Centre for Energy and Environmental Markets

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An ADRA Research Project to Overcome Barriers to Renewable Energy in Rural Indonesia by Community Capacity Building using the I3A Framework

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Maria Retnanestri
m.retnanestri@unsw.edu.au

www.ceem.unsw.edu.au

ADRA EFCC 011: Overcoming Barriers to Renewable Energy in Rural Indonesia by Community Capacity Building using the I3A Framework

- **Australian Development Research Awards (ADRA)** "are designed to attract quality research that informs policy development and increases the general stock of knowledge around development issues " (http://www.ausaid.gov.au/research/awards.cfm)
- **Key Research Questions for thhis project:**
  - Why some renewable energy projects succeed while others fail to facilitate sustainable rural development in developing countries, with a focus on Indonesia
  - Identify & disseminate ways to overcome barriers to renewable energy by community capacity building
- **Funding:**
  - Australian Development Research Award (ADRA): AU$ 310,000 over 3 years
  - BP Solar, e8, Azet Corporation, STTNAS Jogjakarta (In-kind & cash)
- **Project structure and activities:**
  - Interdisciplinary project involving Australian & Indonesian collaborators
  - Fieldwork, workshops, seminars and public lectures in Indonesia & Australia
  - Development of best practice project guidelines, educational curriculum, training materials, papers, journal articles, policy recommendations, proposals for renewable energy education and proposals for rectifying failed past projects

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The ADRA Research Project Activities & Timeline, Progress to Date

2008
- Workshop 1
- Stakeholders Engagement
- Preliminary Site Visits
- Operationalize I3A
- Publications
- Annual Report 1

2009
- Workshop 2
- Field Work & Apply I3A
- Draft RE Best Practices
- Draft RE Curricula
- Publications
- Annual Report 2

2010
- Workshop 3
- Obtain stakeholders feedback on RE Best Practices & Curricula
- Publications
- Annual Report 3

- Final Report
- RE BEST Practices Project Guidelines
- RE Educational & Training Curricula
- Policy Recommendations
- Conference Papers, Journal articles
- Follow-on Project Proposals:
  - o RE Educational Program &
  - o Rectification of failed RE past projects

- **2008:**
  - 12-15 July: Meetings between the Australian & Indonesian collaborators
  - 15 July: DGEEU Jakarta Office – grid-connected PV Workshop in Jakarta & Launch of 10 kWp grid-connected PV at the DGEEU office. The workshop was jointly funded by ADRA & three PV companies: Azet (Jakarta), Mitsui & Kaneka (Japan).
  - Publications: ISES-AP08 papers, public lectures, seminars
  - Capacity Building: Support for 2 representatives of BPPT & STTNAS (Indonesia) to attend ISESAP 08
- **2009:**
  - 19-20 January: Workshop on Renewable Energy & Sustainable Development in Indonesia – Past Experience – Future Challenges. This workshop will be jointly funded by ADRA & e8 (www.e8.org)
  - 11 February: 1st project annual report due
  - April: Renewable Energy Study tour for 35 students & lecturers of STTNAS Jogjakarta College, jointly funded by ADRA, BP Solar Australia & STTNAS
  - July: Seminar – report on the outcome of the STTNAS RE study tour
  - July: Launch of Center for Renewable Energy & Energy Efficiency Studies, STTNAS

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Background information about Indonesia

Islands: > 17,000 islands
Land Area: 1.9 million km2
Coastline: 54,716 km

Population: 237.5 million
Poor Population: 17.8 %
GDP/capita: US$ 3,700
HDI: 0.728 (107/177)
CO2 emission ton/capita: 2.4

Electrification Ratio: 54%
Installed Capacity: 22.5 GW
Average kWh/capita: 484
(NTT- 61; Jak- 2800)
(CIA 2008, PLN 2006, WRI 2008)

Potential impact of climate change on Indonesia:
- A 0.6m sea level rise could lead to land loss of 34,000 km2 and displace 2 million people *(Nicholls & Mimura 1998, IPCC in UNEP/GRIDA 2001)*
- Threat to coastal infrastructure, food (agriculture, fisheries), water & energy security, outbreak of climate-sensitive diseases

The Indonesian electricity situation:
- Problems in extending national electricity grid: Geographic/demographic characteristics of the archipelago, high cost of transmission, low level of demand
- Options for remote area electrification: Diesel, Micro hydro, PV, Wind

