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UK ENGINEERS WITHOUT BORDERS

Power Management

Funded by:

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IKEA Foundation

Our speakers

- **Venkat Rajaraman**
  - Founder/CEO of Cygni Energy
  - Advisory Committee member of National Centre for Photovoltaic Research and Education (NCPRE), India
  - Over 20 years of experience in Product Design and Engineering Management.
  - Previously he was the CEO of Solarsis and Su-Kam Power Systems
  - Holds a BE from Madurai-Kamaraj University and a Master's degree in Electrical Engineering from Stanford University

- **David Tusubira**
  - Chief Technology Officer & Co-founder of Innovex.
  - Hardware developer with a background in robotics.
  - Using IoT(Internet of Things) technology to promote access to solar energy in SSAfrica.
  - Holds a bachelor's degree in Electrical Engineering from Makerere University.

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Power Management

Venkat Rajaraman – Cygni Energy

UK ENGINEERS WITHOUT BORDERS

CYGNI Energy

Powering a billion Dreams

Venkat Rajaraman
Founder / CEO
Cygni Energy Private Limited
E: venkat@cygni.com

CYGNI – EXECUTIVE SUMMARY

01

October 2014:
Cygni Incubated at IIT-Madras

Key Notes

- Confluence of Solar, Storage and Energy Efficient Appliances
- Started with focus on Solar-DC and DC Bus Architectures
- Technology developed in collaboration with IITM

Technology

- 'Inverterless' Solar DC (Low-Voltage 48V)
- Power cost is greatly reduced (40-50%)
- DC Microgrid solutions for energy cost optimization and sustainability

06

May 2019:
Microgrid for Greater Good Award in San Diego, USA

02

October 2016:
First large project with 4,000 homes in Rajasthan

03

December 2017:
First Li-ion product deployed in Assam

04

February 2018:
BIS standards announced for LVDC electrification @ 48V DC

05

August 2018:
Raised funding of $6.4 Million

ENERGY 2.0

DECENTRALIZED

Local power generation instead of Centralized Grid

DECARBONIZATION

Clean and efficient utilization of solar for powering homes

DISRUPTION

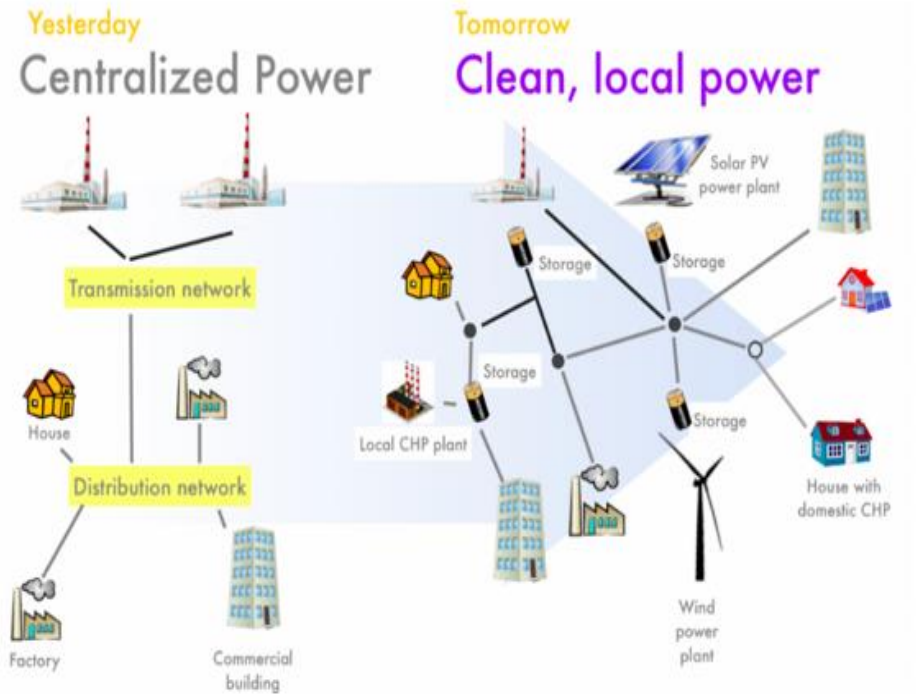
Technological innovation to cater to growing energy demands

