Powering Health

Options for Improving Energy Services at Health Facilities in Guyana

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Background

- Energy Team supported program to electrify health facilities in sub-Saharan Africa (2004-2006)
- Presidents Emergency Plan for AIDS Relief (PEPFAR): launched in 2003 – 5 yr. $15 billion program – 15 focus countries
- PEPFAR implemented by USAID, CDC, DOD and other agencies

HIV/AIDS Power Requirements

Prevention

- Blood safety
- Rapid tests kits

Treatment

- Pediatric ARV drugs
- testing reagents
- Hematology and chemistry lab equipment

Care Facilities

- Lighting
- Communications
- X-ray
- Laboratory equipment
- Refrigeration
- Computer
- Microscope
- Water bath

PEPFAR's Energy Challenge

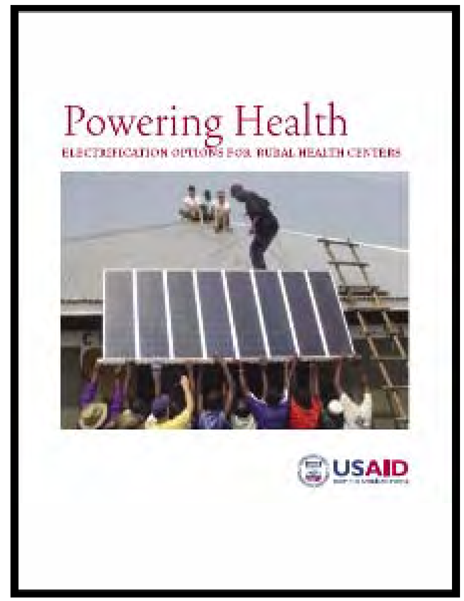
PEPFAR Focus Country	Electrification Rate %	Population Without Electricity (millions)	Population with Electricity
Ethiopia	2.6	67.2	1.8
Uganda	4	24	1
Rwanda	5	7.8	4.1
Mozambique	8.7	16.9	1.6
Kenya	9.1	28.7	2.9
Tanzania	9.2	33	3.3
Zambia	18.4	8.7	2
Botswana	26.4	1.3	0.5
Haiti	33.5	5.5	2.8
Namibia	34.7	1.3	0.7
Nigeria	44.9	66.6	54.3
Cote d'Ivoire	50.7	8.1	8.3
South Africa	67.1	14.7	30
Vietnam	79.6	16.3	63.9
Guyana	not available	not available	not available

292 million people without electricity in PEPFAR countries

USAID FROM THE AMERICAN PEOPLE

Energy Team's Response

- Objective: ensure implementation of sustainable, cost effective solutions
- Launched 2 phase program: 1) brochure, 2) technical assistance to PEPFAR programs
- Model: Energy Team pays for initial assessment/assistance – PEPFAR pays for implementation
- Initial support: Rwanda, Guyana



Assessment Objectives

Key Question

What options exist for utilizing renewable energy sources to improve energy services at Health Facilities in Guyana?

a) reduce cost of power intensive infrastructure?

b) improve energy reliability and quality at grid-connected facilities?

c) expand reach and quality of health services in interior?

Energy Sector Overview

- Majority of population is grid connected (unique among PEPFAR countries)
  - high loss (30% commercial, 20% technical)
  - oil based (Energy Security)
  - varying reliability and quality
- Large areas of country un-electrified
- Some population centers have quasi-grid
  - Power unreliable, costly, poor quality, and intermittent

Key Energy Sector Players

Government Implementing Agencies	Donors	Projects & Funding
Guyana Power and Light	IDB (UAEP)	$22 million for loss reduction, grid expansion
Office of the Prime Minister	IDB (UAEP)	$2.9 million for hinterland electrification program (on hold)
Office of the Prime Minister	UNDP	$100,000 grants per year for PV
Office of the Prime Minister	CARICOM (CREDP)	$100,000 loans for renewables $15,000 grants for renewables
Guyana Energy Agency		

