Regional Centre for Renewable Energy and Energy Efficiency
Centre Régional pour les Energies Renouvelables et l'Efficacité Energétique
Centro Regional para Energias Renováveis e Eficiência Energética
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RE MICRO-GRIDS FOR RURAL ELECTRIFICATION

PRESENTATION

FRIDAY, 27TH SEPTEMBER 2012
DAKAR, SENEGAL

PRESENTATION OUTLINE

1. *BASICS ON MICRO-GRIDS*
2. *ELECTRICITY DEMAND ANALYSIS IN RURAL AREAS*
3. *LEAST COST OPTION SYSTEMS ASSESSMENT*

BASICS ON MICRO-GRIDS

What is a micro-grid? And a mini-grid? And off-grid solutions?

Source: APP (2012)

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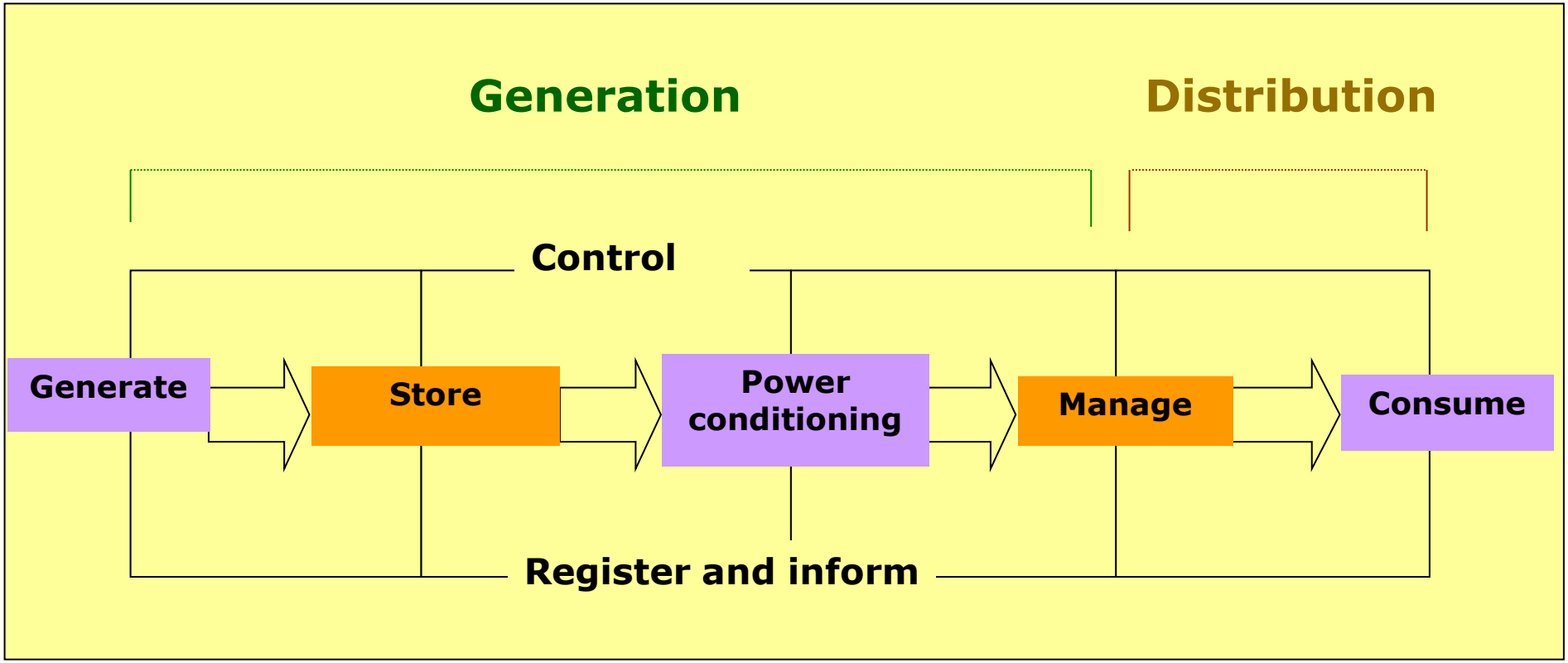
BASICS ON MICRO-GRIDS