DEMOCRATIZATION

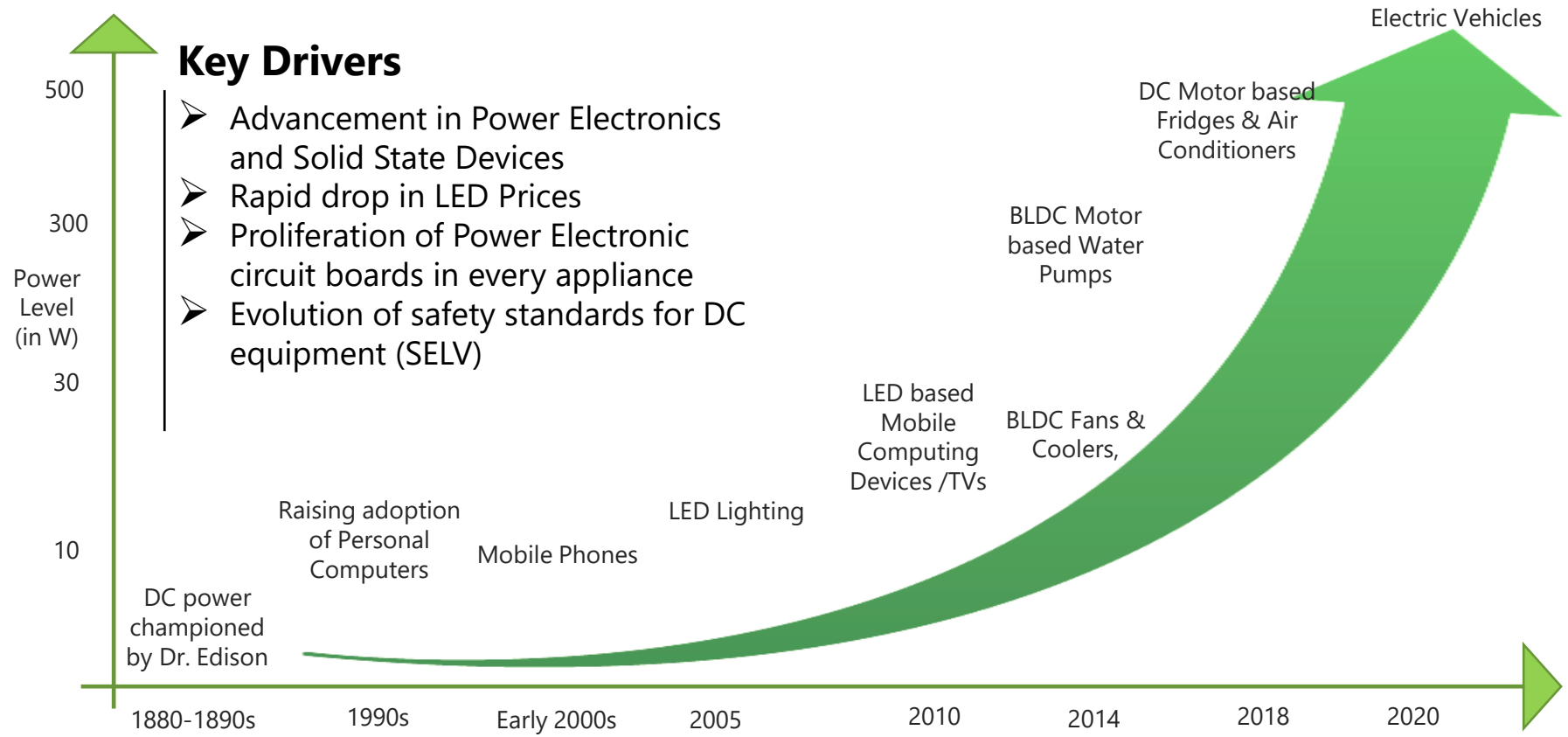
Peer to peer energy transfer to ensure efficient use at consumer level

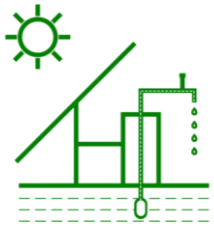
DIGITAZATION

IoT integration to make energy usage more transparent



DC ECOSYSTEM EVOLUTION



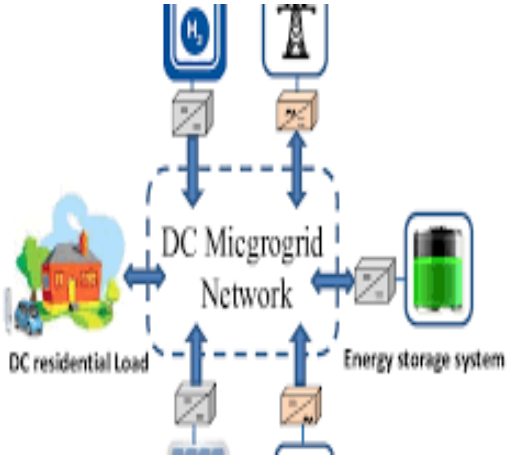


Solar Water Pumps

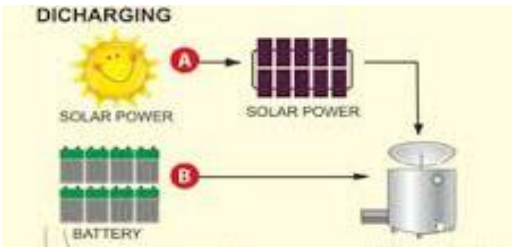
Electric Vehicles – Batteries & Chargers

Grid Level Storage Systems

Hybrid Solar-DG Solutions



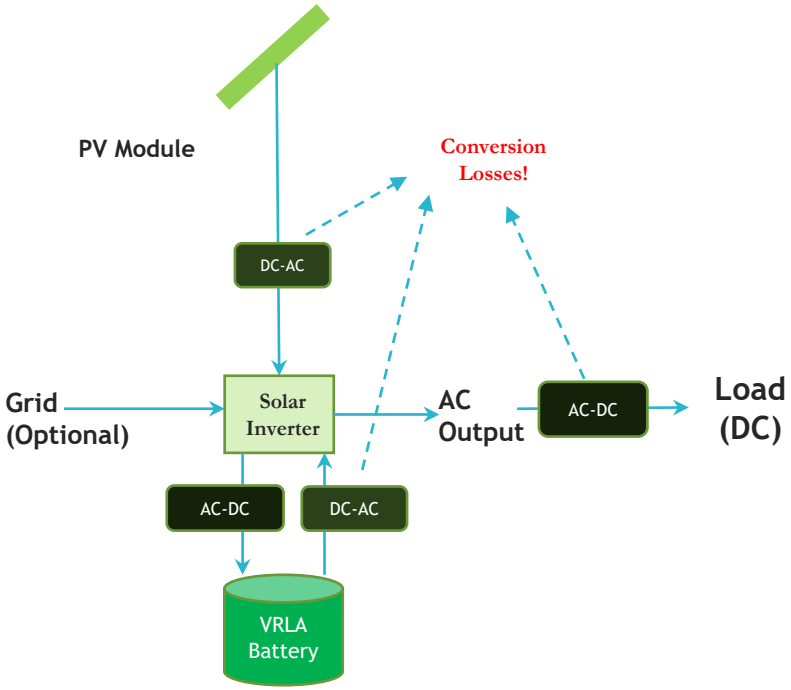
DC Microgrids



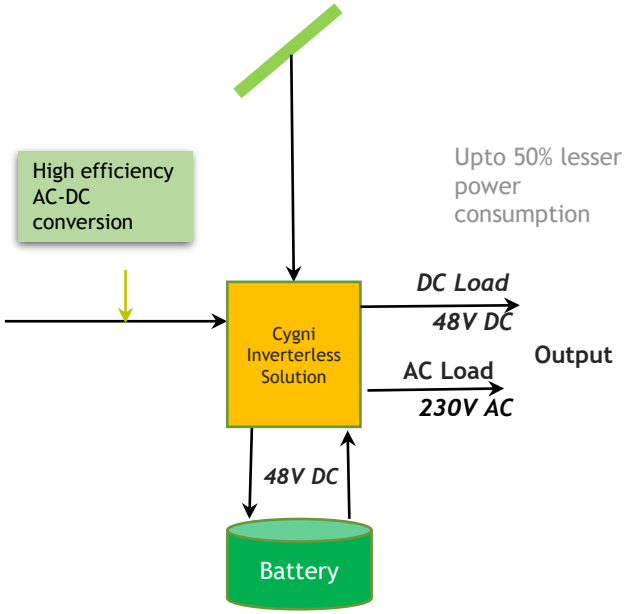
Productive use applications

DC ADOPTION everywhere!