Renewable Energy: Observations

- Strong interest from all government agencies, institutions, and individuals – lack of understanding of potential
- Impressive local capacity and potential
  - Farfan Mendez, Ltd., Eagles Resources, Ltd., OPM, Aubrey Marks and Associates
- Neutral/Positive Policy Environment
  - Exempt from import duty
  - VAT will apply
  - No net metering
- Several Large Scale projects in negotiation phase with GPL
  - Hope wind project
  - Bagasse project
  - 100 MW hydro

Facility Specific Challenges

Category	Facility Characteristics	Example	Challenges
I	Grid Connected, backup generator, large load (AC, etc)	GPH, New Amsterdam, Linden, Blood Bank, Reference Lab	• Expensive ($0.30 KW/h) • Power outages disrupt service • Poor quality power damages equipment
II	Quasi-Grid Connected, Medium Load, power not continuous	Regional Hospitals I, XII, XIII, IX	• Expensive ($1-3 KW/h) • Power unreliable and intermittent • Poor quality power damages equipment
III	No Grid, Small Load, No Power or generator/PV	Hinterland Health Clinics, NGO's offices	• Insufficient power for critical needs • Generator fuel expensive and difficult to transport

Site Visits

<u>Regional Hospitals (category)</u>

Georgetown (I)
New Amsterdam (I)
McKenzie (I)
Mahdia (II)

<u>Health Centers</u>

Williamsburg (I)
Micobee (III)
Tumatumari (III)

<u>Other Facilities</u>

Ribbons of Life (NGO) (III)

Category I

Category	Facility Characteristics	Example	Challenges
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Category I: New Amsterdam

Key Characteristics

- New hospital built by Japan opened in 2004
- Persistent low voltage power from GPL
- Frequent power outages (two, fifteen minute outages in 3 hrs)

- Back-up generator too small for critical load
- Operating theater not AC when blackout

75 kVA backup generator

New PEPFAR blood bank likely to face similar problems

CDC blood bank

Category I: New Amsterdam

AC

- low voltage causes burn out
- not on backup system

Lab

- voltage fluctuation produces questionable results

Category I: New Amsterdam

Possible Solutions

- Attempt to solve power quality issues with GPL
  - Pursue possibility of Dedicated Feeder Line
  - Look to assure adequate generating capacity at GPL station
- Check into Automatic Voltage Regulator that was installed with the new building
- Consider self generation with a generator that will power the hospital and/or the blood bank
- Incorporate a UPS system that will also function as a provider of clean power

Category I: New Amsterdam

Self Generation

- estimated 350KW system for blood bank and hospital. Capital Cost: $250,000
- Generation costs likely to be similar to the current cost of $0.25/kwh