Typical functions in a decentralised electricity delivery scheme



In the context of decentralised (or stand-alone or off-grid) electrification the term microgrid should strictly refer to the combination of a generation microplant which feeds a distribution microgrid

BASICS ON MICRO-GRIDS

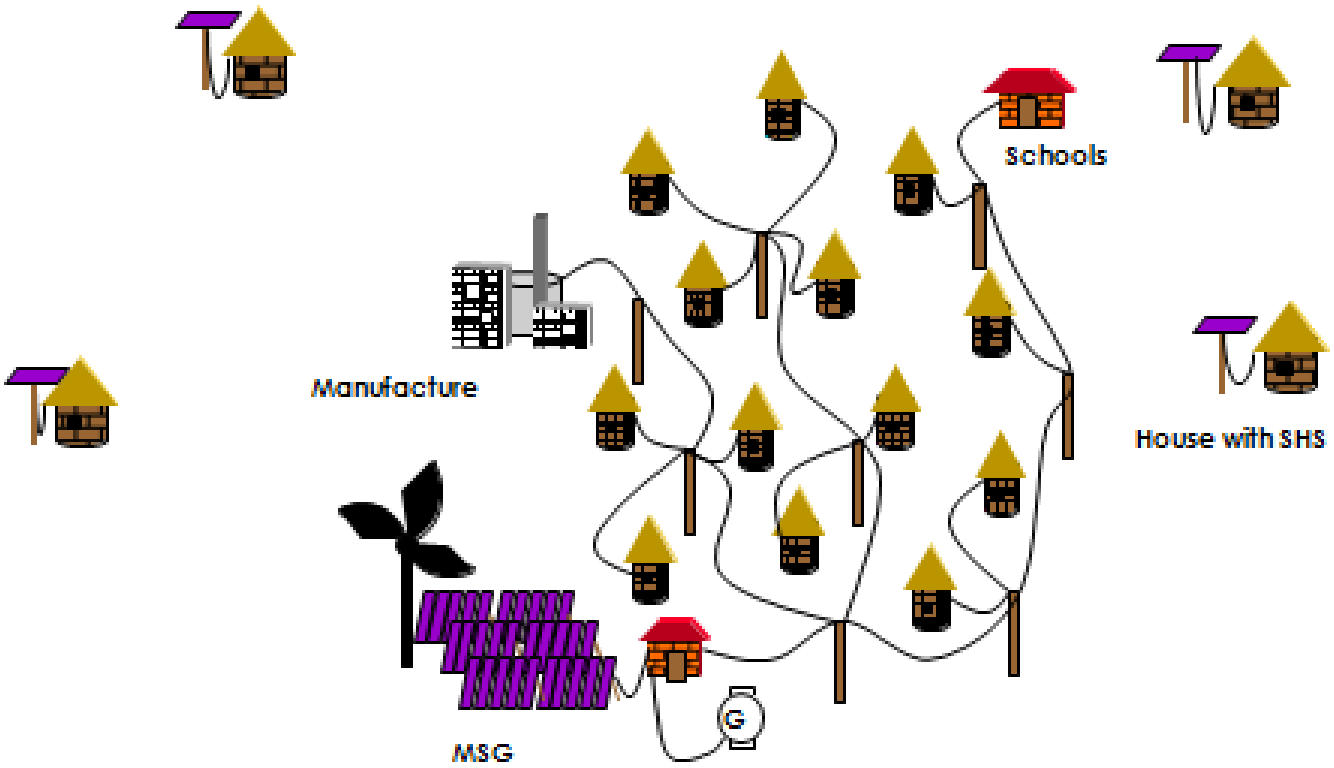
Microgrids vs Individual Systems (Microplants)