Inverterless Technology

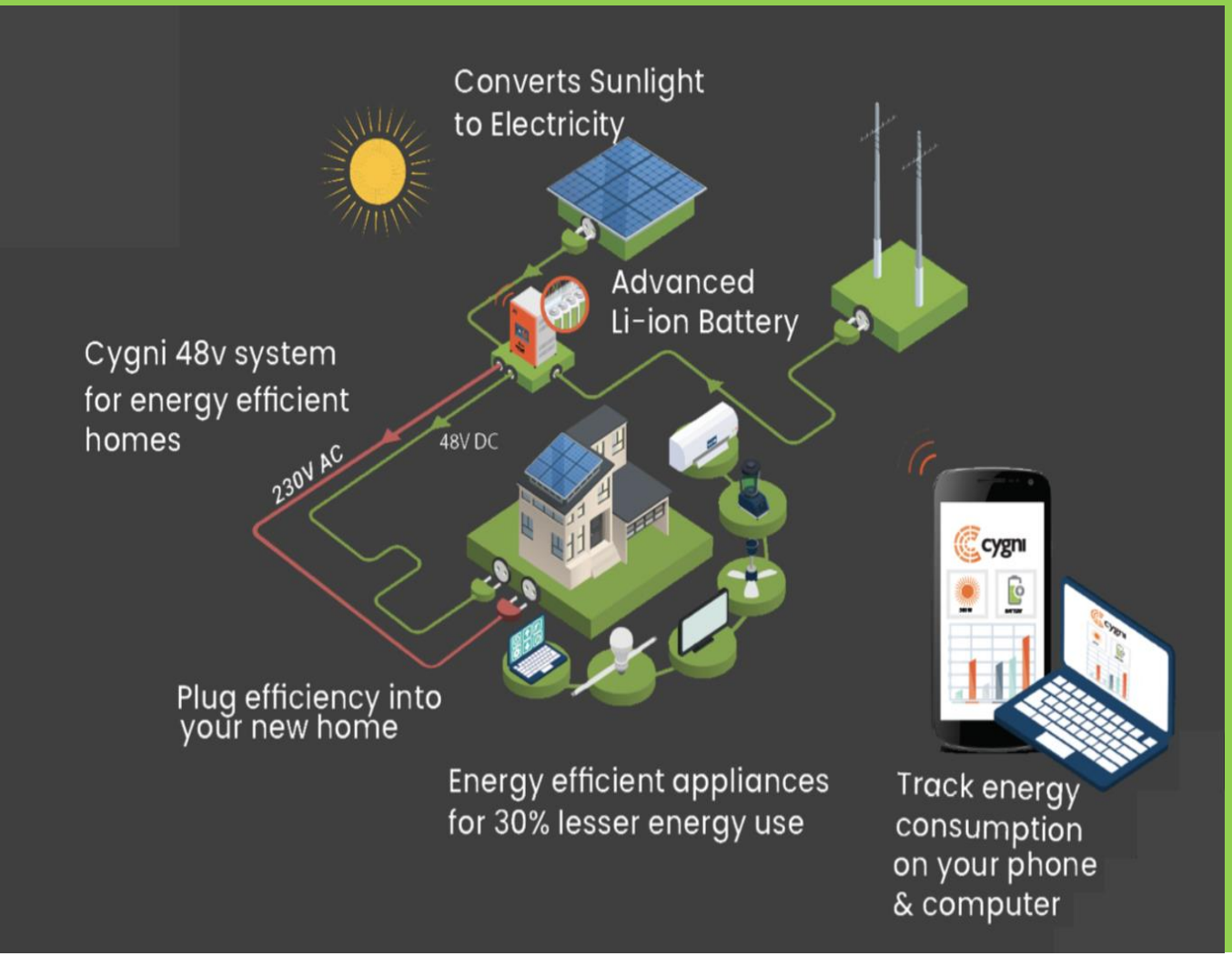


Solar Inverters



Cygni Inverterless

AC/DC Hybrid System



FEATURES
Solar and Grid Input
Upto 5 kWh Lithium Battery
230V AC Output
48V DC Output
Remote Energy Monitoring

LET IN THE SUN

Product Portfolio

Inverterless (upto 1kW)

- Seamlessly integrates solar, grid and battery.
- Integrated Li-Ion Battery
- Smart Load Control
- Prioritized source selection

Inverterless Variants (125W - 1kW)

- Inverterless Standalone
- Inverterless Lite & Standard
- Inverterless Pro & Duo
- Upto 1kW Capacity

DASH (2.4 kW and multiples)

- A patented solar inverter for commercial and SOHO applications
- 2.4, 4.8 and 7.2 kW capacity and multiples thereof
- Customized enclosures

KEY FEATURES

- Remote monitoring and management
- DC digital metering - 0.5 class accuracy
- Intelligent Solar MPPT control
- Meter reading integration with mobile Apps
- NoC with centralized management
- High efficiency at >96%

