

# **Development of Solar PV Deployment in Sri Lanka and its Challenges**

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# **Status of solar PV Development in Sri Lank**

# Status of Electricity Generation:2015

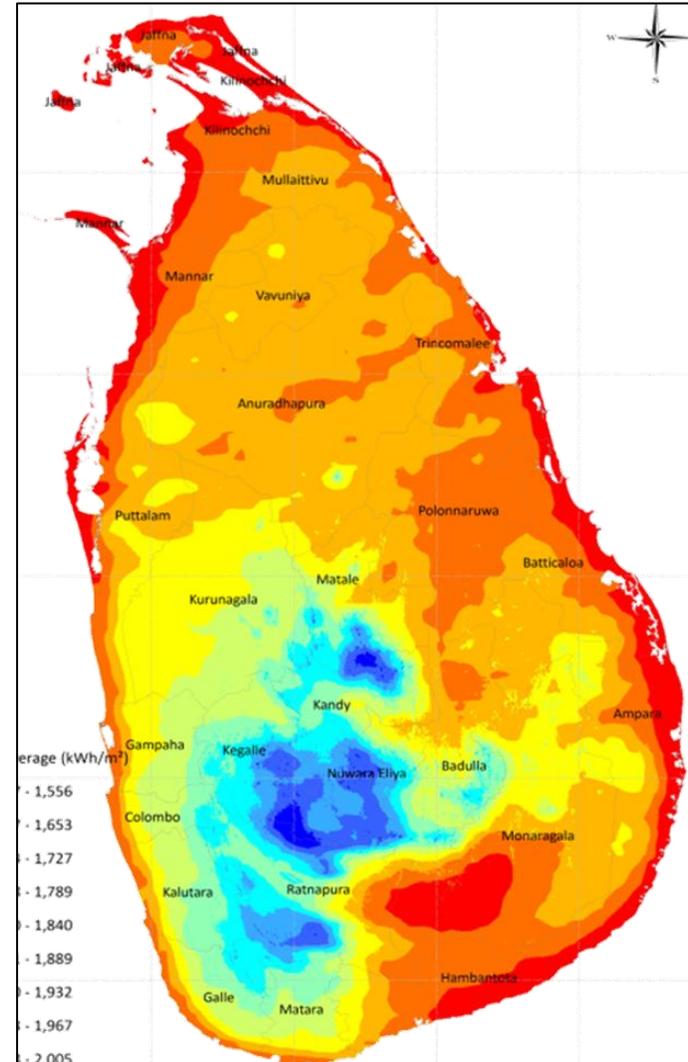
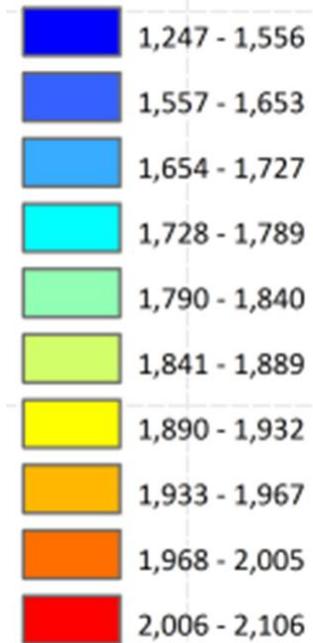
Type of Plant	Total Installed (MW)	Generation (GWh)	% Share in Generation
Major Hydro	1,377	4,904	37%
Other Renewables	455	1,467	11%
<b>Total Renewable</b>	<b>1,832</b>	<b>6,371</b>	<b>48%</b>
Thermal-Oil	1,115	2,275	17%
Thermal-Coal	900	4,443	34%
<b>Total</b>	<b>3,847</b>	<b>13,090</b>	<b>100%</b>

## Electrification level

- 99.9% of the households are provided with grid electricity, no potential for off-grid solar in the household sector

# Solar Energy Resource Map of Sri Lanka

Spatial distribution of annual average Global Horizontal Irradiation (kWh/m<sup>2</sup>/year)



# Types of Solar PV Plants in Sri Lanka

- Small IPPs of less than 10 MW each
  - Total Installed Capacity 41 MW (2016)
  - Operate on “Standardized Power Purchase Agreement (SPPA) on a fixed tariff for 20 year contract period
- Roof Top Solar PV Systems
  - Total Installed Capacity 60 MWp ( May 2017)
- Hybrid Renewable Energy Mini-grids
  - Solar – Wind – Diesel hybrid systems with battery backup, for electrification of isolated islands ( one system in operation and three more are under development)

# Roof-top Solar PV Systems

## Net Metering

- Introduced in 2010 June, consumers were allowed to install solar or any renewable energy plant (with capacity equivalent or less than the contract demand) connected to the grid as “micro power producers”. Consumer pays the “Net amount of Electricity Use”, no payment for surplus energy to grid but allowed to carry forward, grid works as an energy bank.
- Two additional options were introduced on 2016 September
  - Net Accounting and
  - Net Plus

