Centre for Energy and Environmental Markets

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A Holistic Approach to Overcoming Barriers to Renewable Energy in Indonesia using the I3A Framework

Workshop: Renewable Energy & Sustainable Development in Indonesia: Past Experience – Future Challenges
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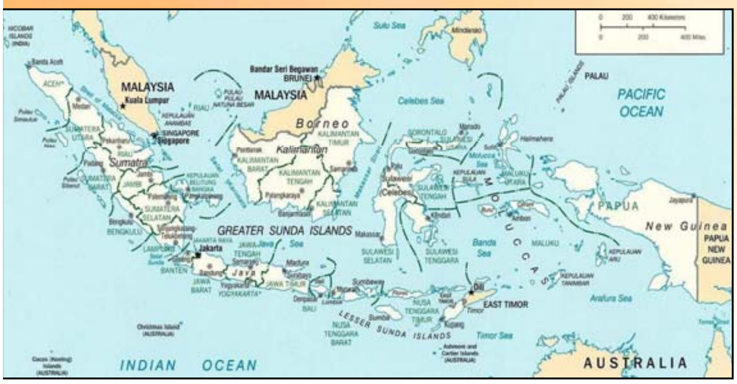
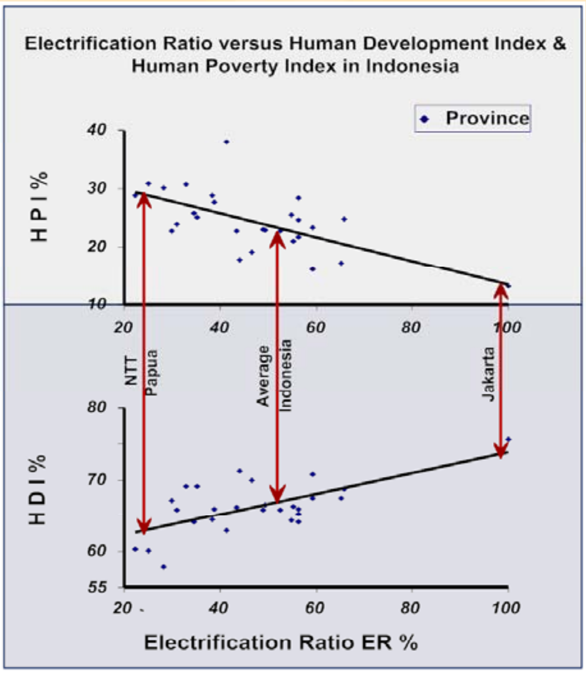
Maria Retnanestri
m.retnanestri@unsw.edu.au

Electrification Ratio & Socioeconomic Development in Indonesia
ER, HDI & HPI Correlation





Population: 237.5 million, **Electrification Ratio:** 60%, **Average kWh/capita:** 536, (NTT- 40; NTT-70; Jak- 2000)
(CIA 2008, PLN 2008)

HDI components: life expectancy, educational attainment and standard of living
HPI components: poor health, illiteracy, access to clean water and earning below a dollar a day

Renewable Energy & Sustainable Development in Indonesia

RE Systems	Technical Potential	Installed Capacity
PV	4.8 kWh/m2/day	>10 MWp
Micro Hydro	460 MW	84 MW
Biomass	50 GW	302 MW
Wind	4 m/s	0.5 MW
Geothermal	27 GW	800 MW

(ADB 2003, ESDM 2005)

Renewable Energy & SD: promote RE domestic industry, local job opportunities, low carbon lifestyle, energy security, mitigation technologies

However, RE decentralized nature requires a holistic approach that considers:

- RE sustainability dimensions: institutional, financial, technological, social, ecological
- RE Hardware: The equipment used in RE systems
- RE Software: The skills & information required to master the use of RE hardware
- RE Orgware: The set of institutions required to develop, implement & maintain RE systems

(IIASA, 2006)

