Centre for Energy and Environmental Markets

UNSW

Sustainable PV Energy Service Delivery

Its Potential Role in Strengthening Rural Social Capital and Facilitating Sustainable Rural Development in Indonesia

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Research Project Description and Methodology

Research Description

A combination of Social and Engineering research featuring qualitative survey work

Research Topic

How PV Energy Service (PVES) can play a sustainable role in strengthening rural social capital and facilitating sustainable rural development in off-grid applications in Indonesia

Research Objectives

1. **To understand to what extent the existing delivery models of off-grid PVES in Indonesia address the sustainability issues (technical, social, institutional, economic and environmental) assessed through these four lenses: Implementation, Accessibility, Availability, Acceptability (I3A)**
2. **To understand to what extent appropriate delivery of off-grid PVES can strengthen rural social capital and facilitate SRD in Indonesia**

Research Methodologies

Literature research, Secondary sources, Interviews, Field Research.

Background about Indonesia

- ***Population (2003): 215 m***
- ***Ratio of Electrification: 53%***

The problems in extending the Indonesia's power grid:

- **Geographic/demographic characteristics of the archipelago**
- **High cost of transmission, low level of demand**

Solutions for remote area electrification:

- **Diesel, Mini/Micro hydro generation**
- **PVES (SHS, Hybrid system, specific applications)**

PV power installed since 1980s: 8 MWp; PV technical potential: 900 MWp

Off-grid PVES Applications: Some Positive Findings

- **PVES has been used for supporting economic activities**
  → a measure of PVES acceptance into rural life
- **PVES has been kept as back up power after grid connection**
  → a measure of user satisfaction with PVES reliability
- **PVES users are willing to invest in bigger capacity systems**
  → a measure of user's enthusiasm
- **Some revolving funds have been generated from past governmental projects**
  → a measure of financial sustainability
- **PVES has been installed at refugee barracks in Aceh (post-Tsunami)**
  → a measure of the suitability of PVES use in the disaster risk management (DRM) context

Off-grid PVES Applications: Some Positive Findings

Off-grid PVES Applications: Some Positive Findings

PVES in the context DRM: PVES for street lighting, verandah lighting and communication purposes installed at the tsunami refugee barracks, Aceh, Sumatra Island.

The 3,600t 10 MW diesel barge, swept 4 km inland, Banda Aceh

The washed away distribution cable.

PVES Sustainability Issues

- **Lack of access to finance**
- **Inadequate institutional infrastructure**
- **Inadequate after-sales service**
- **Whether PVES meets the local energy requirements**
- **Existence of indigenous capacity to adopt, adapt, apply and develop PVES to better fit local conditions**

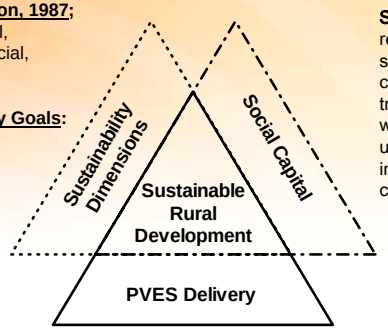
Requirements for PVES Sustainability

- **PVES should be more than a technocratic solution**
- **PVES should strengthen the pre-existing rural social capital (RSC) and facilitate sustainable rural development: utilization & enhancement of RSC**
- **A holistic approach to project design accommodating the interests of all stakeholders is required**

The Proposed Sustainable PVES Delivery Framework: PV in the context of ES, SC and SD nexus – Conceptual Background

Brundtland's SD definition, 1987;
SD Dimensions: Technical, Financial, Institutional, Social, Ecological

The WEC's Three Energy Goals:
Accessibility, Availability, Acceptability



SC is defined as dynamic resources of a community, both structural (organization, union, cooperatives) and cognitive (skill, trust, norms, entrepreneurships), which, subject to its proper utilization, its availability may increase, decrease or remain constant.