Productive Appliances

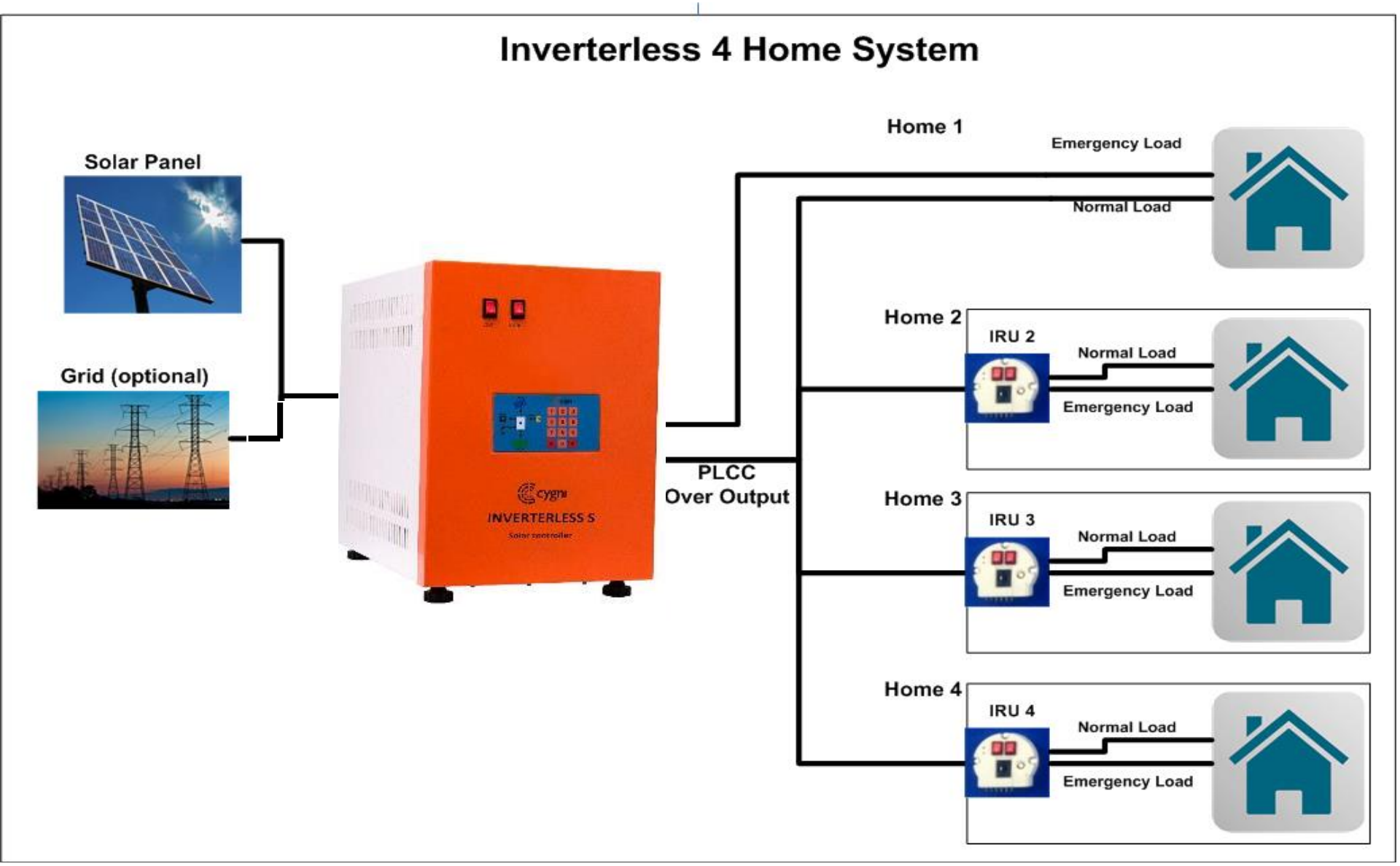
- **Poultry**
  - Exhaust Fans
  - Egg Incubator
- **Dairy**
  - Milk Chillers
  - Milking Machine
  - Milk Cool Storage
- **Fisheries**
  - Solar Aerators
- ≈ **Cottage Industries**
  - Solar Charakhas
  - Solar Weaving Machines
- ≈ **Horticulture**
  - Solar Dryers
  - Solar Spray Pumps

Cygni is partnering with innovative companies to create energy efficient productive use appliances for rural usage

Solar Powerlooms

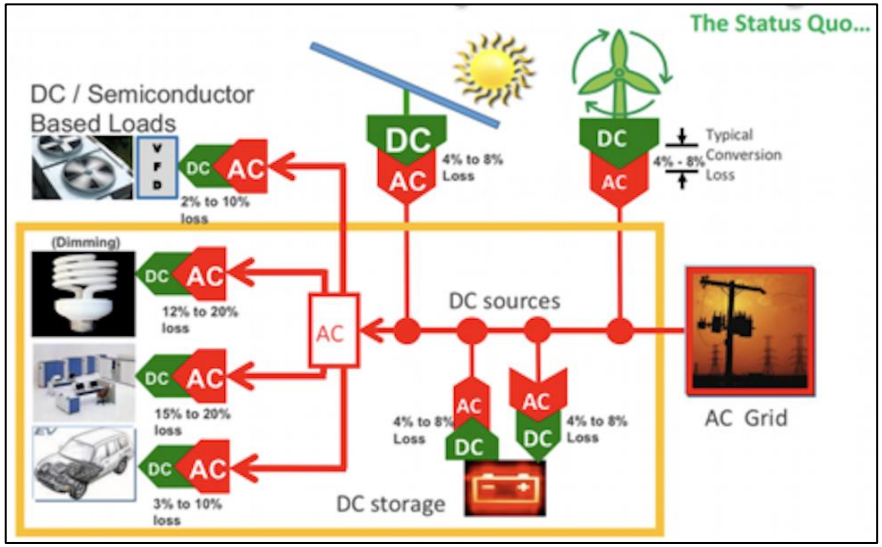
Solar Freezer / Chillers

DC Tiny Grid (4/8/12 Homes)

