encourage innovation to solve poor people’s problems. Both inventing new clean energy technologies and spreading them around the world are behind schedule. We don’t have as much time as it took to create a vaccine against malaria.”

However sustainability issues aren’t solvable with clean energy technologies in developing countries alone. As discussed in the previous sections, organizations like Cambia and Lens are pushing for open source innovation thus making it a level playing field for the rich. Poor are already reeling from the financial and technological divide, adding stricter IP regimes further widen it and limit change to meeting climate goals with scarce time and resources.

Even with research aims addressed at social challenges, Chapter 14 in the handbook of best practices [184], proposes strategies that research institutions can pursue in their quest to provide developing countries with access to new patentable medicines (i.e
working around the system). Today, only in actual negotiations between research institutions and companies can these issue be determined and no strategy can be effective unless both research institutions and companies first become more aware of their obligations to the poor in developing countries. Awareness being the first step, IP regulation will need to meet needs of research institutions and the companies that are developing new technologies to improve human health. [184] Similarly for sustainable technology patents apart from above mentioned barriers, based on the effectiveness of the technologies potential for impact and scale, incentives for making the patent public must exist.

Policies developed for integrated innovation systems in developing countries need to be designed taking into account the capacities and realities of public and private stakeholders in developing countries across R&D, Innovation, Growth, Economics and Intellectual property.

The measurement of R&D and construction of associated indicators for evaluation is critical for policy formulation and is currently dynamic, more so in rapidly growing emerging economies. Considerable work on R&D indicator measurement is taking place in Latin America (Red de Indicadores de Ciencia y Tecnologia Iberoamericana e Interamericana or RICYT) and in Africa (S&T Secretariat of the African Union - New Partnership for Africa’s Development or AU-NEPAD).[185] However, due to the aim of R&D within these countries- being able to solve complex issues though innovation- measurement of science, technology and innovation will need to include innovation parameters of creativity, finance, business models etc. With China and India’s R&D expenditure being among the top 10 countries in the world and prevalent issues despite economic growth of these two countries, proves that a coordinated R&D investment ‘green and inclusive’ strategy is still needed [186].
8. Recommendations

For impact investors, fund managers, incubators, knowledge hubs and social entrepreneurs alike, the goal is to positively change the world for better social, economical, environmental outcomes for all, which include improved well-being, health, education and livelihood outcomes. Across all enterprises there exists an articulation of the outcome of their efforts and businesses, say for example, a company selling car seats for babies- the difference they want to make is that the child is kept safe in the car. Similarly, to quote an example of the innovation network: a highway construction company’s outputs are project design and the number of highway miles built and repaired. Outcomes are the difference made by the outputs: better traffic flow, shorter travel times, and fewer accidents. It hence becomes critical to focus on the outcomes to be able to gauge the end result or effectiveness of the outputs.

Deborah Mills-Scofield in its Not Just Semantics: Managing Outcomes Vs. Outputs in the Harvard Business Review further writes:

“We all can see where focusing on outputs got us: In education we’ve focused on test results (outputs) and ended up with some high-scoring kids who don’t know how to apply what they’ve learned to the world at large (outcome), like how the reasons leading to the American Revolution are similar to those that led to the Arab Spring. We have a plethora of apps for our smartphones and tablets (output), but how many do we consistently use—and how many actually improve our lives (outcome)?”

A holistic value change assessment aims to be a guideline for impact investors to better define, understand and evaluate businesses based on their sustainability or impact outcomes: thus leading to substantial social returns. Today unfortunately the focus is on few becoming millionaires by selling products to the poor [187] and not on how the 2.6 billion poor can increase their asset base. For example, an article in ‘measurement resources’ [188] provides a hamburger analogy in their outcome workshops-“McDonald’s sells approximately 33 million hamburgers a day. Five Guys (a competitor) sells approximately 350,000 burgers daily. Based on this information, the workshop
participants were asked to decide who makes a better burger. They definitely couldn't reach to a conclusion that McDonald's makes a better hamburger based on this data alone.

