DECODING ENERGY ACCESS CHALLENGES THROUGH ENERGY INNOVATIONS INTEGRATING ATTAINMENT OF UN SDGS

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Energy Access Issues

1. Energy access issues leading to energy poverty can have deadly consequences.

2. Approximately 3 billion people cook and heat their homes using open fires and simple stoves burning biomass (wood, animal dung, crop waste) and coal.

Energy Access Issues

"Energy poverty remains a barrier to economic well-being for such a large proportion of humanity that the rationale for action now is compelling."

Energy Access Issues

"Renewable energy technologies such as solar panels, wind turbines and small-scale hydro plants can generate power on a smaller scale – and these technologies promise to bring power to rural, highly impoverished places without the need to invest in a huge central grid."

Energy Access Issues

"But Nathwani UW observes technological innovations are not enough on their own – because solutions must ultimately be adopted in the cultural context of the way people live their lives."

Decoding Energy Access - CHALLENGES

1. The Social Value of Energy
2. Socio-Energy Systems & Enterprises
3. Energy Innovation Ecosystems
4. The Social Value of Energy- Equation

Decoding Energy Access - CHALLENGES
1. The Social Value of Energy

Fundamentally, people don't care about access to green electrons or carbon-neutural fuels; they care about what they can do with that energy

Decoding Energy Access - CHALLENGES
2. Socio-Energy Systems & Enterprises

Socio-technical systems design requires a user-centered approach that configures systems appropriately to facilitate socially valuable energy use

Decoding Energy Access - CHALLENGES
3. Energy Innovation Ecosystems

Energy access can rarely be accomplished or meaningfully scaled in off-grid contexts without also attending carefully to an array of other elements besides energy users and energy enterprises within what can be defined as an energy innovation ecosystem

Decoding Energy Access - CHALLENGES
4. The Social Value of Energy- Equation

$$Social\ Value\ of\ Energy$$
$$= \sum (Economic\ benefits + Other\ non - economic\ benefits)$$
$$- \sum (costs + burdens + risks) - \sum (externalities)$$

Dr.Miller, Arizona State University

ECOSYSTEM CHALLENGES

1. Financial Innovations
2. Technological Innovations
3. Business Model Innovations
4. Policy Innovations

ECOSYSTEM CHALLENGES

1. Financial Innovations	• Including those in the area of micro-finance that enhance and users ability to pay for energy services
2. Technological Innovations	• Including the integration of ICT with energy systems to allow for remote monitoring and maintenance of technology that is highly dispersed
3. Business Model Innovations	• Including partnerships between enterprises and local organizations in the marketing and sales of clean energy products within communities that are skeptical of new technologies
4. Policy Innovations	• Including the introduction of quality standards and certifications that provide a leg up for trusted suppliers of high quality clean energy products

Social Experiment using Cookstoves?

An experiment to evolve a project integrating

Policy

Technical

Financial

Business

INNOVATIONS

Climate Challenge

The global community cannot reach its goals of eradicating poverty and addressing climate change without addressing the way millions of people cook.

"By touching a critical aspect of human life"

- A socially relevant product
  - "10 fixes for the planet" – A Newsweek article by environmental thinkers towards making the planet greener/energy efficient; "Stoves for the masses" one of them.
  - Address at least 5 of the 8 MDGs that the UN is working to meet by 2015.
    - Health, Livelihood, Environment, Gender, Well being

- Shared Concerns
  - 3 Billion households
  - Shared misery; shared aspirations

Economic Challenge

Charcoal Collateral
Charcoal Micro-enterprise
Charcoal co-operatives

"Making BoP credit worthy"

Why slot them as "with fortune" or "no fortune". . Just enroll them in an entrepreneurial process that co-creates

These unhappy times call for the building of plans …. that build from the bottom up and not from the top down, that put their faith once more in the **forgotten man at the bottom of the economic pyramid"**

Social Challenge

They are not just victims of poor technology but a critical component of the sector's ability to scale the economics.

IF – they are given a technology with an economic model around it, they can find their way out of the "energy-poverty-gender" cycle

"One woman entrepreneur per kitchen"

The Product
- TLUD Biomass Gasifier Cookstove-

- TLUD stands for Top Lit Up Draft.
- Most cook stoves are Bottom Lit Up Draft.
- TLUD technology is pursued around the world since it saves fuel.
- is a stove with a canister
- which when filled with fuel (any Dry Biomass waste like twigs, coconut husks, cow dung, Carpentry waste, etc) and combusted,
- will enable cooking for an average of 30 minutes depending on fuel type
- and produces precious charcoal at the end ; can be used for various commercial applications.

