ILLUMINA

THE POWER OF THE SUN

Introduction to Illumina Africa's Solar Energy Solutions

ERC Solar PV Contractor, Vendor, Importer and Manufacturer licenses.

C1 – ERC/SPVC/00585; V1 -ERC/SPVC/00589; V2 – ERC/SPVC/00584

About Illumina Africa

Illumina Africa Limited is a Kenya based company which was incorporated in September 2016 and co- founded by **Rushab Haria (CEO), Pulkit Shamshery (CTO) and Nikhil Shah (COO).**

Corporate Culture:

Creating **sustainable value**; **Customer centric** approach; **First principles reasoning**

Our Vision:

Key contribution to the energy value chain through **innovations in technology, engineering, operational excellence and finance**

Our Core Values:

Customer is at the center of our core values and approach to business. **Transparency**, highest quality **engineering/safety,** excellent **customer service** and **kaizen** are our most important core values. We are **able to understand and accurately quantify the monetized benefit of new technologies.**

Why Go Solar?

Reliability, Independence, Cost Reductions and Go Green

	Grid Power + (backup)	Generator + (backup)	Solar Power + Storage + Generator
1 **Reliability**	**Fairly Reliable** Power outages, backup available	**Fairly Reliable** Breakdown and downtime for generator maintenance	**Uninterrupted** 24- hour power with backup
2 **Operational costs**	**High & unpredictable** expensive regional electricity costs which are unpredictable	**High & unpredictable** expensive diesel prices which are unpredictable	**Fixed & potentially lower** power, setup, and maintenance. All costs are well known.
3 **Independence**	**Low** power is generated & maintained by external enetities	**High** Power is generated and maintained by an telecom provider or ESCO	**High** Power is generated and maintained by an telecom provider or ESCO
4 **Carbon Footprint**	**Medium** Kenya's electric mix is 70% renewable (estimate gCO2/Kwhe = 295)	**High** Burning fossil fuels (estimate gCO2/Kwhe = 778)	**Low** Harnessing renewable energy (estimate gCO2/Kwhe = 32)

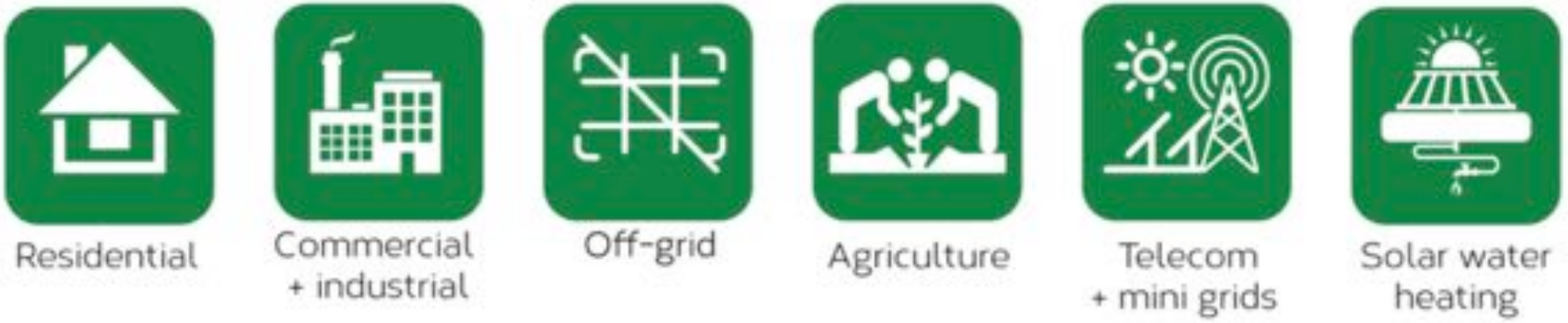
Illumina Africa

Our Core Values and Competitive Advantage

1	**Customer Centric**	Client centric service and solutions Understanding Client needs and constraints Customized Solar and Storage Solutions
2	**Transparency**	Transparency with our client, partners and employees Keep the customer well informed (if or if not - solar works for them) No hidden costs, Illumina Africa core value lies in honesty and being upfront
3	**Design**	Genetic Algorithm Optimization (subset of Machine Learning) MIT engineering First Priciples Reasoning is at the core of each design Innovation and Well informed of Latest trends and Tech
4	**Cost Competitive**	Lean Team Low Overheads Ability to provide lowest cost per watt installed
5	**Storage**	Relationships with established battery manufacturers Constantly innovating with battery manufacturers Technology agnostic (Li ion, Lead Acid and other chemistries)
6	**Technology agnostic**	Source the best and optimal components Procurement is customized to clients and projects
7	**Partners**	H Young & Co EA Ltd - Kenya's largest EPC Waaree Energies - India's largest Solar EPC Schneider Electric - System integration and design Jinko - World's Top 5 panel manufacturers Ezteech - Large Electrical EPC
8	**Vertically Integrated**	In house: Design, installation and O&M expertise End to End model- we take care of everything
9	**Finance**	Finance Option for All Cash Purchase, Low Interest Loans, Fixed Leases and PPA's

Illumina Africa and Solar

Applications



Steps to Go Solar

Energy Storage

Illumina Africa positions itself as a Solar and Storage Company

Illumina Africa is working with companies such as **Tesla, LG Chem and Axitec** to bring the most advanced Lithium Ion Storage into Kenya

We design longer lasting battery banks such that the **cost per usable kWh per cycle** over the lifetime of the solar system is lower

For grid-connected systems can can be integrate seamlessly with solar and storage**, for increases self consumption of solar as well as performing peak shaving (to reduce demand charges) and load shifting operations.**

For off-grid: **Replace or prevent the need for Generators, save on diesel (extremely high IRR)**

Storage Choice

Lithium Ion Vs Lead Acid

Characteristic for comparison	Lithium Ion	Lead Acid
Initial Investment	Higher upfront investment	Lower upfront investment
Maturity of technology	Newer	Older
Number of cycles	Up to 5000 cycles at 80% Depth of Discharge (DoD)	Up to 3000 cycles at 50% DoD
Recycling facilities	Coming Up	Recycling facilities already exist
Energy Density	Much higher	Much lower
Deep cycling capability	100% DoD capability We design for 80% DoD.	Recommended at 50% DoD
Cost per usable Kwh per cycle	Lower	Higher
Ability to add more batteries to existing in future	Yes, using AC-coupled design	Yes, using AC-coupled design.
Performance when voltage level drops (at a lower state of charge/SoC)	The voltage vs state of charge curve is essentially flat – means that a 20% charged battery will be providing nearly the same output voltage as an 80% charged battery	Discharge performance drops as voltage level reduces with the state of charge of the battery
Effect of higher currents (larger loads)	Li-Ion is better suited to deliver at full rated capacity and power for higher discharge current loads.	Peurkert's losses mean that lead acid is not really suitable for loads requiring a higher current.
Charge Efficiency/Round Trip Losses	Higher charge efficiency of ~90%	Lower charge efficiency of ~85%
Performance under higher operating temperatures	Low heat losses – beneficial in climates such as Kenya.	Experiences greater efficiency reduction for higher temperatures
Charge and discharge speed	Can charge and discharge faster, retaining capacity (unlike lead acid)	Fast charging/discharging can significantly damage the battery

We make Going Solar Easy

You Sign, You Enjoy, We take care of the rest

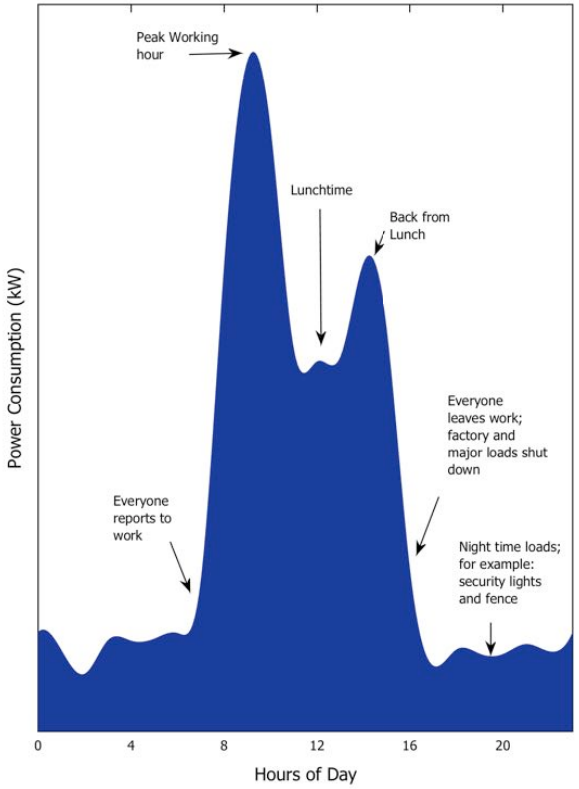
- **Introductory Presentation/ Information transfer**
- **We gather preliminary data –** Size of generators, size of UPS/batteries, Safety equipment, SLD's, monthly bills (preferably last 12 months), roof/ land area (using Google maps) and customer specifications
- **We track your loads –** We fit a load analyzer for around 1 weeks to get a more accurate picture of the load profile or if the client has there load profile then request for access to them
- **We design a system –** Optimization based on maximizing IRR coupled with minimizing LCOE and initial investment.
- **We then provide a customized quotation for the system**
- **You sign the Agreement –** Know your cost for electricity will be for the next 20-30 years! We also provide all the necessary warrantees and guarantees, and financing where necessary
- **We procure, install, test and commission –** not only do we oversee all the necessary documentation such as permits, but we aim to complete the installation in as timely a manner as possible
- **You can enjoy cleaner, more affordable energy and monitor it from anywhere!**