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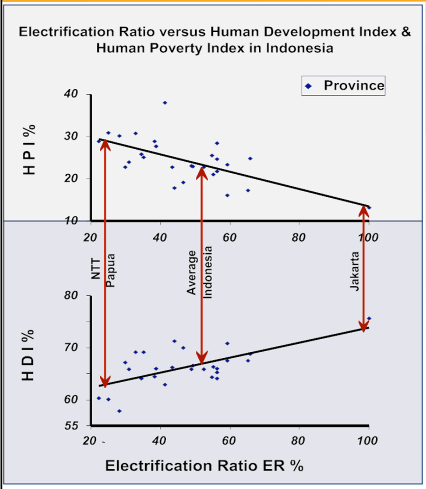
Electrification Ratio & Socioeconomic Development
ER, HDI & HPI Correlation



(BPS 2004, PLN 2004, UNDP 2004)

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

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)

RE roles: sustainable development, low carbon lifestyle, energy security, mitigation technologies

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)

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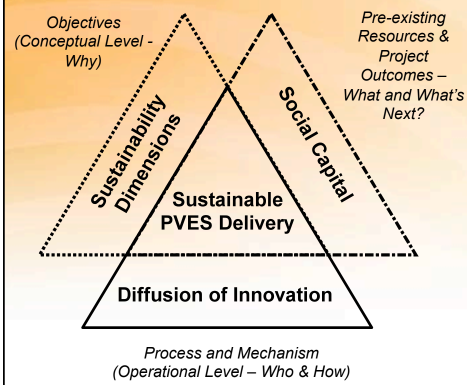
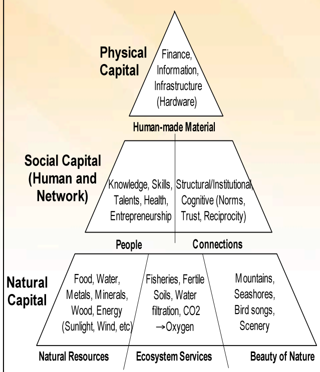
Conceptual background to the I3A Framework
PV in the nexus of Sustainable Development, Diffusion of Innovation & Social Capital



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.

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What is technology? (www.iiasa.ac.at)

Software & orgware are critical issues in complex technological systems such as electricity supply

The Art of Knowing and Doing

The study of **technology** concerns *what* things are made and *how* things are made. Technology, from the Greek *science of* (practical) *arts,* has both a *material* and an *immaterial* aspect.

Technology = Hardware + Software + "Orgware"

Hardware:	Manufactured objects (artifacts)
Software:	Knowledge required to design, manufacture, and use technology hardware
"Orgware":	Institutional settings and rules for the generation of technological knowledge and for the use of technologies

Technology's most important characteristic: ***Continuous change >>***

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Technology acculturation into local community life

(Maria Retnanestri, 2008)

Innovation Attributes & Local adaptation:
Relative Advantage, Compatibility, Complexity, 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).

→ Facilitators need to understand the extent to which technology can enhance pre-existing resources to support beneficial social innovation

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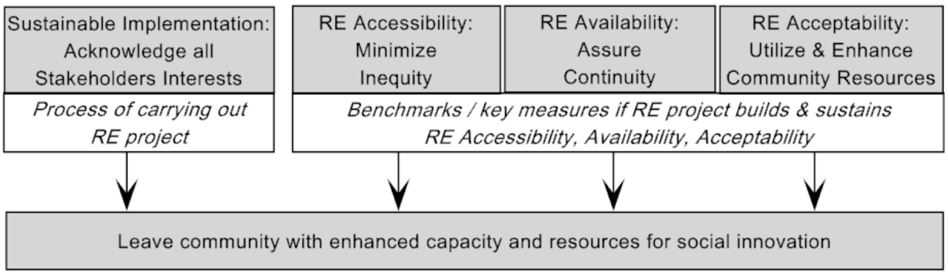
The I3A framework

Assessment & design tool for sustainable RE delivery

I3A Framework: An **implementation** that maintains renewable 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



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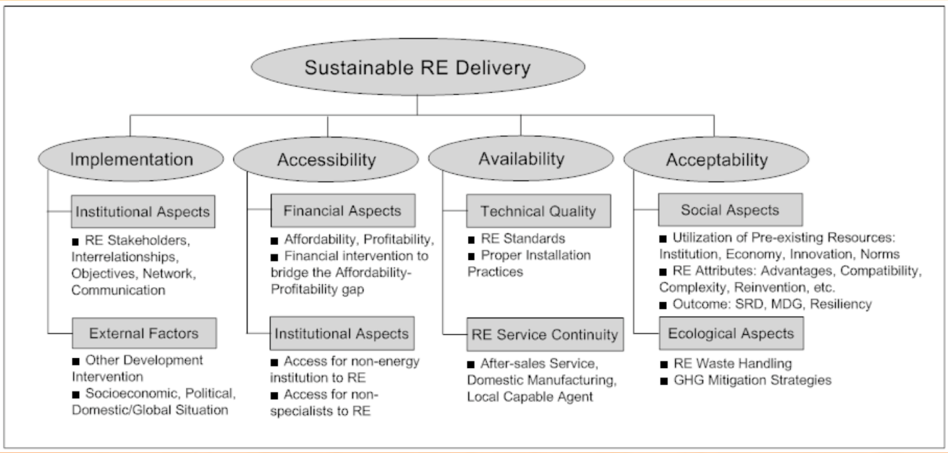
The I3A Sustainable Energy Service Delivery Framework