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

Institutional: Building local institutional capacity

Financial: Support local economic activities & income generation

Technological: Create PV domestic manufacturing, provide autonomous power (DRM context: PV for communication & street lighting at refugee barracks following the Dec 04 Tsunami disaster in Aceh)

Social: Improve local socioeconomic situation (clean water provision, better quality of lighting)

Ecological: Reduce kerosene & diesel use, battery charging

→ RE acculturation into local life

Off-grid PV Applications in Indonesia:
Some Issues

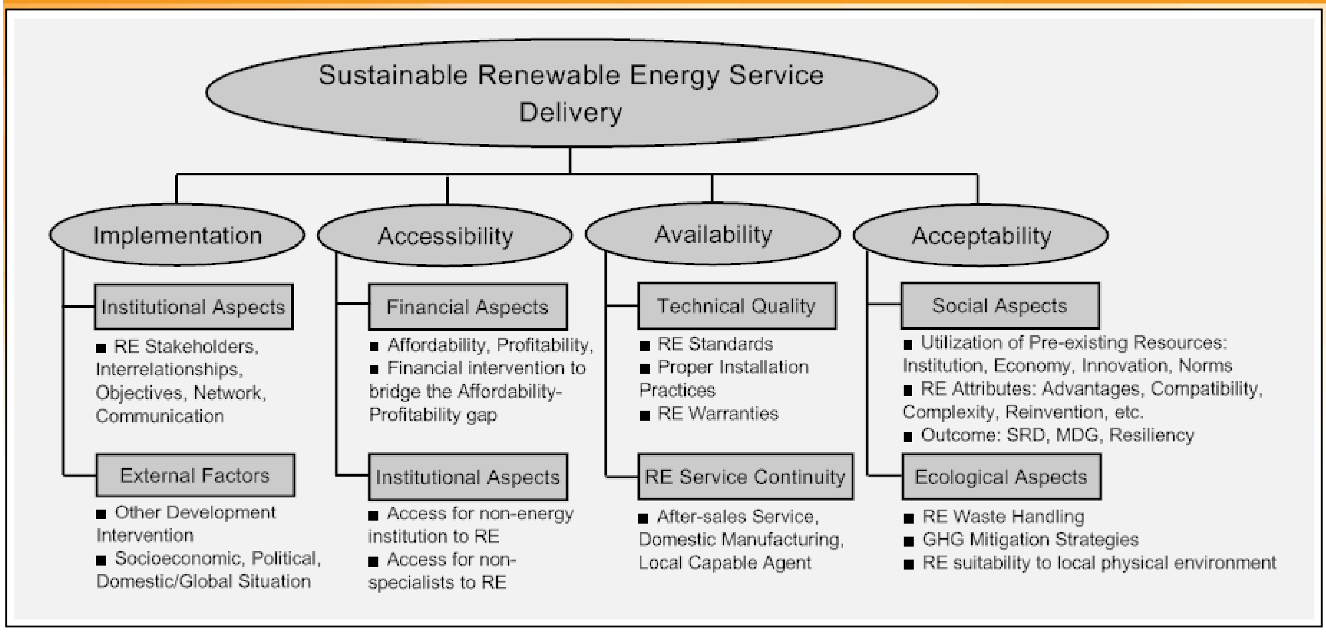
Photo: Courtesy of Azet Surya Lestari

Bjarnegard 2006

Photo: Courtesy of Claus Dauselt

Institutional: Lack of adequate after sales service infrastructure; **Financial:** Poor fund management; **Technological**: Lack of spare parts and technician availability; **Social**: Users “disconnected” from RE technology, externally derived problems on rural communities leading to social fragmentation; **Ecological**: Inadequate RE waste handling, RE suitability to local physical environment

The I3A Sustainable RE Service Delivery Framework



Implementation: Institutional aspects & external factors affecting RE service delivery

