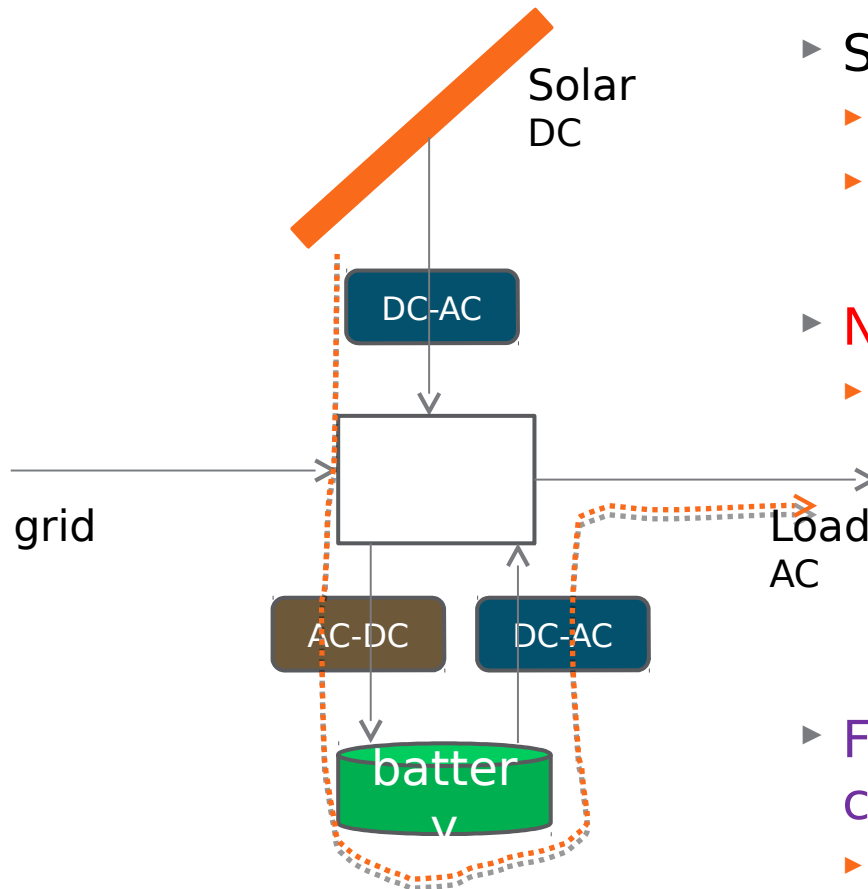


Towards Next Gen Powering of
Indian Homes capitalising on
Decentralised Solar Green Energy
Energy-efficient DC Appliances
Smart Load Management

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Decentralised Solar Power at Homes



- ▶ Solar PV gives DC Power
 - ▶ But load is AC
 - ▶ Needs a DC-AC convertor
- ▶ Now if we add a battery
 - ▶ Battery stores only DC
 - ▶ Require a AC-DC convertor for charging
 - ▶ Require a DC-AC convertor during discharging
- ▶ For low power, each convertor* can have 10 to 15% loss
 - ▶ Solar with battery may have 25 to 45% loss

* Solar DC-AC may have slight better efficiency

And it gets worse

- ▶ As one realises that home-load is moving towards DC

AC fan	72W	BLDC fan	30W
at speed 1	60W		9W
CFL tube	36W	LED tube	15W
low intensity	na		4W

volume prices similar for fans

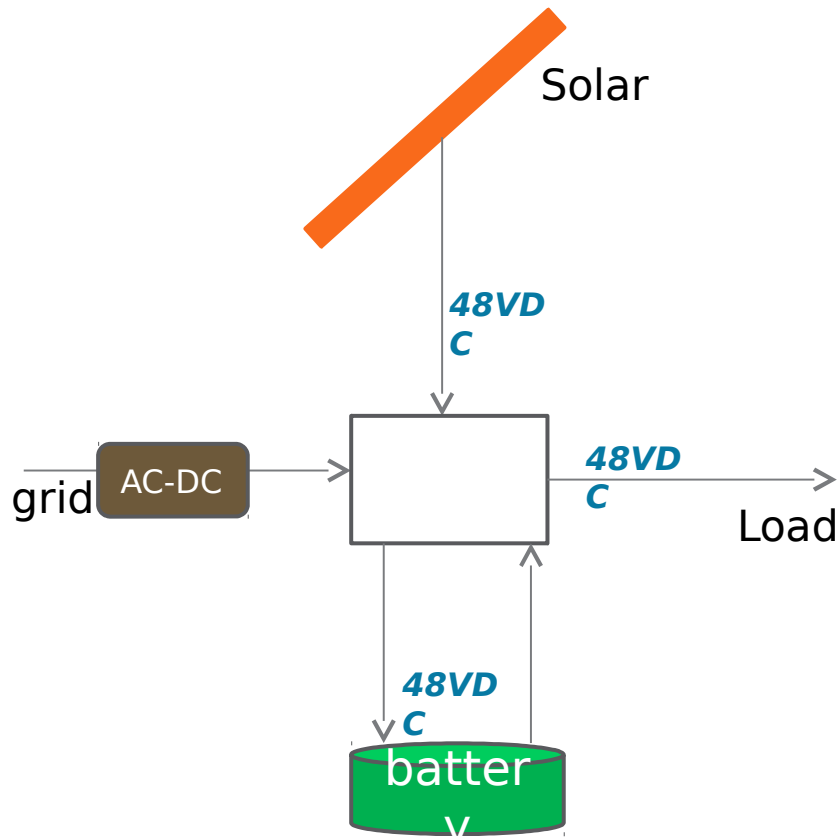


LED tube life much longer (DC powering enhances reliability)