We Track your loads

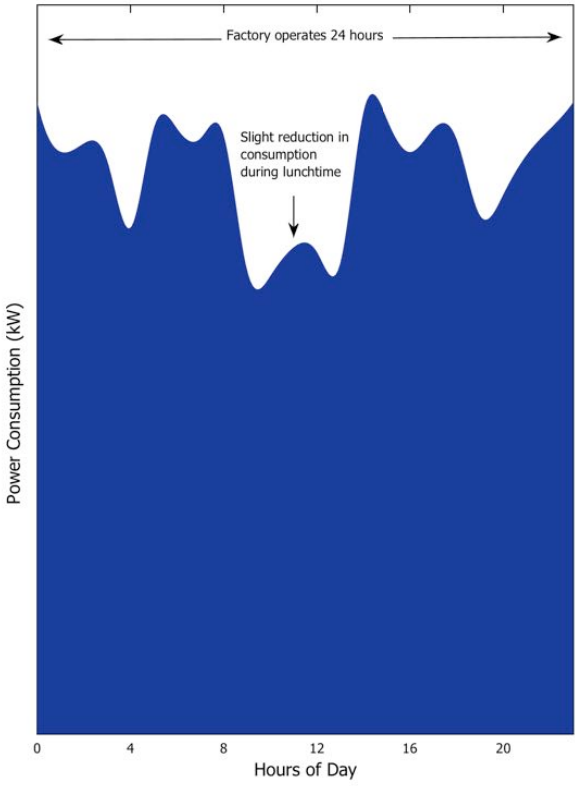
We Track your loads for a minimum of 1 weeks

The graphs below shows the data logged by Illumina Africa Limited over a period of 1 week, averaged over a day.

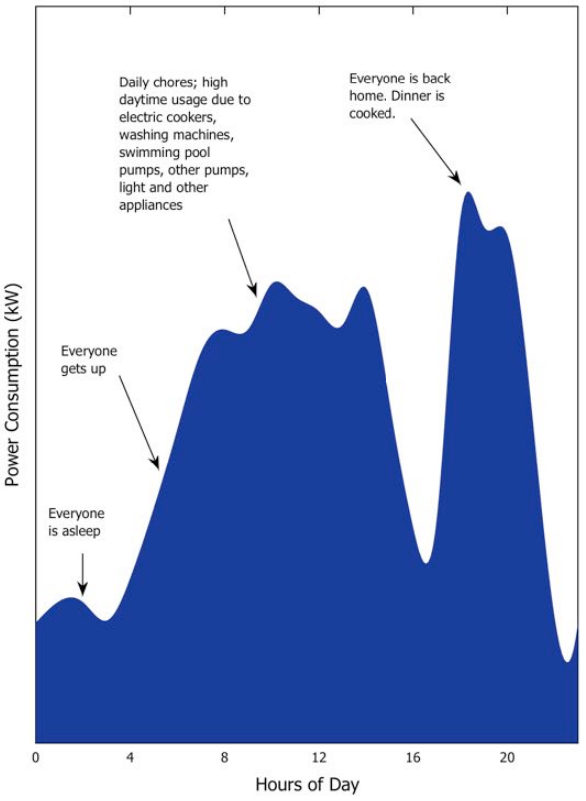
Factory 1 (12 hours)



Factory 2 (24 hours)



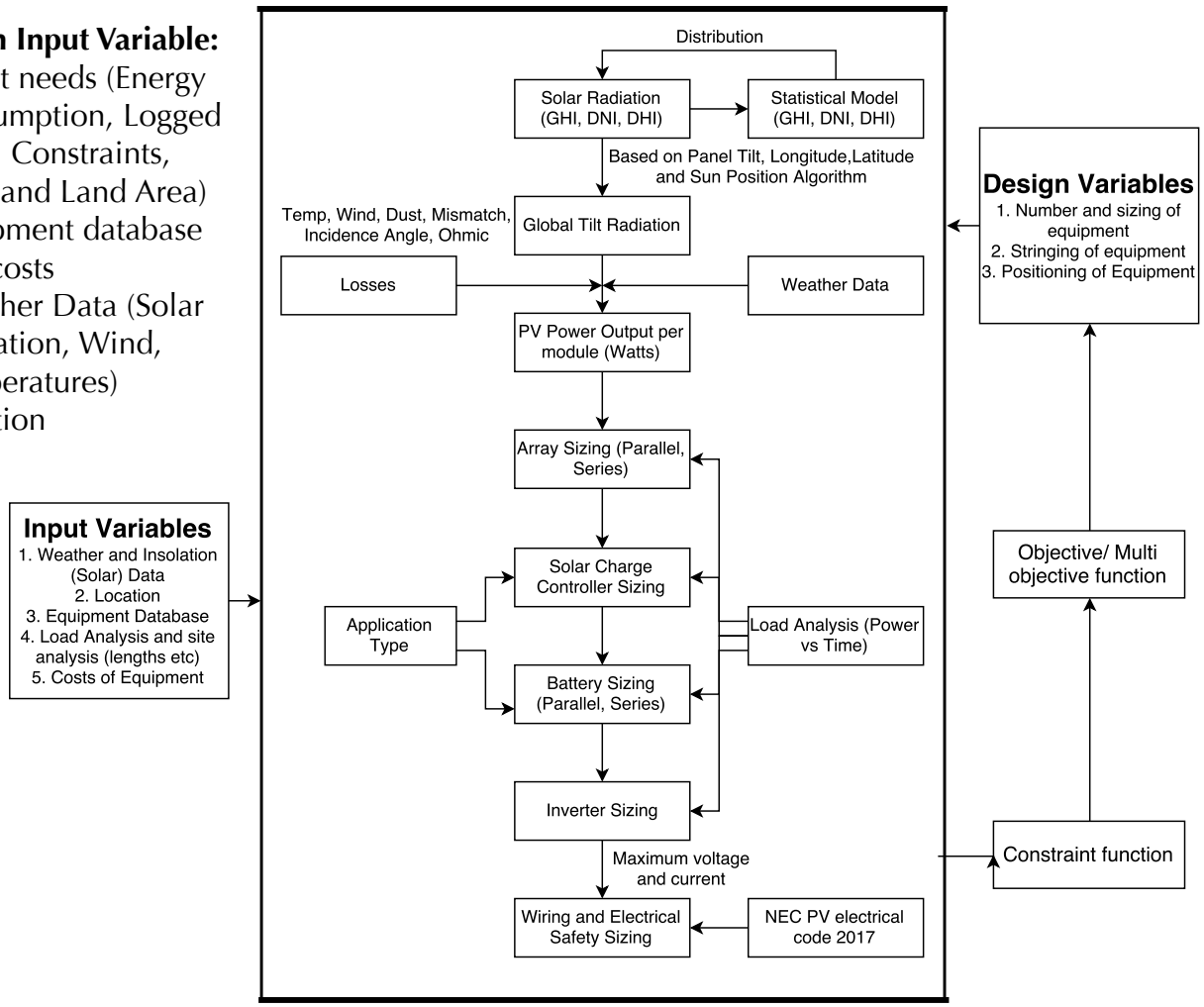
Residential



Self- developed Design and sizing Algorithm

Common Input Variable:

1. Client needs (Energy consumption, Logged Data, Constraints, Roof and Land Area)
2. Equipment database and costs
3. Weather Data (Solar Insolation, Wind, Temperatures)
4. Location



Common Design Variable:

1. Solar Components Types and Sizing and Stringing (Modules, Inverters, Charge Controller, Mounting, Switch gear + Control Panel)
2. Storage Type and Sizing (Li ion, LA)
3. Position (Tilt, Azimuth, Tracking, Shading)
4. Financing

Common Optimization functions:

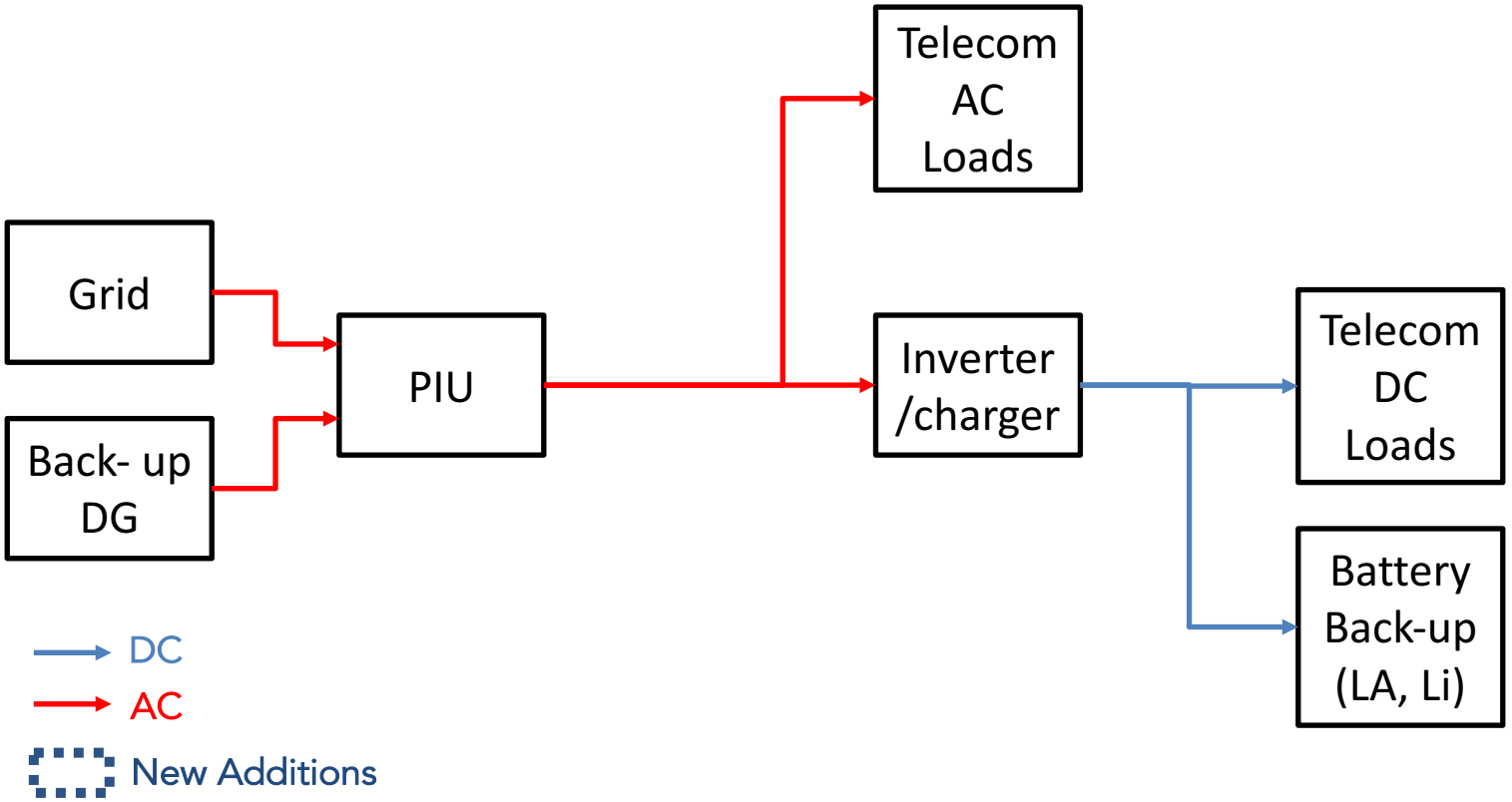
1. LCOE
2. IRR
3. NPV
4. Payback
5. Low CAPEX

Common Constraint functions:

1. Initial CAPEX
2. Financing option

Grid Connected Telecom System

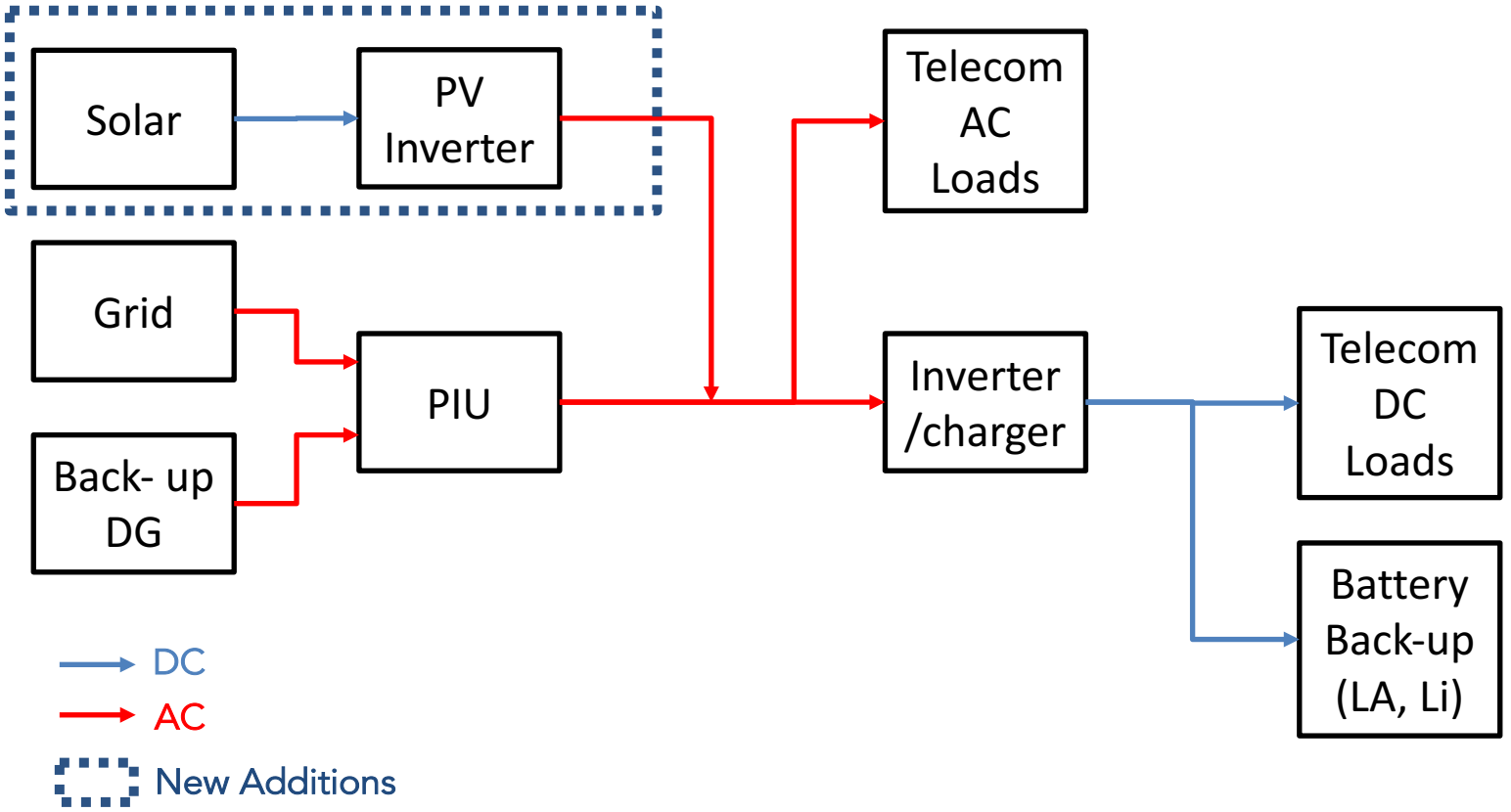
This basic SLD shows how a telecom is usually powered if it is grid connected. Usually have a back up DG and/or Back up Battery (for 6 – 9 hours) which is usually a Lead Acid Battery (VRLA type) [48V; 600 – 900Ah on average]