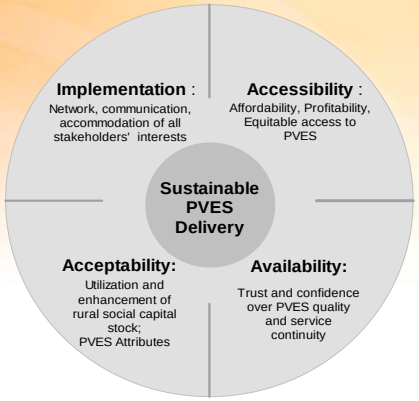
Objectives (Conceptual Level)

Pre-existing Resources & Project Outcomes

Diffusion of Innovation (DOI, Rogers, 1995, 2003):
"The process in which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p5).

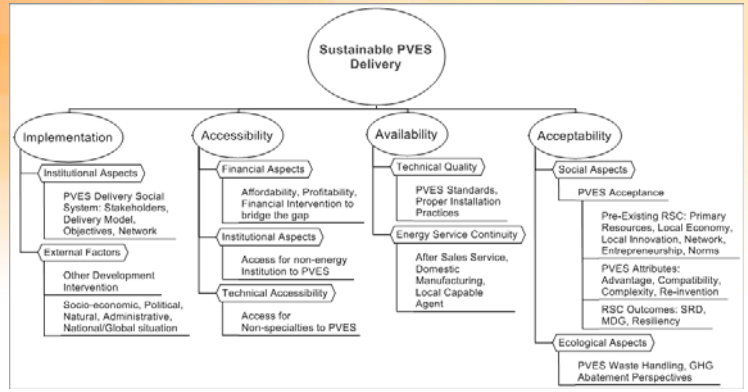
Process and Mechanism (Operational Level)

The I3A PVES Sustainable Delivery Framework



To be sustainable it is necessary that off-grid PVES projects are **Implemented**/delivered in a framework that addresses PVES:
Accessibility (financial, technical, and institutional),
Availability (technical quality and continuity of energy service) and,
Acceptability (social and ecological goals).

The I3A PVES Sustainable Delivery Framework



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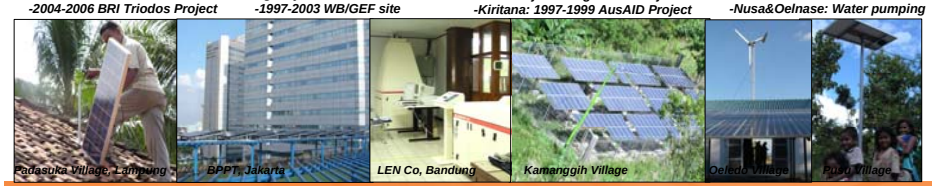
PVES Project Locations Visited

-Organic market sites
-1997-2003 WB/GEF site
-2004-2006 BRI Triodos Project

-Industries, Donors, Research Agency, NGO
-1997-2003 WB/GEF site

-Kamanggih: Water Pumping System
-Pambotajara village: DPE Project
-Kiritana: 1997-1999 AusAID Project

-Oeledo: 1997-2000 E7 site
-Pusu: 2004 DPE-Womintra site
-Nusa&Oelnase: Water pumping



Padasuka Village, Lampung
BPPT, Jakarta
LEN Co, Bandung
Kamanggih Village
Oeledo Village
Pusu Village

Getting to the Field

Case Study 1: The Organic SHS Market in Lampung

Informal Network, characterized by a high degree of trust and close connectedness between the entrepreneurs and clients.

Accessibility: Second hand module transaction; flexible payment terms; SHS without BCR purchase

Availability: Readability of after sales service and spare parts; SHS without BCR practices (self management);

Acceptability:
PVES advantages: Better quality of light for study at night; save children from the risk associated with kerosene lamp preparation;
Re-invention: SHS without BCR practices
Local capacity to deal with PVES
Challenges: Limitation in second hand module availability in the market

SHS in Padasuka Village; SHS outlet, Lampung, April 2005.

Case Study 2: The World Bank/GEF SHS Project

Formal Network

Accessibility: 20% subsidy;
Repayment rate: high (limited to wealthier households);
The project closure has restricted the distributors' ability to provide credit for cutomers;
SHS would be more accessible if marketed at 50-60% of its current price

Availability: Readibility of after sales service and spare parts at local outlets; establishment of SHS standards

Acceptability:
PVES advantages: Better quality of light; support economic activities;

The World Bank/GEF SHS Project in Cirata Dam, West Java, March 2003 and June 2005.

