



Energy Group

SOLAR POWER USED TO REDUCE DEPENDENCE ON UNRELIABLE ELECTRIC GRID

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CLIENT

- ▶ Theological College of Zimbabwe (TCZ)



DEFINITION OF PROBLEM

- ▶ The Theological College of Zimbabwe has problems with unreliable power from the electric grid.
- ▶ Power goes out roughly 40 times a week



PROPOSED SOLUTION

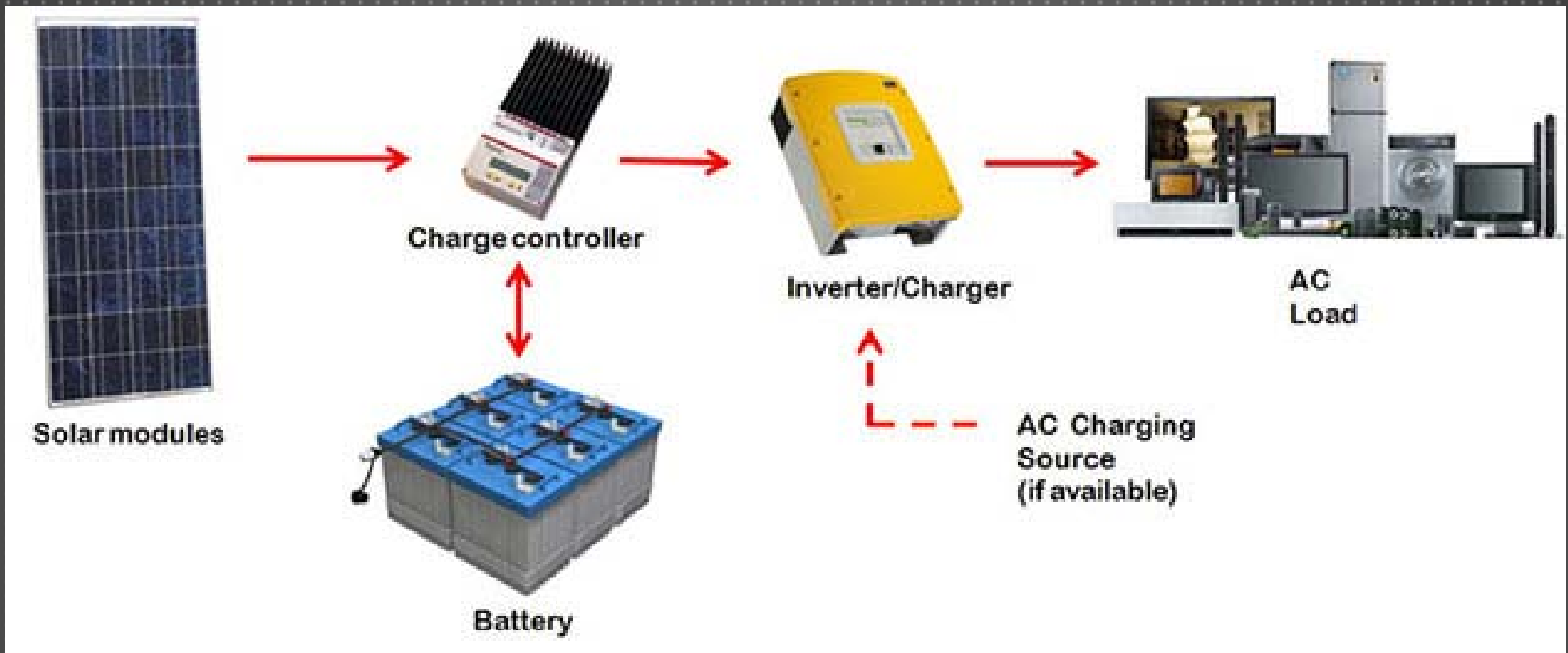
- ▶ Photovoltaic System
 - ▶ Computer Lab
 - ▶ Library



DESIGN FACTORS FOR A SOLAR PV SYSTEM

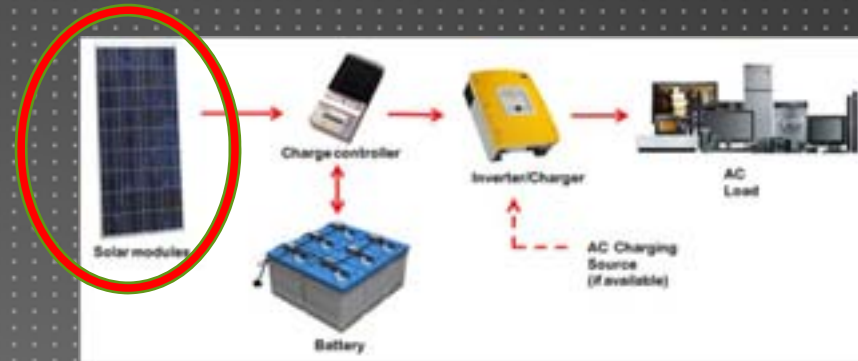
- ▶ Select Type of PV System
- ▶ Specific Customer Constraints
- ▶ Internal System Constraints
- ▶ Physical Location Constraints
- ▶ Financial Constraints