Grid Connected Telecom System

Grid Tied Solar

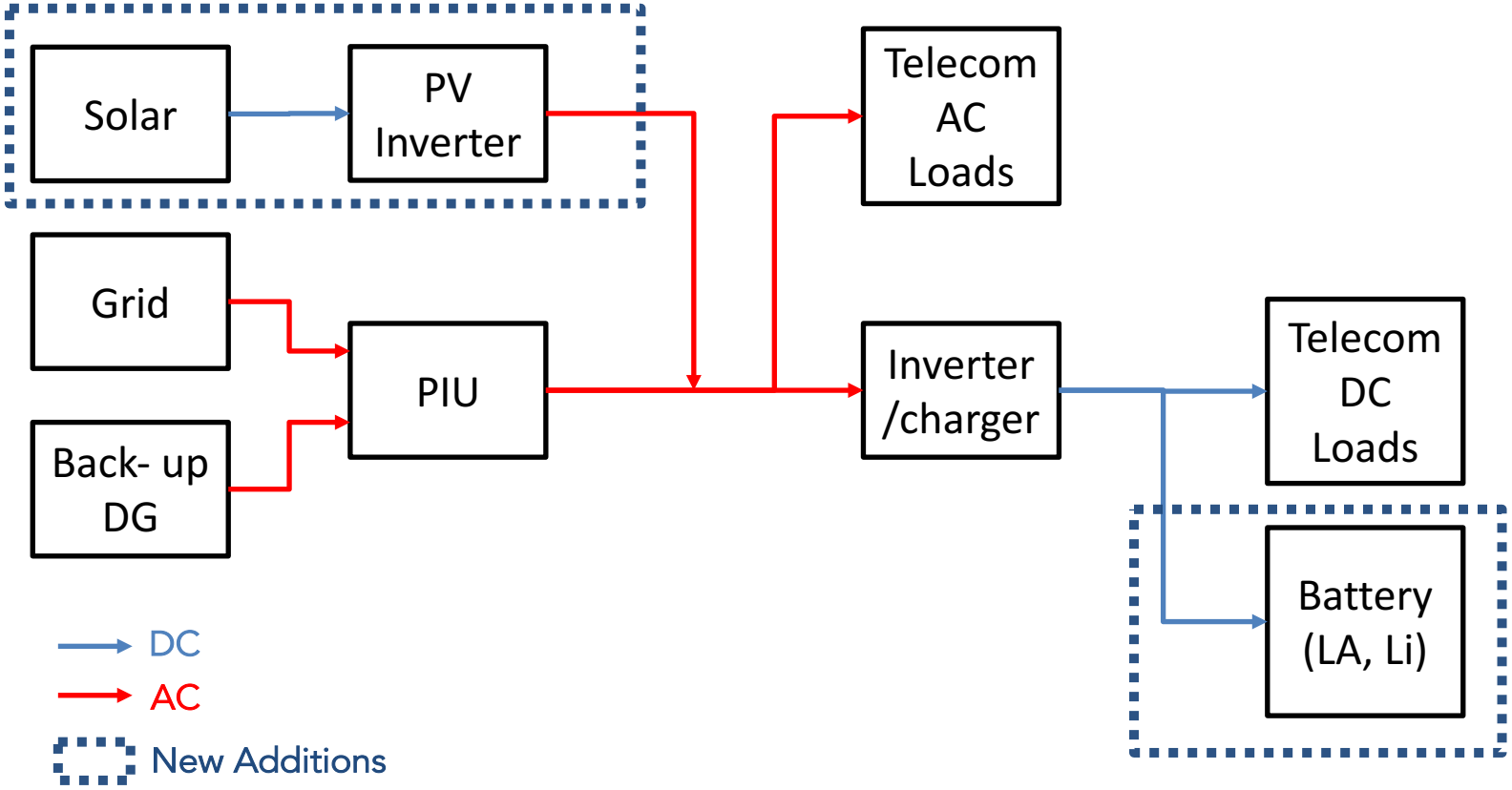
This basic SLD shows how a **Grid Tied Solar Solution** can be integrated into the existing system. The Solar will be sized for captive use such that whatever **solar energy is produced is immediately used.**



Grid Connected Telecom System

AC Coupled Hybrid Solar

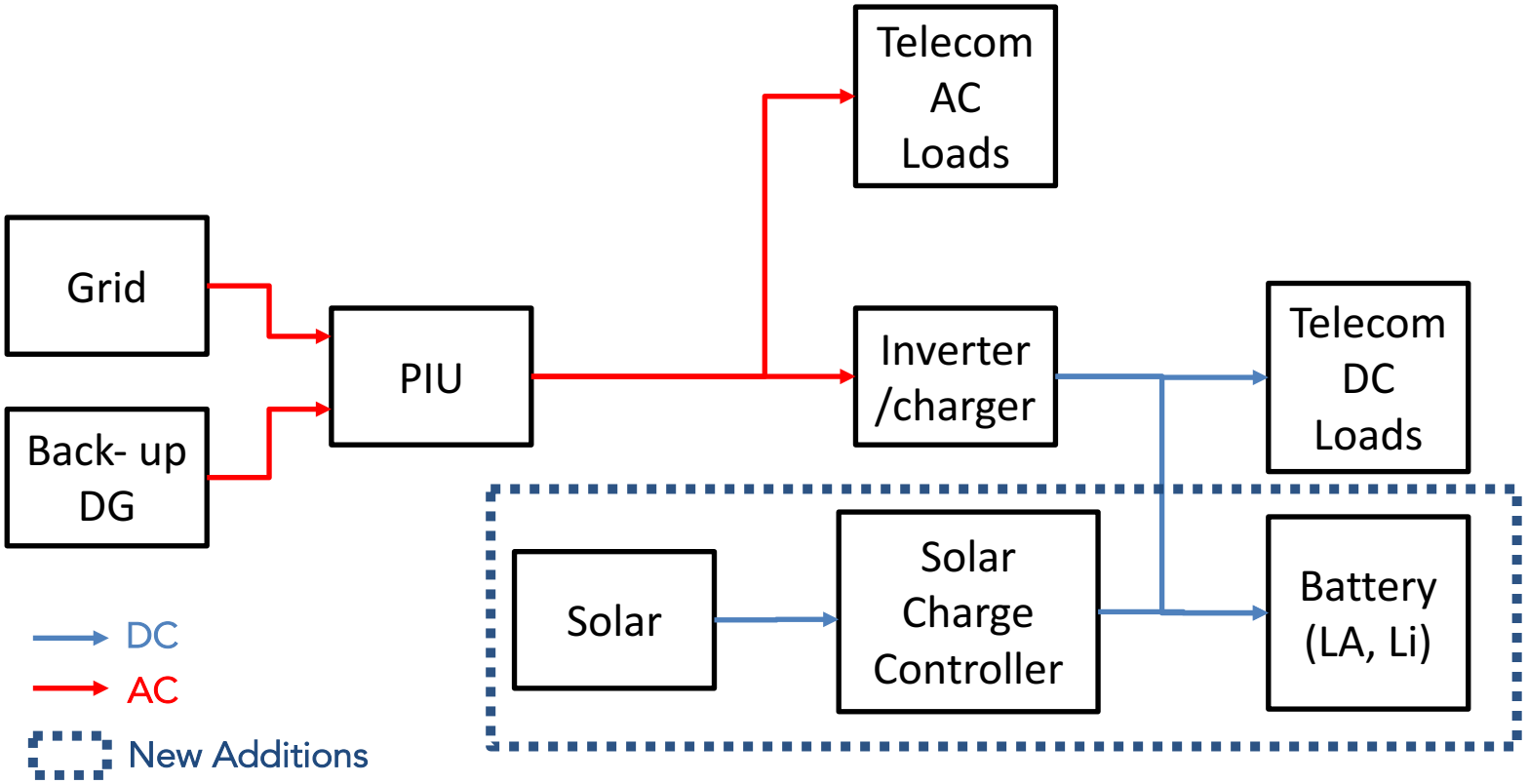
This basic SLD shows how an **AC coupled hybrid solar system** can be integrated into the existing system. The Solar will be sized for captive use such that whatever **solar energy is produced is immediately used and/or is stored in the batteries** which are now sized for daily cycling and not only backup purposes. **The Grid and the DG will be the back up.**



