Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

The I3A Framework – Enhancing Sustainability of Off-Grid PV Energy Service Delivery in Indonesia

ISES-AP 2008 Conference, Sydney, 26/11/08

Maria Retnanestri
m.retnanestri@unsw.edu.au
www.ceem.unsw.edu.au

Improving Sustainability of Energy Service Delivery in Rural Indonesia Using the I3A Framework

Objective – to develop a coherent & consistent methodology to:

- Improve the sustainability of renewable energy service delivery to facilitate sustainable rural development
- Strengthen community governance
- Enhance community resiliency in the face of climate change & energy security concerns

Outline of the presentation:

- Off-grid PV applications in Indonesia: Positive findings & issues
- The I3A Framework – Implementation, Accessibility, Availability, Acceptability – Conceptual background & use
- Conclusions

Off-grid PV Applications in Indonesia: *Some positive findings*

PV & socioeconomic improvement: Improved access to clean water, better quality of lighting, access to telecommunications & infotainment, rural job creation; which altogether can improve HDI, reduce HPI and improve energy security

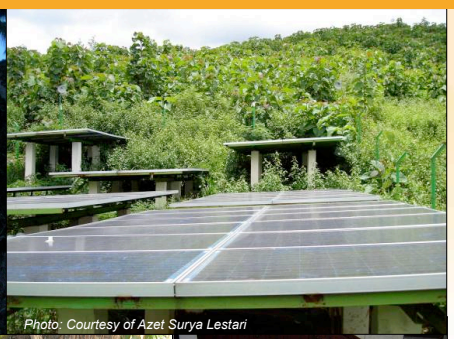
PV use in the disaster risk management, community resiliency, sovereignty & energy security context:

1&3. Aceh (2005): PV for street lighting, lighting at refugee barracks & communications

2. PV installed in a village located near the Indonesian-Malaysian border

4. NTT (1992): PV for communications after the Maumere tsunami

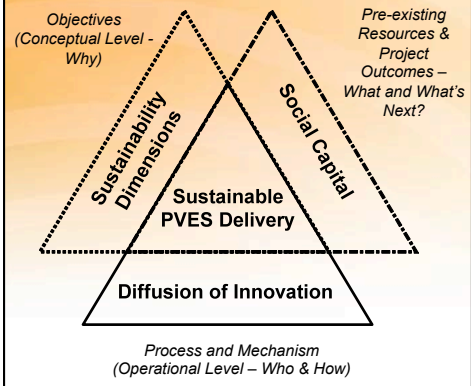
Off-grid PV Applications in Indonesia: *Some Issues*



Beyond project life: Lack of adequate after sales service infrastructure, users "disconnected" from technology, externally derived problems on rural communities, social fragmentation, inadequate PV waste handling

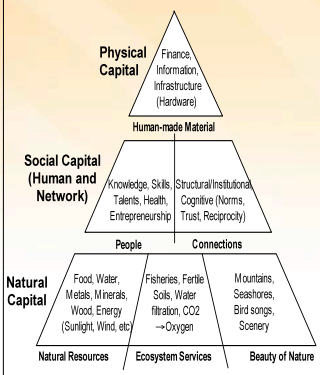
Conceptual background to the I3A Framework

PV in the nexus of Sustainable Development, Diffusion of Innovation & Social Capital



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

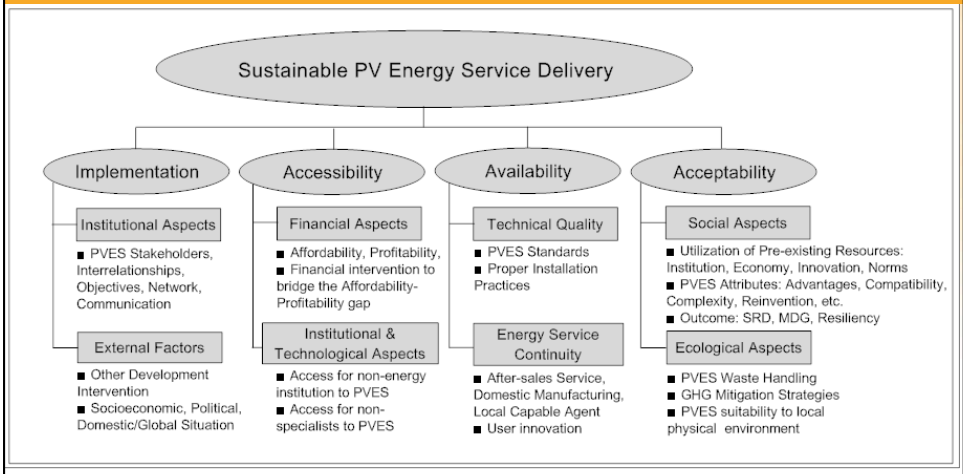
Community Capital / Resources



Reproduced from Hart, 1998, with some modifications.