	Advantages	Disadvantages
Individual Systems (micro plants)	Consumption is user managed on a day to day basis. Black outs affect only one user. PV micro plants can be easily moved to a new location.	Limited surge power capacity. Monitoring individual plants can be expensive and difficult. Maintenance and repair service complex to organize in rural areas.
Multiuser Microgrids	Improved quality (surge power, load shedding, etc). Lower investment for compact villages. Energy saving can be practiced using improved management tools. Lower maintenance costs. Remote monitoring can be feasible and even economic	In a general power plant failure, everybody is cut off. Social rules required to distribute energy availability. Local management required. Plants generally need to be serviced on site

Source: Trama Tecnoambiental (2010)

BASICS ON MICRO-GRIDS

Microgrids vs Individual Systems



Source: Trama Tecnoambiental (2010)

BASICS ON MICRO-GRIDS

Technical specifications of Hybrid Microgrids

(partially adapted from IEC 62257 TS series, IEA PVPS Task3 and Task11 recommended practices

A combination of different but complementary energy generation technologies based on RE or mixed (RES + genset)

Should provide steady community-level electricity service (24h), with the possibility to be upgraded to grid connection in the future

Total installed power up to 100 kW (IEC standards)

Distribution line in Low Voltage (up to 1.000V) (only distribution)

Single or 3-phase grid

BASICS ON MICRO-GRIDS

Monte Trigo (Cape Verde) – 274 habitants
27 kW PV with battery storage + diesel back-up – 3.120 kWh/month

Source: APP (2012)

GENERATION TECHNOLOGY OPTIONS AND CONFIGURATIONS

Generating-types	Life Span (Year)	Off-grid		Mini-grid		Grid-connected			
						Base Load		Peak	
		Capacity	CF (%)	Capacity	CF (%)	Capacity	CF (%)	Capacity	CF (%)
Solar-PV	20 25	50 W 300 W	20	25 kW	20	5 MW	20		
Wind	20	300 W	25	100 kW	30	10 MW 100 MW	30		
PV-wind-hybrids	20	300 W	25	100 kW	30				
Solar Thermal With Storage Solar Thermal Without Storage	30 30					30 MW 30 MW	50 20		
Geothermal Binary Geothermal Binary Geothermal Flash	20 30 30			200 kW	70	 20 MW 50 MW	 90 90		
Biomass Gasifier	20			100 kW	80	20 MW	80		
Biomass Steam	20					50 MW	80		
MSW/Landfill Gas	20					5 MW	80		
Biogas	20			60 kW	80				
Pico/Microhydro	5 15 30	300 W 1 kW	30 30	 100 kW	 30				