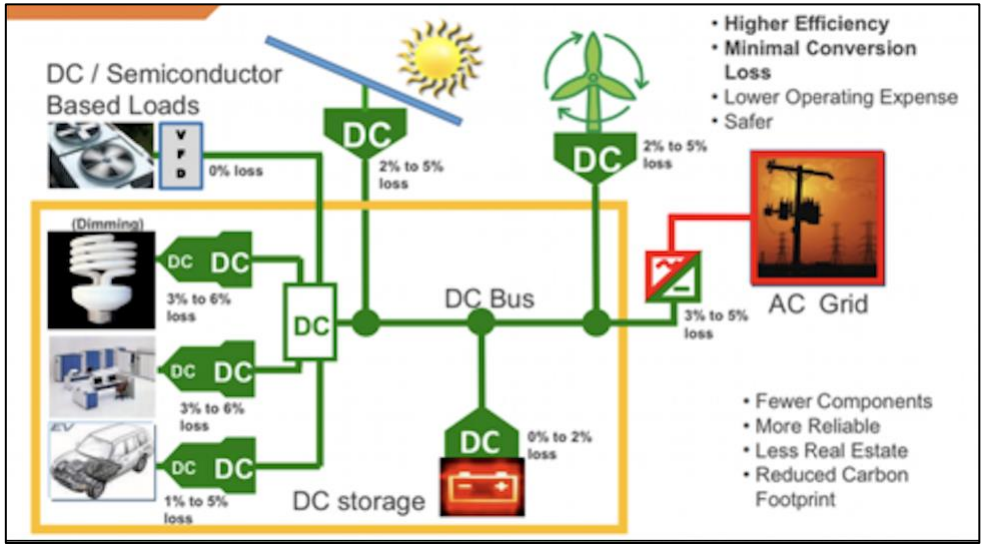


AC Vs DC Microgrids

Traditional AC Microgrid

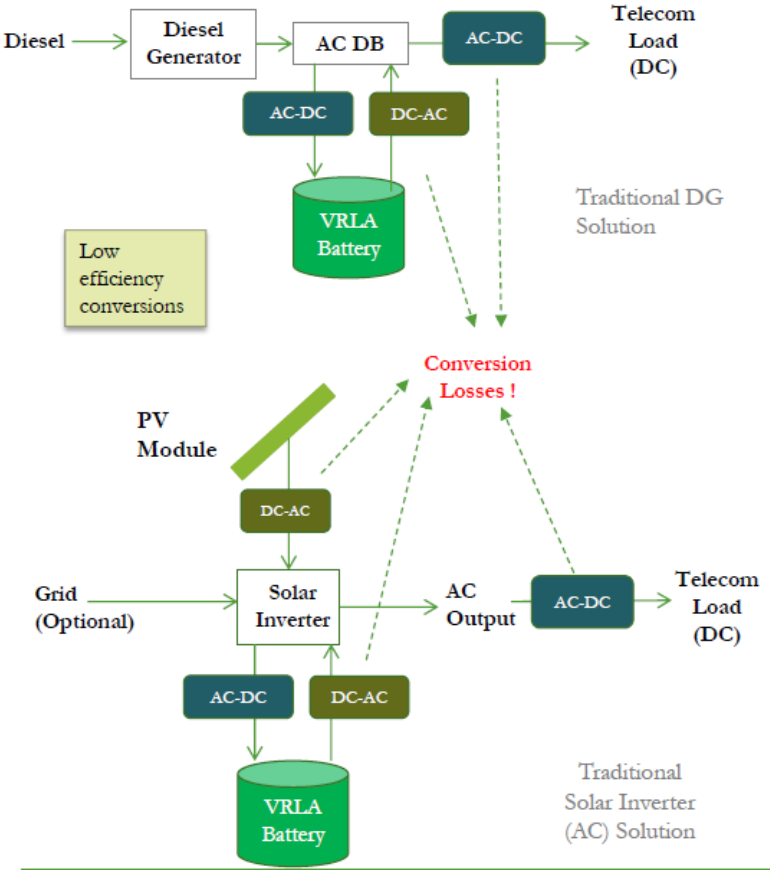


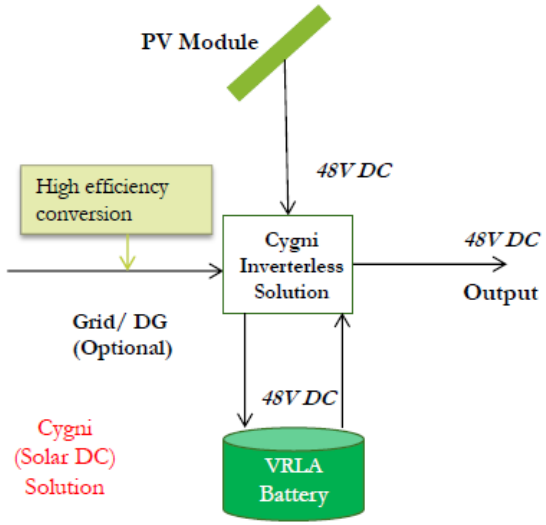
DC Microgrid

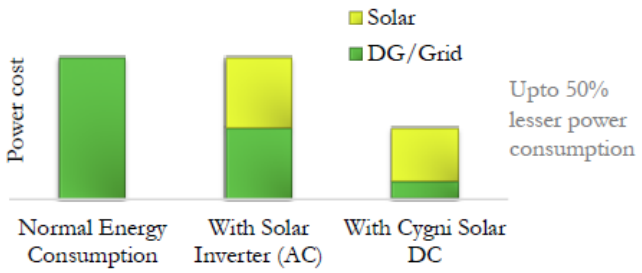


Every AC-DC or DC-AC conversion results in 4% to 20% power conversion loss!