The I3A Framework & Off-Grid PV in Indonesia 5

The I3A Sustainable PV Energy Service Delivery Framework

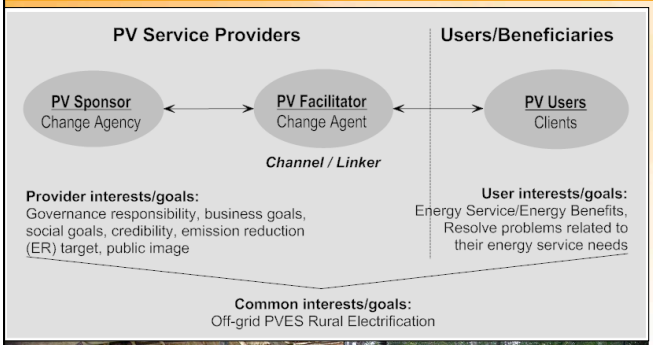


Implementation: Institutional aspects & external factors affecting PV delivery
Accessibility: Financial, Institutional, Technological accessibility
Availability: Technological, Institutional aspects to maintain service quality & continuity
Acceptability: Social (PV Acculturation), Ecological aspects

The I3A Framework & Off-Grid PV in Indonesia 6

Implementation: Process of implementing PV project

Stakeholders, Roles, Interrelationships, Acknowledge all Stakeholders Interests



Facilitator role: Secure PV adoption in the direction deemed desirable by Sponsor, balancing this with Users requirements

Of importance:
- Acknowledge all stakeholders interests
- Promote local governance
- Build end users autonomy

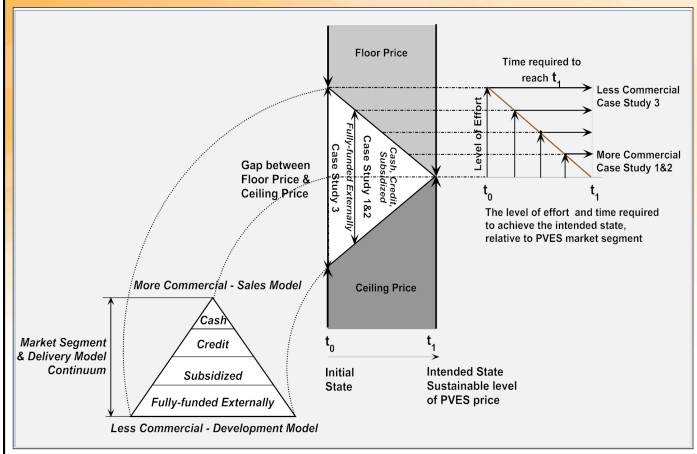
Active involvement of Users: SHS users at Pusu Village meet regularly to elect cooperative board members, define rules of payment, fines, fund management, etc.

Accommodation of local requirements: The 120 kW Cinta Mekar Village MH, West Java. A written agreement was made to allocate at least 300 litre/second to irrigate 50 hectares of fields prior to water being used for electricity generation.

The I3A Framework & Off-Grid PV in Indonesia 7

Accessibility: Equitable Access to PV

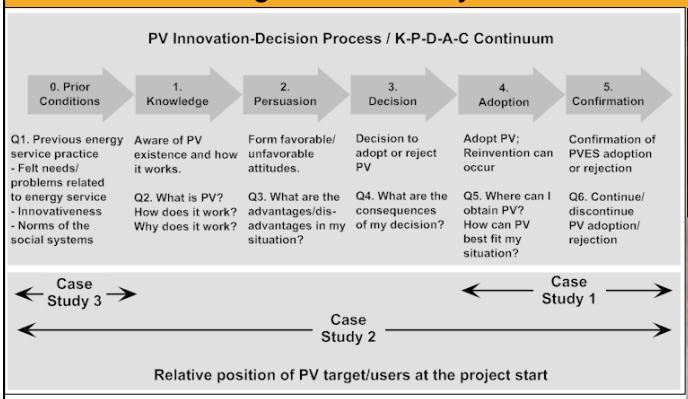
Financial Accessibility: Bridging Affordability – Profitability Gap



Generalization: Need relevant delivery approach for different market segment:
- **Commercial:** Market facilitation to bridge the Affordability and Profitability gap
- **Less-commercial:** Community empowerment; Active adopters rather than passive recipients of innovation/aid; Empower users to be able to become part of the merchant society

The I3A Framework & Off-Grid PV in Indonesia 8

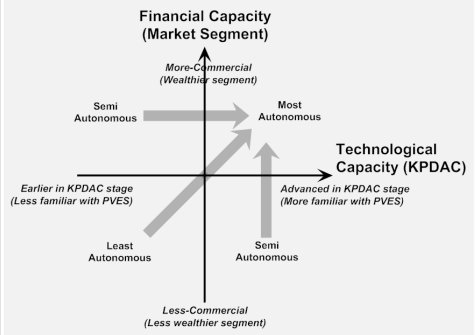
Accessibility: Equitable Access to PV
Technological Familiarity & the KPDAC Continuum