Unfortunately, many impact investors are merely counting “hamburgers” and trying to use these data as proof of their effectiveness or impact. Based on the goals of social enterprises, all stakeholders need to work towards creating an ecosystem (refer to section 4, figure 3) that can enable social entrepreneurs to achieve and measure the outcomes as opposed to outputs only. It is assumed that outputs (e.g.: more systems sold, better efficient stove deployed, number of students reached out to etc.) both tangible and intangible eventually do change the outcome. Measurements of qualitative outcomes are normally left to third parties. Although one could argue that outputs are designed to reach outcomes, in the development sector there remains a lack of an effective way to demonstrate, prove and measure it.

Stories, anecdotes and capturing potential impact that a certain product, service or system helps people empathize for the user base and that may help in raising more capital for an enterprise, but the goal eventually of impact investors and entrepreneurs should be to solve a problem in a social and financially sustainable manner. Effective approaches, tools and techniques to measure outcome directly defines the criteria of selection (process of evaluation) of a social enterprise. It can also lead to uncovering critical gaps that need to be bridged or refinement of the social and business model.

The UNDP 2013 report on “Humanity divided: Confronting inequality in Developing Countries” [130] talks largely about outcomes and mentions that:

“It requires a leap of faith to assume that, with better opportunities for health care, education and training, poor households and disadvantaged groups can attract the demand necessary to earn a living wage either by working for others or by employing themselves as entrepreneurs.”
Similarly, it requires a much greater leap of faith to assume that with access to reliable energy (i.e. by selling clean energy products), communities can effectively and sustainably be uplifted from poverty or become less vulnerable to climate change. Because of these ‘leaps of faiths’, even though millions of dollars and plentiful resources get spent on impact driven initiatives, the status quo of social and environmental issues seems to remain or gets even worse [189] [190]. Organizations like Root Capital, in partnership with ANDE, have been piloting outcome measurement by evaluating ‘level of income stability’ of their investees [191], counter factual comparisons and impact of their specific intervention by comparing the two.

8.1 Defining and Evaluating Enterprise Outcomes

Parameters (orienting enterprises towards better outcomes)

Referring to the example quoted earlier in the section: A highway construction company’s outputs are project design and the number of highway miles built and repaired. Outcomes are the difference made by the outputs: better traffic flow, shorter travel times, and fewer accidents.

Outcomes have to be accounted for during the designing and planning stage: thus the evaluating outcomes can then yield improved future efforts as opposed to incremental changes. Holistic Value Chain Assessment [discussed in section 4 and section 6] can be used to gauge an enterprises mission, commitment and understanding of grass root issues: by developing measurable parameters that connect with micro, meso and macro level outcomes [section 8.2, section 5].

Sections below give a brief conceptual overview of how the categories (I,II,III..), parameters (A,B,C..) and sub parameters would work by providing examples of potential categories, parameters and sub parameters. Each of the sub parameter can be graded on a scale between 1 and 10.
Defined below are 10 parameters from A to J that are designed keeping in mind macro and meso level outcomes [section 8.2, section 5]. Quantification of social returns on the basis of the 10 parameters, from an outcomes perspective, may be more accurate than existing methods. Once the various factors are defined for the scales between 1 and 10, including the sub-parameters, an average score can be obtained for each parameter (A, B, C…). The sum of the average parameter scores can then be determined for each category (I, II, III…).

The type of impact investment for the enterprise can then be designed based on the sum of the scores of all categories. The higher the score the more patient capital would be required. Lower the scale it would be easier the decision for an impact investor to determine whether the enterprise even qualifies as an impact driven or social enterprise versus a regular (market-based) investee. Impact Investors can also prioritize categories by giving weightage percentages to each category depending on the type of impact investor and their preferences.

I. Types of Products Sold or Services by the Enterprise

A. The product: Type of product or service provided to the end user in terms of design (an incremental solution or a long term need based solution), quality (durability, serviceability), functionality (how customizable, adaptable and adoptable is it), pricing (cost of the product on a life cycle analysis), consumer driven or asset based.

