The Swarm Electrification Concept

Input Presentation for the *Research Development Session „Swarm Electricity“* at the MES Conference 2013

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Forschungsschwerpunkt

Mikroenergie-Systeme (MES)

MES‘s Perspective

The focus is micro empowerment from the bottom-up

- Individual households and businesses are the basis for the development
- Technology is based on the identified end-user needs
- Implementation with End-User Financing (Microfinancing)

Challenges Faced

SHSs

- Serve only basic needs
- Productive use is limited
- Excess generation is dumped

Minigrid

- Unable to recover capital costs
- Capacity is quite inflexible
- High risks are associated for investor

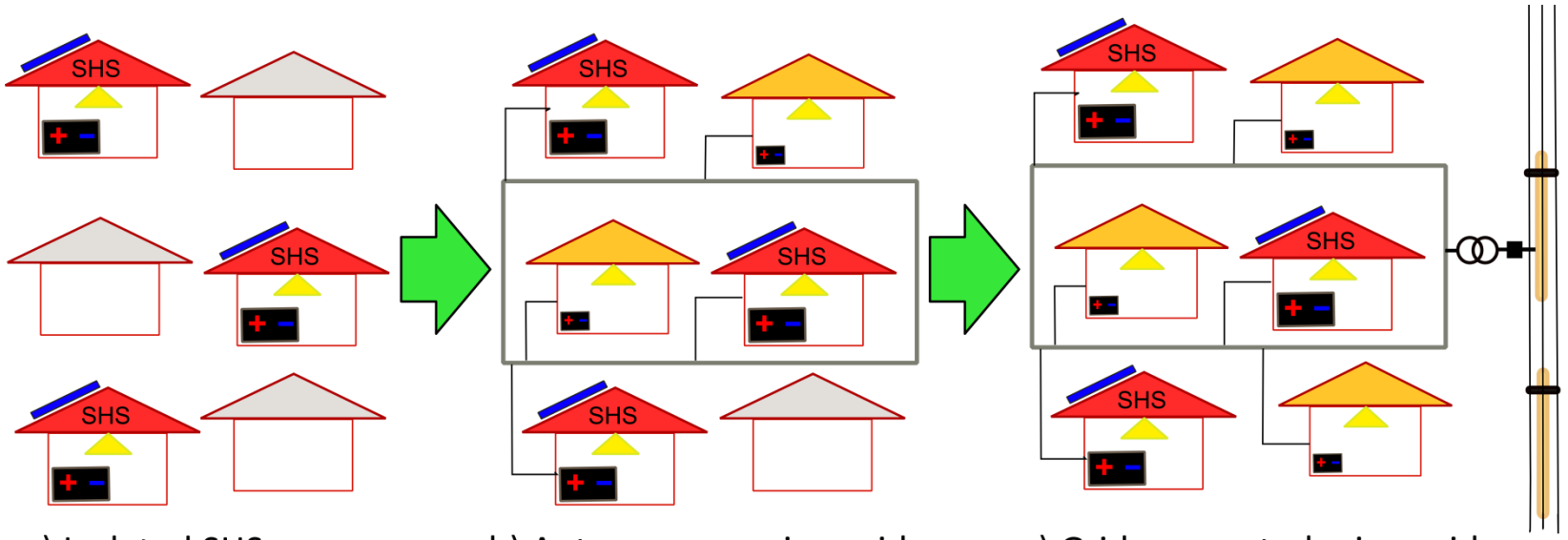
Grid Extension

- Timeline is uncertain
- Frequent outages occur
- Large amounts of capital are required