UPS / Power Conditioner

- Critical loads - 100 KVA system
- $150,000 to $200,000

Category I: New Amsterdam

<u>Solar Power Options</u>

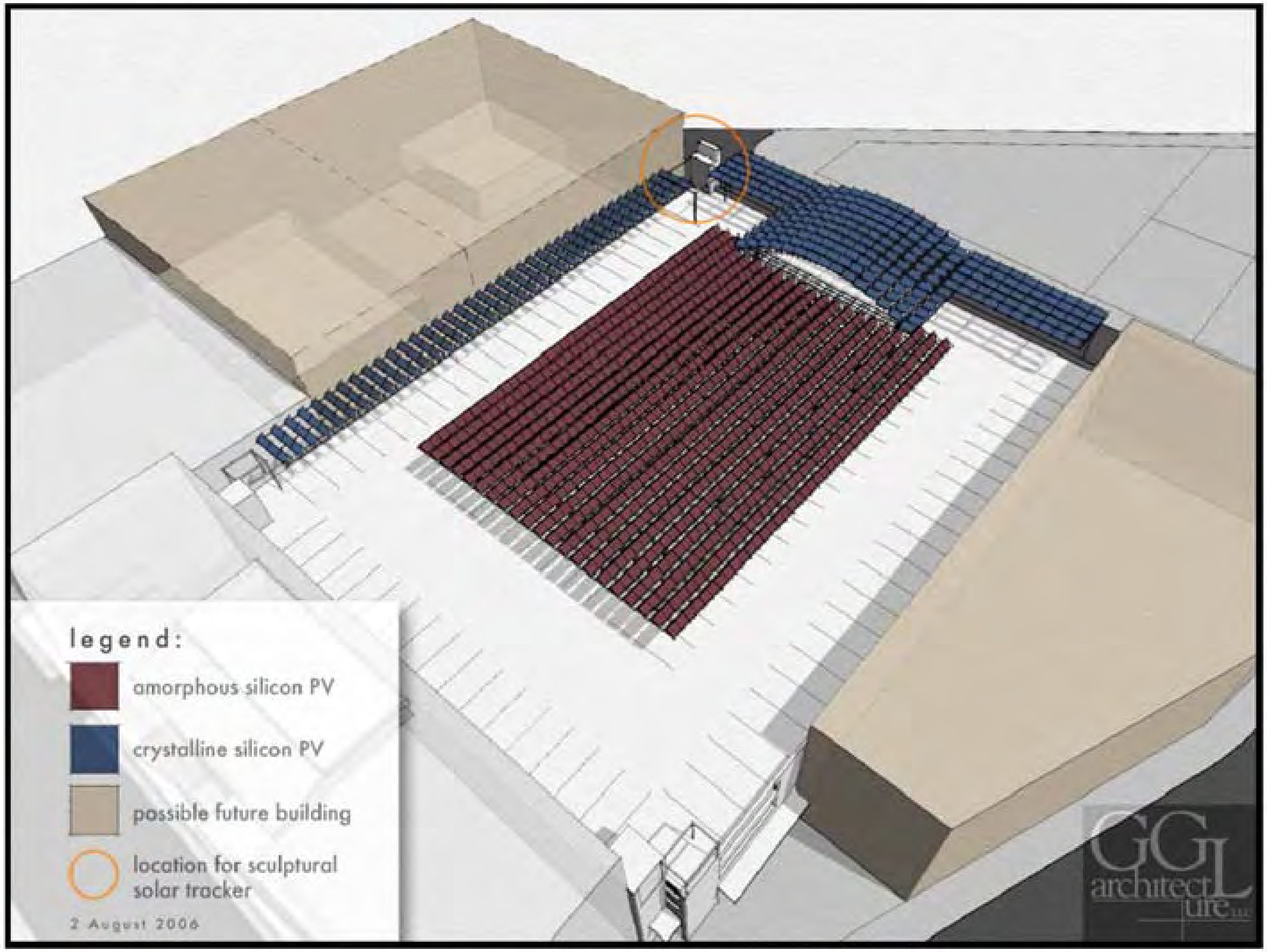
- Solar power could be added after the power conditioning is incorporated to offset long term power costs
- To offset just the *emergency power* loads, would require 200,000 watts of solar panels, or 2,000 - 100 watt panels
- To offset the entire load would require approximately twice this number of panels

