The business case of PV-hybrid Mini-grids: actors, contracts, drivers for profitability

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The German Solar Industry Association

TASK	To represent the German solar industry in the solar thermal and photovoltaic sector
VISION	A global sustainable energy supply provided by solar (renewable) energy
ACTIVITIES	Lobbying, political advice, public relations, market observation, standardization
EXPERIENCE	Active in the solar energy sector for over 30 years
MEMBERS	More than 850 solar producers, suppliers, wholesalers, installers and other companies active in the solar business
HEADQUARTERS	Berlin

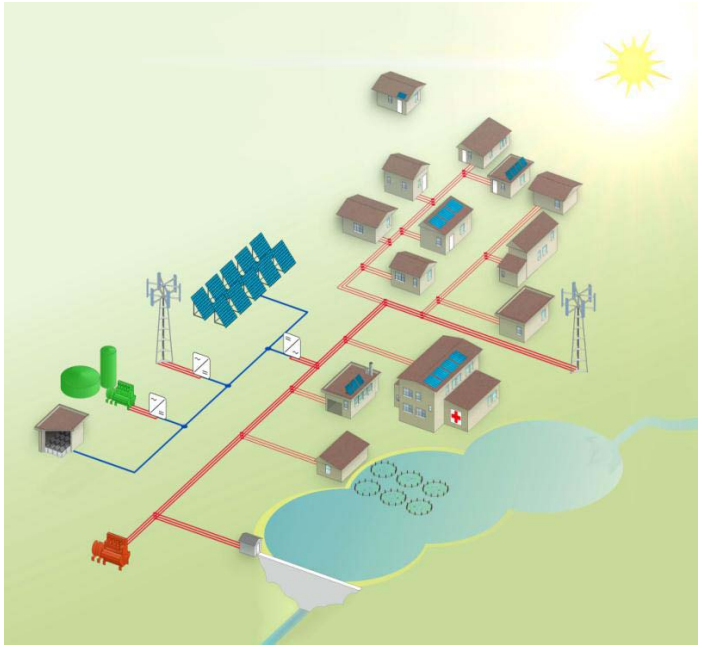
New business models for PV: Investor guideline for international markets

BSW-Solar in cooperation with Intersolar Europe

- Overview of business models in international PV markets
- Information on market potentials, project structures, cash flow models, stakeholders,
- Practical guideline to develop markets with Power Purchase Agreements, net-metering, self-consumption, mini-grids, etc.
- Description of barriers and success factors for the different business models
- Now available: **www.solarwirtschaft.de/en/business-models-pv**
- Or at BSW-Solar booth in hall B1.580 at special Intersolar Europe discount!

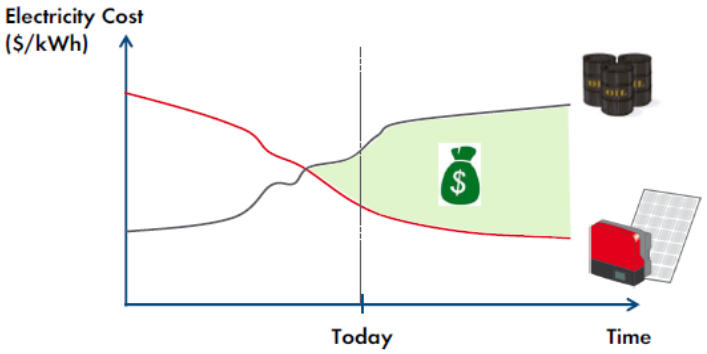
PV- hybrid Mini-grid Technical Characteristics

- distributed grid-integrated or off-grid energy system consisting
- distributed generation with PV and other sources
- multiple energy loads of different customers
- may include energy storage technology
- usually based on a monitoring and control system which manages generation, distribution, consumption and storage
- if grid connected, a parallel or “islanded” mode of operation is usually selectable