Grid Connected Telecom System

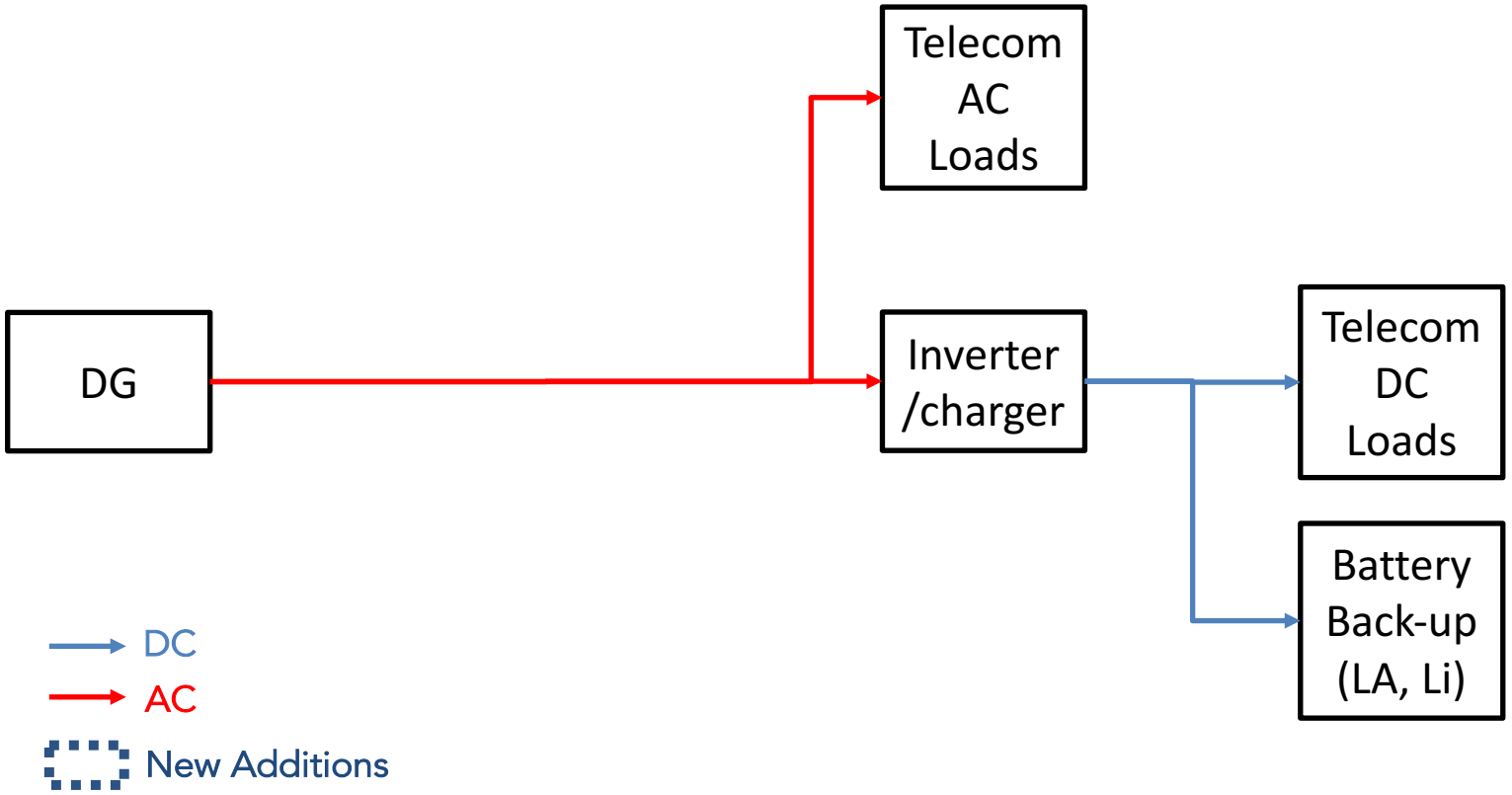
DC Coupled Hybrid Solar

This basic SLD shows how an **DC coupled hybrid solar system** can be integrated into the existing system. The Solar will be sized for captive use such that whatever **solar energy is produced is immediately used and/or is stored in the batteries** which are now sized for daily cycling and not only backup purposes. **The Grid and the DG will be the back up.**



Off- Grid Telecom System

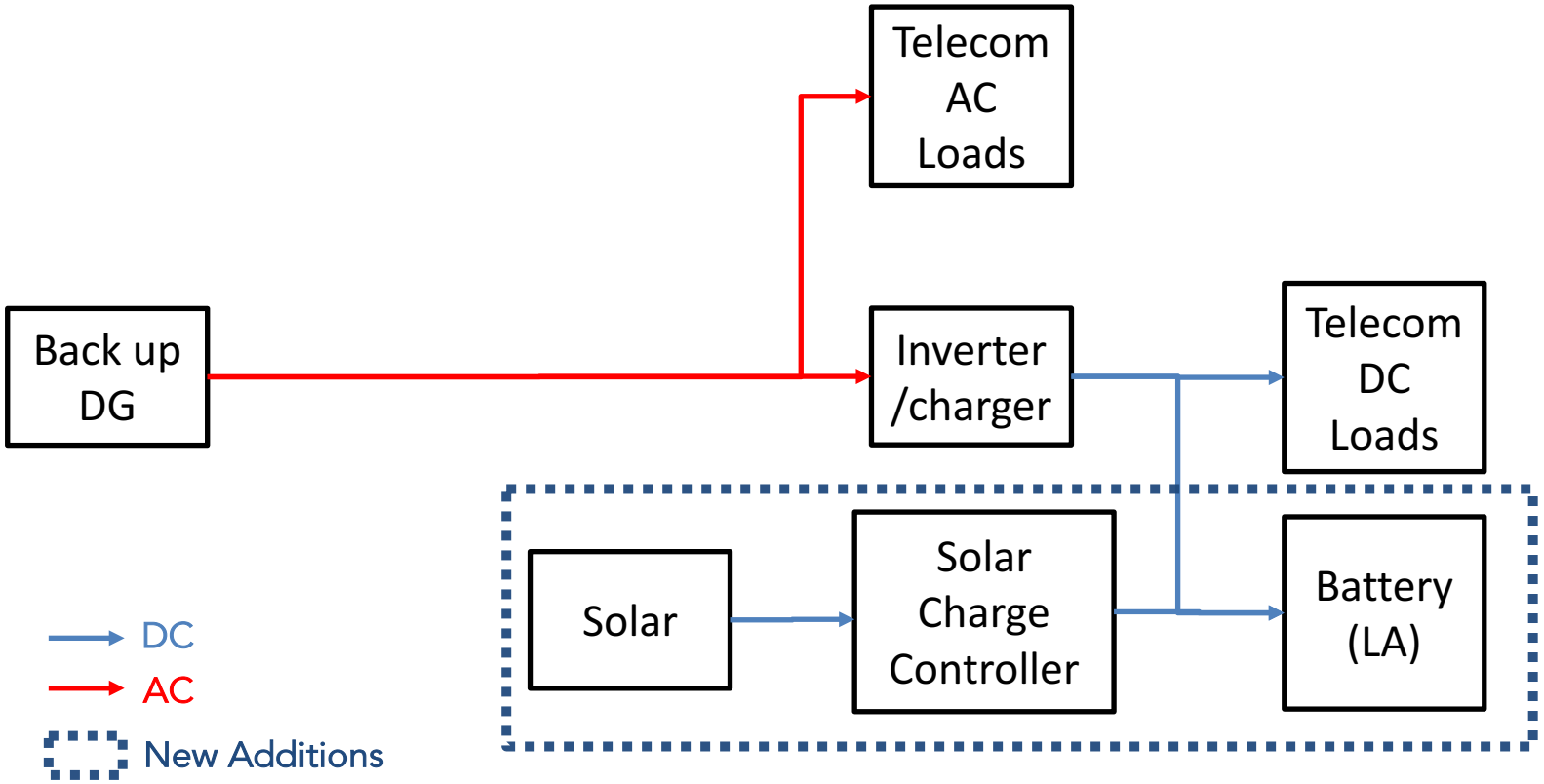
This basic SLD shows how **a telecom is usually powered in an off- grid setting.** A **slightly bigger generator** than load is operated, the **extra power is used to charge the batteries** which are then used when the generator is switched off. If the battery is **Li ion, an even bigger more efficient generator can be used** as **Li ion can be charged at a much more aggressive rate than Lead Acid without damage.**



Off- Grid Telecom System

DC Coupled Hybrid Solar

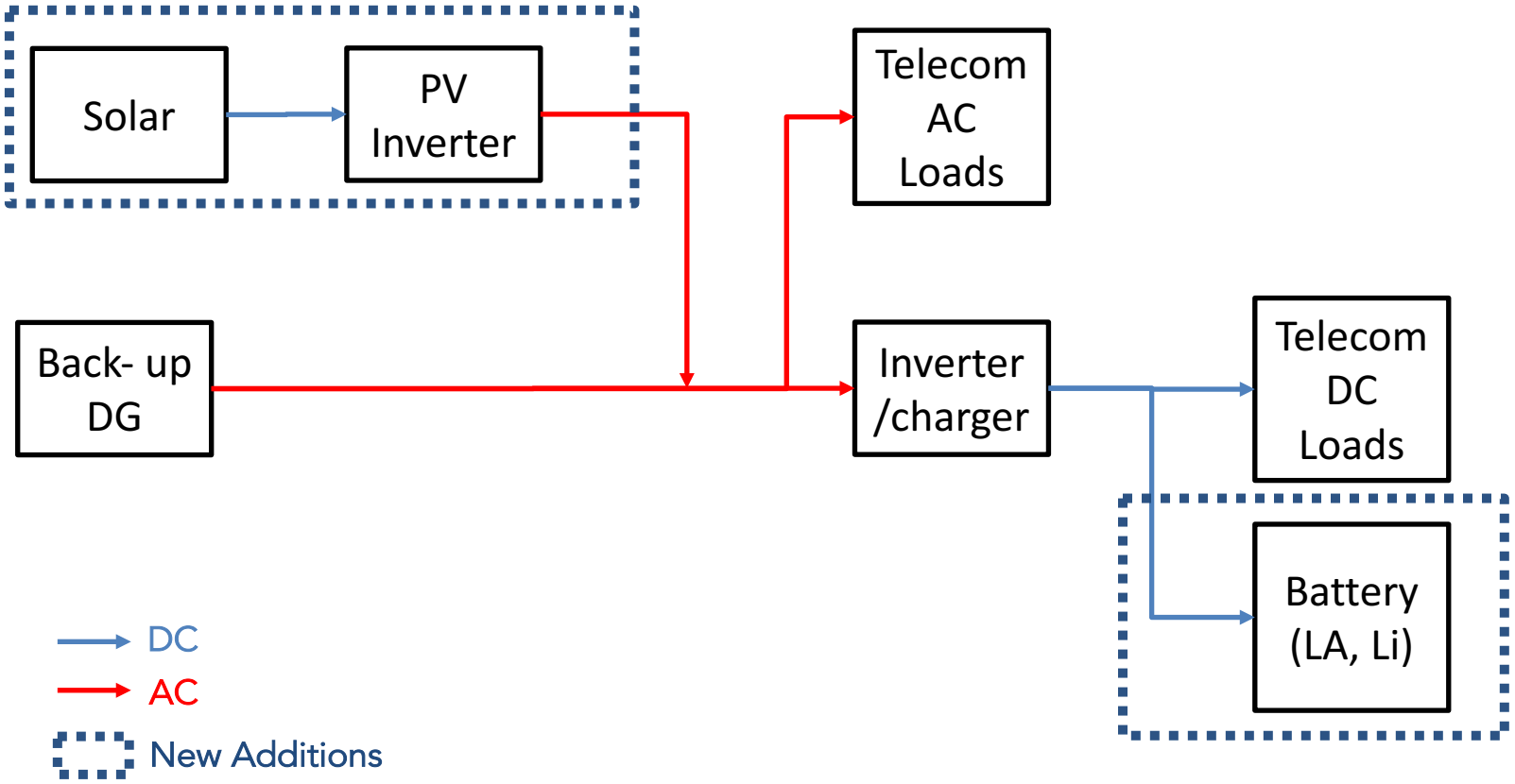
This basic SLD shows how an **DC coupled hybrid Solar solution** can be integrated into the existing setup. The Solar will be sized for captive use such that whatever **solar energy is produced is immediately used and/or is stored in the batteries** which are now sized for daily cycling and not only backup purposes. **The DG will be the back up. An optimization needs to be performed to establish the hours of battery autonomy required.**