TLUD Gasifier Stove
- Key User benefits -

- Pyrolysis technology
- Lower cost of cooking fuel
- Significant saving of Biomass material
- Versatile Biomass possibility
- Low Maintenance
- Faster cooking
- Reduced indoor air pollution (IAP)
- Resultant Charcoal

“Earn While You Cook” Features

- Gasifier Cookstoves – A Certified “Carbon Asset”; eligible for Carbon Credits ☑
- Gasifier Cookstoves Residue– A New Source of Energy
  “Green Charcoal” ☑
- Innovation
  “Green Charcoal”, Unique Business Model ☑
- Proven Economic model ☑
- Measurable Social metrics
  (Energy Efficiency, Livelihood, Deforestation, Wellbeing) ☑
- Scalable, Replicable ☑
- Possibility for R&D and Soft-Skill Interventions ☑

Is not just a cookstove program…

Earn As You Cook

The “Earn while you cook” program with the humble cook stove at its heart, is a triple bottom line economic model that touches three tiers of improvement.

- Economy
- Environment
- Society

Earn As You Cook

- Recognizes an improvement spiral and makes a meaningful contribution to it.
- Shows the potential to provide every community with choices to live the way they like and value what they have reason to value.
- Concurrently, addressing issues of ecological sustainability, distributional equity and well-being in a sustainable manner.

Needs of the poor

- *Saving in fuel cost*
- *Indoor Air Pollution*
- *Safety*
- *Saves time*
- *Better cooking experience*

Needs of the Economy

- *Entrepreneurship*
- *Energy model that calls for close collaboration between producers and local community*
- *Better awareness of global concerns*

Needs of the Planet

- *Energy conservation*
- *Green energy generation*
- *Climate Change*

The Call for Cooking Energy Solutions -Some Declared Statistics -

- **Address at least 5 of the 8 SDGs that the UN was working to meet by 2015.**

Climate Change : Clouds of Pollution

- Carbon dioxide, Methane and nitrous oxide present in biomass stove emissions
- Apparently 25% of the problem of carbon emissions is caused by stoves

Indoor Air Pollution: Health Risk

- Fourth leading health risk in developing countries.
- Premature deaths - estimated 4.3 million people each year ; women and children most affected.

Deforestation: Cooking with wood a significant cause

- Annual consumption of wood - 34% of wood harvested from the world's forests.

Source (http://www.aprovecho.org)

Global Mandates; Not Just Needs

Highlights of Sunderban Project - I

- For the User – Community of 5000 TLUDs
  - Saves 208 kg per months per HH (2.5 tonnes per year)
  - Improved health due to lower indoor air pollution.
  - Easy cooking
  - Faster cooking.
  - Charcoal Income (almost 5000 RS per year)
  - Its environmental benefits do have a direct impact on the improvement of livelihood of users

Highlights of Sunderban Project - II

- For the community – Cluster of 5000 TLUDs
  - Energy savings (wood and charcoal).
  - Direct impact on the environmental situation in project area
  - Working together with local community and raising awareness of pressing environmental problems.
  - Positive Climate Change - Lower CO2 emission.
  - Better quality of life to rural and urban poor, especially for women and children

Highlights of Sunderban Project - III

- Environmental Impact - Cluster of 5000 TLUDs
  - 87500 tonnes of wood saved in 7 years; equivalent of a 437 ha forest in 7 years
  - CO2 savings of TLUD compared to baseline stove are 50%
  - 25% of wood is converted to charcoal
  - Each stove is saving up to 2.5 tons CO2
  - User need less than up to 50% wood for cooking than cooking with their traditional woodstoves
  - It reduces deforestation in the project Area

ACKNOWLEDGEMENTS

- THE SUNDERBAN PROJECT HIGHLIGHTS HAVE BEEN PROVIDED BY SERVALS,CHENNAI , INDIA AND WE THANK THEM FOR SHARING THE INFORMATION AND EXPERIENCES

Profiling the Residue

High Grade Charcoal

What is the big deal about TLUD charcoal Vs. Conventional Charcoal

- Conventional charcoal requires in average 6 kg of wood to produce 1 kg of charcoal. In the TLUD, it is produced as a by-product when cooking, so no additional wood is needed.