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



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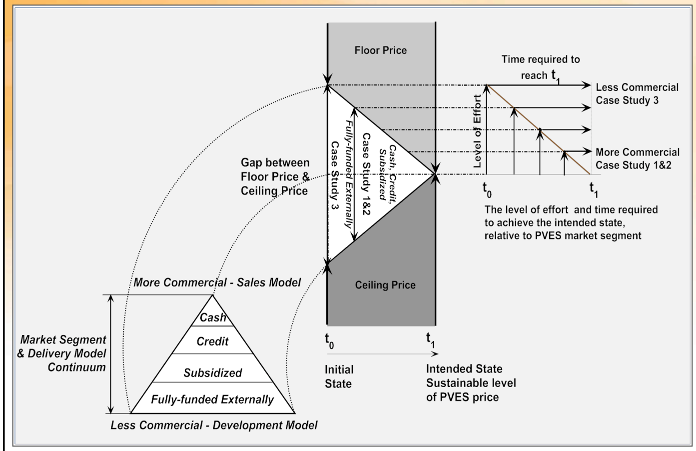
Accessibility: Equitable Access to PV

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

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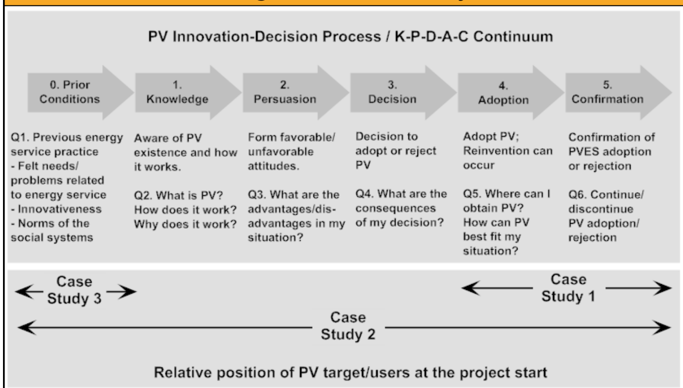
Accessibility: Equitable Access to PV

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

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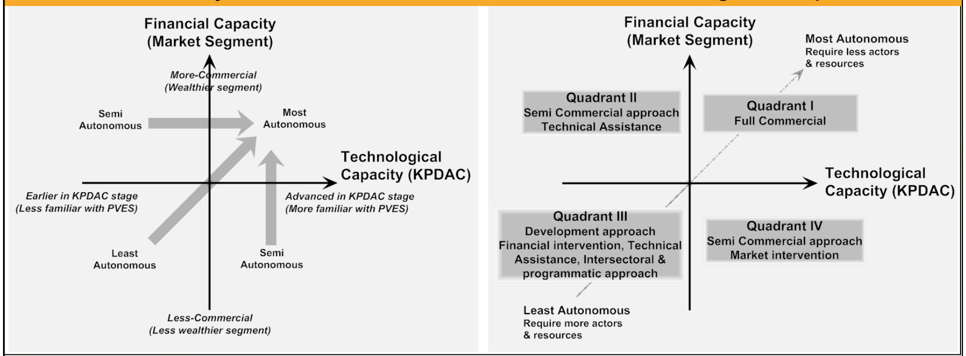
Accessibility: Equitable Access to RE technology

RE Autonomy as a function of Financial & Technological capacities



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

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

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

Conclusions

- Sustainable renewable energy services:
  - Can facilitate sustainable development, MDG, low carbon intensive lifestyles, energy security & climate change mitigation
- The I3A Framework can be used for project assessment or design, 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
  - Availability: both during & beyond project life
  - Acceptability/Acculturation: Utilize/enhance pre-existing local resources
- Future research initiatives & potential linkages:
  - Interdisciplinary research to strengthen local governance & community resiliency as a key to climate change mitigation & adaptation
  - Application of the I3A framework to energy supply in Tonga