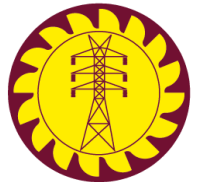


Solar PV on Electricity Grid - Impact, Guidelines & Procedure -

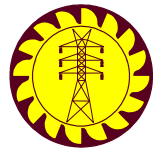
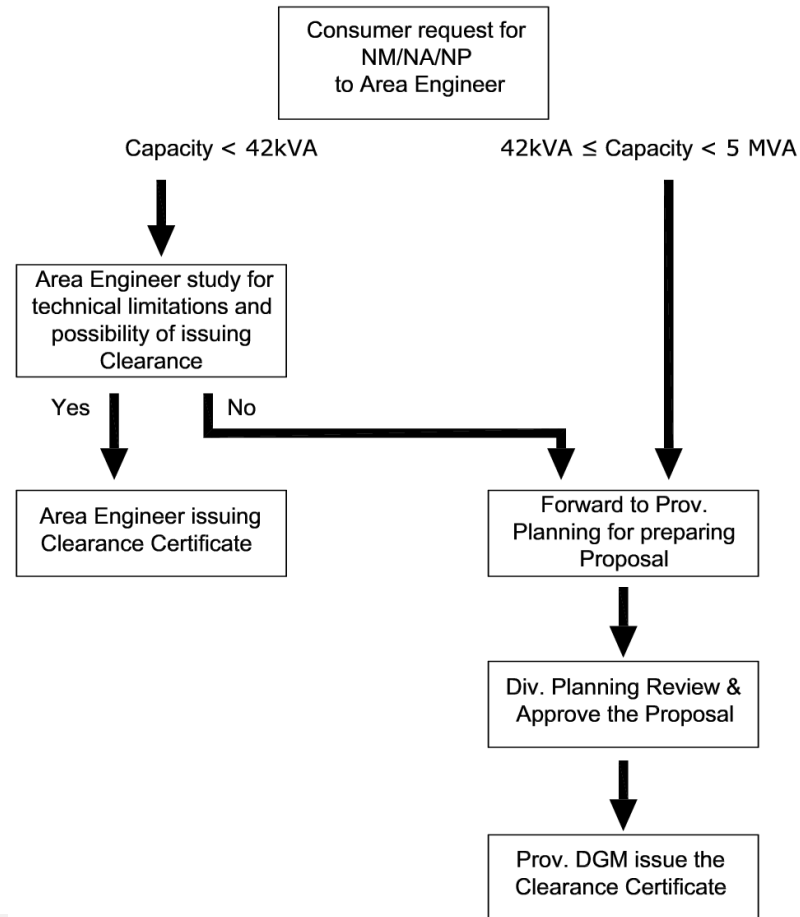
Eng. S. C. Diddeniya
Deputy General Manager
Distribution Coordination Branch

ලංකා විදුලිබල මණ්ඩලය
இலங்கை மின்சார சபை
CEYLON ELECTRICITY BOARD



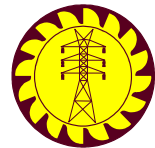
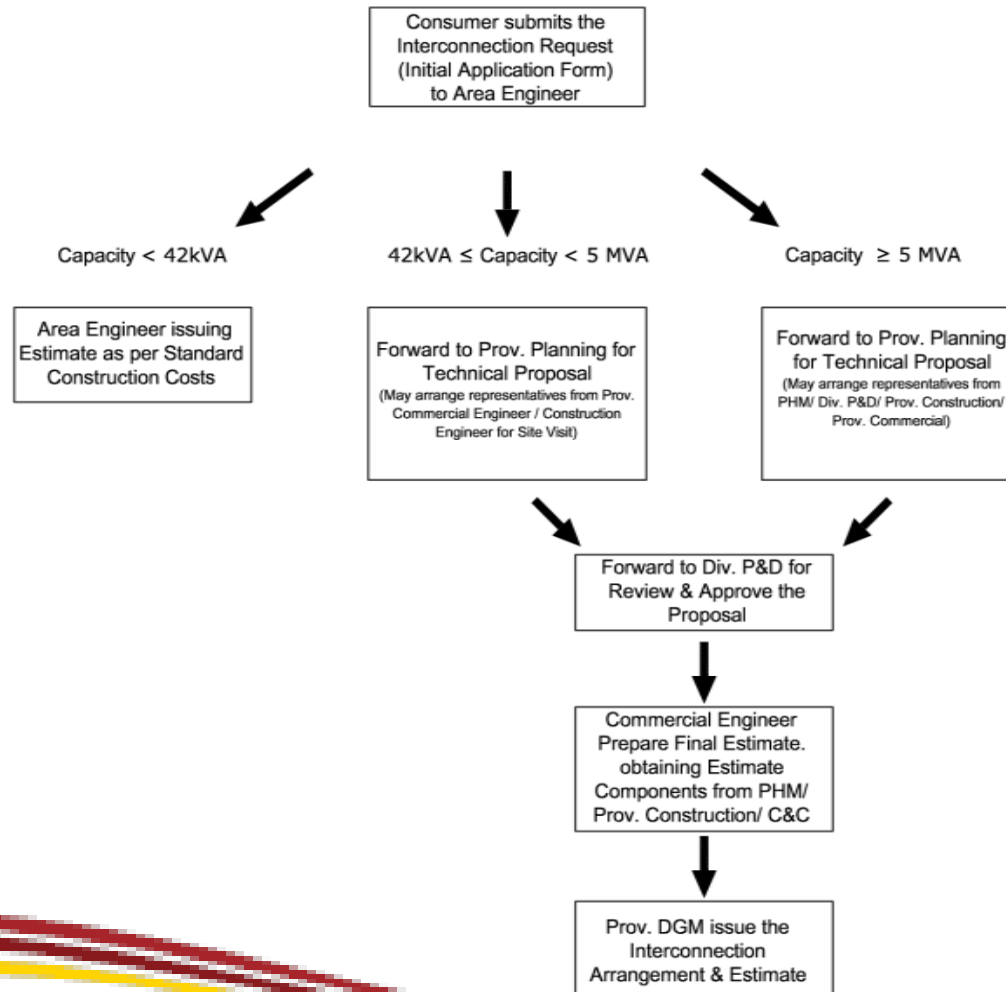
Solar Rooftop connection procedure