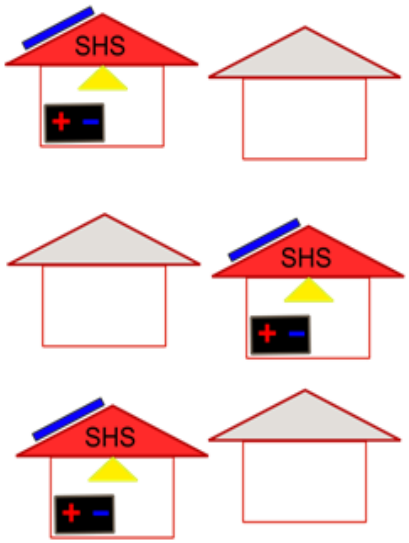
Bringing the Advantages Together

Household based	• Bottom up • Microfinacing
Minigrids	• High quality of power • Enhances productive use
Decentralized generation	• Usage of rooftops etc. reduces land use • Less transmission capacity required
Decentralized storage	• No need to run the grid 24/7 • Islanding down to smallest node possible
Microgrid	• Autonomous operation, on or off-grid • Building block of a smarter main grid

Proposed 3 Phase Process

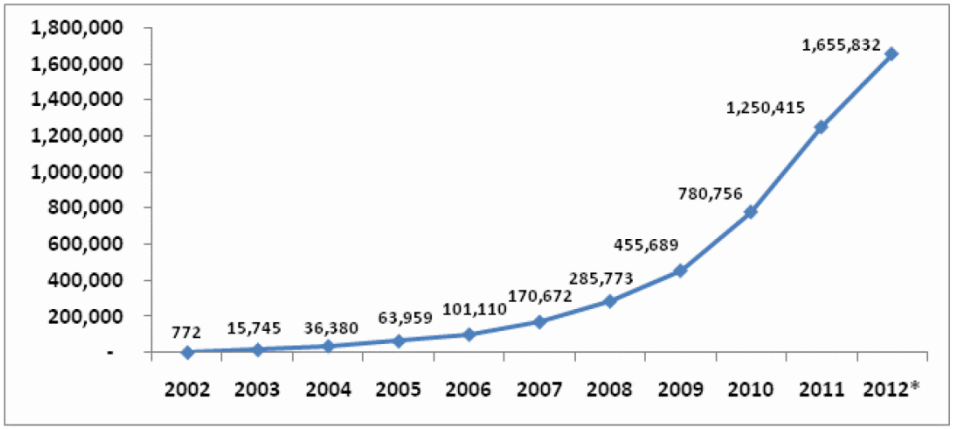


The Starting Point: Isolated SHSs



a) Isolated SHSs

- Status-quo electrification
- Decentralized generation and storage
- Located at the customer's side
- Intelligent local control units
- Serves basic needs (=small loads)
- End-user micro-financed



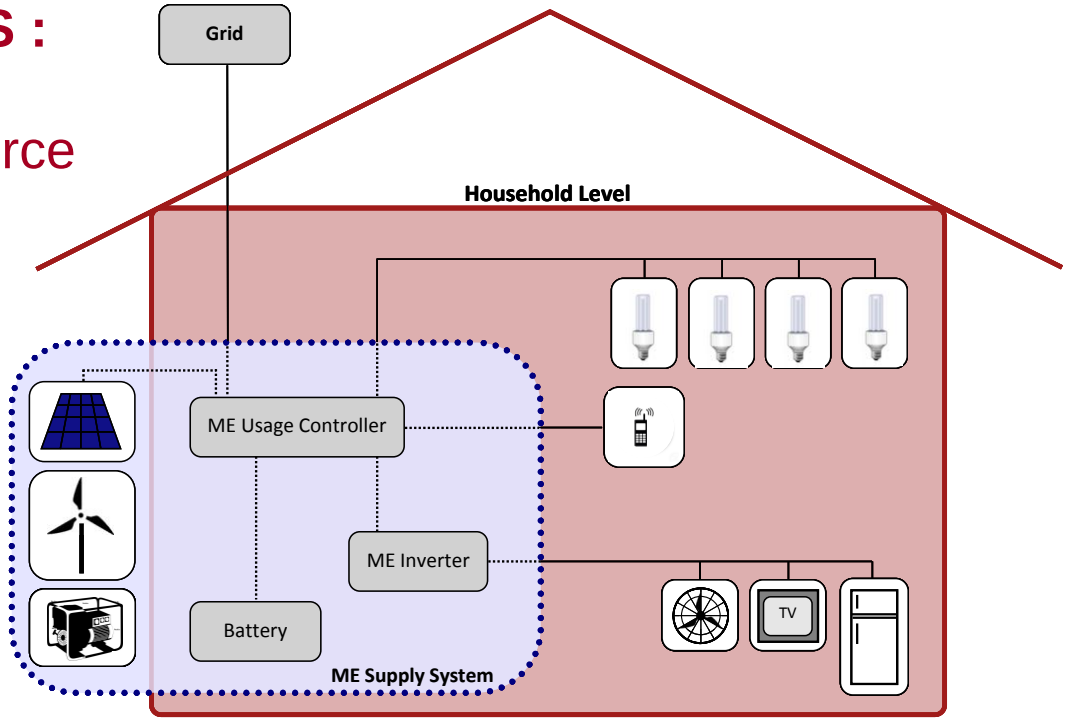
Number of installed systems: IDCOL (Bangladesh)

