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The Role of Renewable Energy in Rural Development

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Theme

- Energy plays a facilitating role in most aspects of human life. This has become largely taken for granted in western societies due to the progress that has been made since the industrial revolution.
- However, growing concerns about climate change impacts as well as concerns about energy security (eg. flow constraints for oil and natural gas) mean that it is more important than ever to develop energy service options in the context of long term sustainability, considering its economic, environmental, social and technical dimensions.
- Moreover, even the basic issue of access to affordable and reliable energy services remains a major problem of concern in developing countries, particularly in rural areas.

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Interrelated threats to global human society
(Diamond, 2005)

1. Destruction of natural habitats
2. Collapse of wild fish stock
3. Loss of biodiversity
4. Loss of soil quantity & quality
5. Fossil fuel constraints
6. Fresh water quantity & quality
7. Photosynthesis limits
8. Toxic chemicals
9. Introduced (alien) species
10. Climate change
11. Population growth
12. Per-capita human impact

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Renewable energy resources and efficient and appropriate energy use offer promise in this context. However, they have yet to meet that promise in practice.

For example in Indonesia, despite the large number of off-grid Photovoltaic Energy Service (PVES) installations to date and the considerable support provided by the government and donors, PVES has yet to prove its sustainability and remains inaccessible to most remote Indonesian communities.

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PV energy service delivery in 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)

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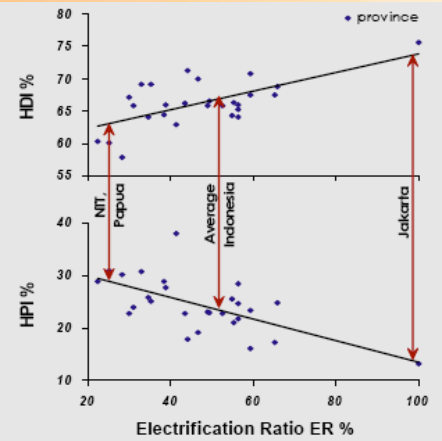
Electrification ratio & socio/economic development



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

Nearly 50% of the Indonesian population does not have access to the electricity grid and the indicators for Indonesia show a strong correlation between access to electricity and both the development index and (inversely) the poverty index.

The indicators suggest that education, access to communication, health, clean water and other socio-economic related issues need to be at the forefront of rural and national development planning in Indonesia for the people to achieve progress.

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

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

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Off-grid PVES Applications in Indonesia: *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.

Being stand-alone and utility independent, PVES can supply autonomous power for communication, lighting, medical storage, and water purification needs during disaster relief operations.

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

The washed away distribution cable.

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Photos: Courtesy of Mambruk Enery International, Azet Surya Lestari & Bappenas

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PVES sustainability issues & solutions

- Issues:
  - Access to finance (PV is a global market)
  - Adequate institutional infrastructure
  - Adequate after-sales service
  - Need to involve local ability to adopt, adapt, apply and develop PVES suited to local needs
- Solutions:
  - A holistic rather than technocratic approach:
    - Should make use of & augment pre-existing social capital
    - Should provide a net positive cash flow to host community

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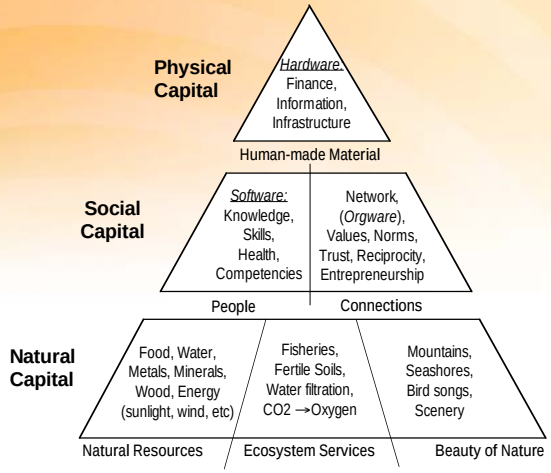
Community Capital/Resources



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.