AC Vs DC Microgrid



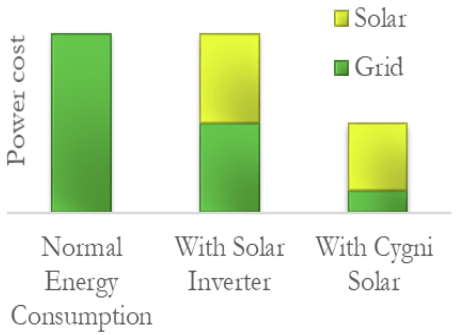




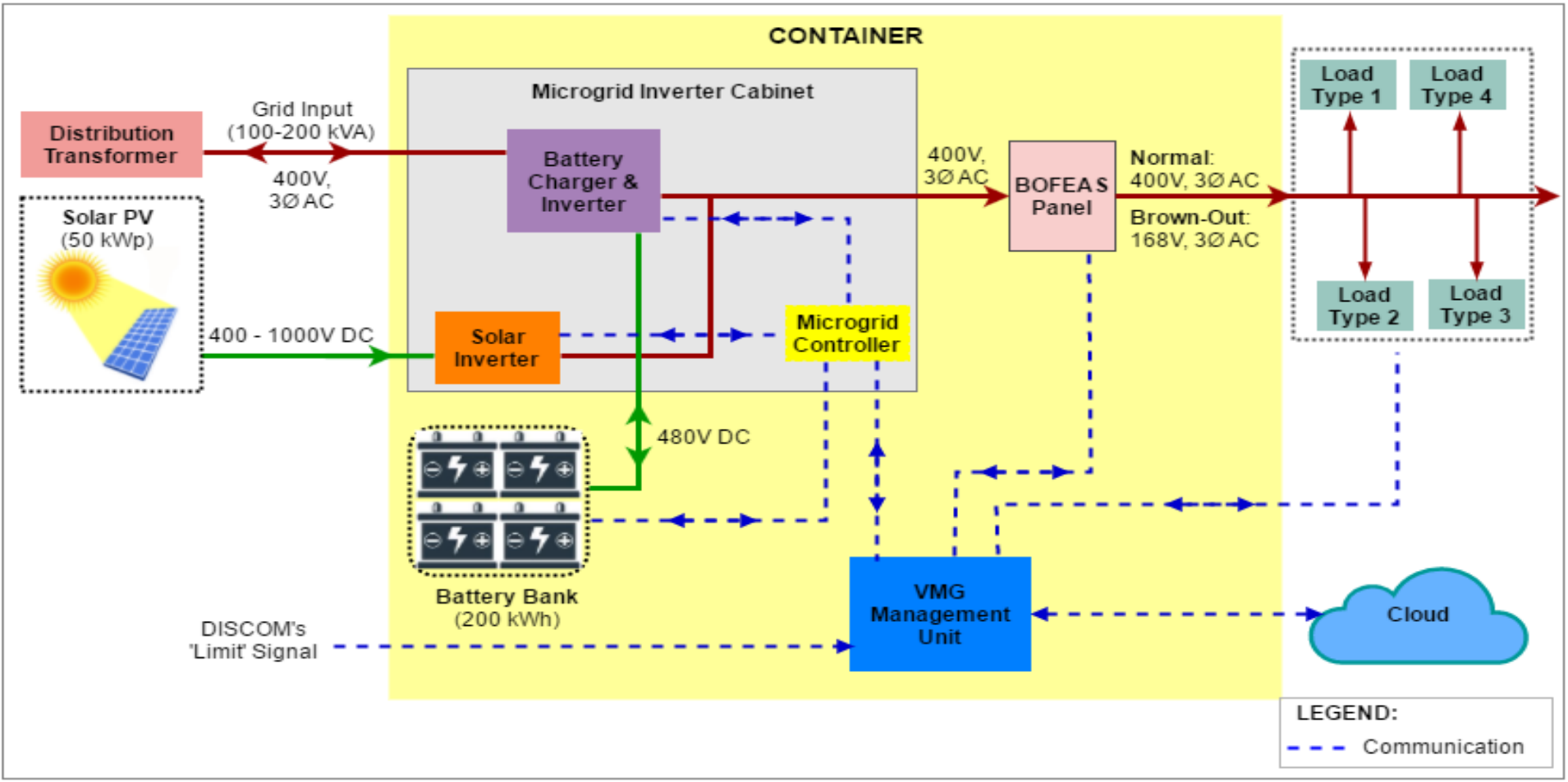
Always ON Microgrid: The Solution of Choice

Cygni Energy's Always ON Microgrid is the only available power solution that provides power both when the grid is available and when it is down, in perpetuity. No existing backup power option offers continuous power no matter the circumstances.

Microgrids					
	Grid	**Diesel Generator**	**Battery**	**Solar + Battery**	**Cygni Energy**
Duration	---	24 hours	2 hours	2 hours+	AlwaysON
Reliability	Above Ground Power Lines	Cold Start Issues	Needs to be Charged	Intermittent	AlwaysON
Fuel Supply	---	Storage Tank or Delivery Truck	Charges from Grid	Dependent on Sun	Always ON
Pollution	NOx, SOx, PM	NOx, SOx, PM	None	None	None