I. Clearance Stage



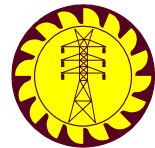
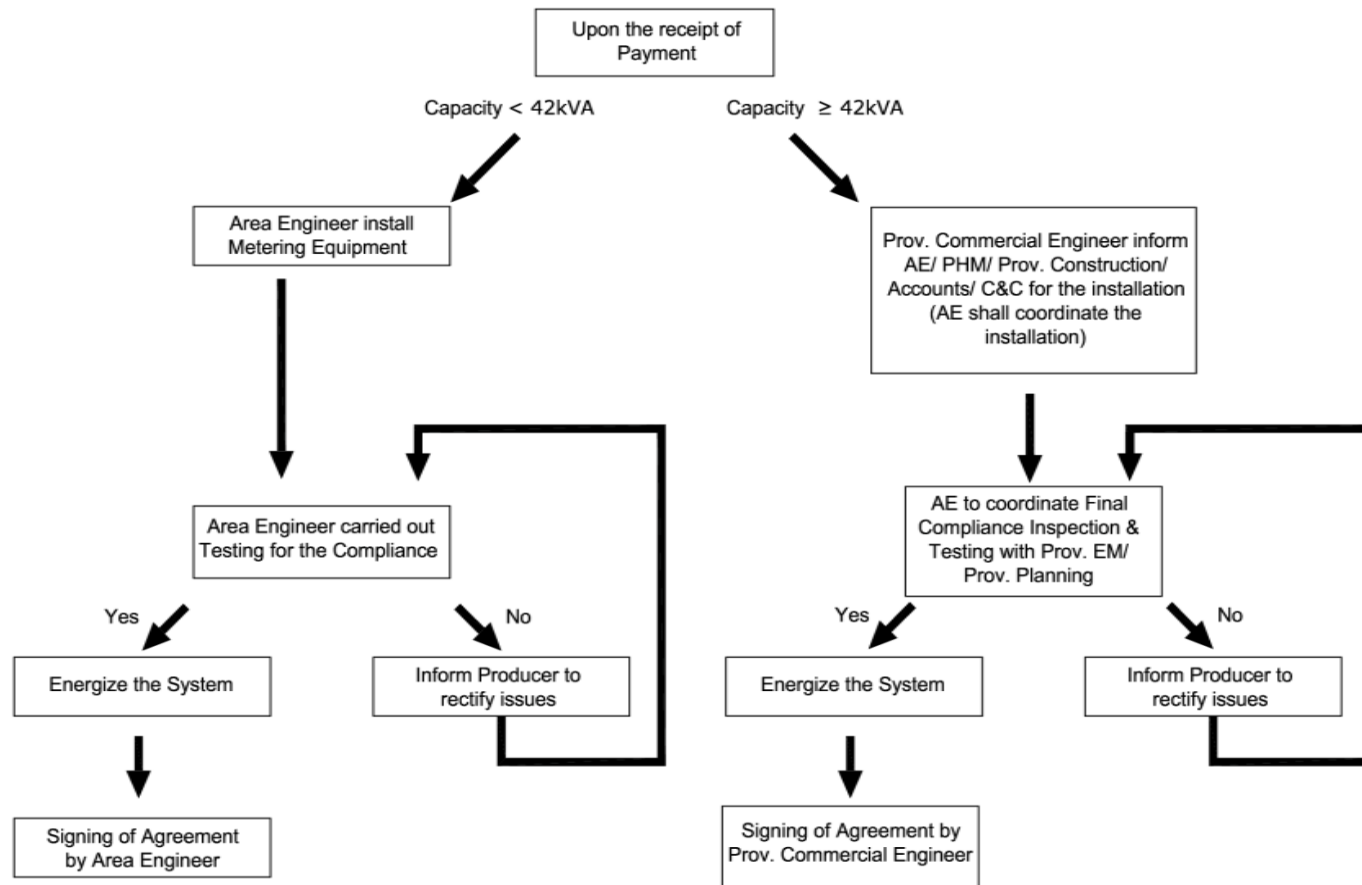
Flow chart of procedure