B. Life Cycle analysis: Use carbon savings (liters of kerosene, diesel or amount of coal grid replaced), parts sourced and assembled (imported or locally sourced), materials used (natural or toxic), recyclability (plan in place for end of life).
A
- Only incremental and immediate impact (most of the standardized)
- Low quality and durability, less warranty, no local repair provision
- High life time cost due to low-end life and reliability of product
- Consumptive and not income generating or long term well being intervention.

B
- Only partially replaces un-healthy fuel sources in the utilization phase.
- Highly dependent on imports
- Poor recycling methodologies
- Utilization of unsustainable materials

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<tr>
<td>• Need-based long term impact (customizable range of products/services)</td>
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<td>• High quality, long warranty and easy local serviceability</td>
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<td>• Highly durable and reliable</td>
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<td>• Leads to increased income or better long-term quality of life.</td>
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<td>• Replaces completely, in specific period of time, all types and needs of energy requirements with clean energy</td>
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<td>• Very much locally produced</td>
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<td>• Strong recycling infrastructure and plan</td>
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<tr>
<td>• Eco-friendly or natural materials used</td>
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II. **Type of User Segment and Motivation**

C. **Targeted user segment**: Socio-economic condition of user base (low income, very poor or absolutely vulnerable communities), geographical and cultural barriers (proximity, reach, remoteness and level of barriers)

D. **Value and Motivation**: Transparency levels (sharing failures, challenges, risks, learning’s and shortcomings from an outcome perspective), exit strategy (pre defined pivot into product diversification or geographical expansion) i.e. aim towards solving the issue(s) for one particular need of area in a pre defined time span could be 5, 10, 20 or more years (to ensure the quality of long term vision or mission of the enterprise)

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<td>C</td>
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<tr>
<td>• Serving clients significant above in the economic ladder</td>
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<tr>
<td>• Serving user segments in very mature ecosystems</td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>• Very vulnerable/ abject poverty ridden user segments</td>
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<tr>
<td>• Informal user segments and mostly excluded populations</td>
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</tbody>
</table>
D  • Closed and exclusive (non-transparency in learning's)
  • Priority is to sell and not to solve the issue.
  • No R&D or innovation initiatives [see section 7.8.1]

  • Transparent and open-source (actively capture and share challenges, learning's)
  • Have a strong strategy to solve the primary issue
  • Measurable R&D and innovation initiatives leading to the appropriate solutions for the poor [see section 7.8.1]

III. **Type of Service or Delivery Model**

E. **Distribution model**: type of channels to connect with users that ensure high level of loyalty, trust and inclusivity (servicing networks, local hubs, business associates, micro entrepreneurs, branches, franchises, dealership etc.), profit margins (market based, average or fair)

F. **Partnerships**: Partnerships built and extended for ecosystem building (end user financing, human resource development, innovation, market linkages, content development, influencing policies etc.)

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<tr>
<td>E</td>
<td>• Selling primarily through a wholesale type</td>
<td>• Setting up or leveraging on local distribution channels with high quality, timely and individual customer care</td>
</tr>
<tr>
<td></td>
<td>model with little or no connect with the actual end-user</td>
<td>• Balanced profit margins (based on potential value user can get receive from the intervention)</td>
</tr>
<tr>
<td></td>
<td>• Unsustainable high margins</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>• Negligible local partnerships</td>
<td>• Multiple local partnerships leading to additional benefits, for the poor clients, like financial inclusion, market linkages, education, information and awareness.</td>
</tr>
</tbody>
</table>
IV. **Type of Capital**

G. **Capital Structure:** Internal Rate of Return (IRR) proposed, break-even timelines (based on pricing structure, interest rates etc.)