Case Study 3: The E7 PLD Concept

Sponsor: E7; Facilitator: Local NGO;

Formal Network: with the establishment of the village electricity management (PLD);
PLD members comprise of end users, the board members were elected from within the end users facilitated by a local NGO; The rule of the games were defined and agreed in the PLD meeting

Accessibility:
Project investment: fully funded externally;
Users pay some down payment and monthly subscription;

Availability: Readability of technician at PLD office;

Acceptability:
Repayment rate: high
Accompanied with a rural community empowerment program;
PVES advantages: Better quality of light; support economic activities; job creation;
Challenges: the future of energy service when the plant reaches its technical life

The E7 PV-Wind-Diesel (21.8 kWp-10 kW-20kVA) Hybrid System in Oeledo Village (Rote Island), May 2005.

Case Study 3: The E7 PLD Concept - Replication

The Local Government SHS Project in Pusu Village, May 2005:

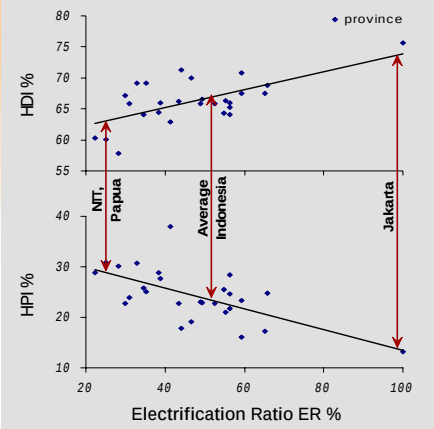
Repayment rate: High; Monthly instalments are paid at the PLD office

Discussion and Conclusion

- Some communities were better able to host PVES projects than others because of the high level of social capital in the community (skill, autonomy, networking capacity) prior to the project. Rectifying failed projects needs to be recommended
- Sustainable delivery of PVES (taking PVES accessibility, availability and acceptability into account) can enhance RSC and facilitate SRD (reduce HPI, improve HDI, improve resiliency) → **positive increment in RSC**
- PVES delivery for the market based and less commercial segments need **different approaches** and different actors that can also be unique for particular setting or situation
- The I3A PVES sustainability examination model proposed in this study offers a holistic approach to accommodate the **interests of all stakeholders**.
- In the detailed discussion this model also covers **PVES attributes** and **technology transfer**; essential components for PVES to diffuse into the local socioeconomic culture, which dictates PVES acceptance
- A practical limitation of this model: it requires a substantial effort to implement in practice.