2. Application Stage



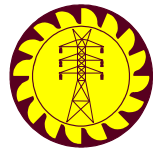
Flow chart of procedure

3. Commissioning Stage



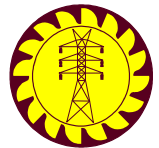
Information to be submitted

1. Duly filled application
2. Final copy of the proposed circuit diagram
3. Compliance certificate from accredited agency
4. Schedule of protective devices and protection settings



Agreement between CEB and Customer

1. Rules, rights & obligations
2. Metering & billing
3. Solar PV facility design & operating requirements
4. Liabilities and Indemnifications



Factors affecting the connection of a solar rooftop

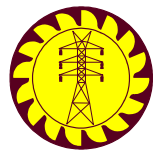
1. Customer's contract demand

- Single phase 30A – Upto 5kVA
- Three phase 30A – Upto 21kVA
- Three phase 60A – Upto 42kVA

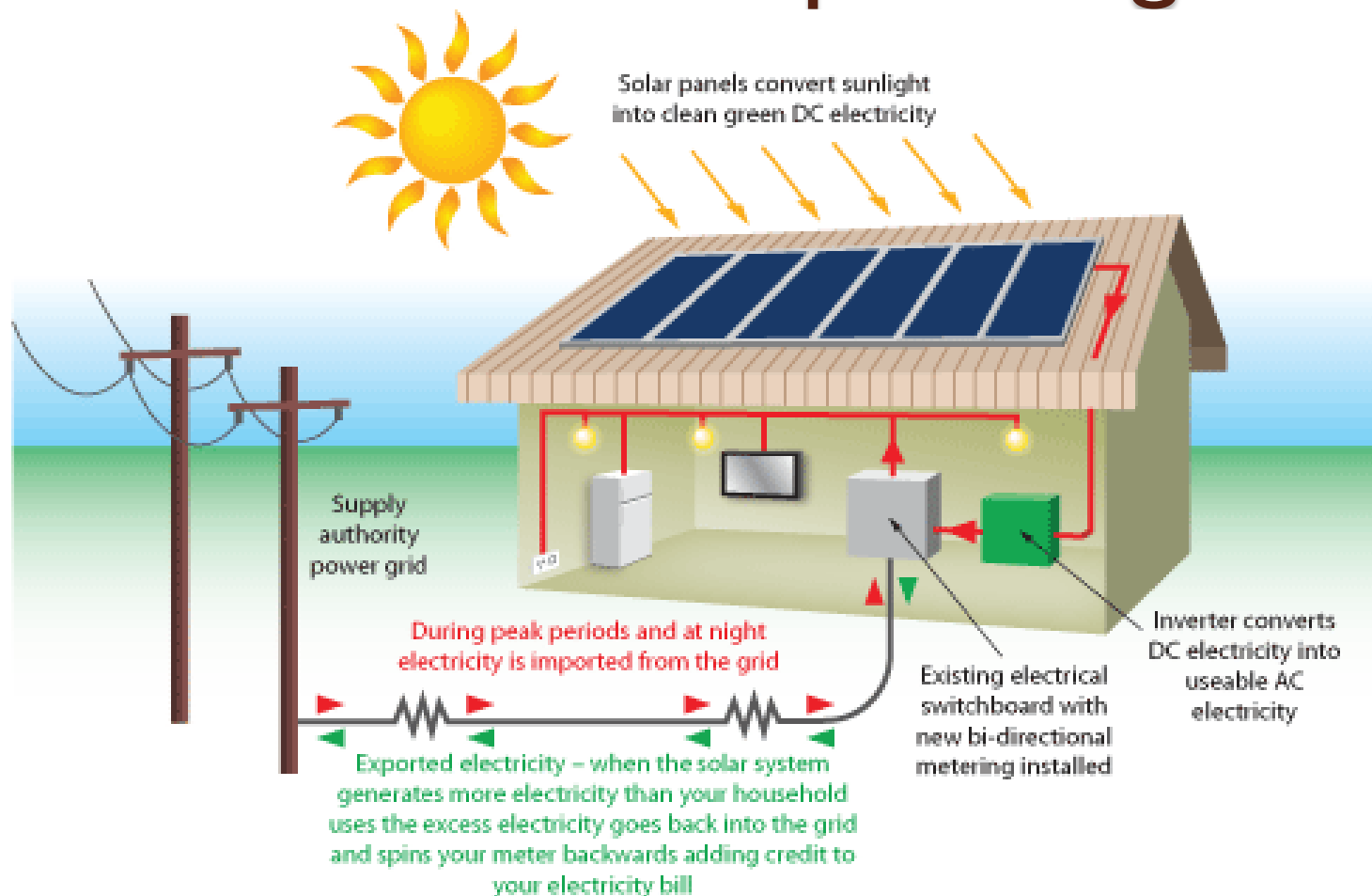
2. Area of solar rooftop

- 2 m² Solar panel → 300W
- Annual energy from 1kW → 100-110 kWh

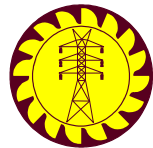
3. Network configuration with respect to location of customer premises