Our Basis: MESUS

ME Supply System (MESUS)
- a decentralized energy supply system

Components of the MESUS :

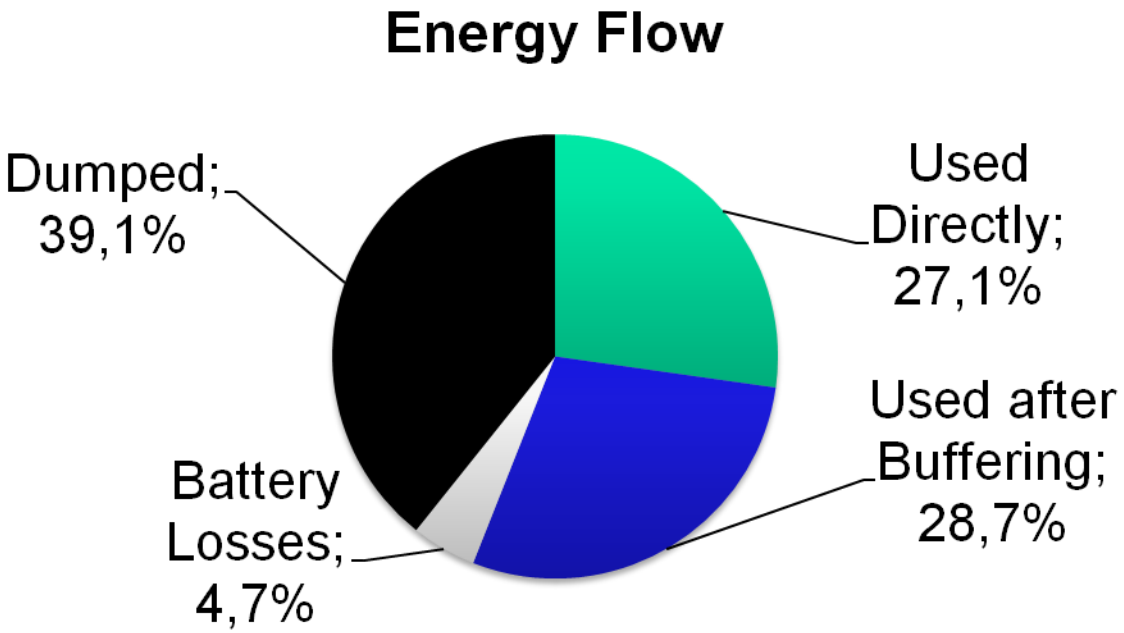
1. Decentralized energy source
2. Grid electricity (optional)
3. ME Usage Controller
4. Storage unit
5. Inverters (optional)