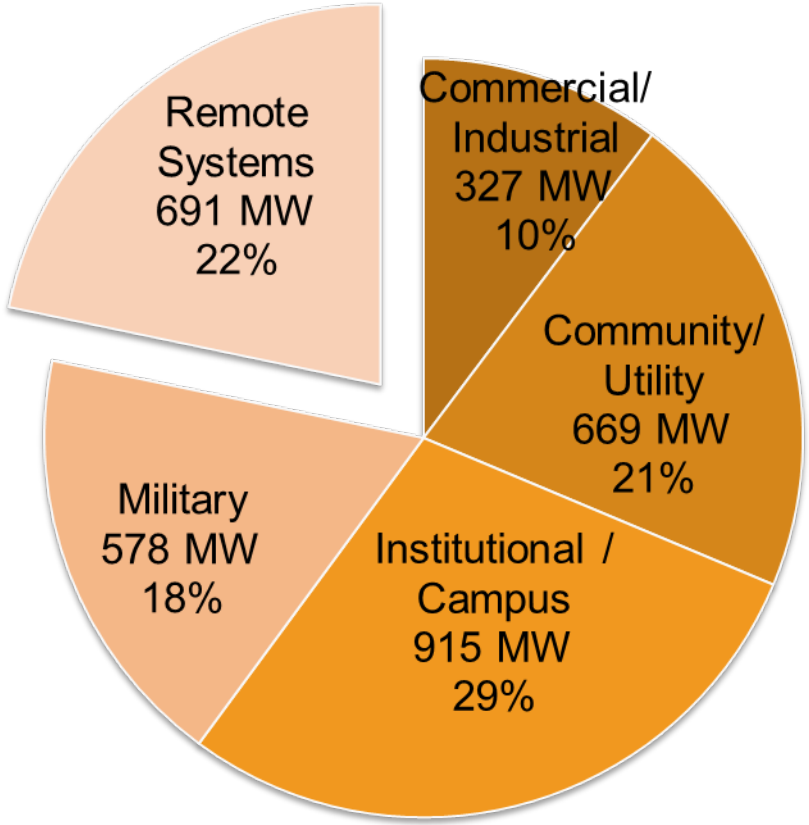


The case of PV-hybrid Mini-grid

Brownfield: Hybridisation of existing Mini-grids

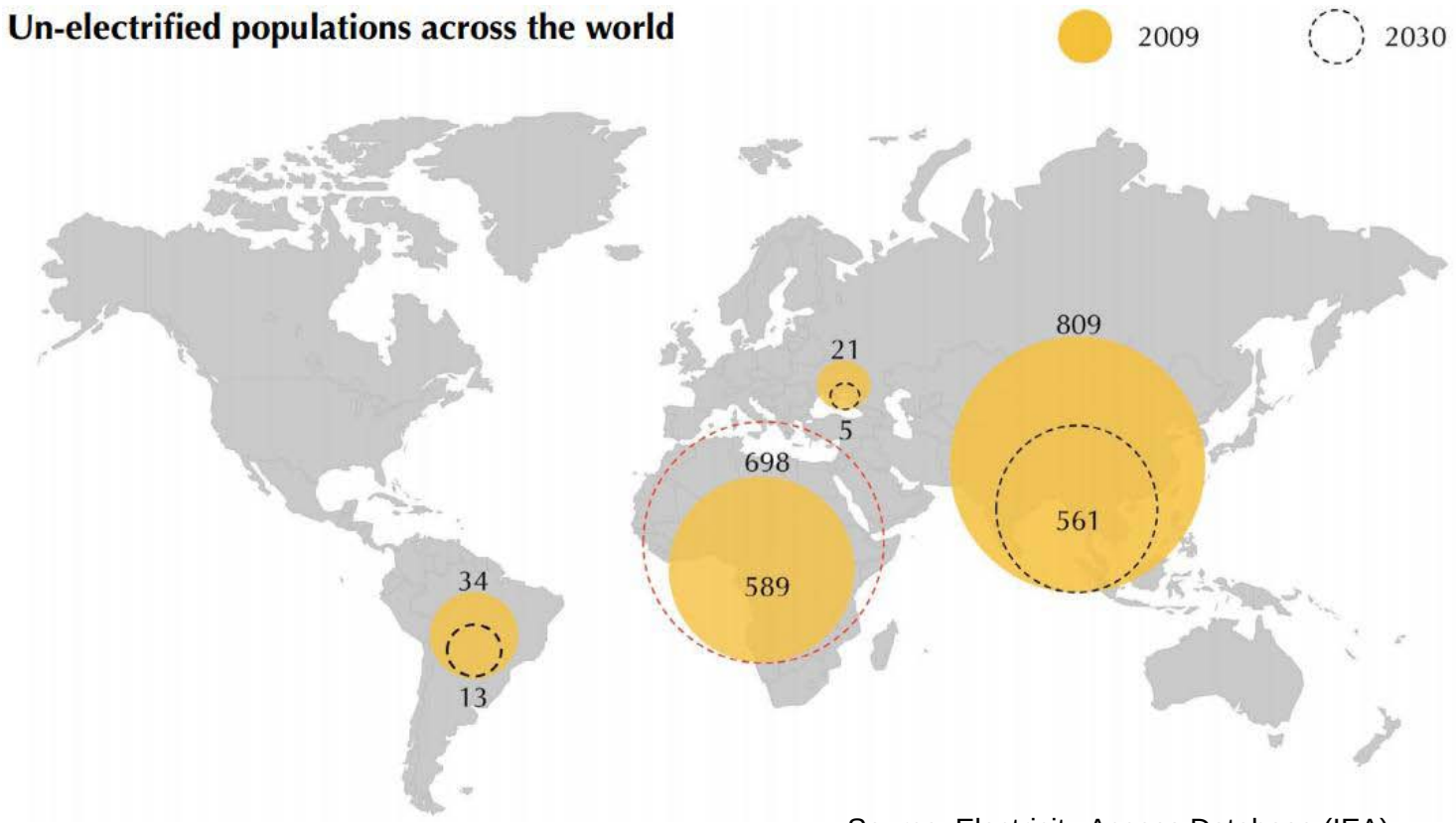


Microgrid Capacity by Market Segment, World Markets: Q4 2012 (Source: Pike Research)