Solar PV Rooftop Arrangement

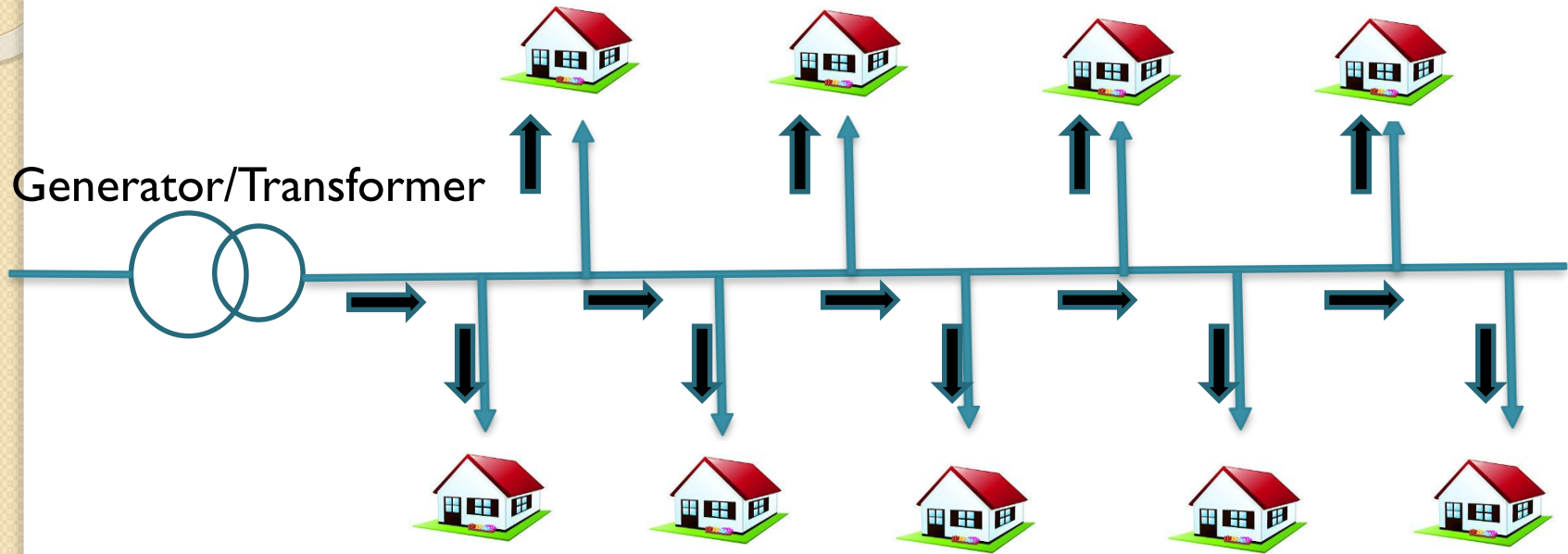


Source : <http://www.pvnepal.supsi.ch/howitworks/>

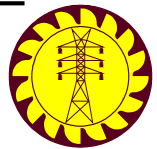


Earlier → Uni-directional power flow

- From generation stations to downward loads

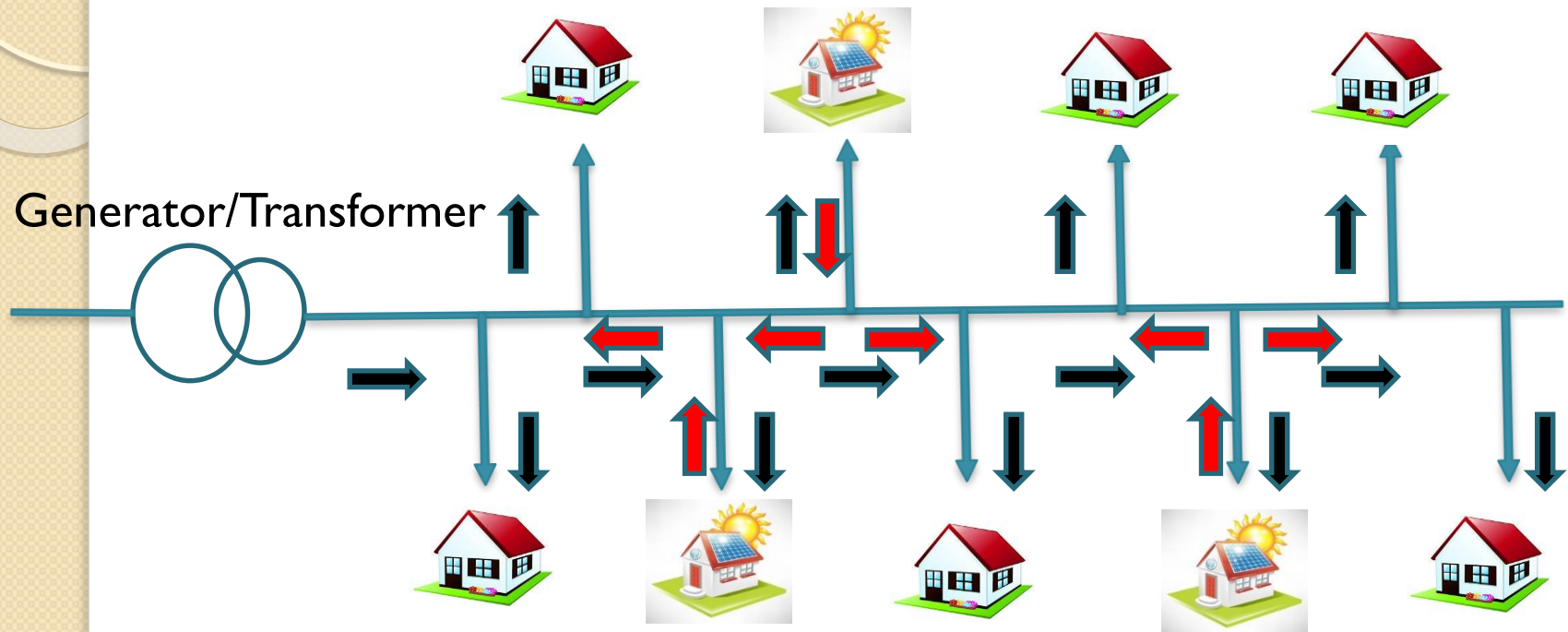


- Allowable voltage drop at feeder end $\pm 6\%$

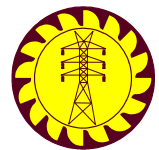


Now → Bi-directional power flow

- From generation stations to load as well as reverse power flow



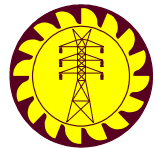
- Solar PV penetration is increasing with the advancements in ICT and reduction of prices



