Lessons Learned at Solar Battery Charging Stations

A Presentation to Village Power ‘98

Stephen Graham

SGA Consulting, Ottawa, Canada

The Study

- World Bank Sponsored to answer:
  1. Do SBCS make sense?
  2. If so what are best practices?
- A four country field survey of SBCS programs
  - Brazil - 40 Stns, since 1996
  - Morocco - 30 Stns, since 1994
  - Thailand - 1350 Stns, since 1988
  - The Philippines - 225 Stns, since 1990
- Findings preliminary

Conclusion: When do SBCS make sense?

1. For small residential demand.
2. Remote from the grid.
3. Where diesel costs are high.
4. As a complement to SHS markets.

- Fluorescent lights (1-2), radio, B&W TV
- Grid BCS unless high battery transport costs
- Diesel BCS unless on-site fuel costs high
- SHS markets serve higher demand and ability to pay (ATP) - SBCS builds confidence & markets, lower cost, local service node

An Economic Analysis

- **Four Options**: Solar Station (SBCS), Diesel Station (DBCS), Solar Home (SHS), Grid Station (GBCS)
- **Base Case** -> Sensitivity Analysis for Access & Demand
  - Fuel price; Diesel BCS
  - Battery transport cost; Grid BCS
  - Demand; Diesel BCS & SHS

Assumptions:

DR = 12%, 15 yr project

Battery - SLI, 12V, 85 Ah, cycle life 100, DOD 80%, user-owned

Insolation - Design 4.2 kWh/m^2-d (Ave 5.0 kWh/m^2-d)

Economic diesel cost $0.18/ litre

Grid LRMC $0.05 / kWh

Household demand 100 Wh/day (2 lts, 3 hrs; 0.3 TV 1.5 hrs; 1 radio, 3 hrs)

No environmental benefits to solar

More Economic Assumptions & Inputs

- SBCS
  - Capacity per outlet based on full charge to battery on monthly min. solar day
  - number of outlets based on battery capacity, HH demand & assumed market size
  - battery life based on cycle life
  - Incremental Management Cost (IMC)
- Grid BCS
  - Charger capacity 60V, 20A
  - Serves broad community to always operate at capacity
  - No IMC
- SHS
  - Module capacity based on daily demand and monthly min. insolation
  - battery life assumed 36 mo.
  - IMC
- Diesel BCS
  - 3 kW capacity, e=1.55 kWh/ L
  - Charger capacity 60V, 20A
  - local diesel cost add $.02 / L
  - serves identical community to SBCS
  - No IMC

Findings of Base-Case Analysis

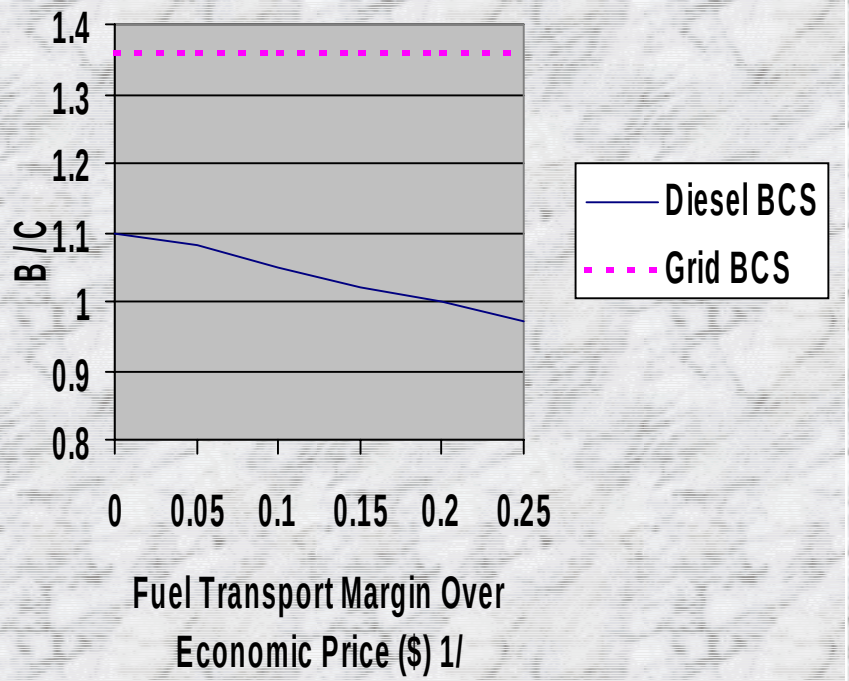
Option	NPV ($/HH-mo.)	B/C
SBCS	7.44	
Diesel BCS	6.81	1.09
SHS	10.01	0.74
Grid BCS	5.45	1.36