H. **Ownership Structure:** Percentage and type of investment requested, evaluating the balance between social and financial objectives (type of share holder agreement and exit strategies proposed)

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<tr>
<td>G</td>
<td>Expectations of higher IRRs with no basic information on the eco-system present.</td>
<td>IRRs that balance social, financial and environmental sustainability.</td>
</tr>
<tr>
<td></td>
<td>Pressure to make profits as a priority and not to build processes.</td>
<td>Focusing on building stable processes.</td>
</tr>
<tr>
<td>H</td>
<td>Very skewed ownership structure with mission and power in the hands of few.</td>
<td>Balanced structures with enough checks and balances for social and financial goals.</td>
</tr>
<tr>
<td></td>
<td>Shifting priorities from sustainable social and financial sustainability to attract investments</td>
<td>No compromise on internal goals of social and financial sustainability</td>
</tr>
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V. **Organizational Structure and Human Resources**

I. **Management and Board Structure:** Type of leadership and management, Type of board (gender, inclusivity, independence, accessibility etc.)

J. **Team Structure** (team mix/ inclusivity, employee health and well being, salary ratios, innovation/ scope for growth)

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<tr>
<td>G</td>
<td>Leadership with no relevant field experience</td>
<td>Visionary Leadership with a strong understanding of energy access and social needs</td>
</tr>
<tr>
<td></td>
<td>Absence of diversity in the board composition</td>
<td>Gender and socio-economic segment balanced board structure</td>
</tr>
</tbody>
</table>
- Non-local employees at critical positions of the company.
- Top heavy, vertical management structure reducing free flowing innovations
- No growth path for field level employees
- Very high salary ratio between top level and bottom level employee.
- Mostly locals on various teams
- Horizontal management structure for better flow of decisions and innovations
- Special attention to employee health, well being and growth
- Fair salary ratio between top most and bottom most employee or on contract individual

Each and every concept in the above hypothesis would need to be well defined and quantified. Sub-parameters in each category also have to be quantified. Thus the categories, parameters and sub parameters would have to be well defined and standardized across the impact investment sector. The weightage percentages given to each category will differ from one impact investor to the other depending on the philosophy of the investor, source of investment, comfort or flexibility levels and social return expected. The weightage can help in identifying the different grades and types of investors in the impact investment space and thus would be an effective method to identify the different types of impact investors and gaps in the impact investment sector. Different types of capital and impact investors are needed for different phases and types of social enterprises, thus the social return needs to be better quantified with relation to outcomes. The aim of the holistic value chain assessment is to enable impact investors to make better-informed information on social and financial returns.
### 8.2 Outcome Based Evaluation

<table>
<thead>
<tr>
<th>Outputs (Enterprise Level)</th>
<th>Outputs (Stakeholder Level)</th>
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<tr>
<td><strong>Short Term/ Immediate Results</strong></td>
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<tr>
<td><strong>User Level</strong></td>
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<tr>
<td><strong>Medium Term Results</strong></td>
<td></td>
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<tr>
<td><strong>Community Level</strong></td>
<td></td>
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<tr>
<td><strong>Ultimate Impact (Conditions)</strong></td>
<td></td>
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<tr>
<td><strong>Sector, Issue and State/ National Level</strong></td>
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</table>

- **Micro**
  - Increase in knowledge and awareness, reverse marketing
  - Improved health, well being, safety and security, education or livelihoods
  - Increased aspirations and motivations
  - Quality of Jobs, reverse linkages
  - Increased in R&D and Innovation
  - Direct added benefits like financial inclusion, stability and other linkages
  - Partner capacity and effectiveness etc.

- **Meso**
  - Quality level and percentage of the population with knowledge
  - Type and percentage improvement of quality of life, health and livelihoods
  - Community ownership, champions and empowerment
  - Resulting outcomes of added benefits (bankability, access to information)
  - Policies influenced, catalyzing ecosystem creation for other services and opportunities etc.

- **Macro**
  - Social
  - Economic
  - Environmental etc*

* (civic, equity, perceptions etc can be others depending on sector)

Table 5: Example of outputs measured and levels of outcomes that need to be measured.