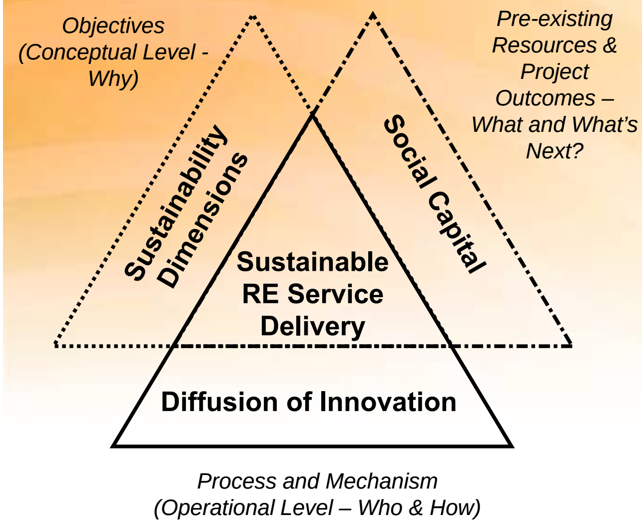
Accessibility: Financial, Institutional, Technological accessibility

Availability: Technological, Institutional aspects to maintain RE service quality & continuity

Acceptability: Social & ecological dimensions

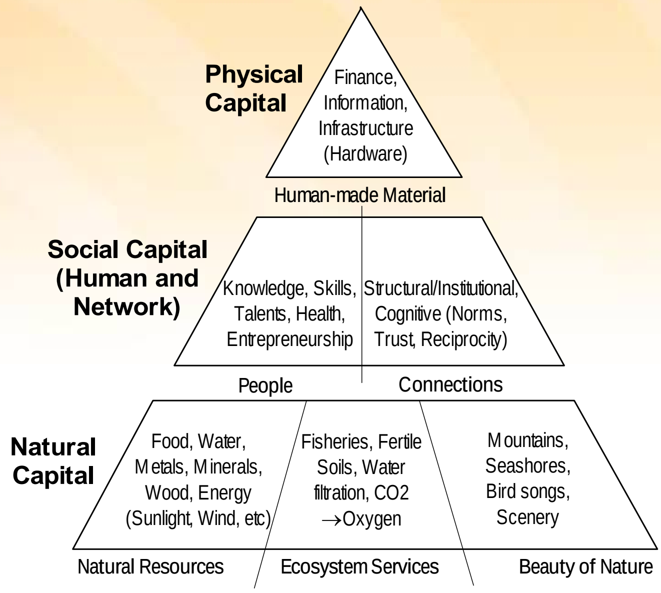
Conceptual background to the I3A Framework:

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

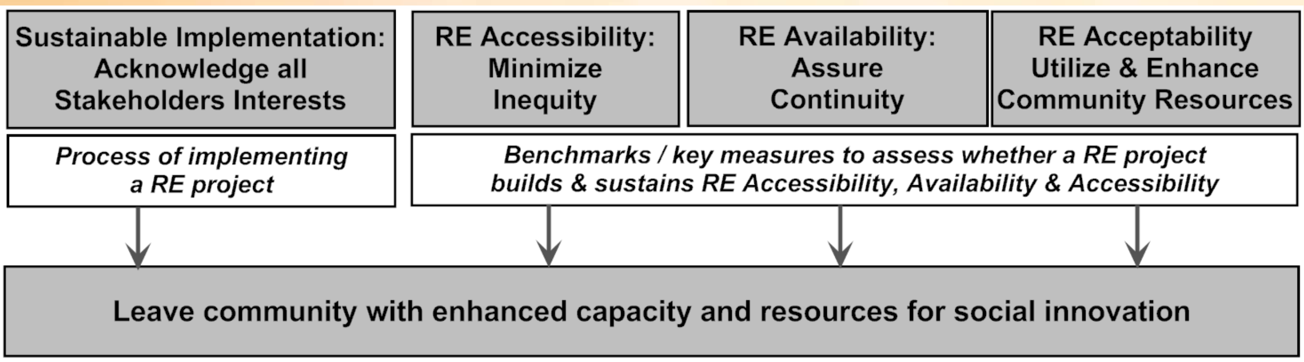


Reproduced from Hart 1998, with some modifications.