Sensitivity to Access: On-Site Fuel Cost

1/ National Economic diesel price assumed $0.18/ litre

SBCS is not Diesel BCS competitive until local fuel price cost is at least 100% of economic price

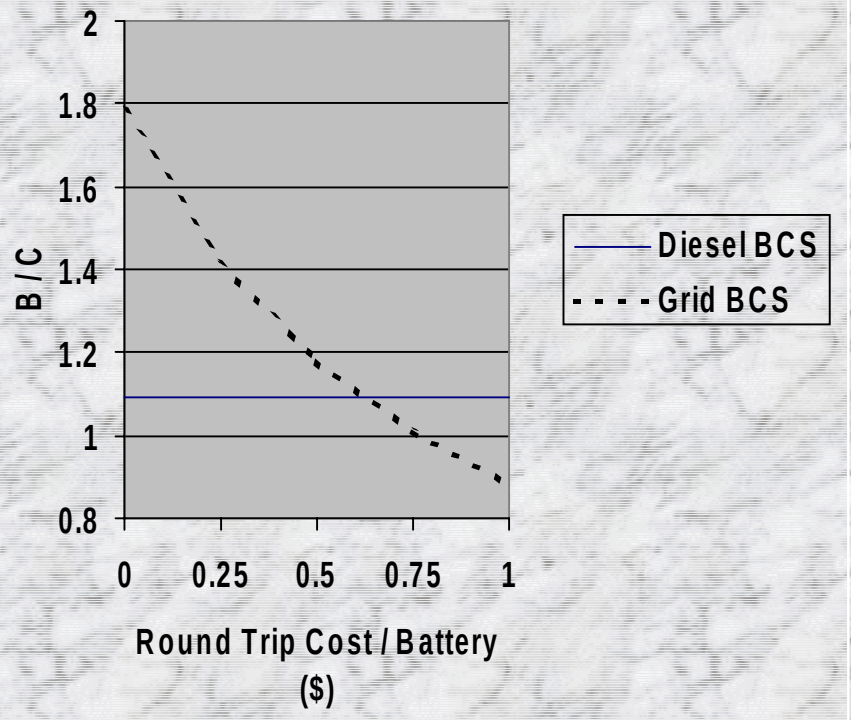
Figure 2.3: SBCS: Sensitivity of B/C to Fuel Price



Sensitivity to Access: Battery Transport Cost

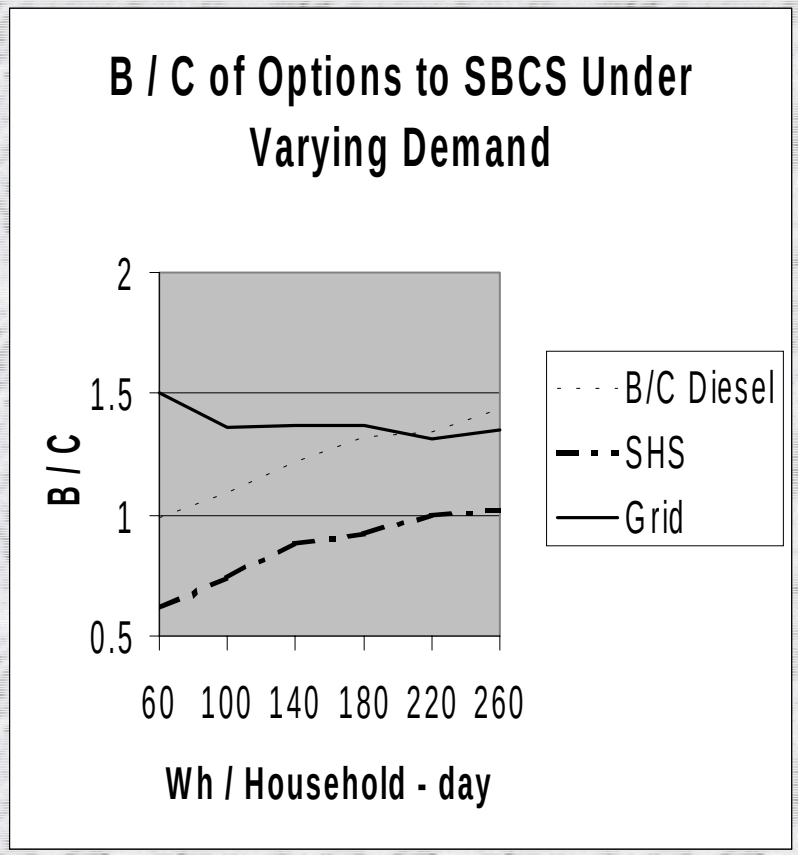
- SBCS becomes Grid BCS-competitive when economic transport costs are more than $0.75 / trip