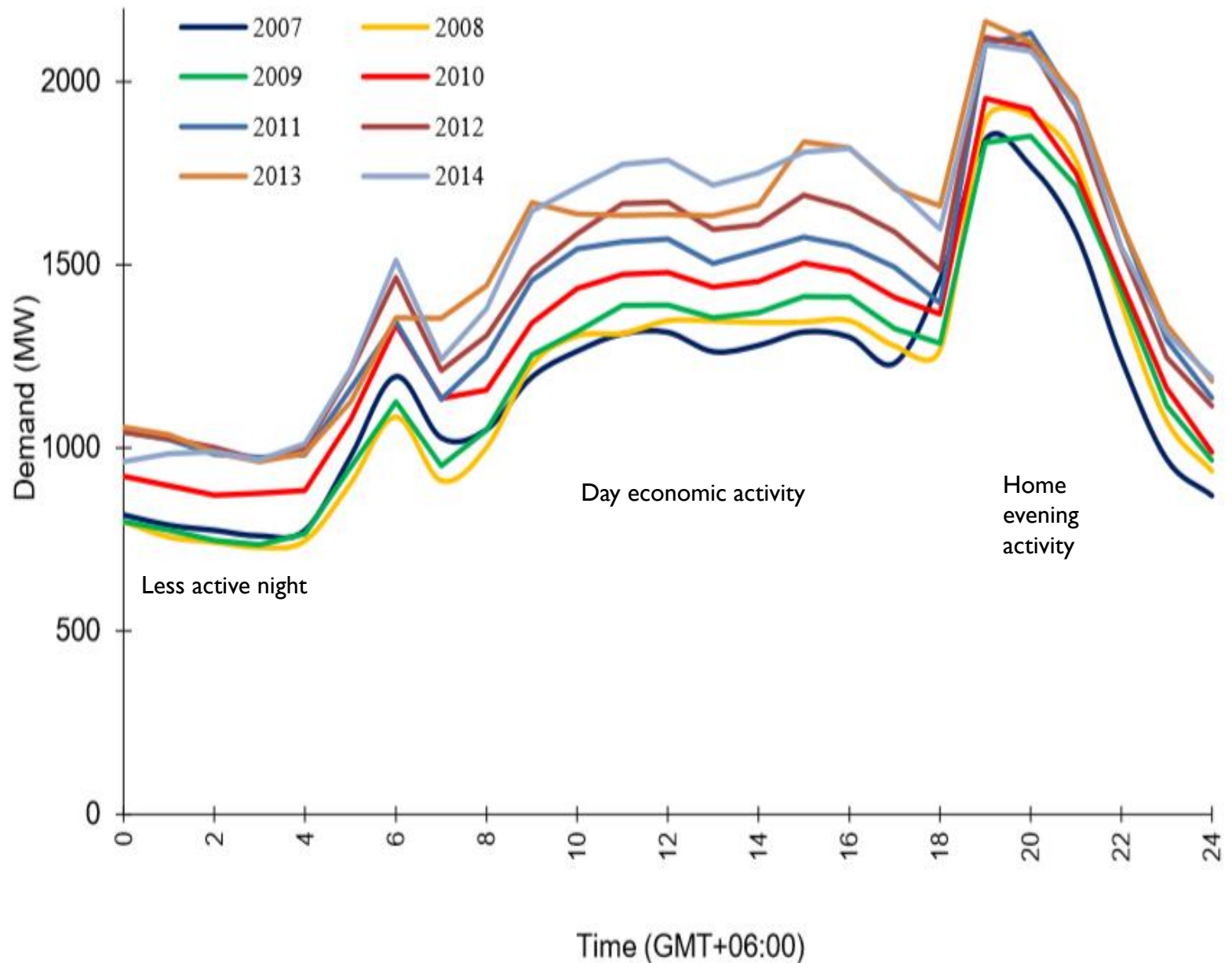
Requirement of imposing an upper limit

I. Power quality aspects

- Harmonics
- Power Fluctuations – {system is more affected}
- Voltage fluctuations
 - Over voltage at the Solar PV customer end - At “PCC” (Meter)