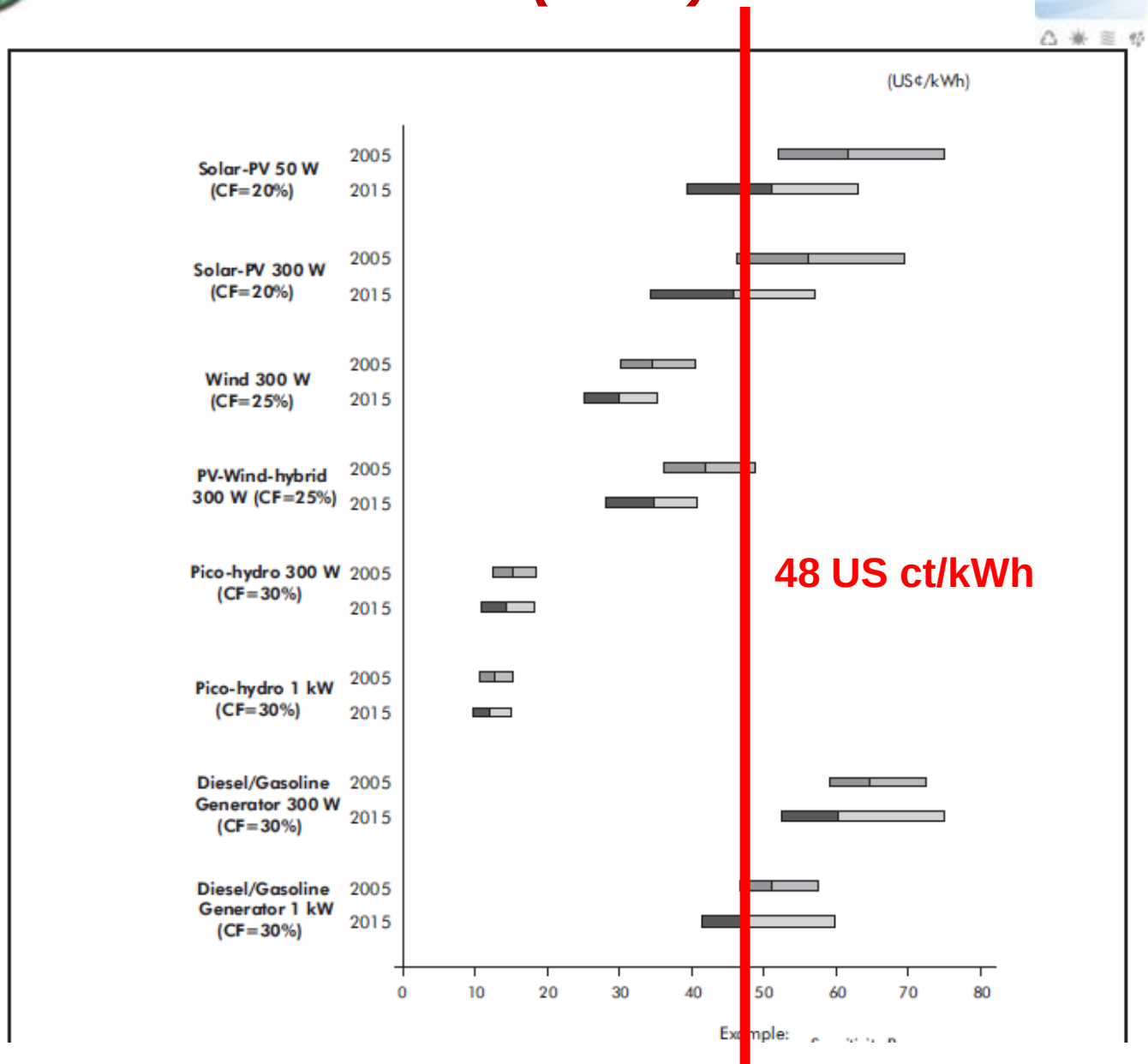
Bank (2007)

GENERATION TECHNOLOGY OPTIONS AND CONFIGURATIONS

Generating-types	Life Span (Year)	Off-grid		Mini-grid		Grid-connected			
						Base Load		Peak	
		Capacity	CF (%)	Capacity	CF (%)	Capacity	CF (%)	Capacity	CF (%)
Diesel/Gasoline Generator	10 20	300 W, 1 kW	30	100 kW	80	5 MW	80	5 MW	10
Microturbines	20			150 kW	80				
Fuel Cells	20			200 kW	80	5 MW	80		