Figure : SBCS: Sensitivity of B/C to Battery Transport Cost



Sensitivity to Demand: A Role for SBCS at low demands

- Low demand = lower Diesel capacity utilization
- as demand increases SHS becomes competitive - cost effective use of batteries



The Synergy of SBCS and SHS

- Same service, potential complementary markets,
- SBCS benefits over SHS markets
  - lower economic costs for low demands - serves lower ATP
  - proof of concept
  - community presence for marketing, finance and servicing SHS
  - modular for conversion to SHS
- SHS benefits over SBCS
  - convenience

Conclusion: What are best practices?

- Keep design simple and low-cost,
- serve basic market demand; allow SHS to serve higher end
- Emphasize operator skills and community participation
- Keep utilization high
- Subsidy may be necessary in remote areas and to pilot/demonstrate technology

Technical Design Features

- Minimize costs
- assume a low load demand- SHS serves higher
- no bus; dedicate panels to each charge outlet
- eliminate HVD; self-regulating system
- meters for charge status of batteries and operator control
- user owns and controls discharge of battery

Organization & Operation Design Features

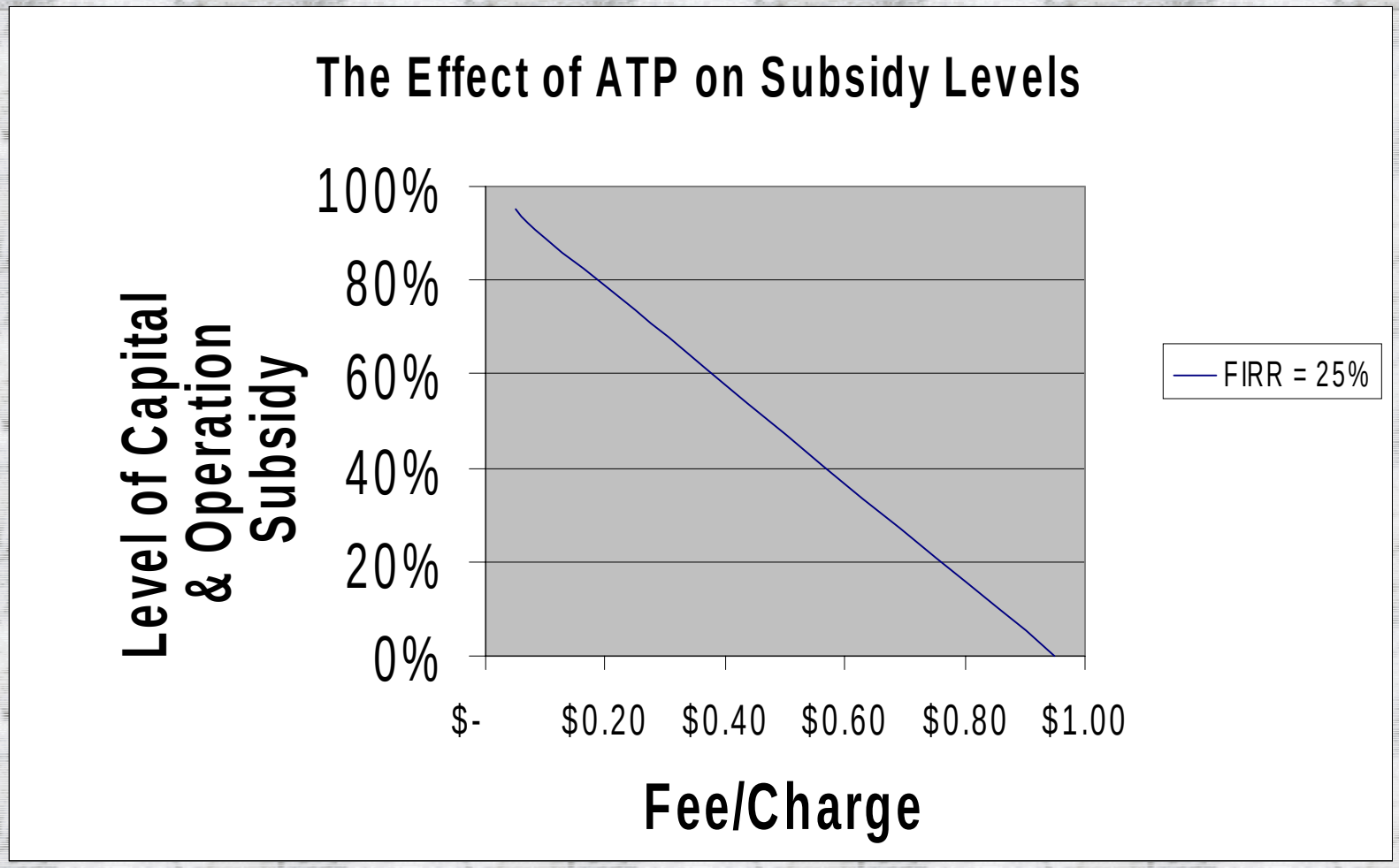
Isolated areas with low Ability To Pay (ATP)