- Thus 1kg of TLUD charcoal saves 6 kg of wood - corresponding to approx. 7 kg of CO2.

Cookstove Charcoal is "Green Charcoal"

Why is it "Green" Charcoal..

TLUD charcoal production	Conventional charcoal production
• Probability of Charcoal yield is high	✓ Probability of charcoal yield is low
• Better utilization as cooking also takes place during char production	✓ The heat produced during charcoal production goes wasted
• Sorting of quality and sizeable char is easier in TLUD	✓ Sorting of quality and sizeable char is cumbersome
• Impact on environment sustainability is in positive sense	✓ Impact on environmental sustainability is greater in a negative sense
• Uses waste wood for charcoal production	✓ Encourages rampant agro forestry
• Encourages community participation in charcoal production and drives equal revenue distribution among the households.	✓ Kiln is owned by the land owner and the revenue from charcoal production goes to a single individual.

Profiling the TLUD Charcoal

High Calorific Value	6980kCal/kg
Low sulphur content	0.01%
High carbon-to ash ratio	Fixed Carbon 76%; Ash <6%
Low Inorganic Impurities	Mineral content as low as 6.5%
High Surface area	Iodine value 1200 mg/g; Methelyene Blue 124 mg/g

- Despite doing a convincing – and carbon-neutral – impersonation of a 'fossil fuel', charcoal is largely neglected in the developed world.
  - Used really only for cooking and heating

Sustainable substitute for coke, petroleum coke, lignite and coal.

Sustainable Small Scale Industry…

- **What is sustainable production**
  - The process must be sustainable
  - Have minimum Environmental Impact

- **FAO's definition of improved charcoal production**
  - 1t of charcoal from 3.5t of wood (current processes consume 4.5 t of wood)
  - TLUD charcoal yields one tonne of charcoal from 5 tonnes of wood; with 3000 hours of thermal power for cooking

- **Simple production process**
  - Actually one of our oldest human skills.

Widen the Economic Power
- Drive Affordability down to the BOP-

Household Charcoal is “Sustainably Produced” charcoal

- Well – the ‘right’ type of production of charcoal is a choice
  - Depends on the balance between social, economic and climate perspectives.
- Traditional and industrial charcoal making have been given the choice
  - have not found it
- Perhaps it is time to explore the “household charcoal making” production method –
  - as a way to strike the right climate, economic and social balance.

52 Uses of Biochar

Animal Farming

1.Silage agent

2.Feed Additive/ Supplement

3.Litter additive

4. Slurry Treatment

5. Manure composting

6. Water treatment in fish farming

Biogas production

21. Biomass additive

22. Biogas slurry treatment

Soil conditioner

7.Carbon fertilizer

8. Compost

9. Substitute for peat in potting soil

10. Plant protection

11. Compensatory fertilizer for trace element

Waste water

23. Active carbon filter

24. Pre rising additive

Building sector

12.Insulation

13.Air decontamination

14.Decontamination of earth foundations

15. Humidity regulation

16.. Protection against electromagnetic radiation

Waste water

25. Soil substrate for organic plant beds

26. Composting toilet

Decontamination

17. Soil additive for soil remediation

18.Soil substrate

19. A barrier preventing pesticides getting into surface water

20. Treating pond and lake water

Drinking water

27. Micro filters

28. Macro filters in developing countries

Other uses

- Exhaust filters (29. Controlling emissions, 30. Room air filters)
- Industrial materials(31. Carbon fibers, 32. plastics)
- Electronics (33. Semiconductors, 34. batteries)
- Metallurgy(35. Metal reduction)
- Cosmetics (36. Soaps, 37. Skin cream, 38. therapeutic bath additives)
- Paint and coloring (39. Food colorants, 40. Industrial paints)
- Energy production (41. Pellets, 42. Substitute for lignite)
- Medicines (43. detoxification, 44. carrier for active pharmaceutical ingredients)

Textiles

- 45. Fabric additive for functional underwear
- 46. Thermal insulation for functional clothing
- 47. Deodorant for shoe soles