The I3A framework

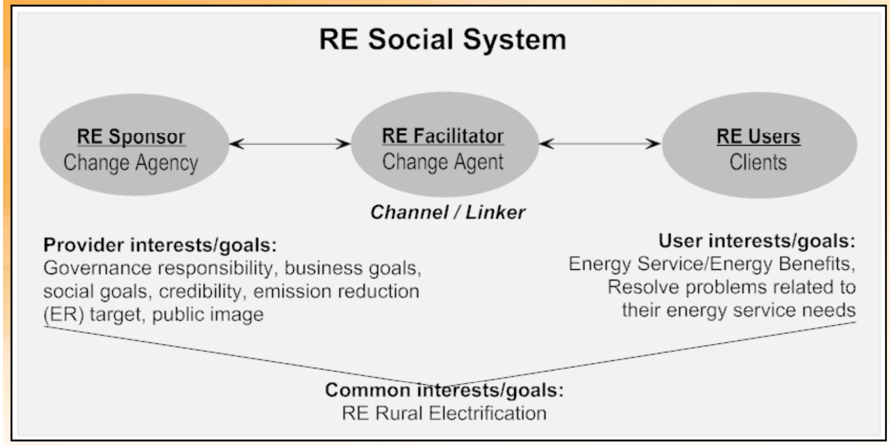
Assessment & design tool for sustainable RE service delivery

I3A Framework: An **implementation** that maintains energy service **accessibility** (financial, institutional, technological), **availability** (technological, institutional) and **acceptability** (social, ecological), considering the hardware, software and orgware aspects of energy service delivery during & beyond initial project life



Implementation: Process of implementing a RE project

Stakeholders, Roles, Interrelationships, Acknowledge all Stakeholders Interests



Facilitator role: to secure adoption in the direction deemed desirable by Sponsor, balanced with User requirements

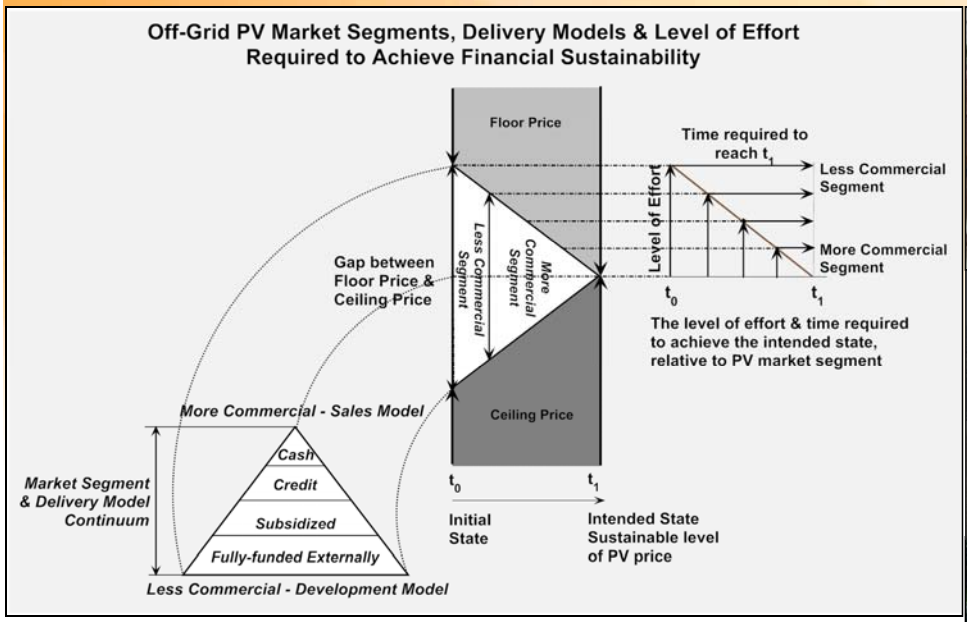
Of importance:

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


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.