Many of our publications are available at:
www.ceem.unsw.edu.au

Electrification Ratio – Socio/Economic Develepment

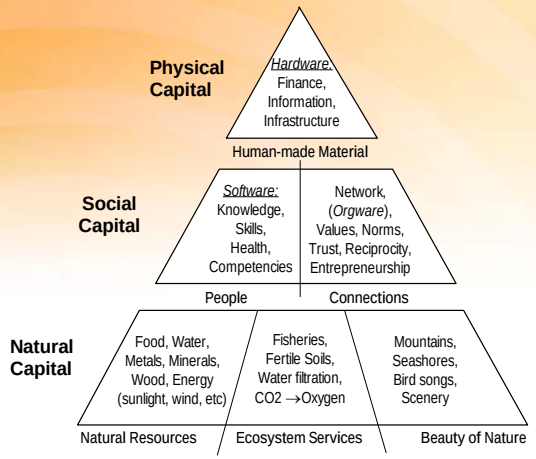


Trends and Correlation of the Indonesian Provincial ER, HDI and HPI

PVES Sustainability Issues

PVES Sustainability Issues

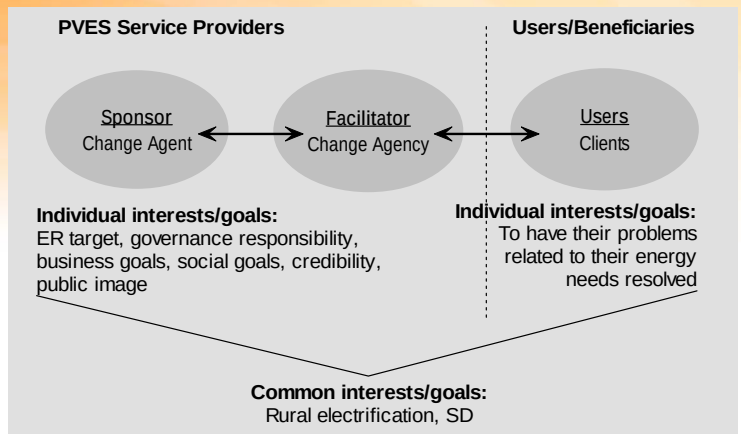
Community Capital/Resources



Social Capital (SC):
Putnam, 2000; Fukuyama, 1999; Coleman, 1988; Bourdieu, 1985; Portes, 2000;
"Features of social organizations, such as networks, norms, and trust, that facilitate action and cooperation for mutual benefit" (Putnam, 2000, p19)

Reproduced from Hart, 1998, with some modifications.

PVES stakeholders, interrelationship and objectives



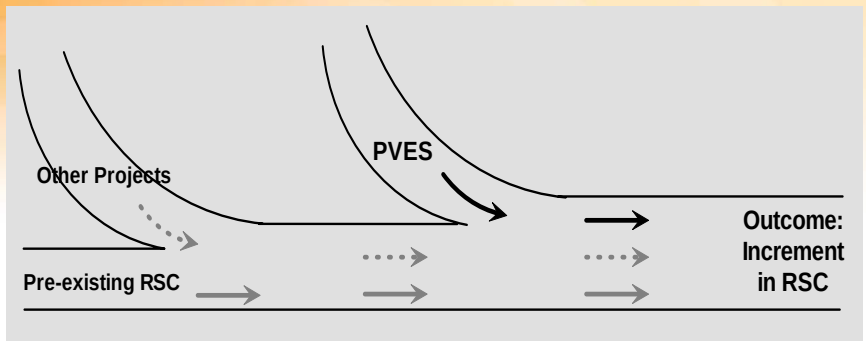
The 120 kW Public-Private Partnership MH in Cinta Mekar Village, West Java

Accommodation of local requirements related to water allocation for the irrigation and MH turbines: A written agreement was made to allocate of no less then 300 litre/second to irrigate the fields, of approximately 50 hectares, prior to the water being channelled to the turbine

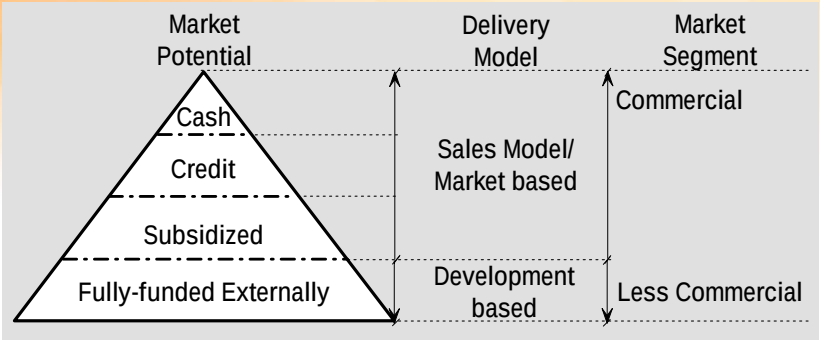
Palmyras Economy

For generations the Oeledo villagers had relied on palmyras (*Borassus Flabellifer*) trees for their subsistence living; the edible fruit, the flower stem for producing sugar, *sopi* an alcoholic drink and medicine, the trunk for producing sago and building shelters, the sap for glue and the leaves for shelter roofs or for making bucket, hats, fans, and other plaiting crafts

Positive Increment in RSC



Delivery Model – Market Continuum



Innovation Attributes: Re-invention

Re-invention: the degree to which an innovation is changed or modified by users in order to solve a wide range of user's problem (Rogers, 1995, 2003).