Excess generation

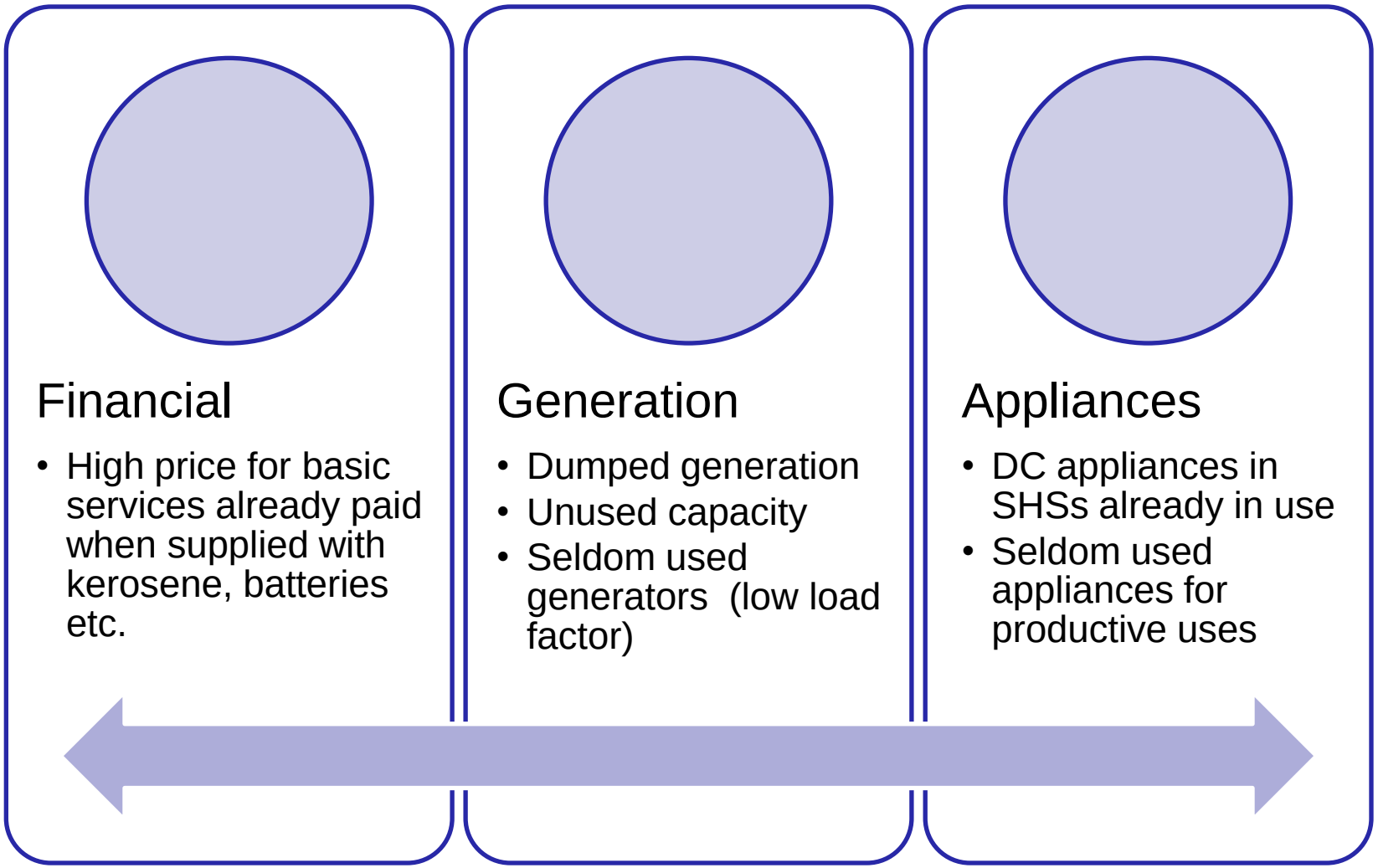
Simulation for Tamil-Nadu (India)