Off-Grid Telecom System

AC Coupled Hybrid Solar

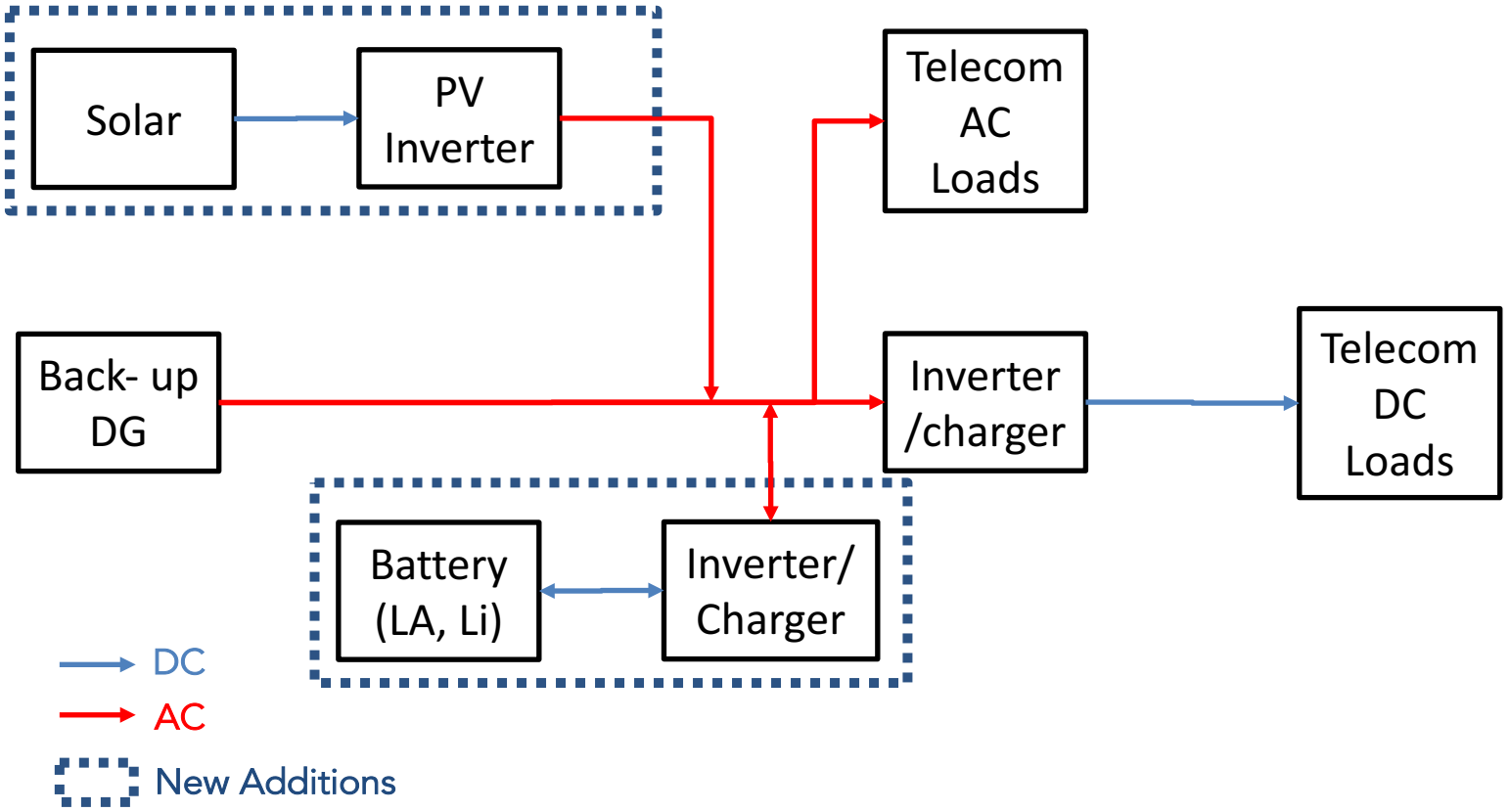
This basic SLD shows how an **AC coupled hybrid solar system** can be integrated into the existing system. The Solar will be sized for captive use such that whatever **solar energy is produced is immediately used and/or is stored in the batteries** which are now sized for daily cycling and not only backup purposes. **The DG will be the back up.**



Off-Grid Telecom System

AC Coupled Hybrid Solar

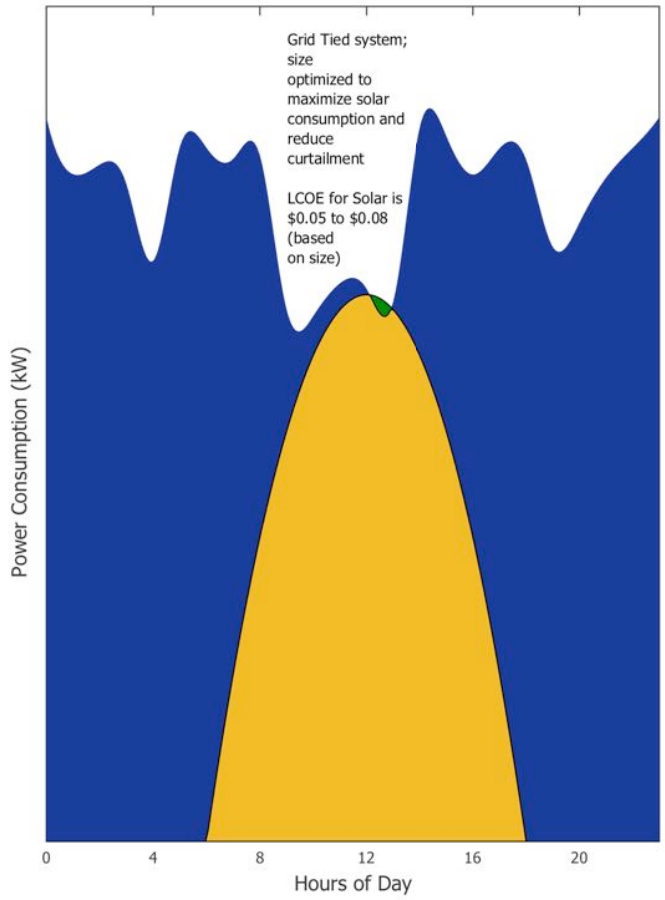
This basic SLD shows how an **AC coupled hybrid solar system** can be integrated into the existing system. The difference between this AC couple design and the design in the previous slide is the additional inverter/charger which is necessary with batteries such as the Tesla Batteries which come with an inbuilt inverter.