 - Under voltage at the Solar PV customer end - At “PCC” (Meter)
 - Voltage and current unbalance - Due to single phase loading



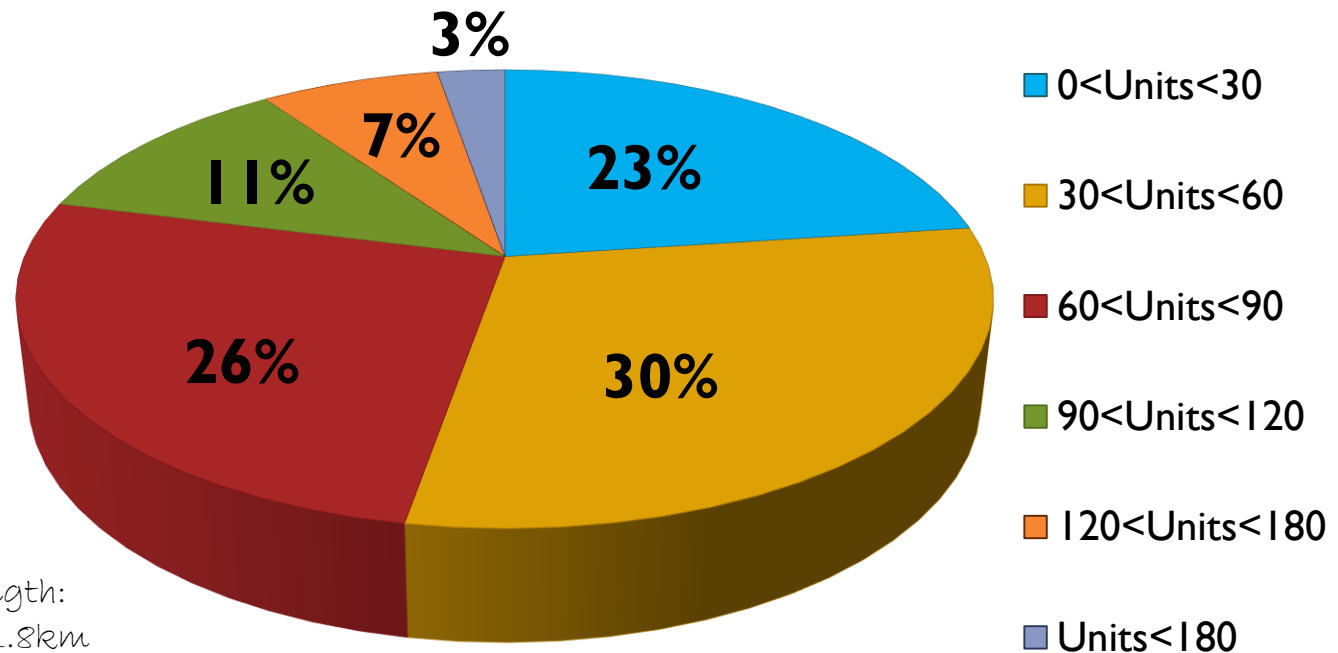
System Demand



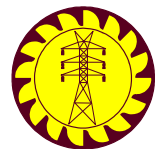
Factors affecting the connection of a solar rooftop