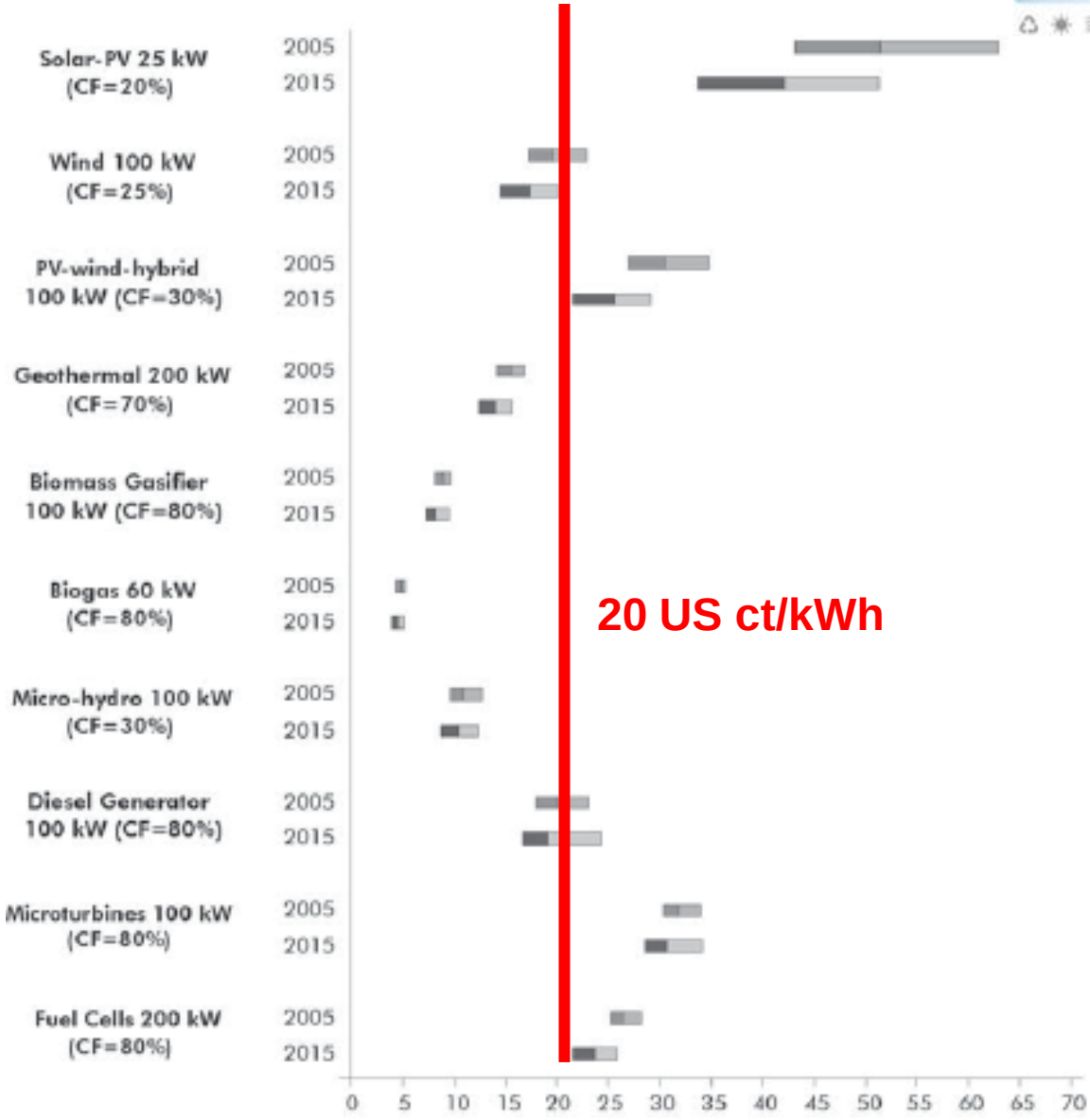
Source: World Bank (2007)

OFF-GRID FORECAST GENERATION COST (LCOE)



Source: World Bank (2007)

MINI GRID FORECAST GENERATION COST (LCOE)