Category I: New Amsterdam

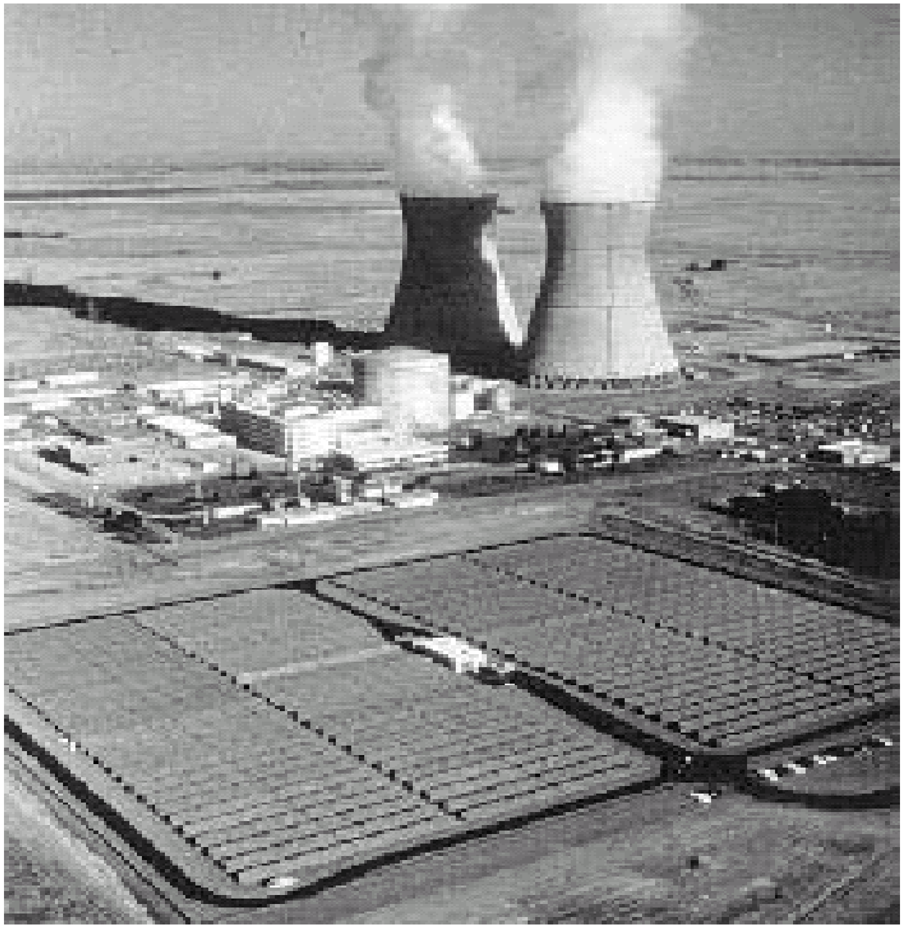
<u>200,000 Watt Array of Solar Panels</u>

- Initial Cost – Approximately $2.4M
- Power produced in a year: 240,000 kWh
- Savings: ($0.25/kwh) $60,000 per year
- $2.4M / $60,000 = 40 Years
- Any subset of this 200,000 W array of solar panels could be applied (for example – an amount equal to the added load of the blood bank)

200,000 W Solar Array



Perspective



1 Megawatt PV Power Field Sacramento

Category I: Take Home Points

- Poor quality and unreliable power from grid extremely damaging to laboratory equipment and overall health care services
- Problems must be addressed with “non-renewable” solutions
- Renewables can offset long term power bill but systems very large

Category II

Category	Facility Characteristics	Example	Challenges
I	Grid Connected, backup generator, large load (AC, etc)	GPH, New Amsterdam, Linden, Blood Bank, Reference Lab	• Expensive ($0.30 KW/h) • Power outages disrupt service • Poor quality power damages equipment
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Category II: Mahdia