Each of the parameters (A-J) in the previous section can be linked with the three levels micro-level, meso-level and macro-level categories defined below:

### 8.2.1 Micro or immediate outcomes

Micro outcomes, conducted at a user or individual level, are the bare minimum outcome metrics that can be evaluated without visiting the field, i.e. based on data collected through remote questionnaires or added questions to existing data gathering or
feedback collection mechanism that the social enterprise already carries out through internal processes (like sign ups forms, service reviews, internal record keeping efforts etc.). Baselines could be set for every outcome parameter, which can be calculated along with the output data. To elaborate on a few micro outcome examples:

- **Increase in knowledge and awareness, reverse marketing** [192]: can be evaluated by analyzing ways (channels and methods) in which inquiries are generated, sales are completed or services are accessed.

- **Improved Health, well-being, safety and security, education or livelihoods**: These can be evaluated by determining standard or potential impact that the intervention is designed for. By using parameter ‘A’ it can be evaluated through a user feedback loop. Defining ‘A’ accurately for this criterion is extremely critical. The feedback loop would give a fair idea of the outcome return i.e only at a micro level. (Fluctuations and actual effectiveness can be determined only through a meso evaluation [see next section 8.2.2].)

- **Increased Aspirations and motivations**: can be measured by identifying what are the other, new or further requirements that existing users want/ request for after owning the system or service provided by the enterprise. This would mean introducing platforms or opportunities to generate or identify- the new inquiries post availing the system or service. (However, the micro level will only give you data weather there is a positive change in aspirations and motivations of the users (along with the degree of the change) and not as to weather those aspirations and motivations can be or are being met - only a macro level evaluation would provide that [see next section- ecosystem development].

- **Quality of jobs provided and reverse linkages** [193]: These parameters can be determined through employee feedback and involvement levels (by analyzing internal meetings minutes, employee reviews etc.) as well as background of new employees. The more the evidence of inclusivity better the ratings of the organization.

- **Increase in R&D and Innovation**: [see section 7.8.1 for guidelines of measurement]. The variables in the R&D can be evaluated based upon quantification of parameter ‘D’. Data can be attained via new technology, process, finance or business model innovations adopted or piloted by the enterprise.
• Direct added benefits like financial inclusion, stability and other linkages: These can be evaluated via the new partnerships created, types and engagement of partnerships.

Quantifying micro level outcomes would mainly depend on the outputs captured. Once a process is developed, conducting and preparing a micro outcome report and quantifying the return should be possible to evaluate and monitor by an individual from any background with very little training. These evaluations should be part of the responsibilities of evaluators, concentrating on financial returns, to also start institutionalizing social returns.

8.2.2 Meso-Level or community level outcomes

Meso outcomes, conducted at a community level, ideally require an external evaluator with field experience and should be conducted with high level of community engagement. Meso-level outcome evaluations can use any of the social impact assessment methods (PRA, control groups, stakeholders discussions etc. [refer to section 3.6.1]). Community level outcomes are, for the most part, a nuanced, consequential, qualitative and comparative outcome of the relevant parameter and micro level outcome. The outcomes can be evaluated across:
• Quality, level and percentage population with knowledge
• Type and percentage improvement of quality of life, health and livelihoods
• Evidence of community ownership, champions and empowerment (stability, vulnerability and social capital evaluation)
• Resulting outcomes of added benefits (bankability, education levels etc.)
• Policies influenced
• Catalyzed ecosystem creation for other services and opportunities to thrive
8.2.3 Macro Outcomes

Based on the meso-level evaluation the evaluator should be able to benchmark the progress with macro-level goals (once defined and quantifies, the parameters and micro and or meso outcomes that connect to each macro outcome can be determined:

- Social: true inclusivity in which the poor become integral part of the system (from decision making to implementers) and efforts are recognized on the basis of passion and work/experience but not on the basis of social, economic pedigree.
- Economic: where the economic divide exists not because of any uneven level playing field but because of individual efforts. Economic sustainability is no longer defined in a closed form but in a holistic manner.
- Environmental: There is a net zero impact on the natural resources of the earth because of all intervention that is done in the name of well-being, health, education and livelihoods: growth of human species should not be in conflict with other living species (animals and plants).