The case of PV-hybrid Mini-grid

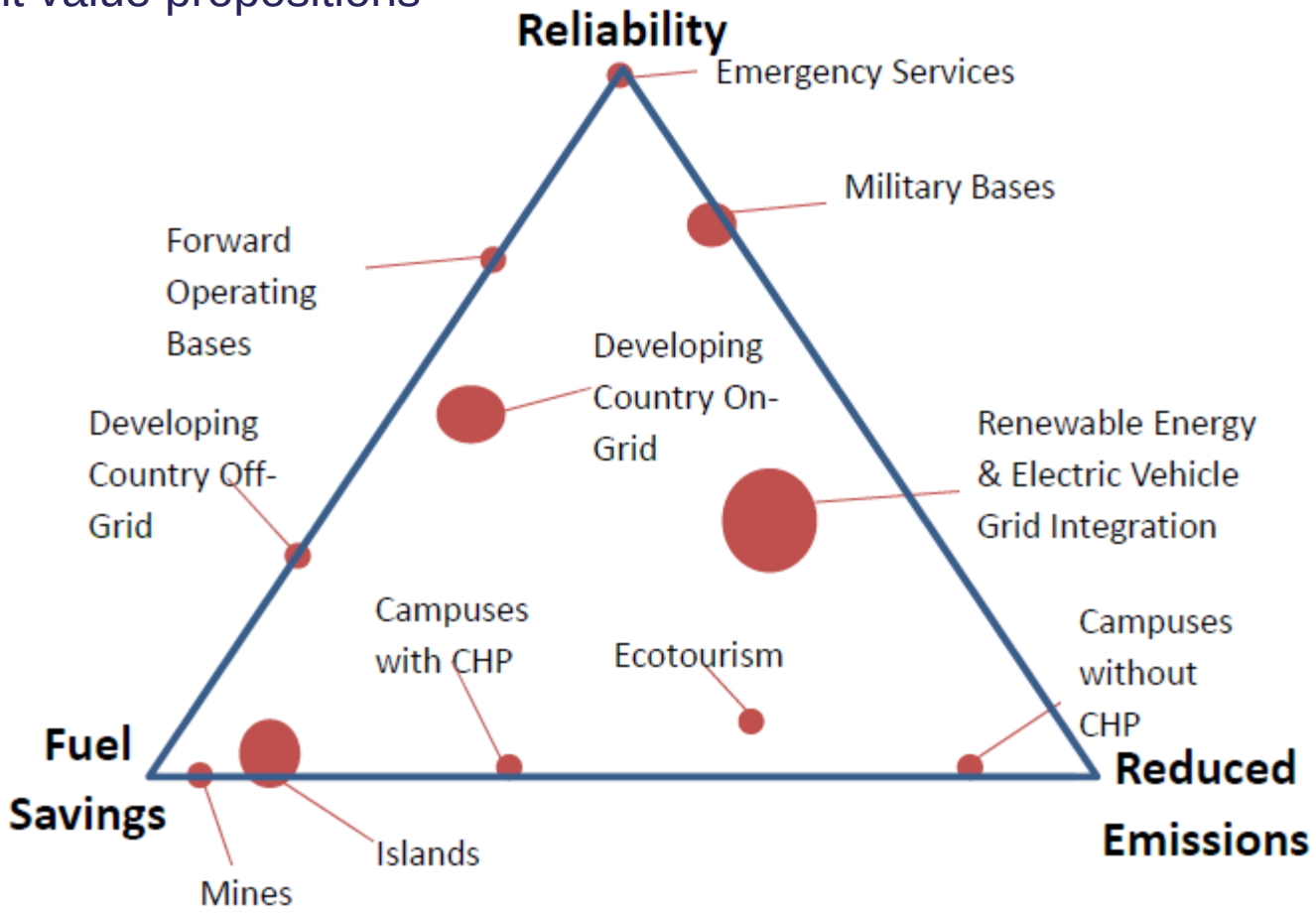
Greenfield: New PV Hybrid Mini-grids



Source: Electricity Access Database (IEA)

The case of PV-hybrid Mini-grid

Custumer segmentation
by different value propositions



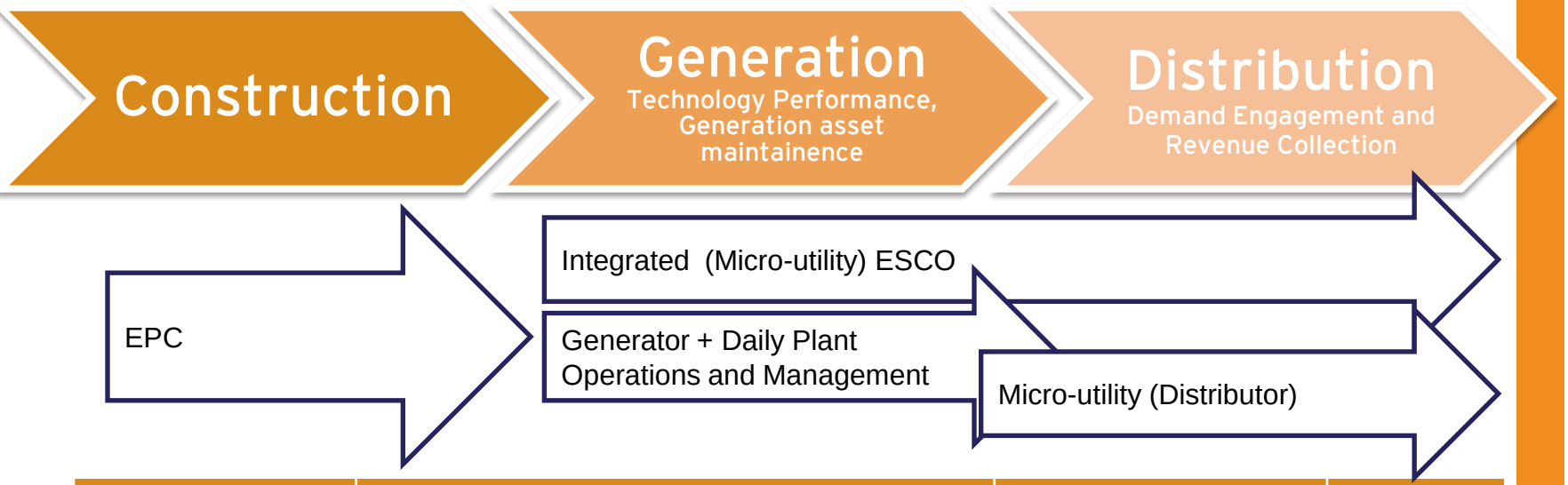
Source: Lilienthal HOMER Energy

The case of PV-hybrid Mini-grid
Private sector investment

Delivery models for PV-hybrid Mini-grids in remote areas in developing countries – selection

Fully Public	BOO by public entity (goverment / state utility / agency
Community based / cooperative model	BOO by community / cooperative / municipal utility
PPP Model 1	Public entity builds and owns, Private sector: operation under concession or management fee
PPP Model 2	Private sector builds and owns generation assest and sells power (eg. PPA) Pubilc entity operates distribution element
Fully Private	BOO of generation and distribution assest of mini-grid by private sector under concession. Sells power

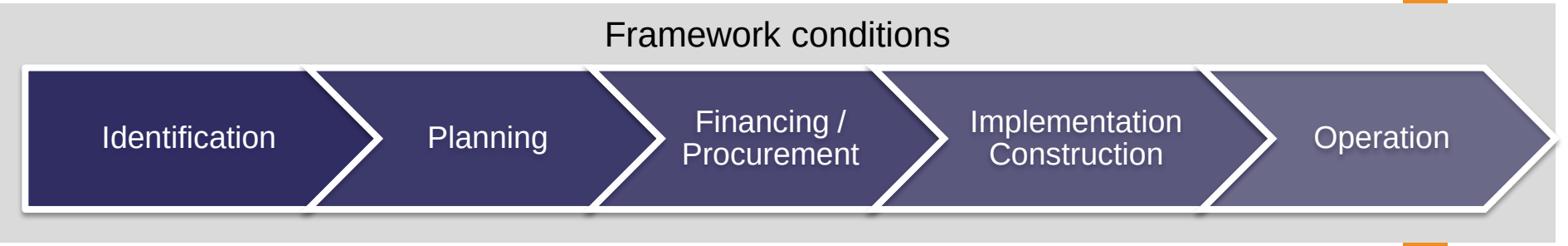
PV-hybrid Mini-grid
Possible business models for private sector