- Often community-control
- Battery SOC rarely monitored
- users scheduled charge time; limit at Stn. (1 day)
- restricted closed market - community sets fees
- few operator incentives

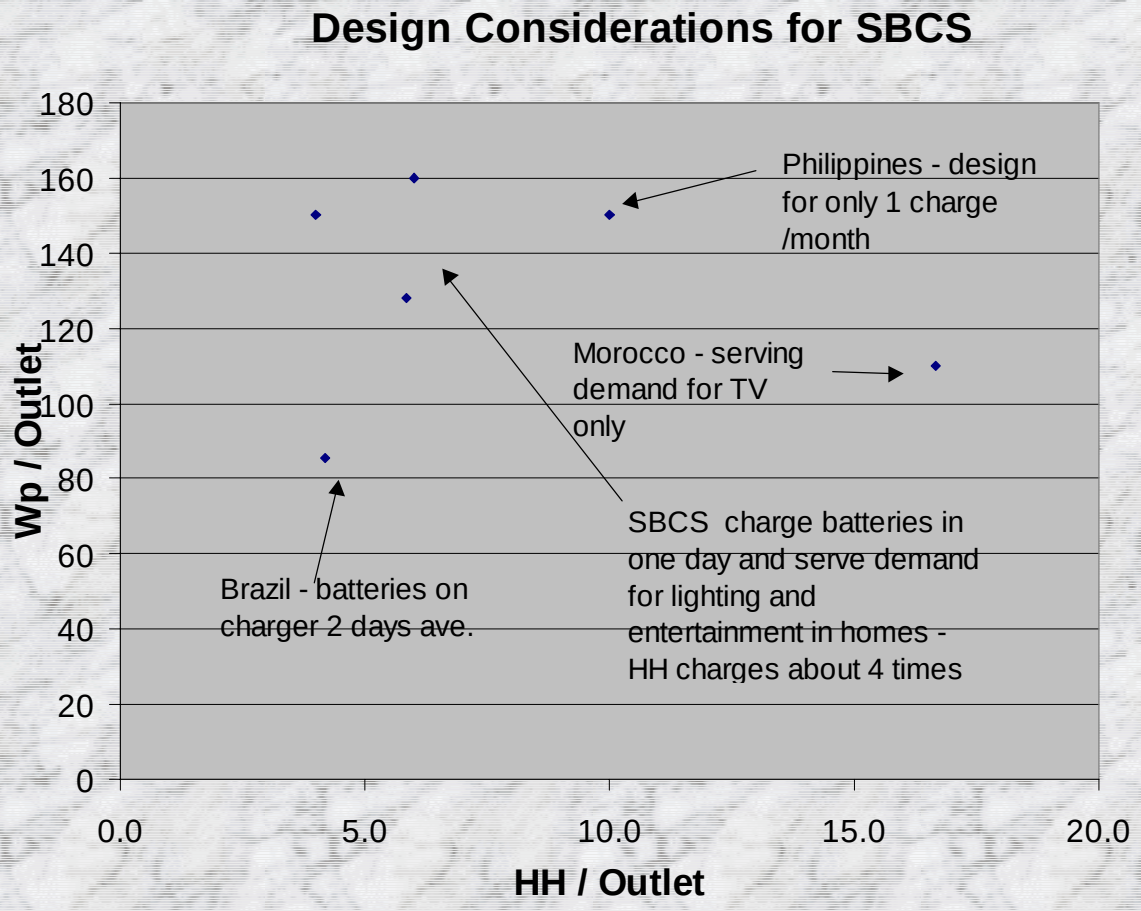
Areas with high ATP

- Owner-operator potential
- Battery SOC monitored before & after charge
- SOC determines battery residence time
- open market - competition sets fees
- operator incentives