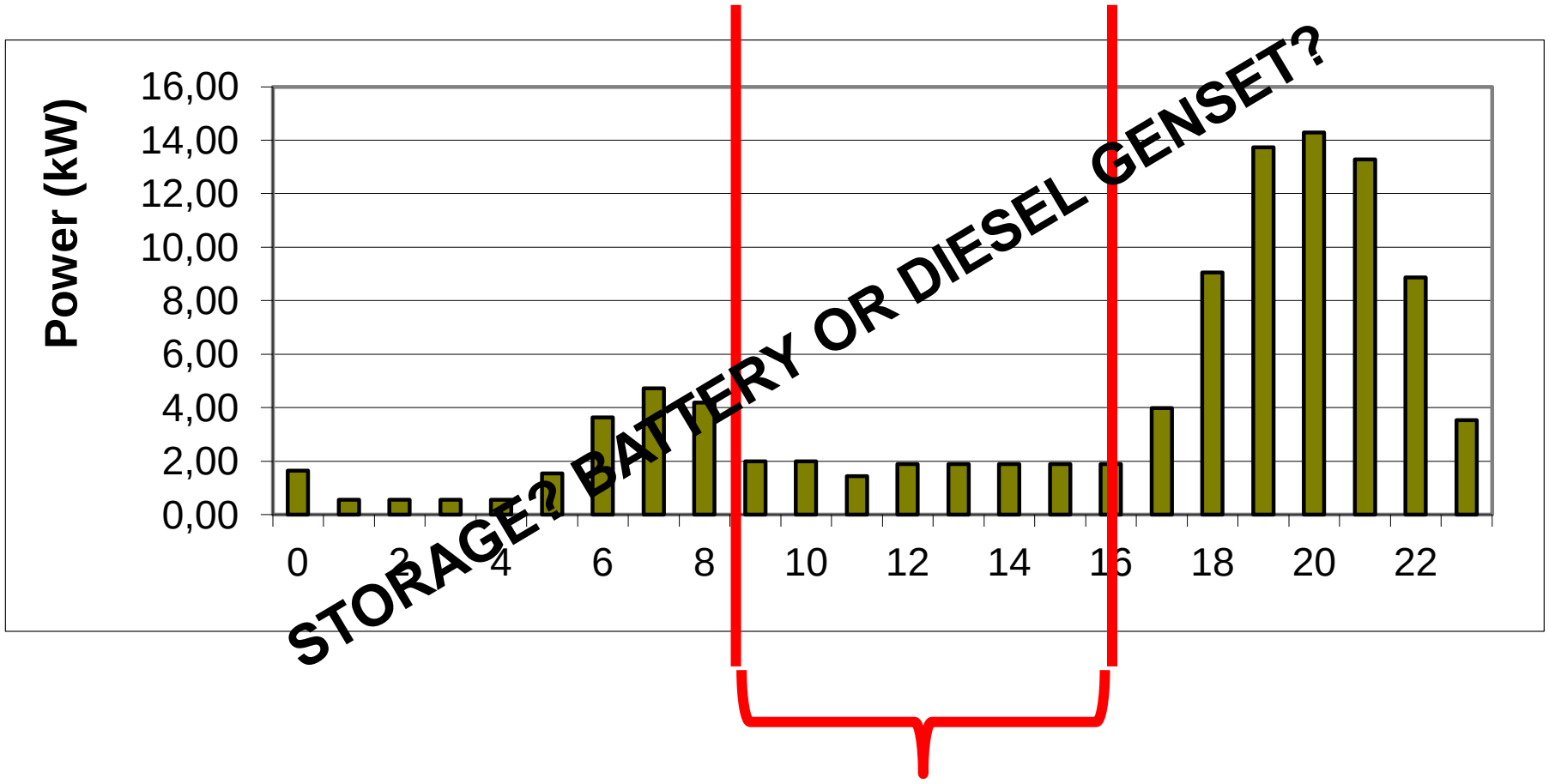


Source: World Bank (2007)