Model	Description	Typical Capacity	Expected Equity IRR
Integrated (micro-utility) ESCO	Genergation, Transmission, Distribution Sites are owned and managed by the ESCO	15 ~ 40 KW	Low to medium
Assest Light ESCO	Variant: the asset is not owned by the operating ESCO itself but a third party owner (TPO). ESCO operates the asset and pays a monthly fee.	15 ~ 40 KW	high
GENCO	Focussed on primarliy generation	15 ~ 50 KW; or fewer plants of 100~ 200 KW	medium
Micro-Utility Distributor	Invests in the mini-grid (distribution systems) and focuses on shaping demand in the area of operation	Variable	Not viable without subsidies

Source: cKinetics

PV-hybrid Mini-grid
Private sector investment



Framework conditions

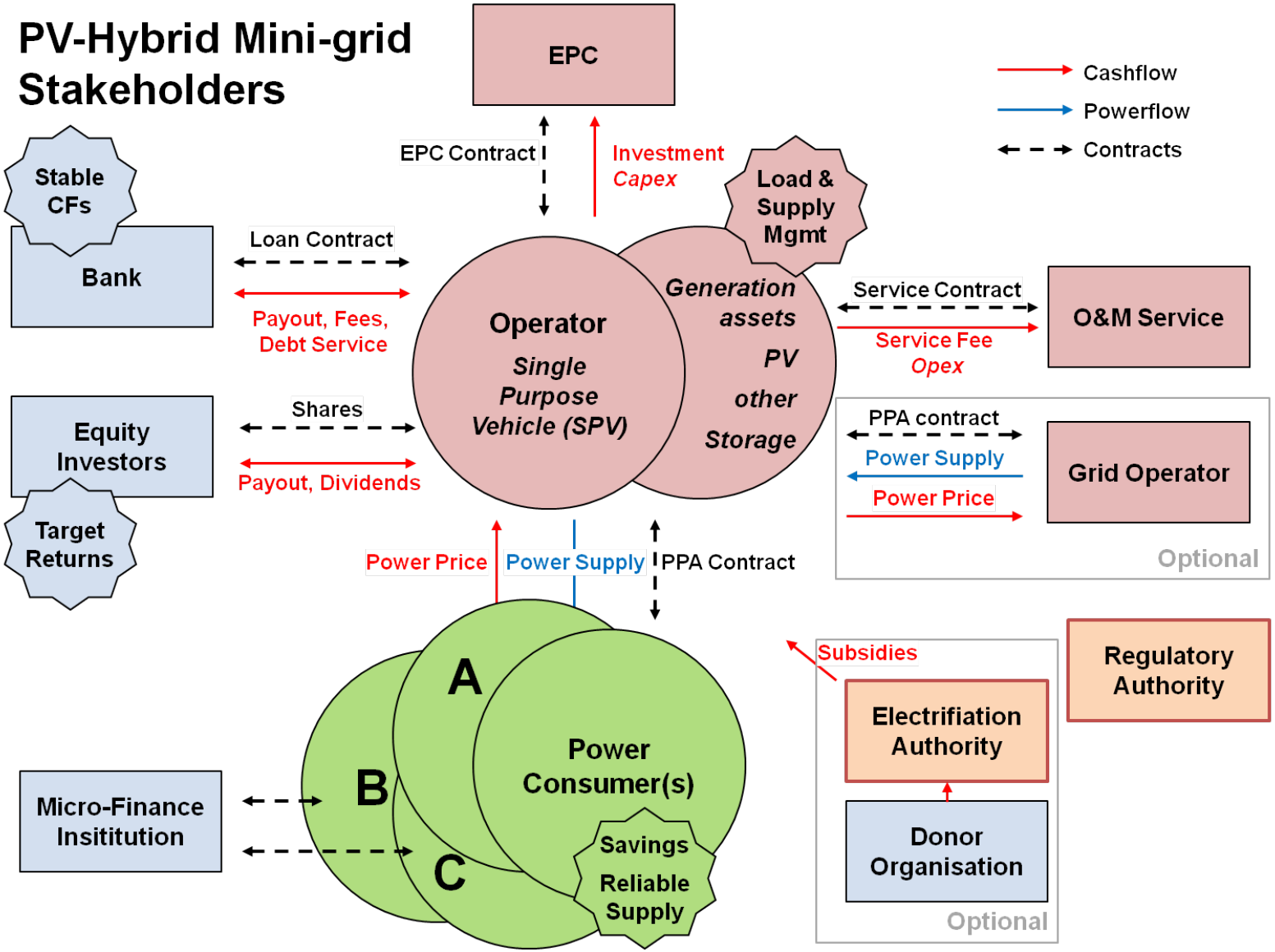
Requirements to be met for private sector investments in fully integrated ESCO (generation and transmission)