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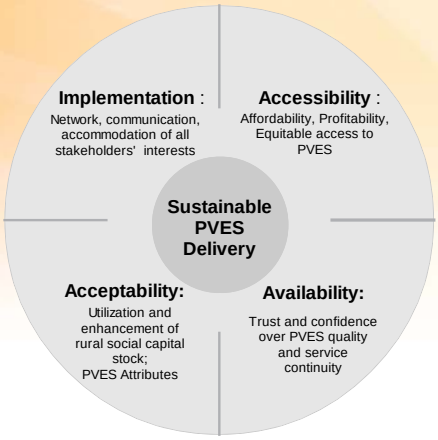
The I3A PVES Sustainable Delivery Framework



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

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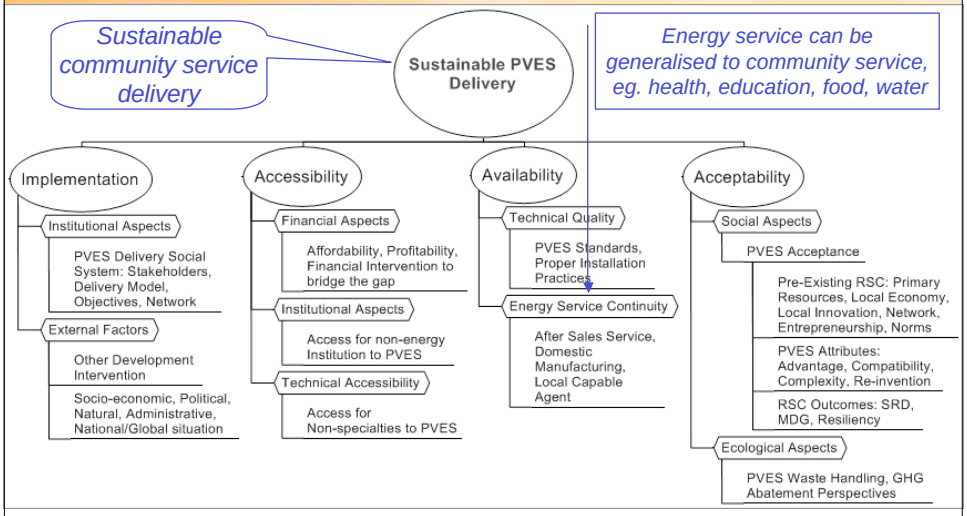
The I3A *Community Service* Sustainable Delivery Framework



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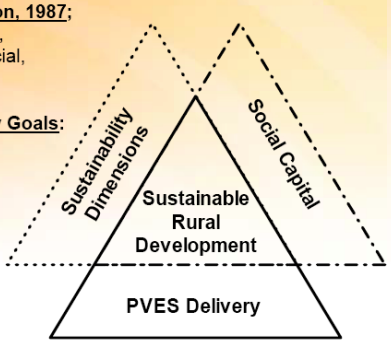
The I3A PVES Sustainable Delivery Framework: *PV in the context of Environmental Sustainability, Social Capital & Sustainable Development*

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

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

Objectives (Conceptual Level)



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.

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)

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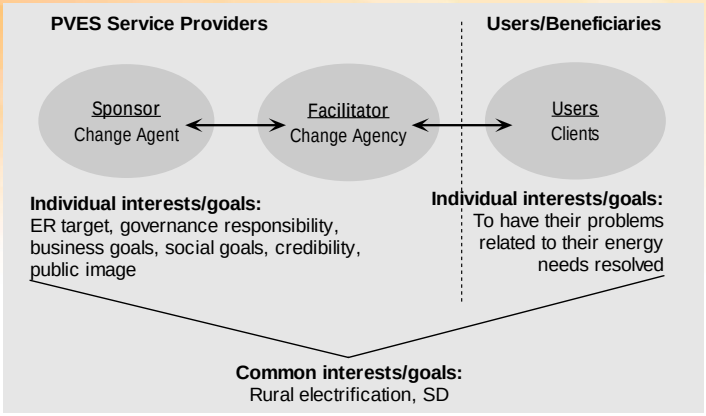
The I3A PVES Sustainable Delivery Framework: *Implementation*