Wellness

- 48. Filling for mattresses
- 49. Filling for pillows
- 50. Shield against electromagnetic radiation

Biodiversity

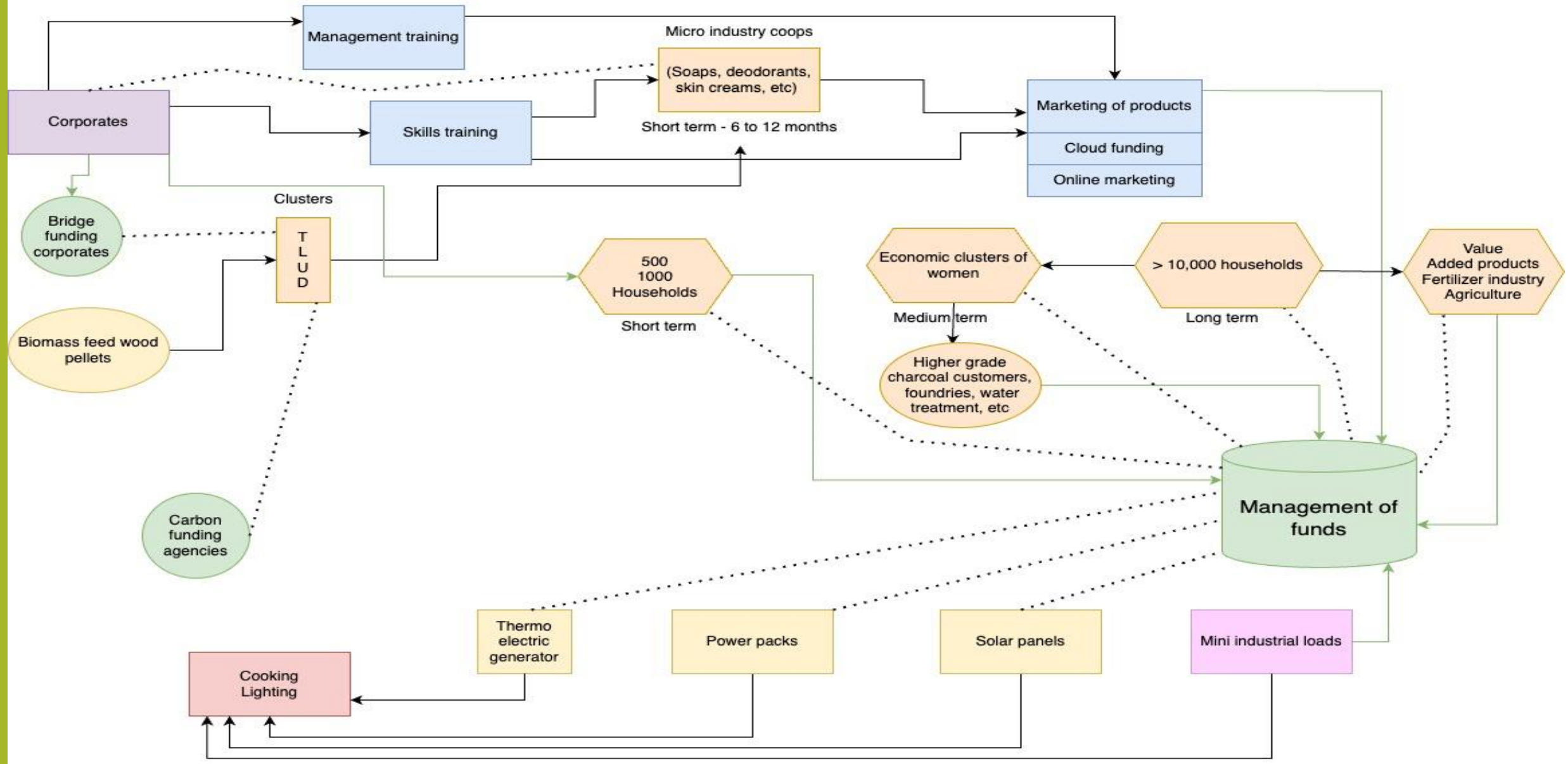
- 51. Microbe
- 52. Earth worm

Source: http://www.ithaka-journal.net/55-anwendungen-von-pflanzenkohle?lang=en

“Earn While You Cook”