OVERVIEW OF GRID TIE PV SYSTEM

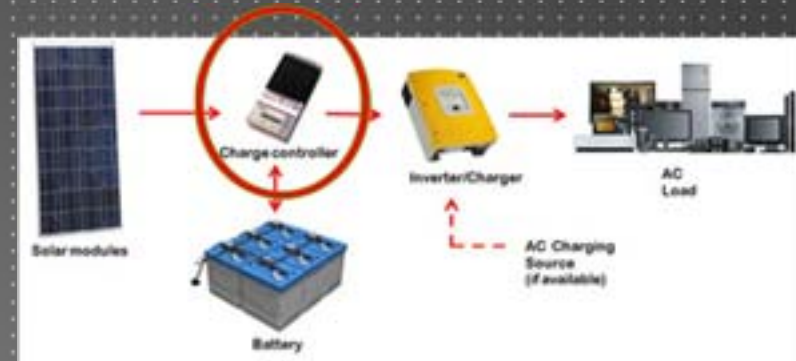


SOLAR PANELS

- ▶ Sunlight into electrical power



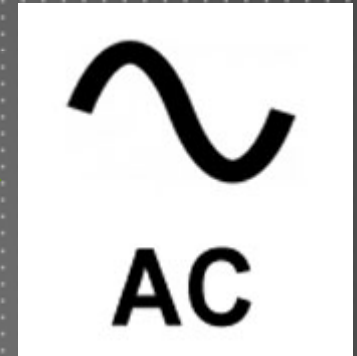
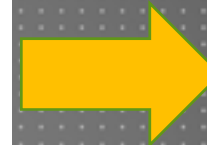
CHARGE CONTROLLERS



BATTERIES



INVERTERS



CUSTOMER CONSTRAINTS

► Loads



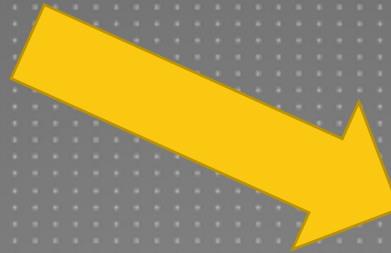
LOAD ANALYSIS

Load Description	Load Power [W]	Quantity	Daily Usage [Hours]	Unit Load Current [A]	Unit Daily Energy [kWhrs/day]	Total Daily Energy [kWhrs/day]
LEDs (Computer Room)	4	5	9	0.017391304	0.036	0.18
Thin Clients & Monitors	45	20	8	0.195652174	0.36	7.2
Servers	525	2	24	2.282608696	12.6	25.2
LEDs (Library)	16	12	8	0.069565217	0.128	1.536
Thin Clients & Monitors	45	10	8	0.195652174	0.36	3.6
LEDs (Library Office I)	4	2	9	0.017391304	0.036	0.072
LEDs (Library Office II)	4	2	9	0.017391304	0.036	0.072
Admin Offices (4)	65	4	5	0.282608696	0.325	1.3
LEDs Office 1	16	1	8	0.069565217	0.128	0.128
LEDs Office 2	16	1	8	0.069565217	0.128	0.128
LEDs Office 3	16	1	8	0.069565217	0.128	0.128
LEDs Office 4	16	1	8	0.069565217	0.128	0.128
PBX (Telephone system)				0	0	0
Switches (5)	15	5	24	0.065217391	0.36	1.8

BATTERY FUNCTION



ND
Dglt

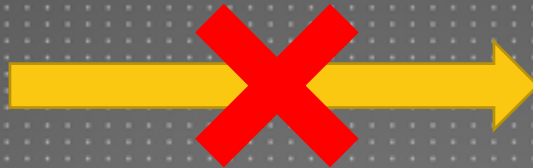


BACKUP POWER

State of Charge	12 Volt battery	Volts per Cell
100%	12.7	2.12
90%	12.5	2.08
80%	12.42	2.07
70%	12.32	2.05
60%	12.20	2.03
50%	12.06	2.01
40%	11.9	1.98
30%	11.75	1.96
20%	11.58	1.93
10%	11.31	1.89
0	10.5	1.75



COMPONENT CONSTRAINTS



4 kW rating



LOCATION CONSTRAINTS

- ▶ Peak Sun Hours
 - ▶ Pennsylvania – 4 peak sun hours
 - ▶ Zimbabwe – 8.5 peak sun hours



TCZ CAMPUS



PANEL PLACEMENT



COMPONENT PLACEMENT



FINANCIAL CONSTRAINTS



ACKNOWLEDGEMENTS

- ▶ Theological College of Zimbabwe
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- ▶ Advanced Solar Industries
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- ▶ Messiah College 's Department of Engineering
- ▶ Advisors: Dr. Randall Fish and Liam Tanis
- ▶ Solar PV project team members

QUESTIONS