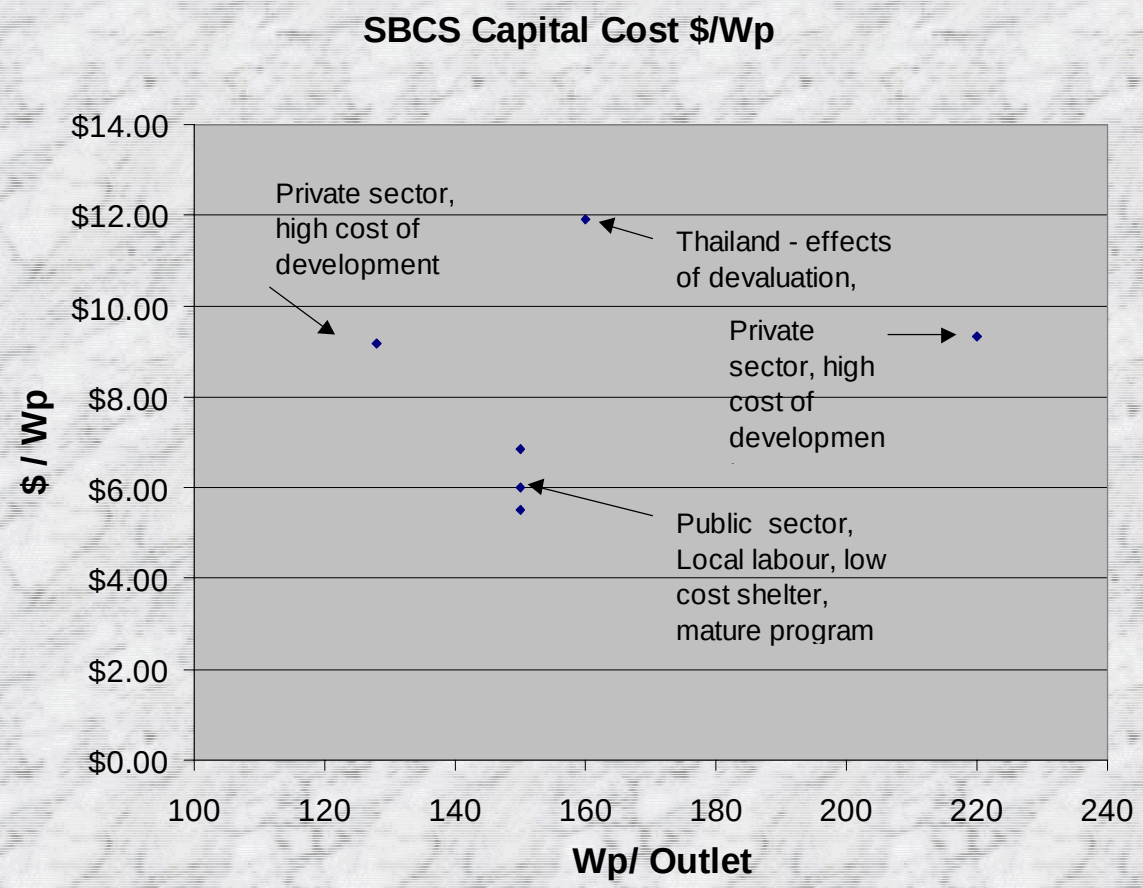
Subsidy May be Necessary



Field Experience: Design



Field Experience: Costs



Field Experience: Implementation and Operation

Country	Implement Institutions	Demo. Costs Borne by:	Implementation Strategy
Brazil	National NGO	US equip supplier & Govt.	NGO mobilizes locally Equip supplier & Devpt Bank finance operator
Maroc	Private firm with franchises	Private Govt / donor aid	Franchise purchases SBCS & set up to market rural energy equip – SBCS "lost leader"
Thailand	Govt. Agencies (2)	Govt	Disadvantaged communities – strong input – capital subsidized
Philippine	Utilities- REC LGU Govt Agncies NGO's Universities	Donor Aid	Disadvantaged communities – capital subsidized

Field Experience: Financial Considerations