Recommended Operational Roll-out…

OFFGRID ENERGY INNOVATION - ENERGY CREATION BY THE HOUSEHOLDS - ECOSYSTEM



EYC's Recommended Operational Rollout

Recommended value Chain **Short Term**	Short-term is defined as the tenure required to "pay-back" the full price of the stove under the program. Price Estimated CAD 60 each	• This tenure is usually between 6-12 months depending on the financing struture of the program. • Charcoal Collateral (So that the charcoal money can be adjusted against the installments of the stove)

EYC's Recommended Operational Rollout

Recommended Value Chain **Medium Term**	Medium is defined as the tenure during which the "Charcoal Value Chain" matures into a reliable and consistent source of highgrade charcoal to large offakers of charcoal (Typically industrial applications such as foundry).	• This tenure is like to be 12-18 months depending on the pace of scale-up • 'Charcoal co-operatives' which are essentially community clusters organized into 500-1000 households who provide unprocessed or minimally processed charcoal residue.

EYC's Recommended Operational Rollout

Recommended value Chain **Long term**	Long term, in this case, does not replace the medium term, but takes root in the medium term in communities that are showing potential to tap other applications for charcoal that require processing and value-addition.	• Charcoal Micro-enterprises, which are essentially economic clusters of women organized into production clusters to produce value-added products around charcoal such as personal care items, fertilizers, incense sticks, dairy consumables, industrial effluents treatment, waste management catalyst etc.

Earn While You Cook Program – Linkages for a Sustainable Movement

Charcoal is the residue of a cooking session with Top Lift Up Draft (TLUD) biomass gasifier cookstove. When monetized, this residue becomes a livelihood option for low income households, while also opening up other avenues for downstream economic activities around charcoal - starting to make the residue look like a meaningful source of new energy.

Earn While You Cook Program – Linkages for a Sustainable Movement

The “Earn while you cook” program with the humble cookstove at its heart, is a triple bottom line economic model that touches three tiers of improvement. It recognizes an improvement spiral and makes a meaningful contribution to it. It shows the potential to provide every community with choices to live the way they like and value what they have reason to value, while still addressing issues of ecological sustainability, distributional equity and well-being in a sustainable manner.

Corporate Community Handshake

Corporates, particularly through their emphasis on Social Responsibility and CSR Programs have a gateway to enable a corporate-community partnership in building sustainability movements in many communities. A corporate's environmental and social behavior as well as its financial performance, to a larger extent can be determined from the character of its CSR investment. CSR is also emerging as an important instrument in the struggling sector of developmental finance and is set to play a very critical role in working towards and achieving the Sustainability Development Goals that the whole world is striving towards.

Corporate Community Handshake

- Public Private Partnerships are increasingly being seen as a viable, feasible and sustainable growth model for building a “People-Profit-Planet” economy.
- Often the key to catalyzing such a growth model is finding the “Right Starting Point” in a community – so that it represents the optimum start to the improvement spiral that will straddle the household, the community and the planet.

The Corporate Success Story

- The Corporate Involvement in the program will benefit from a guided “vision, mission and goals”
  - Because of the emphasis on climate protection technologies
  - Because of the rigour that the monitoring of such projects bring in
  - Because of the ability to report on the “fund use” in terms of an internationally recognised metric
  - Because of its ability to engage at a deeper level in the project, thus enhancing the corporate participation towards social commitment.
  - Because of its ability to provide a platform for its own employees to volunteer and show their social commitment; besides providing the HR team with an avenue to host and promote capacity building and training programs

The Corporate Success Story

- **“People-Planet-Profit”** economy
- It requires several “messiahs” - particularly those who are able to support the project with “patient capital” during the initial gestation period it to start fulfilling the social-economic-environmental agenda that it embodies.
- ***It provides an effective starting point for building sustainable communities for corporates that are keen on creating triple-bottom-line oriented development models in the social sector.***

Earn as a cook Experiences

Earn as you cook initiatives fulfill the vision under the AE4H . We are learning from energy poor communities as well as the innovations that are being nourished in the laboratories of lead universities .The experiences are great catalysts to trigger major innovations and breakthroughs in times to come.

This People-Profit-Planet model can be replicated in other areas of innovation.

THANK YOU!

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References

The Power Shift – University of Waterloo Journal (Spring 2016)

Arizona State University (ASU) – Joint Working Paper – Poverty Eradication Through Energy Innovation