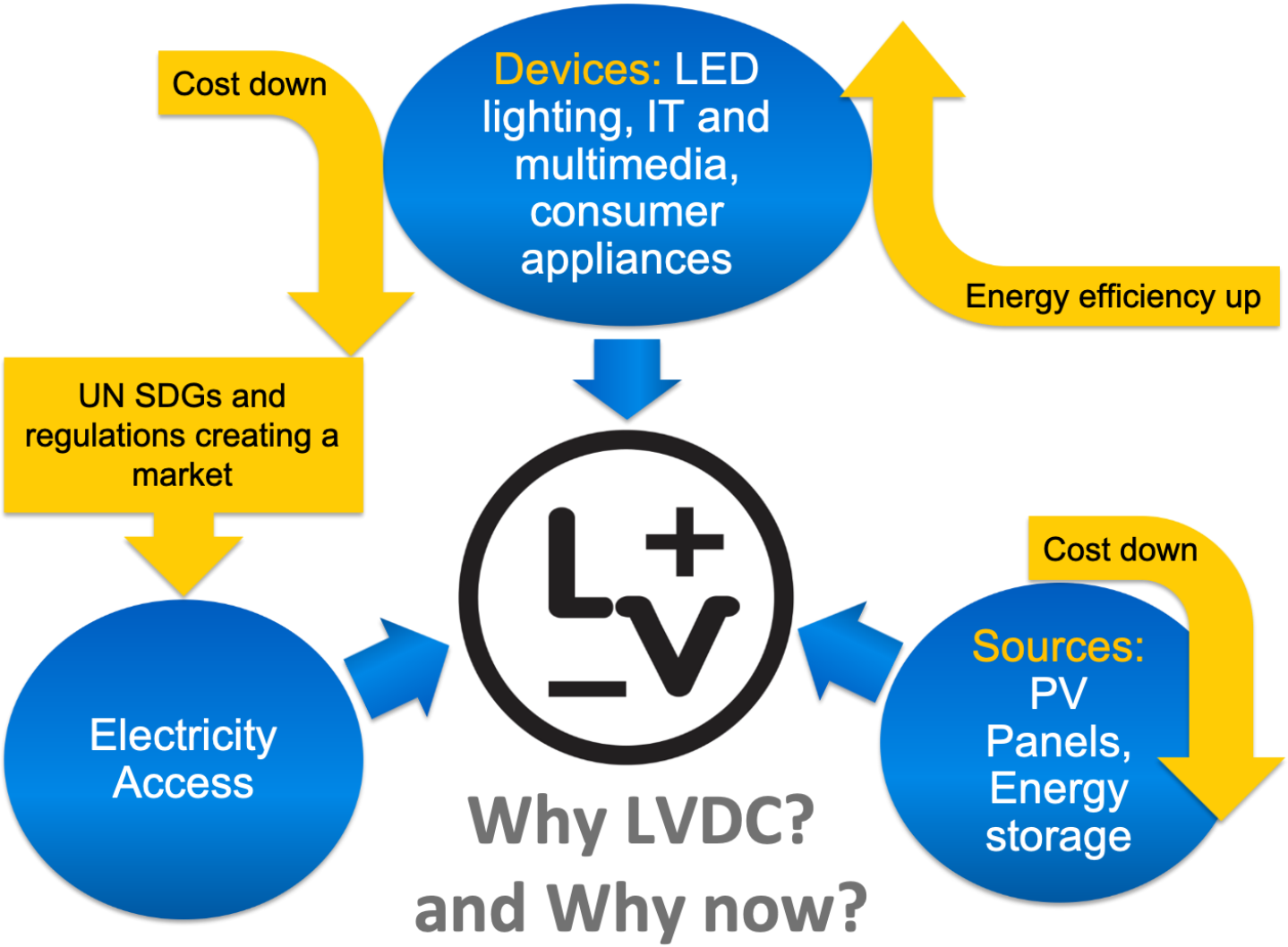
Block Diagram – Always ON Microgrid



DC Microgrid: IITM Research Park, Chennai, India

- ✓ 1.2MW Solar on the Roof-top
- ✓ Solar integration with Incoming Grid.
- ✓ Two levels of DC Distribution: 380, 48V
- ✓ DC Appliances at 48V
- ✓ DC Based VAV, Thermostat Control
- ✓ Solar + DG + Grid + Battery Hybrid
- ✓ Client energy monitoring & billing
- ✓ DG usage option for clients

CONCLUSION


Cost down
Devices: LED lighting, IT and multimedia, consumer appliances
Energy efficiency up
UN SDGs and regulations creating a market
Electricity Access
Cost down
Sources: PV Panels, Energy storage
Why LVDC?
and Why now?

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Thank you

Head Office (Hyderabad, India)
Second Floor, Lansum House, 283, Rd Number 78,
Jubilee Hills, Telangana 500033
+91 40 2354 5001
venkat@cygni.com
www.cygni.com

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Power Management

David Tusubira – Innovex Uganda

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About Innovex

- Started 2015, commercial in 2017
- IoT smart meter platform for solar systems and solar equipment, Remote solar monitoring and control
- Manufacture and distribute IoT hardware
- Data analytics, Machine learning & A.I
- B to B platform, 1,000 smart meters
- Operations in 5 countries; Uganda, Kenya, Tanzania, Ethiopia and DRC

Overview

- The major power management concerns.
- The key aspects of power management in off-grid PV solar systems.
- How data can be leveraged to address the key aspects.