Mahdia District Hospital

Key Characteristics

Provides services for 4000

RHO: reliable power #1 challenge

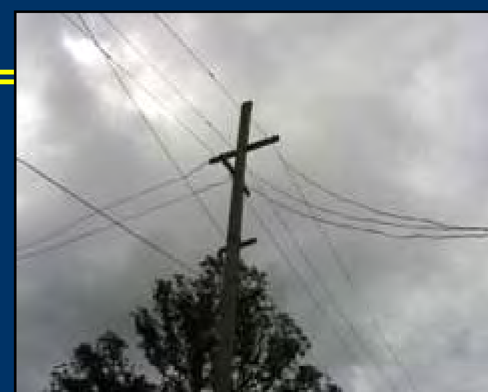
Mining community – high risk

Category II: Mahdia

PV for vaccine refrigerator

On site generator:
10 am – 2 pm

Quasi-grid (Mr. Hinds):
24 hrs for PMTCT refrigerator



Quasi-grid (Mr. Pash Ram):
6pm – 6 am

Category II: Mahdia

Poor Quality Power = Broken Equipment

X-ray lab on hold

Dental chair and light inoperable

Bulbs and ballast burn out

Laboratory equipment inoperable

Category II: Mahdia

Mahdia Current Power Scheme	Cost/ kwh USD	Remarks
6 PM to 6 AM power from IPP	~$3.00	Lump sum of $75,000GD per month paid to Local IPP. Very poor quality power and limited loads.
10 AM to 2 or 4 PM: Power from on site 11 KVA Generator	~5.80	Hospital runs their own generator, mainly to keep one of the three refrigerators from going for more than 4 hours without power. Also poor quality. High costs are partly due to large generator compared to loads being used most of the time.
Solar Powers the Dulas Refrigerator and the CB Radio		
Power for the AIDS lab refrigerator is provided gratis by second IPP		It is likely that this power will be charged for in the near future.
X-Ray Equipment / Building		Nearly built, but no clear picture on how it is going to be powered.
Weighted Average of Existing Power being supplied	~$4.00	This is inadequate power, and of poor quality, causing damage to lab equipment, dental equipment, lights and computer equipment. Most of the critical loads are not being powered.

Category II: Mahdia

Option:

Power the entire facility on solar/diesel hybrid power

Estimated 16,000 watt-hours of energy consumption

Category II: Mahdia

Scheme	Initial Capital	with Initial Cap NPC $/khwr D=.86/L	with Initial Cap NPC $/khwr D=1.80	w/o Initial Cap NPC $/khwr D=.86/L	w/o Initial Cap NPC $/khwr D=1.80
Limited to 16,000 Whrs/day					
Solar Only	55,000	1.00	1.00	0.14	0.14
Solar / Diesel Hybrid (3 KW)	47,000	1.00	1.00	0.14	0.15
Solar / Diesel Hybrid (5KW)	50,000	1.00	1.05	0.15	0.15
Generator Only - (5KW)	7,000	2.40	3.45	2.25	3.35
Generator Only - (10KW)	12,000	4.60	6.80	4.50	6.65

Category II: Take Home Points

- Poor quality power from “quasi grids” extremely damaging to laboratory equipment

- “Make-shift” energy solutions usually very expensive/unreliable

- Self generation utilizing solar/diesel hybrid much more economical than pure diesel generators

Category III

Category	Facility Characteristics	Example	Challenges
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Category III: Micobee & Tumatumari

Tumatumari Health Post

Micobee Health Post

Key Characteristics

No grid power

Serve 360 (directly); 300 (indirectly)

Service		Power Need
Malaria Diagnosis	→	Microscope
Delivery	→	Lighting
Immunization	→	Refrigerator
communications	→	Radio

Total = 330 to 1,000 Wh/day

Category III: Options & Recommendations

Options

Generator

- Small capital cost
- high recurring costs (fuel)
- higher annualized cost of energy ($/kwhr)

Solar

- High capital cost
- lower recurring costs (maintenance)

Scheme	System Description	Solar System Approx Capital USD	Solar System NPC $/kwhr w./capital	Diesel System NPC at $0.86 per Gallon	Diesel System NPC at $1.80 per Gallon
Lighting and radio for 4-6 hours per day	120 Wp	$2,000	$2 to $3	$4 to $4.5	$5 to $5.5
Lighting, radio, and refrigerator	400 Wp	$6,400	<$2	~$3.5	~$5

Category III: Take Home Point

Properly designed and well maintained solar systems are most economic option to meet the small power needs of remote clinics.