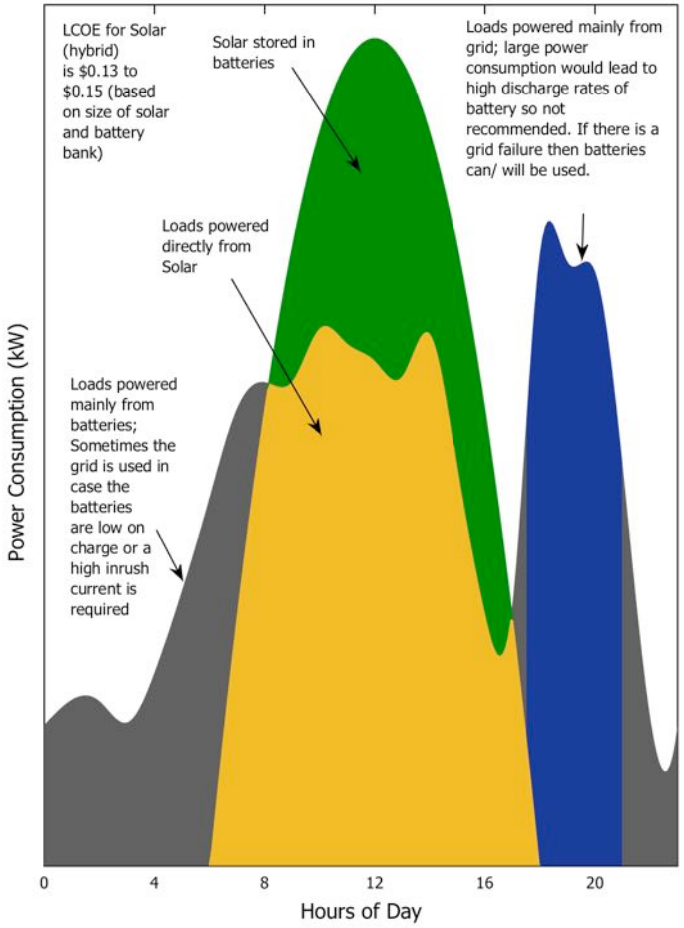
We design a system

Multi-objective optimization using Genetic Algorithm

Grid Tied Solution ($1 - $1.4/ Wp installed)



Off- Grid or Hybrid Solution ($3 - $5/ Wp installed)

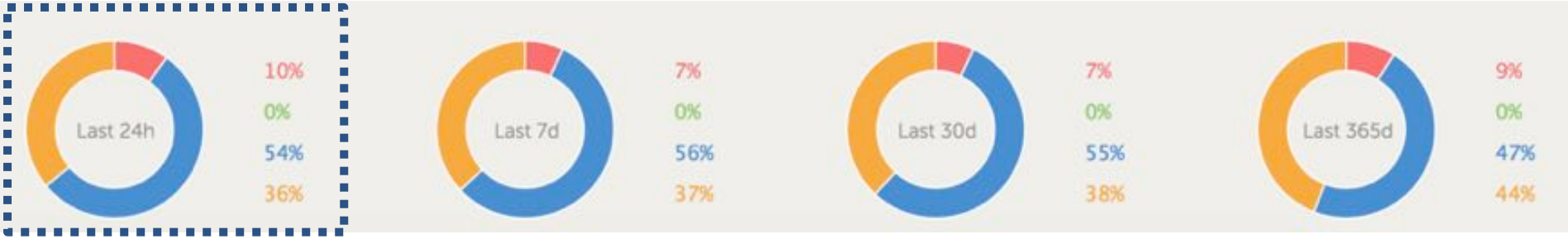


C1 – ERC/SPVC/00585; V1 -ERC/SPVC/00589; V2 – ERC/SPVC/00584

We Procure, Install and Commission

You Enjoy and Monitor

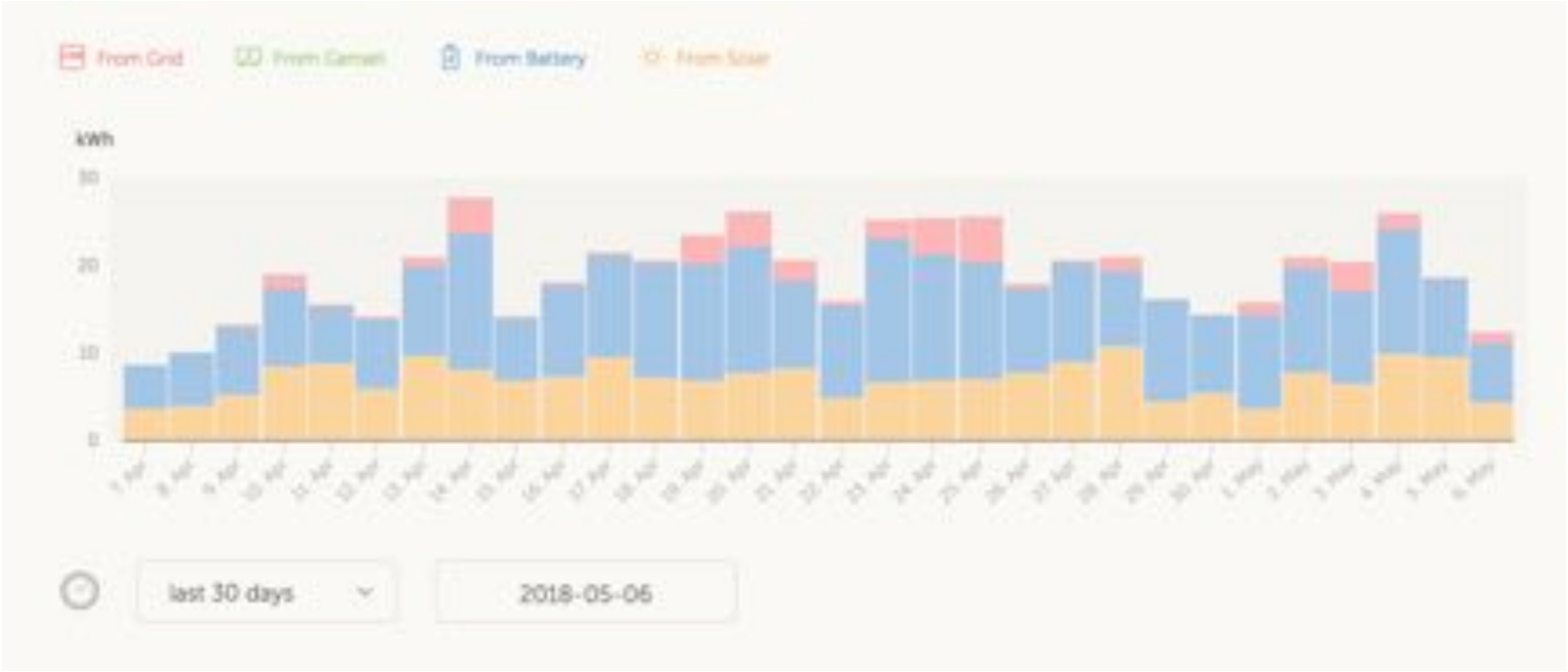
Consumption Energy mix on an hourly basis