ELECTRICITY GENERATION VS TARIFF INCOMES

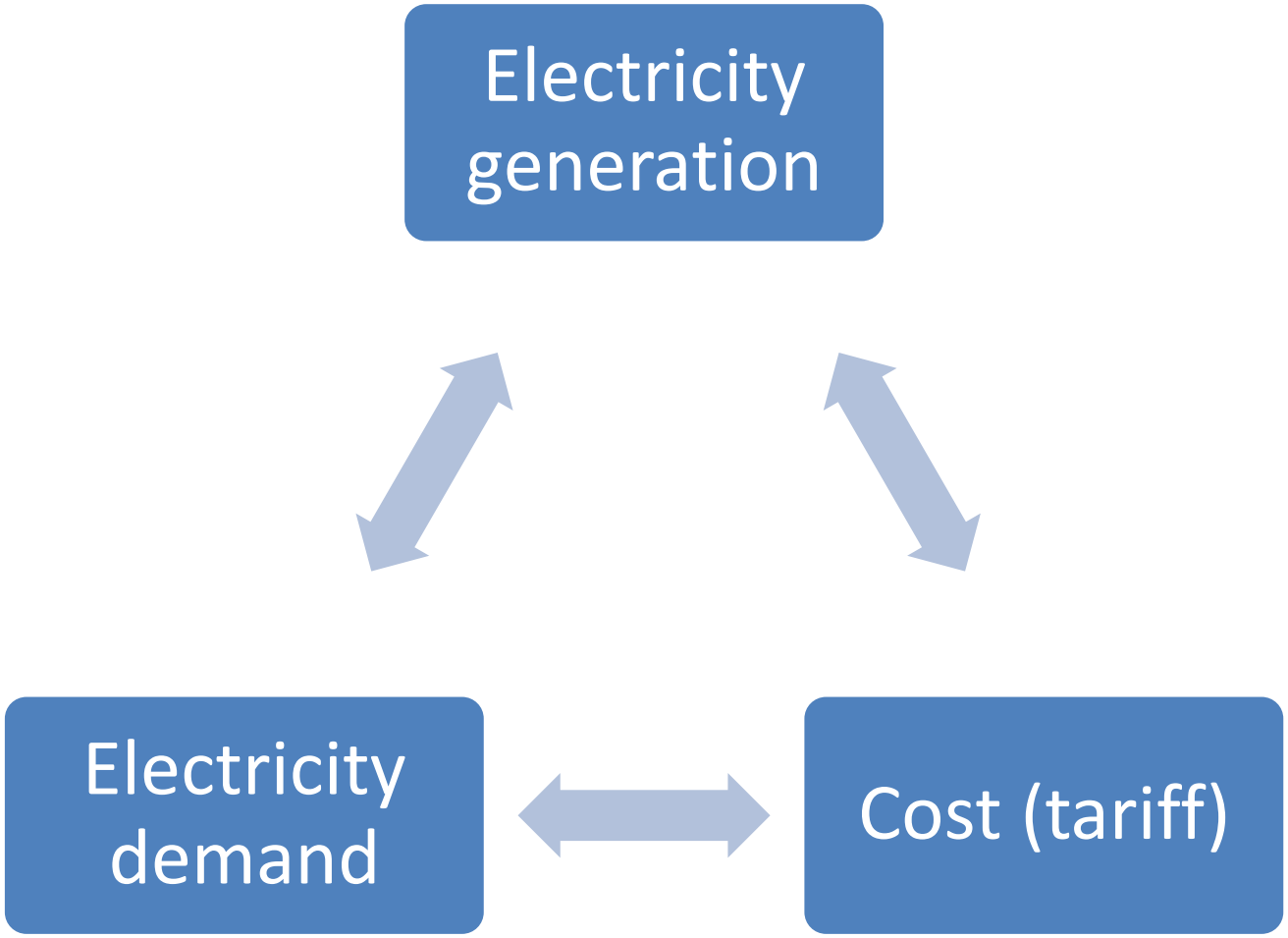
$$\text{INCOME} - \text{COSTS} \geq 0$$

ELECTRICITY DEMAND ESTIMATION



Source: Trama Tecnoambiental (2010)

ELECTRICITY GENERATION VS TARIFF INCOMES



ESMAP STUDY: PADRE COCHA (PERU)