1. It must be legal to operate an micro-utility ESCOs; micro-utility ESCOS should be able to obtained licenses easily.

2. Micro-utility ESCOs must be allowed to charge tariffs resulting in risk equivalent margins.

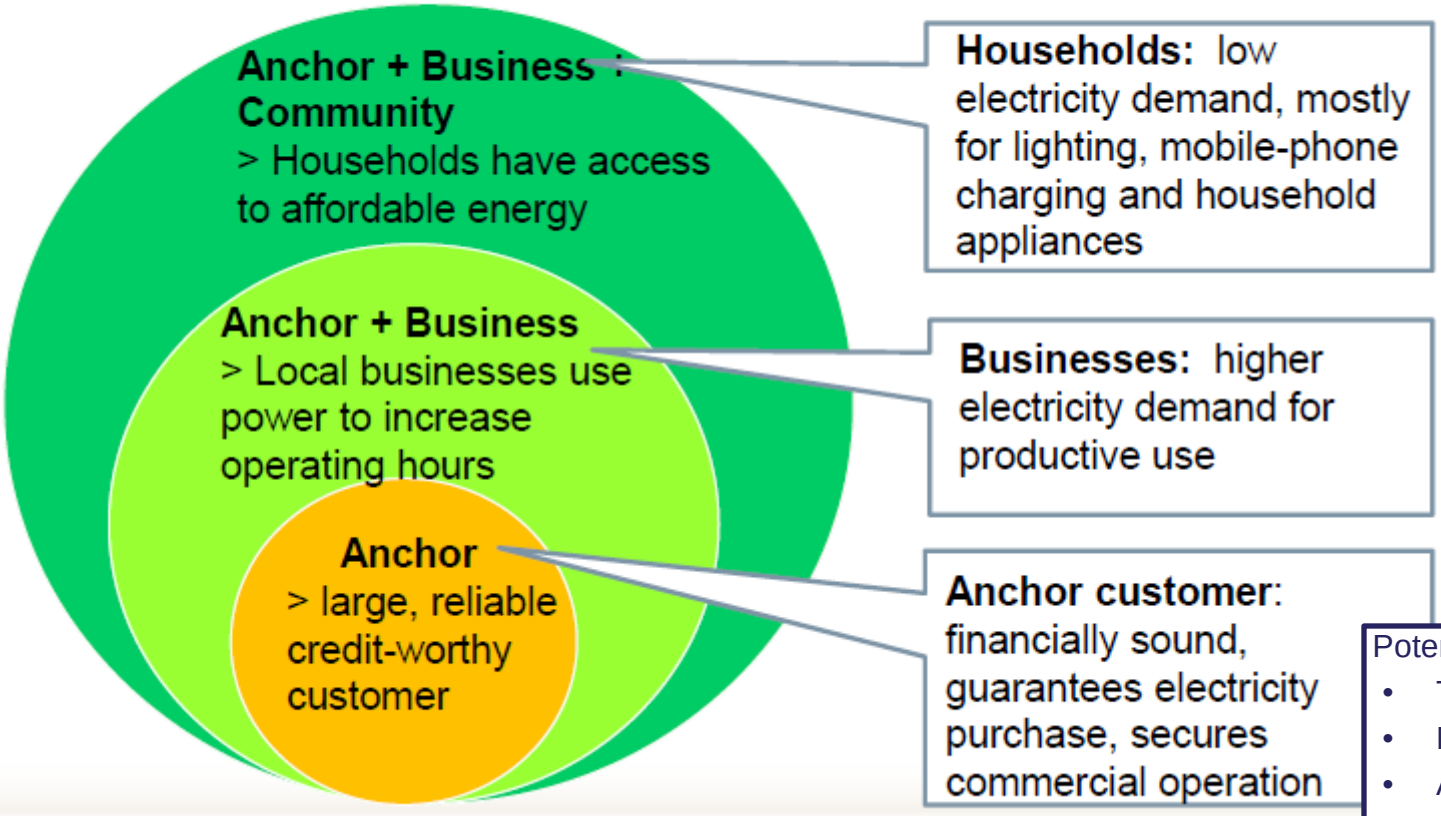
3. Ministries/authorities must disclose attractive villages/towns listed for mini-grid electrification.

PV-hybrid Mini-grid
Business environment



PV-hybrid Micro Utility Custumers ABC Model

The A(nchor) – B(usiness) – C(ommunity) Model



Households: low electricity demand, mostly for lighting, mobile-phone charging and household appliances

Businesses: higher electricity demand for productive use

Anchor customer: financially sound, guarantees electricity purchase, secures commercial operation

Potential anchor customers
- Telecommunication towers
- Mining companies
- Agro-processing industry
- Tourism industry
- …

Source: GIZ

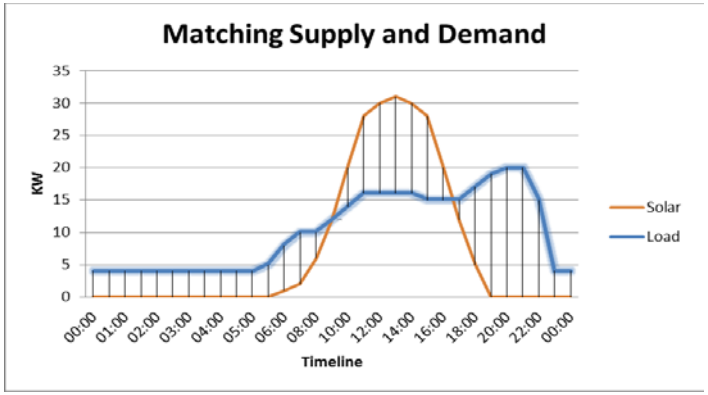
PV-hybrid Mini-grid
Project development steps

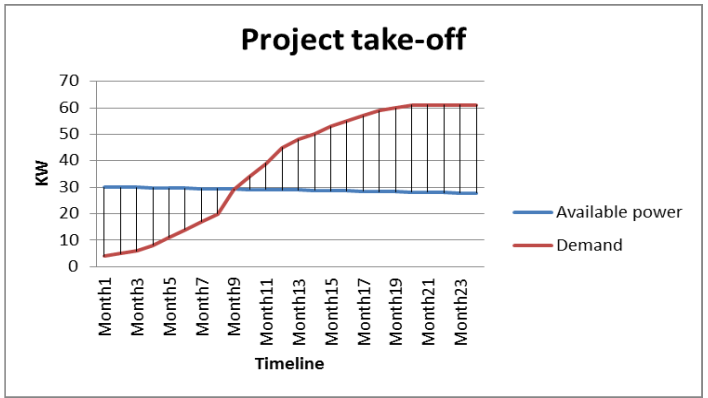
Framework conditions

Identification → Planning → Financing / Procurement → Implementation Construction → Operation