- Per capita electricity consumption – 626 kWh/person

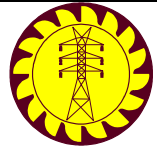
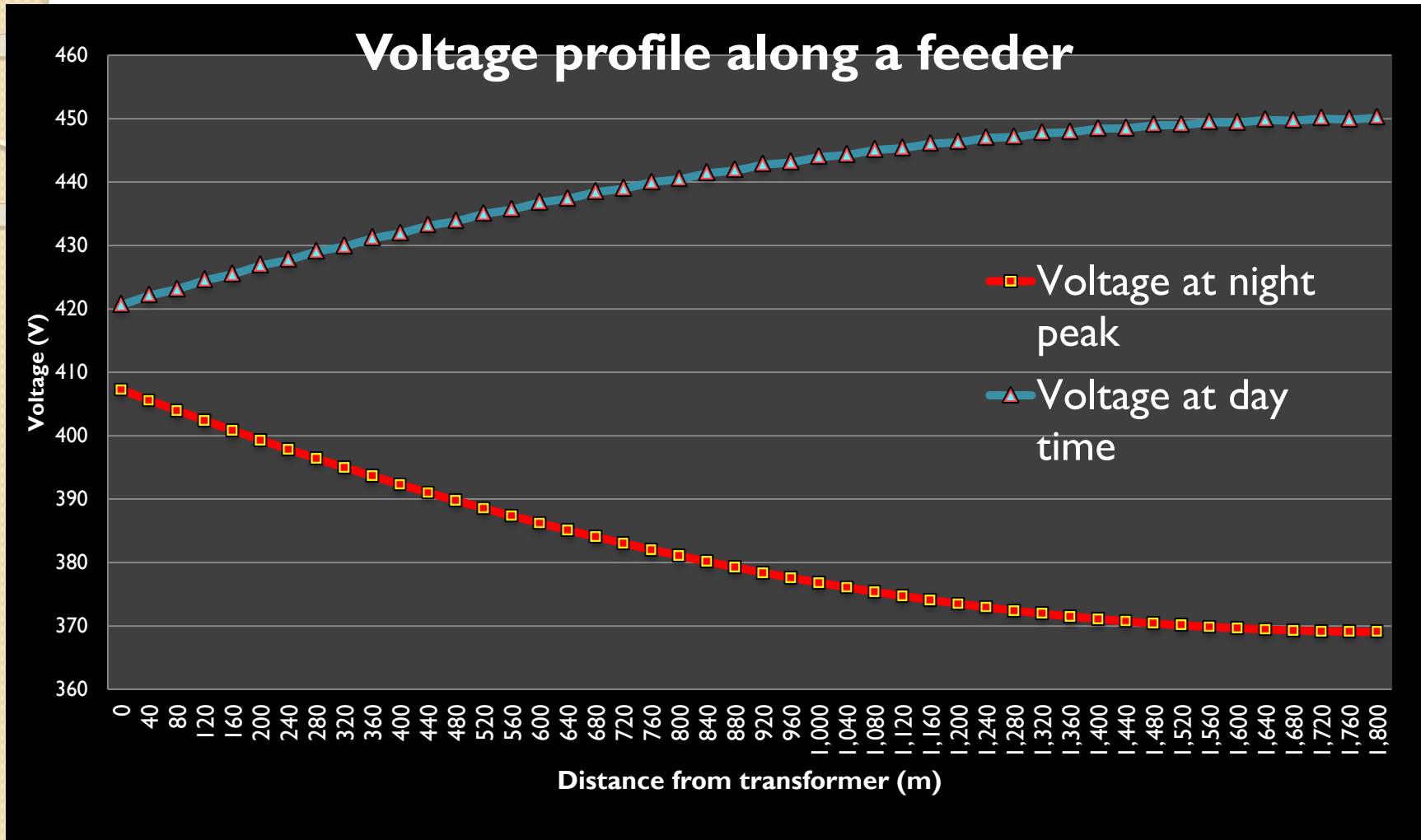
Domestic Customers Categorization based on electricity consumption (kWh)



LT Feeder length:
Earlier 1.8km
Now 1.2 km



Voltage profile along a feeder

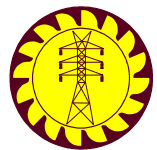


Requirement of imposing an upper limit

Voltage fluctuations

- Voltage rise is high
 - When Solar PV power generation is high
 - When they are located far from the Substation.
- Impact of Solar PV is high
 - when lengthy feeders are lightly loaded

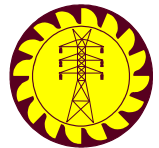
As the solar PV penetration goes up, voltage rise issue comes first before any other power quality issues



Associated costs

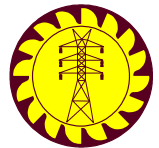
- Energy unit
 - Average cost – Rs. 19.12/kWh
 - Average selling price – Rs. 16.29/kWh
- Rates
 - Price per unit of solar energy – Rs. 22.00/kWh
 - Average cost of a thermal generating unit – Rs. 34.05/kWh
 - Solar prices on competition – Rs. 12 to 18.50 /kWh
- Under “Battle for Solar” programme
 - 200MW by 2020 – Achieved
 - Another 800MW by 2025 – After a review & revision