Accessibility: Equitable Access to RE service

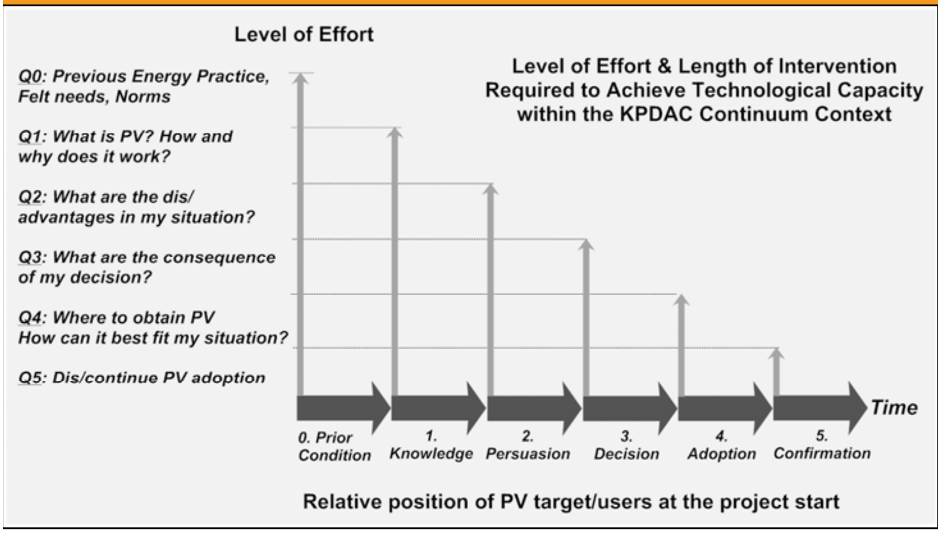
Financial Accessibility: Bridging Affordability – Profitability Gap



Generalization: Need relevant delivery approach for different market segment:

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

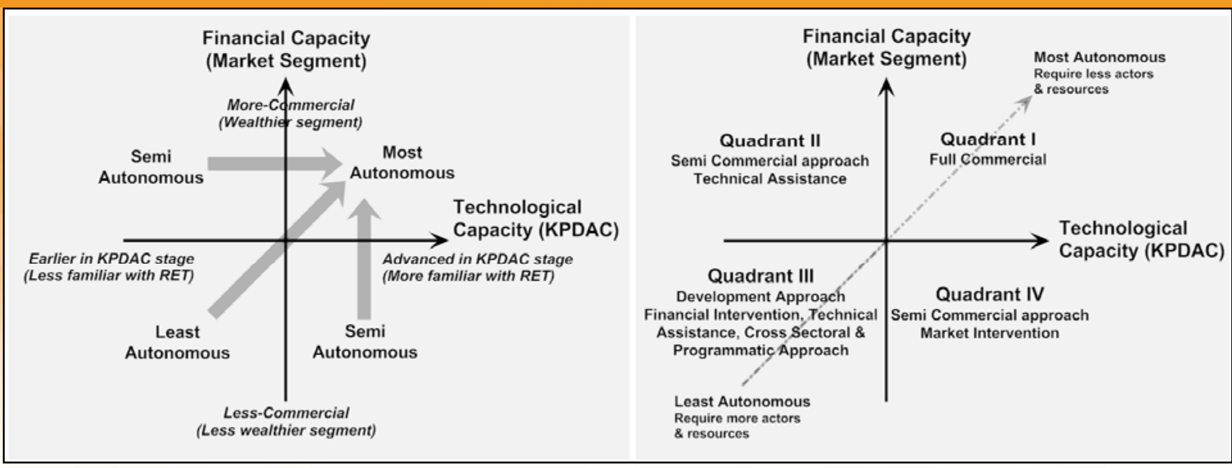
Accessibility: Equitable Access to RE service
Technological Familiarity & the KPDAC Continuum