PVES stakeholders, interrelationship and objectives



- Cross sectoral programmatic approach, PVES/tech as a vector/facilitator
- Capacity strengthening of change agency, change agent, clients

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The 120 kW Public-Private Partnership Micro Hydro (MH) in Cinta Mekar Village, West Java **Accommodation of local requirements** related to water allocation between irrigation and MH: A written agreement was made to allocate at least 300 litre/second to irrigate approximately 50 hectares of fields prior to water being channelled to the turbine

The PLD (Village Electricity Management) Concept: **Active involvement of End Users**

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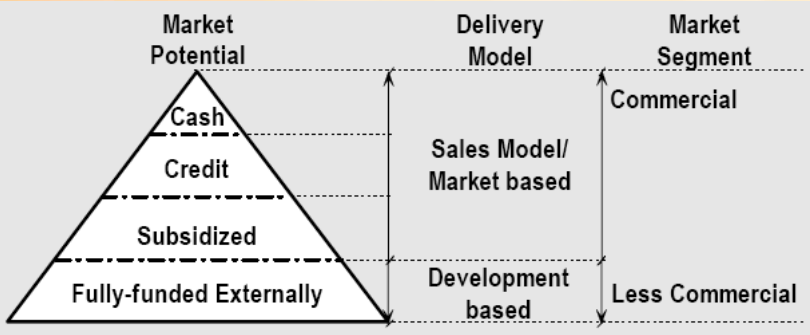
The I3A PVES Sustainable Delivery Framework: *Accessibility*

- Financial accessibility
- Institutional accessibility
- Technical accessibility



Delivery Model: *Market Continuum*

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The I3A PVES Sustainable Delivery Framework: *Accessibility*

Combined program: energy service delivery and rural economy empowerment

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The I3A PVES Sustainable Delivery Framework: *Availability*

Technical quality & continuity of energy service

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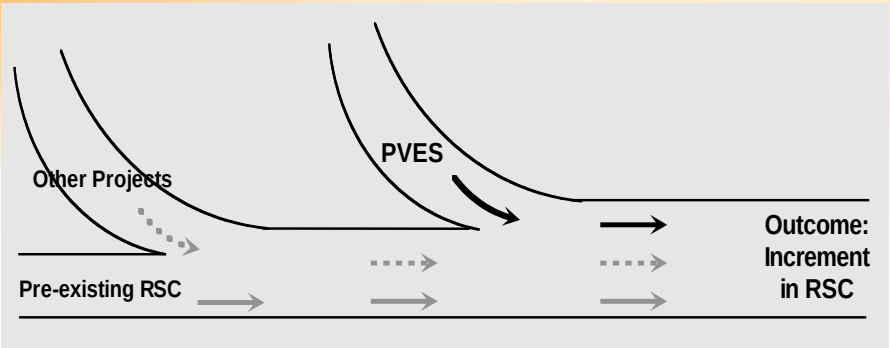
The I3A PVES Sustainable Delivery Framework: *Acceptability*



Positive Increment in RSC: Utilization and enhancement of RSC

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Conclusions

- Overcome sectoral disconnect by integrated approach:
  - Energy is a *facilitator* of services
- Adopt inter-disciplinary approach:
  - Science, technology & society
  - Across all related applications, eg energy, water, education, health
- Many countries face similar issues:
  - Important opportunity for collaborative research

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1. We wish to acknowledge the important contributions made by Stephen Healy of UNSW to this work
2. Key reference: M. Retnanestri, S. Healy and H. Outhred, *Off-grid Photovoltaic Sustainability and its Potential Role in Facilitating Sustainable Rural Development in Indonesia,* World Renewable Energy Regional Congress and Exhibition, Jakarta 17-21 April 2005. Available at www.ceem.unsw.edu.au.

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