Project overview

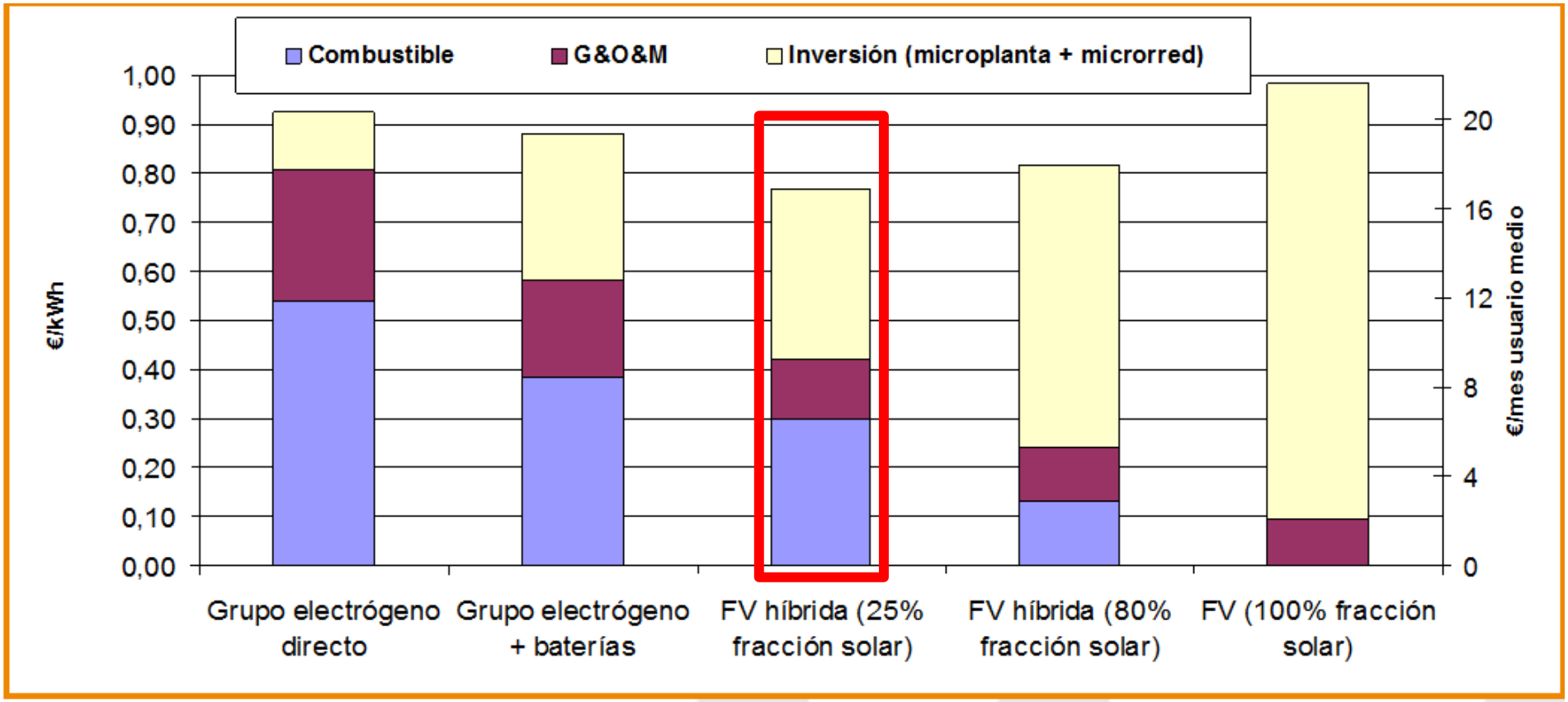
Electricity demand

- 240 rural consumers + Public services
- 220 kWh/day
- Peak load: 22 kW at night

Technically feasible options considered

- Diesel-only
- Diesel-battery-hybrid
- PV-diesel-battery-hybrid with four different PV %
- PV only
- PV-individual home systems

ESMAP STUDY: PADRE COCHA (PERU)



Source: Trama Tecnoambiental (2009)

Thank you! Merci! Muito Obrigado!

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