As mentioned in the outcome document of the United Nations Conference on Sustainable Development 2015: “Sustainable development strategies need to be inclusive and take special care of the needs of the poorest and most vulnerable. Sustainable development strategies need to be inclusive and take special care of the needs of the poorest and most vulnerable.” Strategies need to be ambitious, action-oriented and collaborative, taking into account different circumstances [195].

“Metrics can do one of two things: They can tell you what you should do, or they can tell you what you should have done. If you use them to tell you what to do, you’ll be using them to measure your successes. But if you use them to tell you what you should have done, you’ll be using them to measure your failures. So clearly it’s the first approach, not the latter, that forward-thinking companies should focus on. [194]”

Holistic Value Chain Assessment at this stage is a concept along with guidelines across all aspects before and beyond Life Cycle Analysis, it aims at catalyzing and measuring
more successes by using an integrated approach to inform impact investors on social returns based on outcomes. Before LCA aspects include product type, motivations, organizational structure etc. and beyond LCA aspects include policy, regulation, outcome evaluation etc.

8.3 Type of Social or Impact-Driven Enterprises in Developing Countries

Energy Access and more specifically Decentralized Renewable Energy (DRE) which refers to a wide range of sustainable energy solutions implemented efficiently at individual, group or community levels, within the thesis is used a specific sector and case to illustrate the direction of holistic value chain assessments. DRE enterprises work across local, organizational, business, community, state and national or global levels [fig 10]. To make a significant dent towards reducing climate change and ensuring
Sustainable Energy for All [196], impact investors, invest in improving energy access metrics showing in figure ... across the various levels and output metrics. To ensure that energy access reaches people in a socially, financially and environmentally sustainable manner, social enterprises and impact investors continually work towards defining, understanding and implementing solutions in different parts of the developing world. Impact investors can invest in Clean Energy Driven Enterprises that have the following areas of focus [also discussed in section 6.4.2]:

(i) Energy Efficiency

Vastly increasing energy efficiency has a role to play in providing both sustainable energy and expanding energy access. The global economy is expected to grow over the period to 2030, and with this growth, energy demand and consumption will also vastly increase. Much of the increase in consumption will come from developing economies, accompanied by significant additional greenhouse gas emissions, with potentially devastating impacts from climate change. Energy efficiency measures, however, could deliver up to 57 percent of the most cost-effective greenhouse gas reductions needed by 2030 to avoid the worst consequences of climate change.[197] The UN has set a target of a 40 percent reduction in energy intensity by 2030, and energy efficiency will play an important role in meeting this target. Energy-efficiency technologies and techniques could be better deployed and more widely used. Many energy-efficient technologies and appliances, especially those that save energy on the demand side, can be implemented at negative cost. These include efficient lighting, residential appliances, and equipment. For low-income persons and micro-small businesses, most energy appliances are for cooking, heating/cooling (a fan), lighting, and where possible, refrigeration. Other examples of Energy Efficiency also include built environment or architectural solutions like insulation, natural lighting and ventilation etc. Energy efficiency can play a role: high-quality compact fluorescent lamps are more four to five times more energy efficient than incandescent lamps and have a longer lifespan. Their deployment can thus provide quick results for mitigating climate change.
However, while the potential for energy efficiency to provide fast economic and climate benefits is widely recognized; currently, it is vastly underutilized as an energy resource and climate-change mitigation technology. Challenges include general inertia and lack of individual awareness, economic incentives that promote consumption of energy rather than its limited use, and an inability for many developing countries to design the needed financial and regulatory enabling environments.

Thus, increasing the efficiency of energy supply and energy appliances can have a direct affect on energy access by reducing the poor’s need for energy. It also can indirectly benefit them by leading to more reliable electricity supplies, more efficient use of the supplies and more efficiently run utilities, all of which can potentially lead to more efficiently run utilities, and increased revenue for expanding access. Overall, in developed countries, it contributes to carbon reductions as well as economic efficiency.

(ii) Renewable Energy

The use of renewable energy sources to supply energy to traditional electricity systems and new distributed systems of generation, including micro, mini, and other off-grid sources of energy, will play an important role in providing low-carbon solutions to expanding access. The UN has set a target of renewables sources supplying 30 percent by 2030.