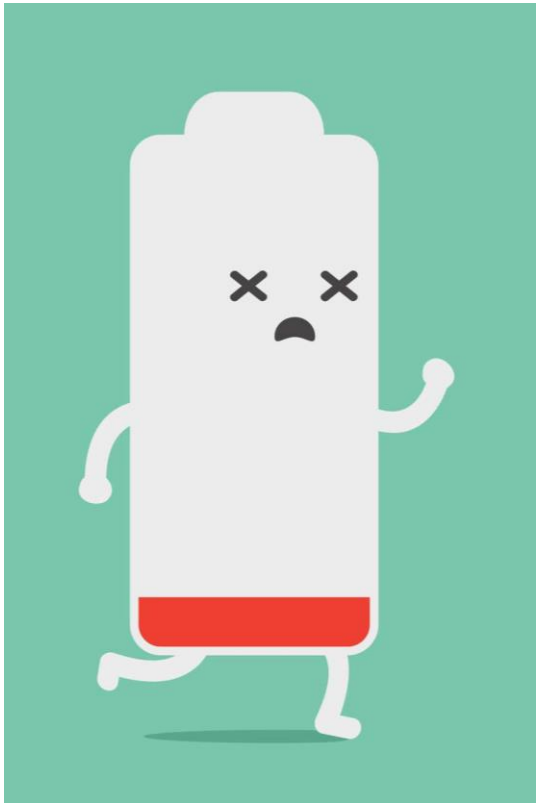
Concern

Cost

Return on Investment

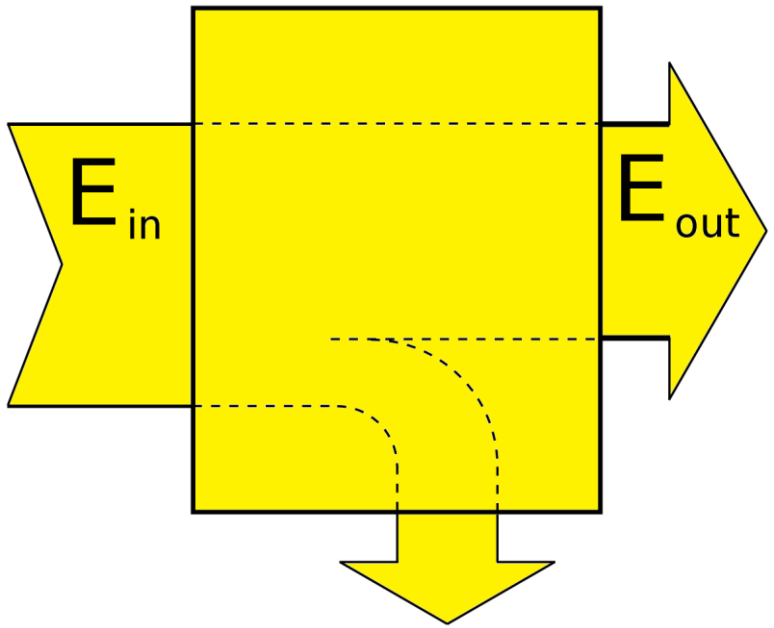
Key aspects

- Conversion efficiency
- Usage, consumption
- System sizing & design

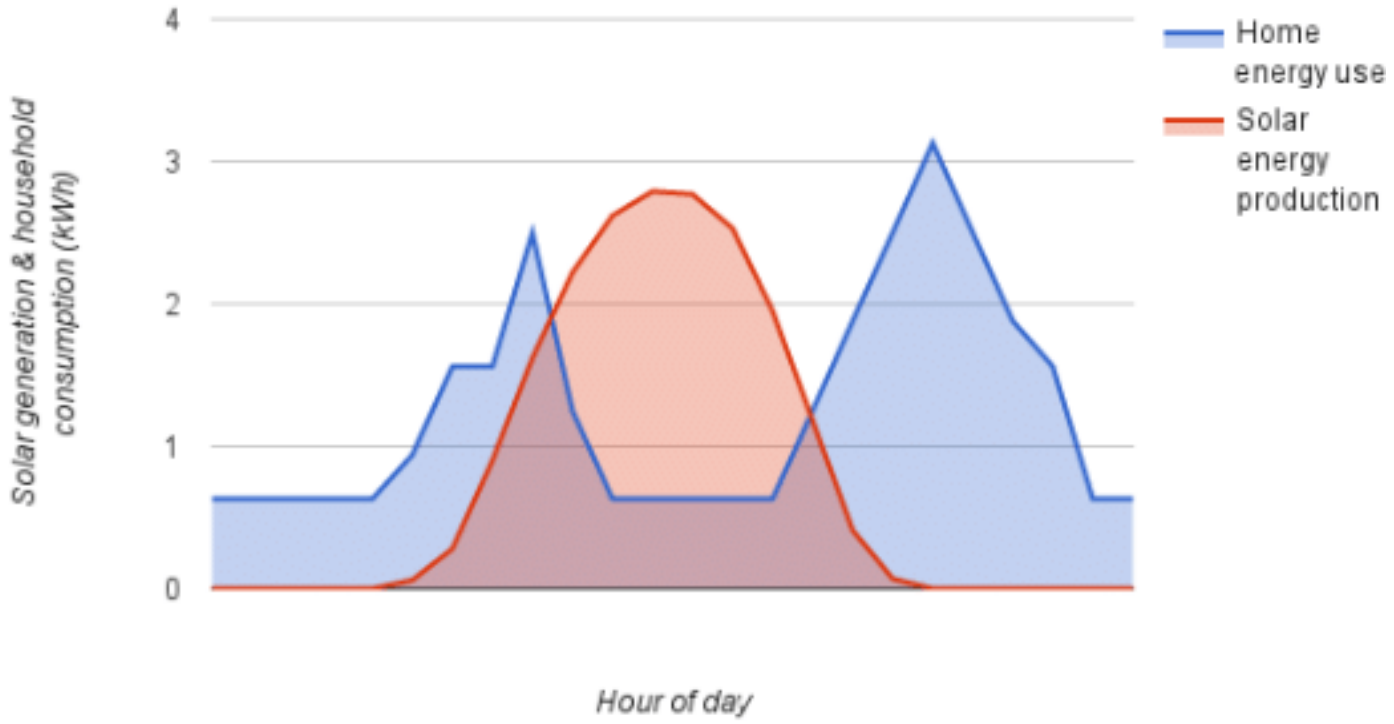


Conversion efficiency

- Sunlight to PV power (Panel array)
- PV power to battery charge (Charge controller)
- Battery charge to output power (Inverter… or not)
- Appliances



Usage



- **System misuse due to:**
  - Negligence
  - Oblivion

System sizing

- Inconsistency of the sun
- Panel array oversizing
- Battery bank oversizing
- System sizing too rudimentary

Data acquisition

What:

- Irradiance
- Weather forecast
- PV power
- Battery charge
- Consumption data

How:

- IoT technology

supply voltage	supply current	battery voltage	panel voltage	panel current	time stamp
249.08	0.15	26.75	66.33	3.66	6/7/2020 13:26
249.08	0.15	26.77	65.57	3.6	6/7/2020 13:26
248.51	0.11	26.84	65.4	4.28	6/7/2020 13:26
248.51	0.15	26.74	65.69	3.85	6/7/2020 13:26
249.37	0.15	26.76	66.76	3.24	6/7/2020 13:26
248.23	0.15	26.84	65.86	3.95	6/7/2020 13:27
250.79	0.15	26.81	65.99	3.73	6/7/2020 13:27
249.37	0.15	26.8	66.64	3.9	6/7/2020 13:27
248.51	0.11	26.81	67.54	3.51	6/7/2020 13:27
248.23	0.15	26.77	65.1	4.1	6/7/2020 13:27
248.8	0.15	26.73	65.03	3.67	6/7/2020 13:27
248.23	0.18	26.8	65.07	3.7	6/7/2020 13:27
249.37	0.18	26.8	65.31	3.97	6/7/2020 13:28
249.37	0.11	26.79	65.88	3.67	6/7/2020 13:28
248.23	0.15	26.73	66.86	3.47	6/7/2020 13:28
250.22	0.15	26.82	69.14	4	6/7/2020 13:28
249.65	0.15	26.77	69.02	3.58	6/7/2020 13:28
248.51	0.11	26.71	68.96	4.47	6/7/2020 13:28
249.08	0.15	26.81	68.43	3.35	6/7/2020 13:29

Applying the data

- Remote switching
- Identifying efficient components
- Usage influencing through notifications

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Thank you

David Tusubira

Innovex Uganda

davidtusubira@innovex.org

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Q&A

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