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 RE technology

Accessibility: Equitable Access to RE services
Energy autonomy as a function of Financial & Technological capacities

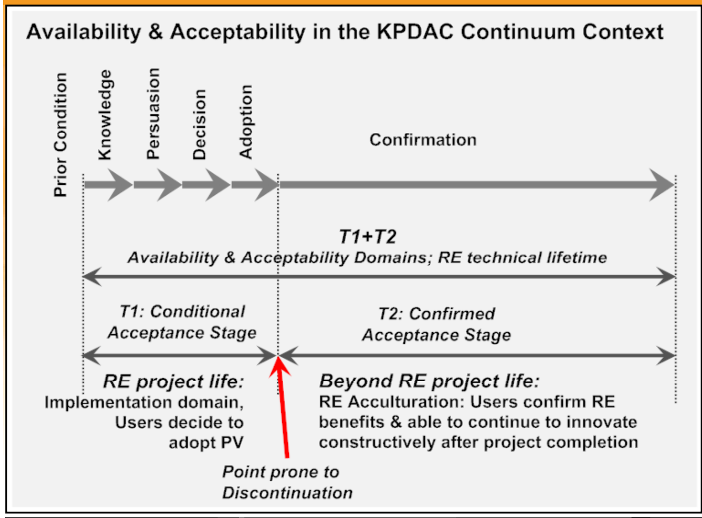


Energy service autonomy: Facilitators need to be aware of each rural community's economic standing & technological capability to promote user autonomy effectively, and to achieve the most desirable community state (most autonomous):

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

Indonesia has communities in all four quadrants – hence need context-sensitive approach
→ Market mapping by considering local RE resources, local socioeconomic situation & pre-existing local institution, is instrumental to design an appropriate RE delivery scheme/approach

Availability & Acceptability
During & Beyond RE Initial Project Life



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

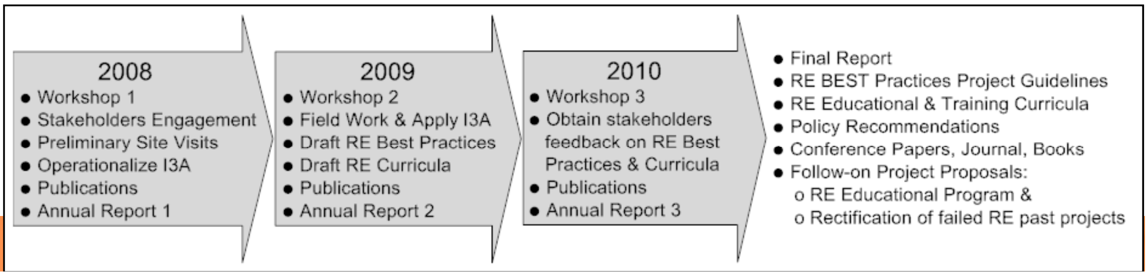
T1 & T2 Accessibility: Conditional & Confirmed Acceptance → Acculturation of energy service technology into local community's life:

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

Conclusions & Next Phase

- Improved RE sustainability → Tool for sustainable development: Improve Human Development Index (HDI), reduce Human Poverty Index (HPI), achieve Millennium Development Goals (MDG), promote low carbon intensive lifestyle, improve energy security & community resiliency, tool for climate change mitigation strategy
- The I3A Framework can be used both as an assessment & design tool for a sustainable renewable RE service by applying the following criteria:
  - Sustainable Implementation: Promote civic network, strengthen local governance, build user autonomy/capacity to enable active participation
  - Accessibility: Facilitate access to financing, skills, network
  - Ensure availability both during & beyond project life
  - Acceptability/Acculturation: Utilize & enhance pre-existing local resources
- Next Phase: An Australian Development Research Award (ADRA) project to identify & overcome barriers to RE in rural Indonesia by community capacity building; Further develop I3A & provide advice on aid project design

The ADRA research project activities & timeline



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