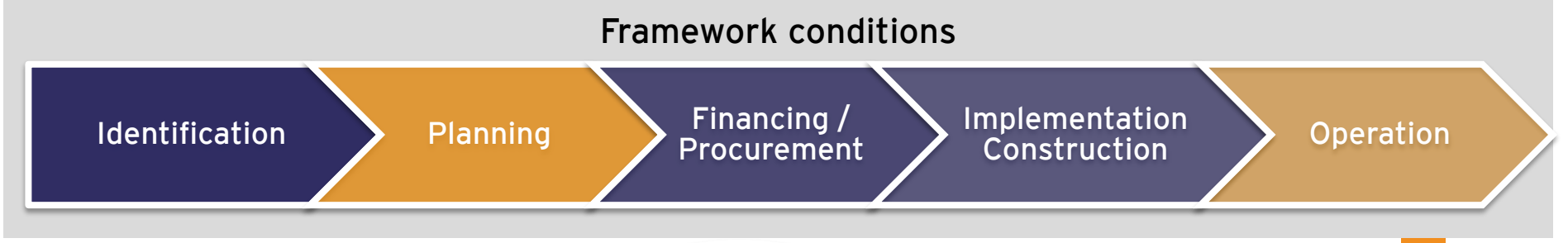
Technical Planning

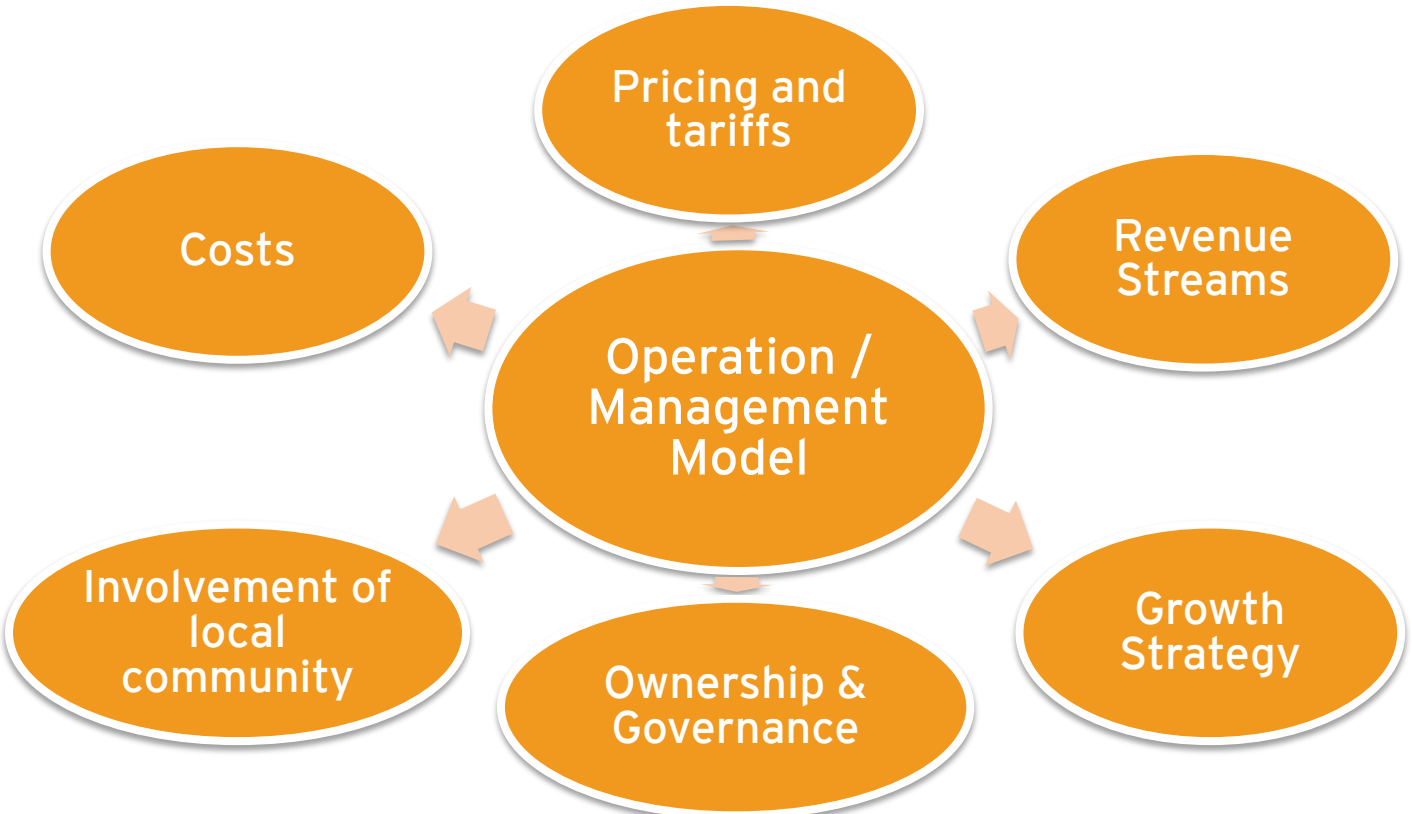
- Loads and generation capacity: Daily and over lifetime
- PV and other RE & dispachable rescources stability of the system
- Control System