Supply: 80% PV and 20% grid

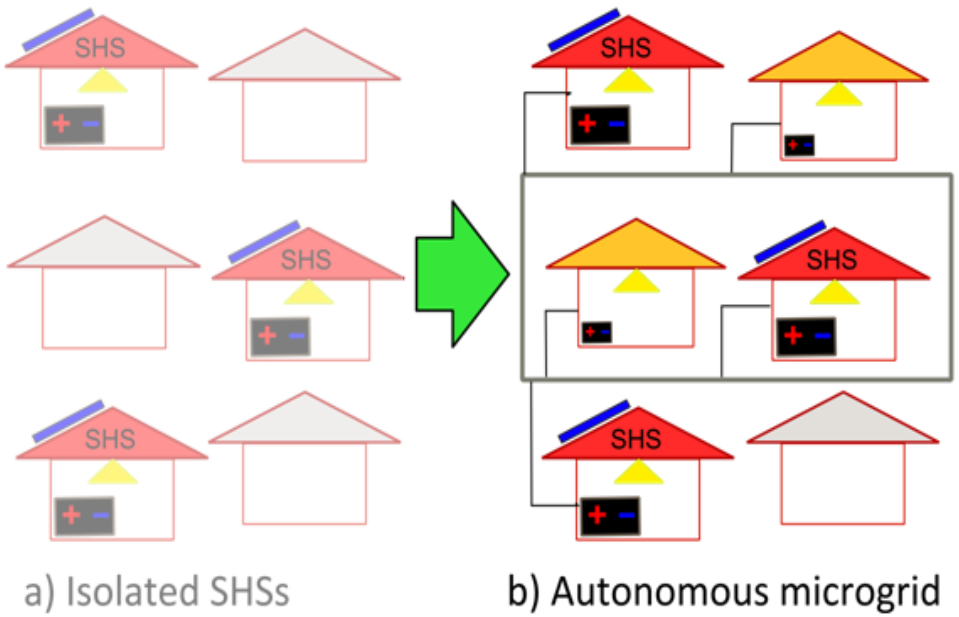


Felix Boldt, *MESUS-Concept- An Innovative Solution for the Electrification of Regions with Poor Energy Infrastructure* (Berlin: Promotionskolleg Mikroenergie-Systeme, 2012).