Previous Experiences with Solar

Poor Track Record for Solar in Guyana

- 20+ solar systems installed on Health Facilities from 1982 to present
- 50 W (1 panel) – 22 kW systems (500 panels)
- Cold Chain Assessment reports conducted in 2000, 2002 (region 1), 2004
- In 2004, 13 of 21 solar systems not working

Solar (cont)

<u>Conclusions of all reports the same</u>

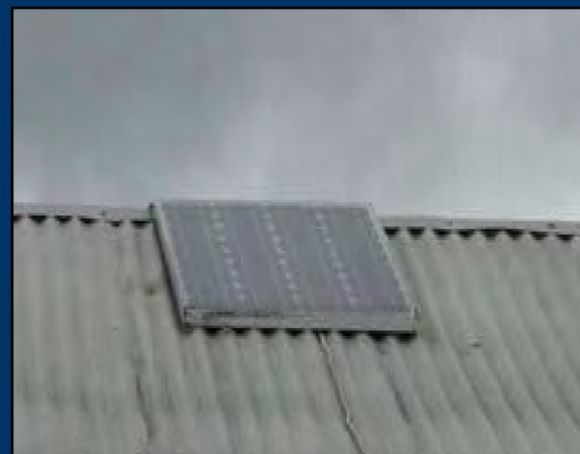
1) Systems not properly designed
2) Users not trained on operation and maintenance
3) Lack of preventative maintenance
4) Lack of security measures in design

Status quo not working

Case in Point

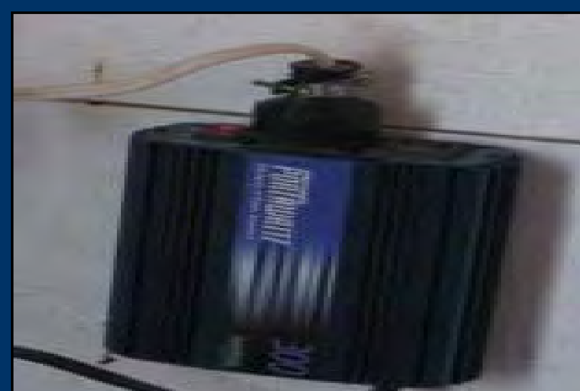
Design & Maintenance Issues

Local medic not trained to provide routine system maintenance



Panel mounted directly on roof

Batteries:
1) oversized for panel
2) almost out of water



Inverter model is sensitive to humidity

Renewable Energy Observations (cont)

Solar Pre-requisites

- Training and maintenance plans must be central component of any solar program, not afterthought
- Dedicated maintenance funds must be established (MOH?, RDC's?)
- Three– tier trained PV support structure
  1) local user
  2) regional technician
  3) national technicians
- Establish design standards including security features

Conclusions

Reduce cost of grid-connected (Category I) power intensive infrastructure?

- Yes … but … solar only economical for grid connected facilities if capital cost discounted
- High upfront costs results in long term savings
- Air-conditioning, x-ray = high power intensity
- Donors must do better job of consulting with local stakeholders to design energy efficient buildings utilizing natural cooling and lighting

Conclusions

Improve energy reliability and quality at grid-connected (Category I) facilities?

Many non-solar based investments would take top priority when considering cost-effective options for improving the power supply at grid-connected health facilities such as New Amsterdam and Georgetown public hospital.

e.g.:

- Backup Generators (or self generation)
- Un-interupted Power Supplies (UPS)
- Power Conditioning units

Conclusions

Expand reach and quality of health services in interior (Category II and III)

- Absolutely! Solar most cost effective solution
- Challenge: find overlap with PEPFAR priority facilities
- Option: off-grid regional hospitals (I, VII, VIII, IX)

Conclusions

Program	Cost
Address power quality problem for new blood bank at New Amsterdam. (solution needs more study)	$150,000
Design / Install a solar/diesel system for Mahdia or equivalent district hospital	$125,000
Establish Basic Design Standards and Prototypes for the MOH – focus on small and medium systems.	$75,000
Training program for technicians – local, regional, national.	$50,000
Retrofit / Install up to 10 small remote health clinic systems.	$100,000
Total	**$500,000**

Next Steps

- Final report completed by end of January

<u>Short term implementation of recommendations</u>

- PEPFAR infrastructure projects currently underway (e.g. blood bank)
- Ministry of Health (WB MAP funds, Global Funds, etc.)

- Other recommendations considered by PEPFAR for inclusion in 2008 COP

- Repeat assessment in other PEPFAR countries as desired.

Acknowledgements

- Guyana PEPFAR staff
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