PV-hybrid Mini-grid
Project development steps





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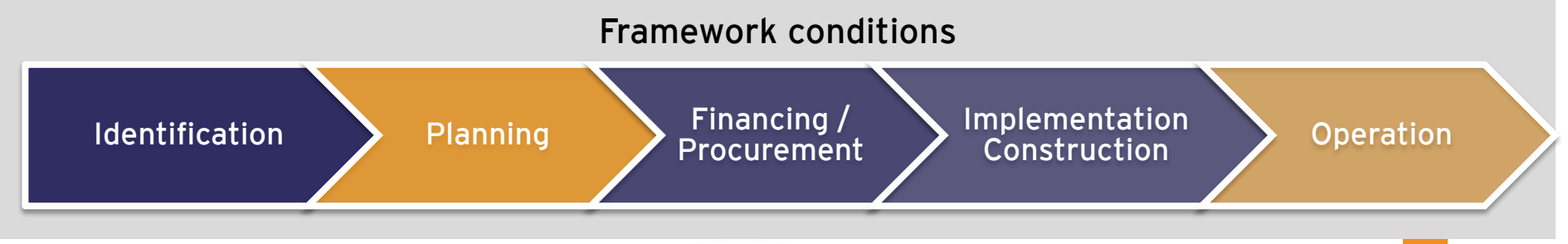
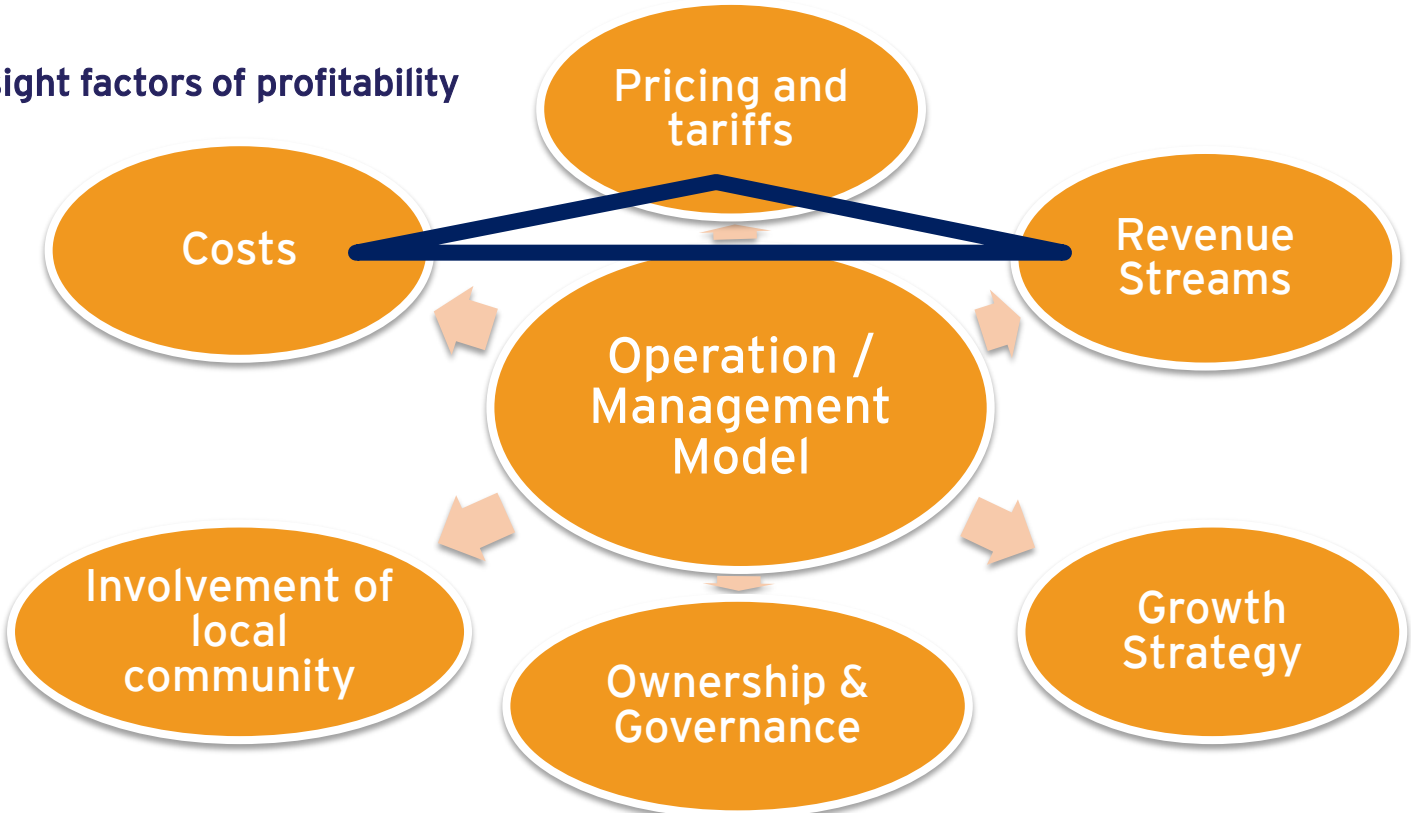


First sight factors of profitability



Operation- Management Modell Costs (Magnitude and Structure)

Costs can be difficult to predict

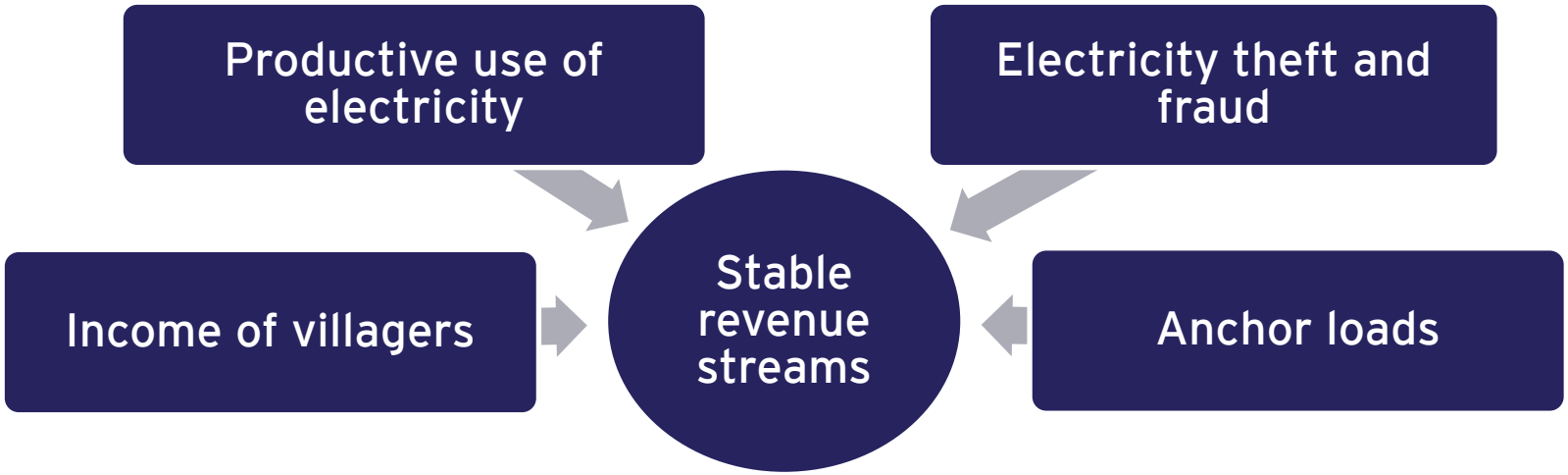
Types of Costs

- Transaction Costs
- Management Costs
- Operation and Maintenance Costs
- Replacement Costs
- System Extension Costs
- CRM costs (training)
- Tariff collection costs
- Monitoring costs
- Fraud / Theft
- Investment and Financing Costs

<u>Cost reduction methods</u>

- Efficient appliances and lights
- Incentives for electricity usage during times of abundant renewable energy generation (tariff / DSM)
- Load management system / Commercial load scheduling
- Integration of quality management and lean enterprise approaches into the electricity metering and billing approach
- Reduction of travel and HR-costs by hiring and training local personnel
- Restrict residential use

PV-hybrid Mini-grid Revenues (kWh sold)