Renewables offer environmental benefits by displacing fossil fuel use. They also provide economic and social benefits by reducing a nation’s overall need for imported fossil fuels, and increasing its reliance on local sources, thus enhancing energy security. They are particularly important because they present decentralized solutions to expand rural access, and in so doing offer important social benefits such as improved health, from reduced indoor air pollution, and improved education, from better lighting.
The renewable energy sector investment has grown significantly over the past decade. In 2010, renewable energy accounted for approximately half the new global electricity capacity, while comprising about a quarter of total global power generating capacity. However, there are still many barriers, including weak policy and regulatory frameworks, large subsidies for fossil-fuel use, and financing.

(iii) Cleaner Cookstoves and Fuels for Cooking and Heating

Cleaner cookstoves can avoid exploitation of fuel-wood from natural ecosystems, have reduced GHG emissions, and can avoid smoke-inhalation and related respiratory illness and death, whilst providing the basic energy service required for cooking and heating. Many call cleaner cookstoves “low-hanging fruit,” as they can relatively cheaply provide these and related poverty alleviation, gender equality, and other environmental and social benefits. However, investment in cleaner cookstoves has been modest: manufacturers, and shipping and import duties, keep unit prices too high for most of the rural poor to afford. Some have found, however, that Certified Emissions Reduction credits can help fund cookstove projects, and some governments and nonprofit organizations have been actively supporting cookstove production. However, the market potential for private-sector mass-production of cheap clean cookstoves, and distribution through existing rural distribution networks and channels, such as those currently used for other BOP distribution, is significant.

(iv) The Water, Food, and Energy Security Nexus

Access to energy is related to other vital human needs. Energy resource issues are often considered in isolation, yet increasingly sustainability compels the need for integrated solutions. Climate change will compound stresses on global supplies of water, energy, and food. By 2030, global water demand will exceed supply by 40 percent, while 67% of people will live in high water stress areas. In 2025, global demand for energy will be 40% higher than current supplies. In 2050, global demand for food will be 70% higher than currently.
Water security, food security, and energy security are interrelated: energy is needed to pump water, to operate agricultural equipment, and to transport food to population centers; water is needed to extract and transport some forms of fossil fuel, to produce electricity from hydropower and to cool thermal power plants; while it is also needed for agriculture to produce food. Thus, greater efficiencies in all three industries contribute to more effective and efficient resource use in the other. Policies and projects that concurrently consider the energy, water, and food sectors are needed. For example, agriculture could be an “anchor” electric load that could provide the business model to justify a renewable mini-grid in a rural area, that could also serve the local community’s basic needs. Reduced carbon footprints in crop production or animal husbandry practice by less water and energy intensive practices is needed. Solar-powered surface and bore water pumps or pumping water from wells and rivers to villages for domestic consumption and irrigation of crops can be an appropriate alternative to diesel pumps. [199] Considering the water, food, and energy nexus, may reveal additional social business opportunities.

9. Conclusion

The fragmentation of socio-economic and environmental issues has been an error over the past hundred years considering the direct impact of climate change on the world today and in the future [200] [201]. Peter Senge describes this through ‘systems ignorance’ [211]- no individual, business or nation intends to produce suffering or bad outcomes for human beings and the planet.

Even if we shift all fossil fuel consumption to clean energy, which is a vital step, our economic operating system that demands ever-increasing infinite levels of extraction, production and consumption by definition, prevents us from preserving the planet in its present state [202] [210]. Hence, it is important to rethink how businesses are structured. Holistic Value Chain Assessment is an attempt to ensure that social enterprises and impact investors are aligned towards socio-economic and
environmental sustainability. *Our Common Future* (WCED, 1987), or the ‘Brundtland Report’ as it is commonly known, marked a profound change in attempts to connect biophysical or environmental, social and economic policy goals. In the years since its publication, there has been a plethora of literature devoted to the general topic of sustainable development but, arguably, a blurring of focus: there are urban sustainability, sustainable management, environmental sustainability, weak and strong sustainability, or just ‘sustainability’, with debates occurring within and between each [203].