Thank you

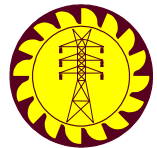
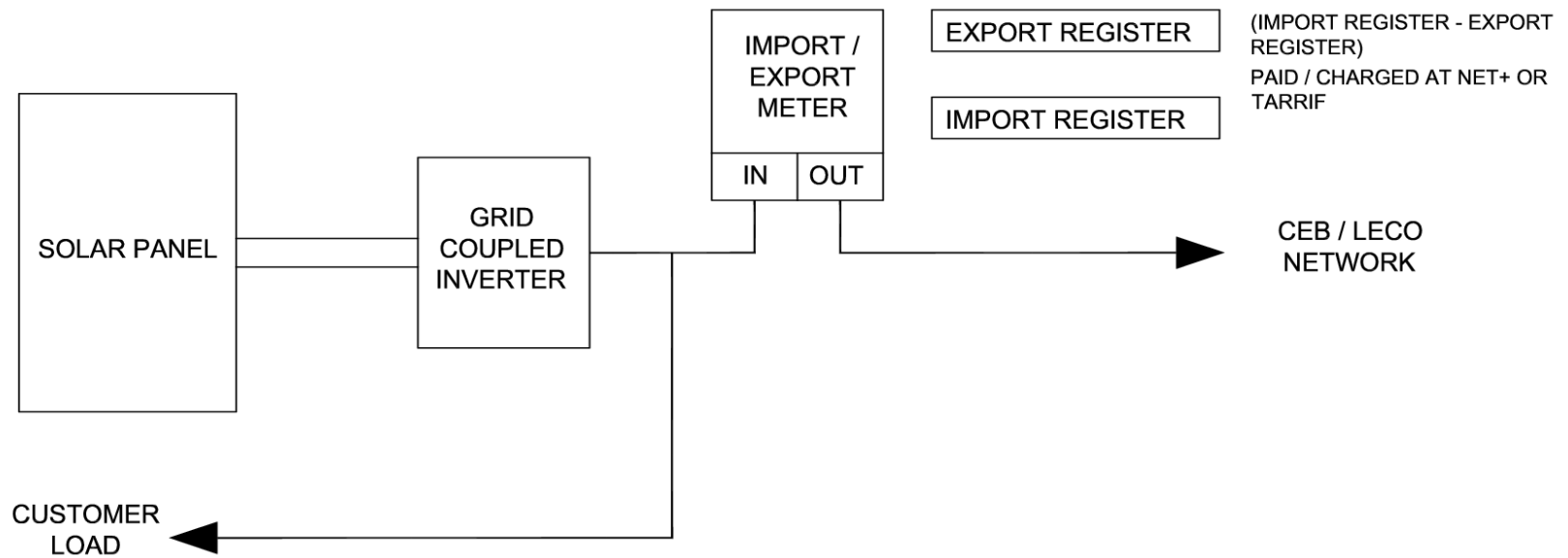


Three schemes available

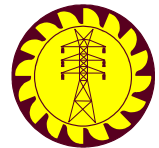
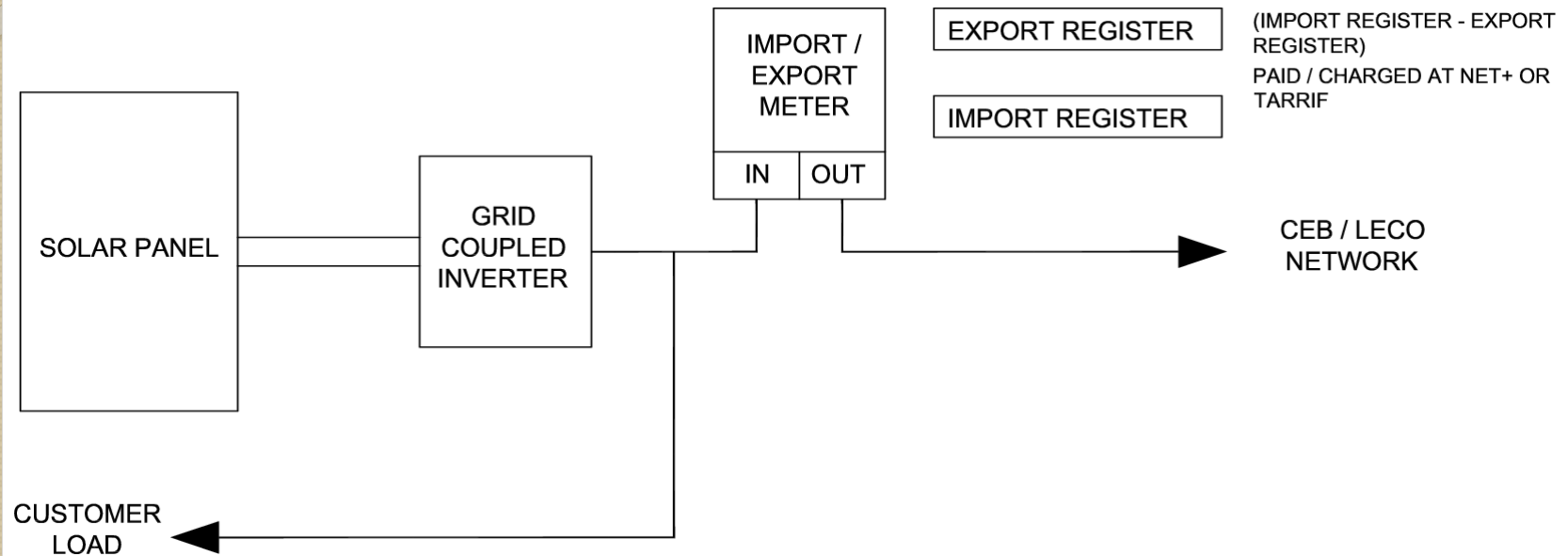
1. Net Metering
2. Net Accounting
3. Net Plus



Scheme I : Net Metering



Scheme 2 : Net Accounting



Scheme 3 : Net Plus