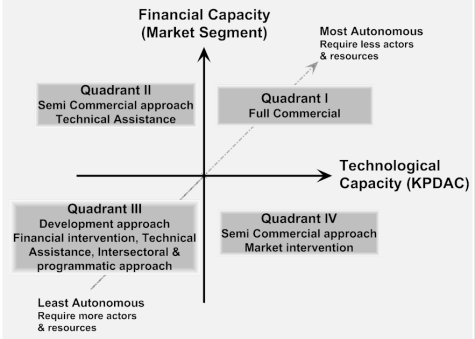


KPDAC Continuum: Facilitators need to understand user position in the KPDAC continuum at project start to facilitate RE familiarity & build user autonomy

Facilitating technological capability: The earlier the position of users in the KPDAC continuum at project start, the greater the level of effort & length of intervention required to facilitate users technological capacity in PV technology

Accessibility: Equitable Access to PV
PV Autonomy as a function of Financial & Technological capacities



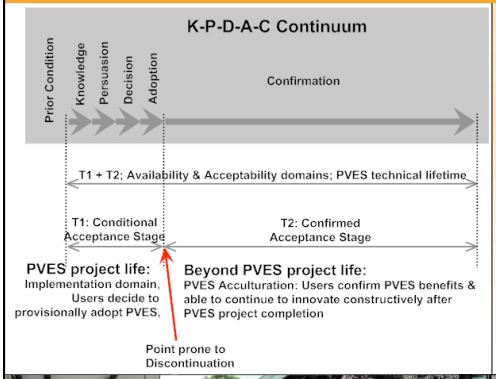


PV Autonomy as a function of Financial & Technological capacities, viewed as a necessary condition for users to actively participate in the PV social system/network/orgware

Facilitators need to be aware of each rural community's economic standing & PV technological capability to promote user autonomy effectively, and to achieve the most desirable state (most autonomous):

- **Quadrant 1:** Most autonomous (investment & PV familiarity)
- **Quadrant 2&4:** Semi to more autonomous
- **Quadrant 3:** Least autonomous (require more actors & financial supports)

Availability & Acceptability
During & Beyond PV Project Life



T1 & T2 Availability: Confidence in PV technical quality & continuity of service (technical standards, after sales service infrastructure)

T1 & T2 Accessibility: Conditional & Confirmed Acceptance → PV Acculturation into local community's life:

- A function of sustainable implementation, accessibility & availability
- A measure of the extent to which PV can improve rural sustainability (solve local energy needs, promote local socioeconomic development) → utilization & enhancement of local community resources
- The nexus of PV attributes & local requirements (benefits, compatibility, complexity, local innovation, reinvention etc)

The I3A Framework & Off-Grid PV in Indonesia 11

Centre for Energy and Environmental Markets

UNSW

Conclusions

- Experience to date shows that the success of rural PV energy projects cannot be taken for granted
- The I3A framework can be used to assess & design rural PV energy projects by applying the following criteria:
  - Implementation: promote a civic PV social system
  - Accessibility: build user autonomy through skills, networks, financing & income generating activities
  - Availability: ensure continuity beyond initial project life by addressing the software & orgware aspects of PV technology
  - Acceptability: approach PV as an enabling technology that should enhance pre-existing local resources

The I3A Framework & Off-Grid PV in Indonesia 12

References

- ADB, 2003, Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement (PREGA) – Indonesia Country Report, www.adb.org
- BPS, 2004, Statistical Yearbook of Indonesia, Jakarta
- CIA, 2008, The World Fact Book, Australia, www.cia.gov
- CIA, 2008, The World Fact Book, Indonesia, www.cia.gov
- ESDM, 2005, Blue Print – National Energy Management 2005-2025, www.esdm.go.id
- Hart, M., 1998, Sustainable Measures – Community Capital, http://www.sustainablemeasures.com/Sustainability/KeyTermCommCapital.html
- IIASA, 2006, What is Technology?, www.iiasa.ac.at
- Nicholls RJ, Mimura N, 1998, Regional Issues Raised by Sea-Level Rise and Their Policy Implications, Climate Research Vol. 11: 5–18, 1998 http://www.int-res.com/articles/cr/11/c011p005.pdf
- Retnanestri, 2007, The I3A Framework – Enhancing the Sustainability of Off-grid Photovoltaic Energy Service Delivery in Indonesia, PhD Thesis, http://unsworks.unsw.edu.au/vital/access/manager/Repository/unsworks:1598
- PLN, 2004, Indonesian Electricity Statistics 2003, Jakarta
- PLN, 2006, Indonesian Electricity Statistics 2005, Jakarta
- Rogers, EM., 2003, The Diffusion of Innovations, Fifth Edition, Free Press, New York
- UNDP, 2004, Human Development Reports, United Nations Development, Project, http://hdr.undp.org/statistics/data/cty/cty_f_IDN.html
- UNEP/GRIDA, 2001, IPCC Special Report on The Regional Impacts of Climate Change – An Assessment of Vulnerability, http://www.grida.no/publications/other/ipcc_sr/?src=/climate/ipcc/regional/300.htm
- WRI, 2008, Electricity Consumption per Capita, http://earthtrends.wri.org/text/energy-resources/variable-574.html