Multiple organizations large and small recognize that sustainable development can only become a path, once the social, environmental and economic sustainability are addressed in the true form. However, the prioritization and balance of the three, are often a result of conflicting development models or areas of focus.

The same conflict within impact investors, gives rise to different terminologies of ‘finance first’, ‘impact first’, ‘user driven’ or ‘scale driven’ impact investors. The document post the United Nations Conference on Sustainable Development [195], provides guidance for achieving the transition to sustainable development as a means of increasing the well-being of current and future generations in all countries, it specifically emphasizes on: sustainable development strategies that need to be inclusive and take special care of the needs of the poorest and most vulnerable. Since both private and public impact investments play a key role in this strategy[204], aiming towards an outcome-oriented strategy with focus on all stakeholders and the end user being served through it, is paramount.

“The world is on the brink of a revolution in how we solve society's toughest problems. The force capable of driving this revolution is ‘social impact investing’, which harnesses entrepreneurship, innovation and capital to power social improvement [204].”
Being able to measure the outcomes of social entrepreneurship and social innovation as an evaluation of progress or impact, one could move towards an improved and coordinated impact investing framework.

Holistic Value Chain Assessment is a concept in that direction. It is proposed in this thesis from the lens of developing countries and decentralized renewable energy. A staggering 71 percent of the world population now lives in countries with a dual-challenge: ecological deficits AND lower-than-world-average income. That percentage was less than 15% in the 1960s. Mathis Wackernagel, president of Global Footprint Network opined, "Putting natural resource security squarely into the development equation will be essential to ensuring that sustainable development is achieved." But while designing or analyzing these solutions that are aiming to be socially, financially and environmentally sustainable businesses, it is important to learn from the efforts of social enterprises and impact investors over the past few decades. Having a very high carbon offset score from a use case perspective, without calculating the environmental harm across the life cycle or a product or service, defeats the core value of environmental sustainability. On the flip side, having an extremely environmentally sustainable product across all the phases of the lifecycle, but without a high desirability and adoption factor, wouldn’t count as an effective solution. Similarly having an extremely environmentally positive supply chain and a business model or capital structure that treats labour as a commodity, business as a piece of property and is designed to truly benefit only a few shareholders and extract as much as possible from other stakeholders doesn’t stand the test of financial sustainability (which is different from maximizing financial gain). Aspects of quality, life and cost also directly alter the environmental impact of the solution. Even if an enterprise has the most environmentally sustainable solution the delivery model, type of capital, organizational structure etc. needs to be designed such that they can encompass social and financial sustainability. Hence aspects of social, financial and environmental sustainability need to be evaluated across type of products sold / services provided by enterprises, type of target segments and motivations, type delivery model, type of capital and type of organizational structure and human resources for a true life cycle analysis of an enterprise.
While solving issues of poverty, injustice, inequality as well as climate change practitioners cannot afford to look at specific parts of the problem in isolation as the design, technical, business and ecosystem related challenges (human resources, policy, innovation etc.) are directly connected to the success and scale of the enterprise and the outcome of the solution.

By building and investing in companies that rank higher on the holistic value chain assessment the aim is to provide a path way for social or impact driven enterprises to remain true to their vision of raising capital and working for improving society and the planet and not working for the capital itself. It deserves re-emphasizing that in the final analysis, differential tax treatment of investment capital and profits from impact-investing needs to be addressed head-on in order that social value and financial value are synchronized in a way that rewards improving social outcomes. This requires a conscious political commitment to achieving sustainable outcomes for the developing countries and for the poor.


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Recent estimates by the Government of India reveal that fuel and light expenditures for the urban and rural poor are the third highest expenditure after food and health. Level and Pattern of consumption expenditure, 2009-10, NSSO 66th round.


library/Poverty%20Reduction/Inclusive%20development/Humanity%20Divided/HumanityDivided_Full-Report.pdf>.


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