- ▶ All Electronics devices work on low-voltage DC
 - ▶ TV (LED/LCD), laptops. Cell-phones, speaker-phones, tablets, speakers
 - ▶ AC to DC conversion has losses from 20% to 50% in each device
- ▶ Even the refrigerators, air-conditioners, washing machine in future will be BLDC motors
- ▶ Use of DC-powered and energy-efficient devices
 - ▶ Consumption **down by 50%**

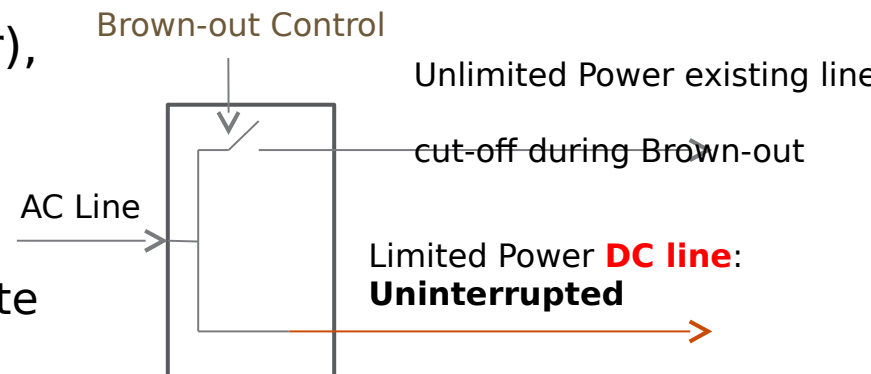
Move to **Solar-DC** at Home Premises



- ▶ 48V DC line as an additional power line at home
- ▶ **Highly power-efficient usage of Solar**
- ▶ Low-power from grid alone converted from AC-DC
 - ▶ Designed to have minimal loss
- ▶ Battery can be added with higher efficiency (no convertors), if required

and the **Load Management Innovation**

- ▶ with the aim to Create a **PULL** for solar-DC and **Prevent** Black-out at homes
- ▶ Power shortage gets Discom to cut power (**black-out**) in select localities
- ▶ Introduce a **new power-level** for distribution to homes
 - ▶ **Brown-out**: low-amount power transmission -- say 10%
- ▶ Grid to supply **power on two lines at homes**
 - ▶ Existing AC **line** (unlimited power), but cut-off during **brown-out**
 - ▶ **A new DC** with **limited power**, but always ON
 - ON during **Normal + Brown-out** state



But what will 10% DC Power do?

- ▶ Assume **uninterrupted but limited** Power: 100 Watts DC
 - ▶ enable three lights + 2 fans + cell-phone charging
 - ▶ or three lights + 1 fan + TV (24" LED/LCD) + cell-phone
 - ▶ can be installed incrementally
- ▶ 100W per home is small enough that it can be supplied even in adverse power situation
- ▶ **But what if one wants more?**
 - ▶ Add Solar PV
 - ▶ And if needed a battery to have a solar DC
 - ▶ 500W solar DC would support 5 fans, 8 lights, two TVs, multiple cell-phone / tablet chargers and a laptop charger



But where is the pull to add solar and DC?

- ▶ Decentralised Solar can make huge difference
 - ▶ 240M homes: Avg 500W solar (50 sqft), will produce nearly
 - ▶ $240M \times 0.5 \text{ kw} \times 1600 \text{ solar hours a year} = 190,000 \text{ GWh per year}$
 - ▶ Close to total Domestic consumption in a year
- ▶ The UDC and Solar-DC approach Enables
 - ▶ No black-out in any home (without significantly burdening grid)
 - ▶ Create a consumer demand and Investment for DC appliances
 - ▶ And making decentralised Solar PV attractive for homes
 - ▶ Reduced domestic demand: energy-efficient appliances
 - ▶ Increase Supply as decentralized solar PV gets added
 - ▶ Reducing supply-demand gap
 - ▶ And at the same time have 24x7 DC power at each home
 - ▶ Adequate for LIH: Mid and high Income homes will install solar



What is happening?

- ▶ Installations at homes, offices, labs at IITM
- ▶ UDC trials for 300 to 500 homes each at Chennai, Hyderabad, Trivandrum and Orissa
 - ▶ Chennai already ON
 - ▶ Ministry of Power POC in one town with 100K homes in 2015
- ▶ Off-grid Homes (OGH): 70 million homes
 - ▶ 25 home deployments in Nilgiris, Orissa, W. Bengal, Sricity and Telegana
 - ▶ Propose to install 100K off-grid homes
 - ▶ With the support of CSR, donations and 30% Government support
 - Need support from alumni