C1 – ERC/SPVC/00585; V1 -ERC/SPVC/00589; V2 – ERC/SPVC/00584

You Enjoy and Monitor

Consumption Energy mix on a monthly basis



10%
0%
54%
36%

7%
0%
56%
37%

7%
0%
55%
38%

9%
0%
47%
44%

C1 – ERC/SPVC/00585; V1 -ERC/SPVC/00589; V2 – ERC/SPVC/00584

You Enjoy and Monitor

Consumption Energy mix on an yearly basis

10%
0%
54%
36%

7%
0%
56%
37%

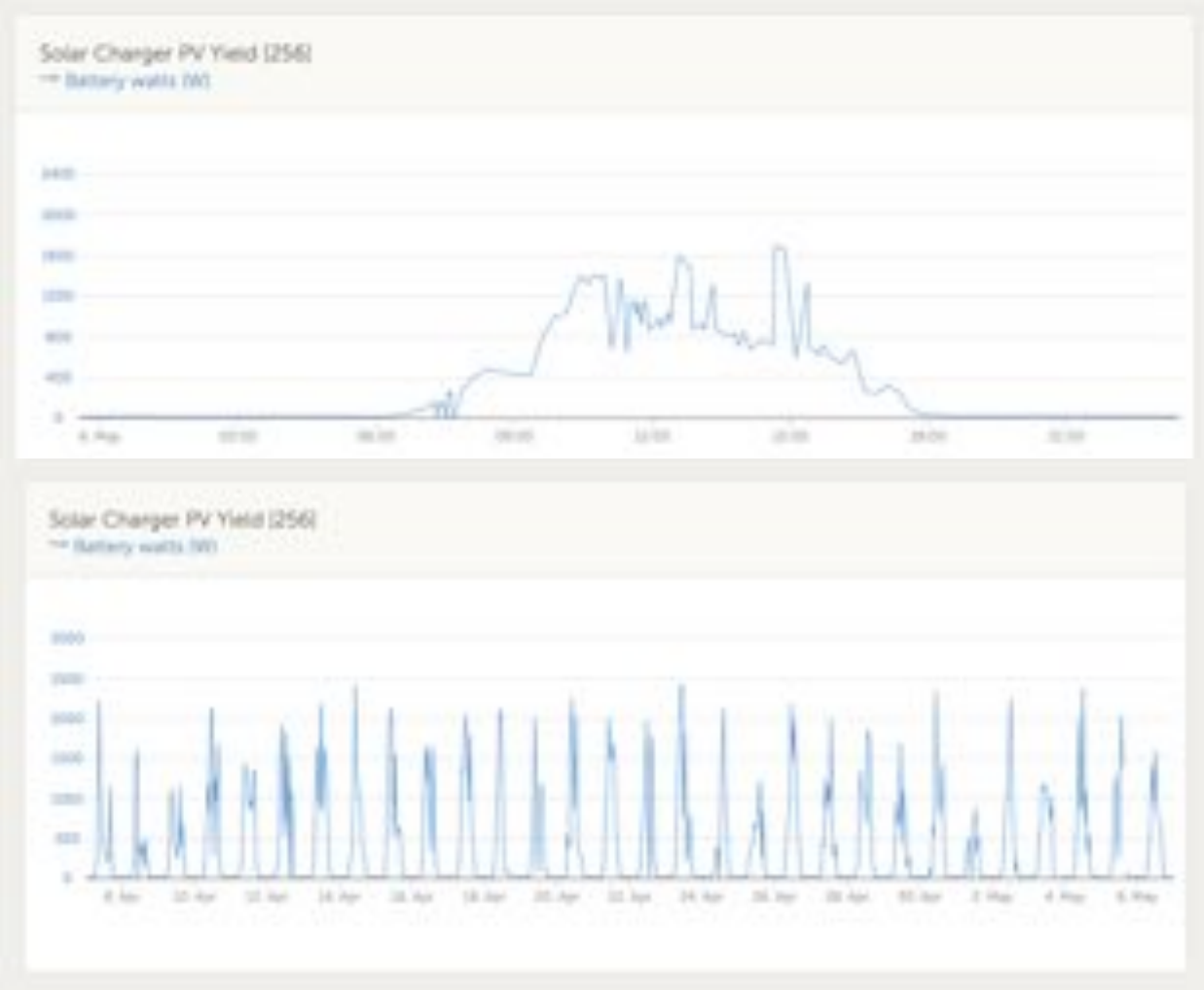
7%
0%
55%
38%

9%
0%
47%
44%

C1 – ERC/SPVC/00585; V1 -ERC/SPVC/00589; V2 – ERC/SPVC/00584

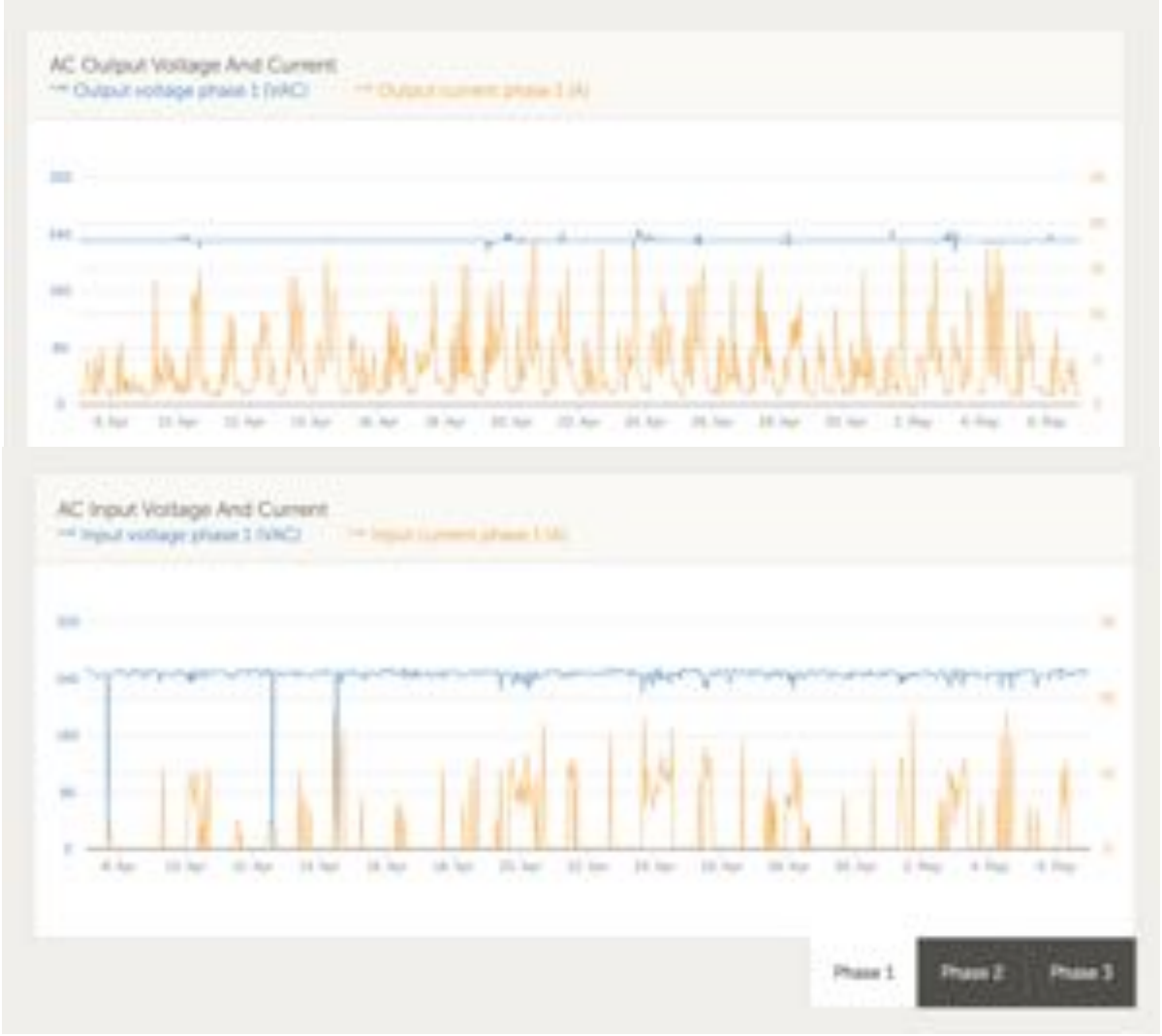
You Enjoy and Monitor

More detailed monitoring – Solar production over a day and a month



You Enjoy and Monitor

More detailed monitoring – Power needs and Power bought from grid over a month



C1 – ERC/SPVC/00585; V1 -ERC/SPVC/00589; V2 – ERC/SPVC/00584

Financing

	Cash Purchase	Loan	Lease	PPA
Contract Term	N/A	4-10 Years	4-10 years	12-20 years
Down Payment	Paid in full	30% upfront	$0 upfront, but option to pre-pay part of lease	$0 upfront
Tax Benefits (see page 6 for more detail)	Depreciation	Depreciation and interest payments on loan	Depreciation and interest portions if finance lease, otherwise operating lease payments	PPA payments are tax deductible
Interest Rate	N/A	6-9% on USD, 12-13.5% on Kshs	Implied interest rate usually 6-9% on USD, 12-13.5% on Kshs	N/A
Payment Terms	N/A	Fixed, Principal and Interest on reducing balance	Fixed, may have an annual escalator	Pay only for power produced
Monitoring Software	✔	✔	✔	✔
Roof and System Warrantee during installation	✔	✔	✔	✔
Maintenance	O&M contract between client and Illumina Africa	O&M contract between Client and Illumina Africa	Covered: O&M contract between Lessor and Illumina Africa	Covered: O&M contract between PPA operator and Illumina Africa
System Ownership	YOU	YOU	YOU for finance lease, LESSOR for operating lease (may have bargain purchase option at end of operating lease)	PPA operator

Our Partners

EPC partners

H Young & Co EA Ltd has successfully delivered and developed **400MW with 150MW in the pipeline of renewable energy EPC projects in Kenya**. Most notably the Olkaria Geothermal power projects in Naivasha. Founded in 1951, H Young boasts a diverse portfolio comprising: energy, petroleum, agro processing, telecommunications, ports and marine, mining, building, cement, and infrastructure development. They have an **expertise in Civil, Electro-mechanical, structural and infrastructure engineering.**

Waaree Energies Limited is a vertically integrated company with global operations, **presence in 68 countries, and 28 years of services excellence**. They have been listed as a Tier1 company as per Bloomberg Finance, with a **module manufacturing capacity of 1.2 GW**, in-house testing facilities and world class R&D facilities. They have **executed with their partners over 500 MW EPC projects and 5000+ projects executed in solar pumps, telecom & Rooftop Solar Energy.**

Ezeetec Limited is a multi-disciplined Electro-mechanical company that has grown into a complete **Engineering Procurement and Construction (EPC) contractor for power generation, transmission and distribution**. They have worked with a number of multinational companies including **Wartsila, Andritz Hydro, NCC international, Areva, T&D, Crompton Greaves Ltd, Alstom Grid etc. Design & Engineering of Transmission and Distribution substations**

Our Partners

Solar Component Suppliers and Design and Optimization Partners

A global presence, a team of over 140,000 employees, and a state of the art set up and office in Kenya that offers **outstanding support and training for Illumina Africa's Solar teams**, and works with us to design Solar energy systems when we specify their components. They provide training and a team when required for system integration of their components. **Warranties on components are always respected, be sure that Schneider will carry out an efficient and full diagnosis and repair on any error or system fault that may occur.**

Jinko Solar is in the top 3 largest crystalline solar module manufacturers, they have a **global market share of over 10%,** and operates the 1st fully automated PV module NPC production line in China. They are also the **first vertically integrated PV module manufacturer** and the worlds **1st company to pass a 1000 hour PID free test under 85 degrees Celsius & 85% RH.**

Our Partners

Solar Water Pumping Segment

DRILLCON

E.A. DRILLCON LIMITED

SINCE 1997

HYDRO WATER WELL (K) LTD.

MAJITEC

BEYOND WATER SOLUTIONS

Thank You