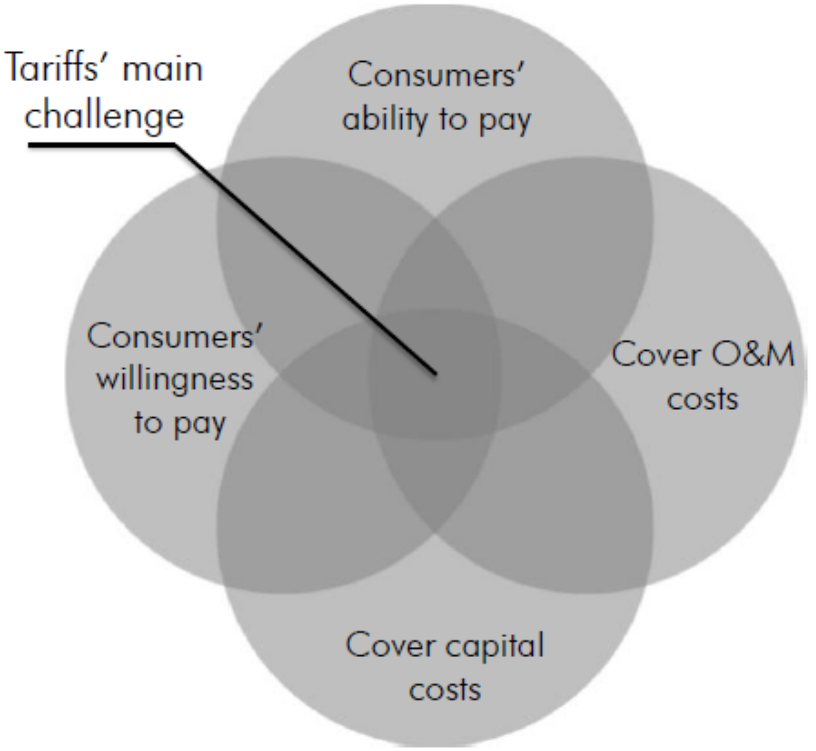
<u>Stabilization methods</u>

- Foster productive and diversified use of electricity, e.g. by cooperating with Micro-Finance Institution
- Incentivize and motivate costumers to plan their consumption ahead
- Appropriate metering concepts, balancing flexibility and

Operation- Management Modell
Tariffs and Pricing Models

Tariff model as the binding element

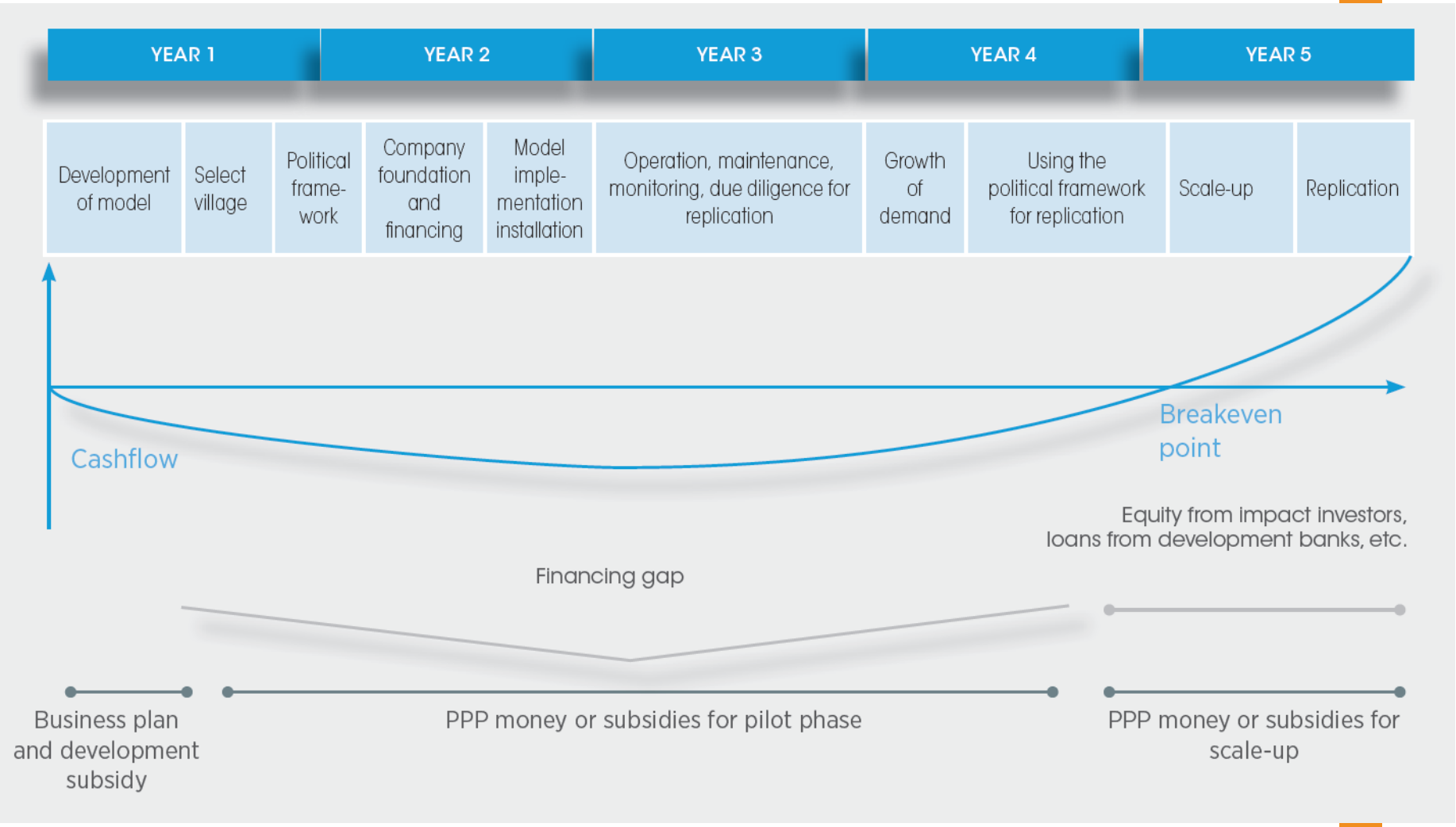
- make Mini-grid financially viable and sustainable
- willingness and ability of custumers to pay
- accepted by regulatory authority
- support economic development and improve living standard in the villages
- enable understanding of mini-grid operation and demand side management



Stepped **pricing model** that differs by levels of availability factors

Client	Price	Availability
Key / Platinum	Premium	Highest
Gold	Medium	High
Silver	Lowest	Regular

Financing along the micro-utility development timeline



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Thank you for your attention…

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BSW
Bundesverband Solarwirtschaft

Source: Solarmarkt