Hidden resources



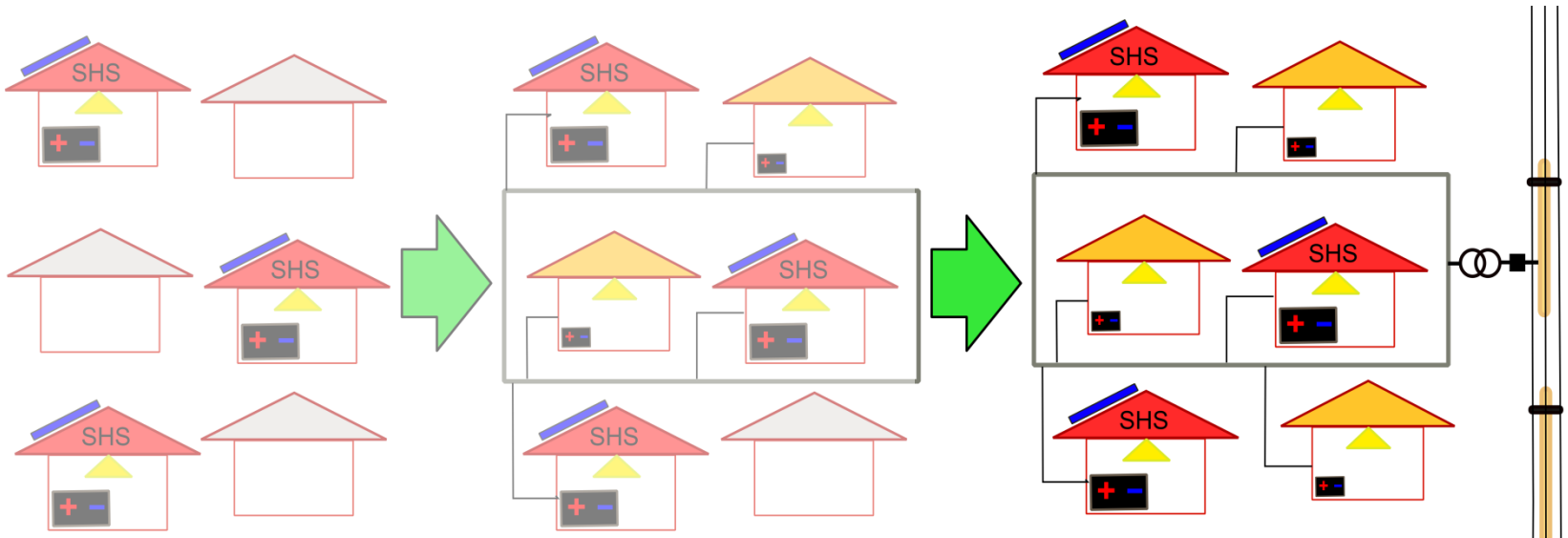
Phase 2: Autonomous Microgrid



- Balancing of systems
- Swarm of generation units
- Further connections
- Bigger loads
- Enhances productive use
- Community based financing

Prosumer units: **Pro**ducer + Con**sumer**

Phase 3 (Optional but Possible): Grid Connection



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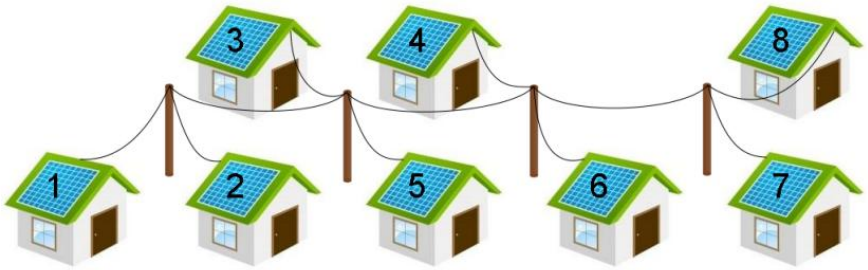
Insights from the DC world

- Simulation for interconnecting 8 SHSs at 24 V
  -> less panels needed



Kurtis Unger, “Organically Grown Microgrids: The Development and Simulation of a Solar Home System-based Microgrid” (Master Thesis, Universtity of Waterloo, 2012), http://uwspace.uwaterloo.ca/bitstream/10012/6727/1/Unger_Kurtis.pdf.

- Solar Mini Grid Design on 240V DC basis- project in Bangladesh -> avoids inverter losses

M.R. Khan, “A Stand Alone DC Microgrid for Electricity Supply in Rural Bangladesh,” in *Developments in Renewable Energy Technology (ICDRET), 2012 2nd International Conference on The*, 2012, 1 –4.

Research Questions

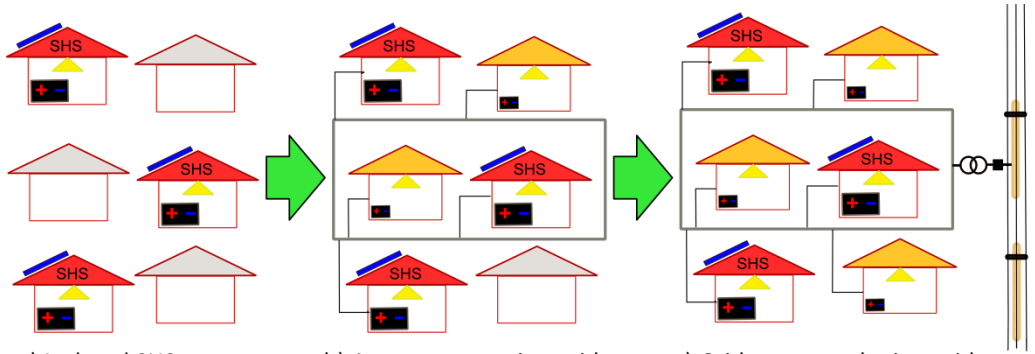
- How closely can **productive use** and minigrid **operation** enhance one another (alternative methods of storage, baseload concepts, demand response, medium size generation, heterogeneity in income generation…).

- Could a swarm generation microgrid run without a central control with **micro source controllers only**?

- Should we have **different voltage levels** within the microgrid and possibly some of them **DC**?

Summary

- Starting from the Status Quo
- Flexible development, supply follows demand closely
- Enhanced productive use
- Three phase bottom-up process
- Multiple financing options
- Research ahead



Thank you for your attention!