# Net Metering Contd.

- **Net Accounting**

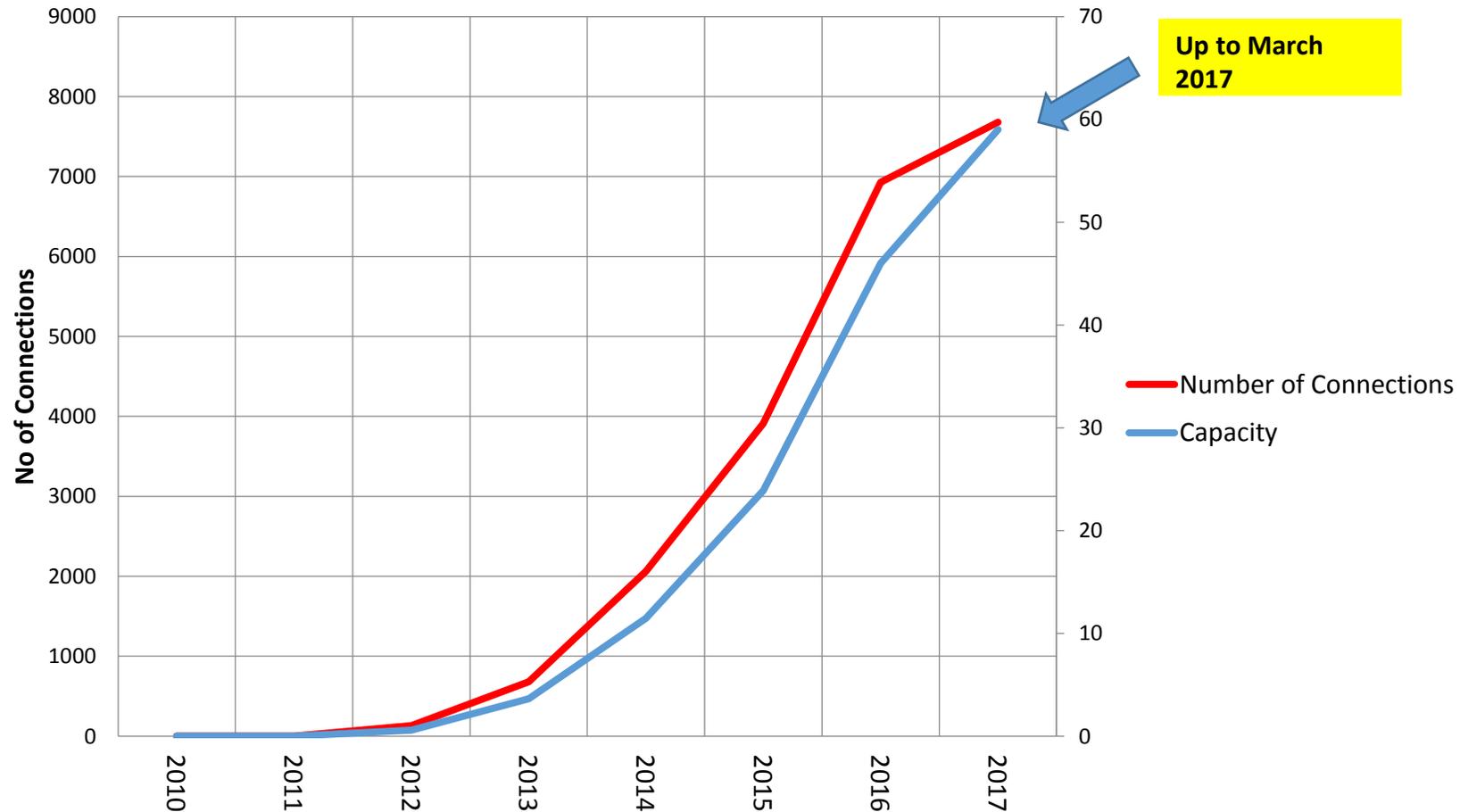
If generation is more than the own consumption, Consumer is paid for the **net amount of electricity** exported to grid (total generation - own consumption) at LKR 22.00 (US \$ 0.15) for 7 years, LKR 15.50 (US \$ 0.10) thereafter for the contract period of 20 years.

- **Net Plus**

Consumers are allowed to installed roof top solar PV plants, equivalent or less than their contact demand and export the **total generation** to national grid at LKR 22.0(US \$ 0.15) for 7 years, 15.50 (US \$ 0.10) thereafter for the contract period of 20 years. (Two separate meters: existing meter measures consumption, new meter for exports.)

# Status of Solar Roof Top PV Systems

- Slow start, accelerated growth at present



# Hybrid Renewable Energy Systems

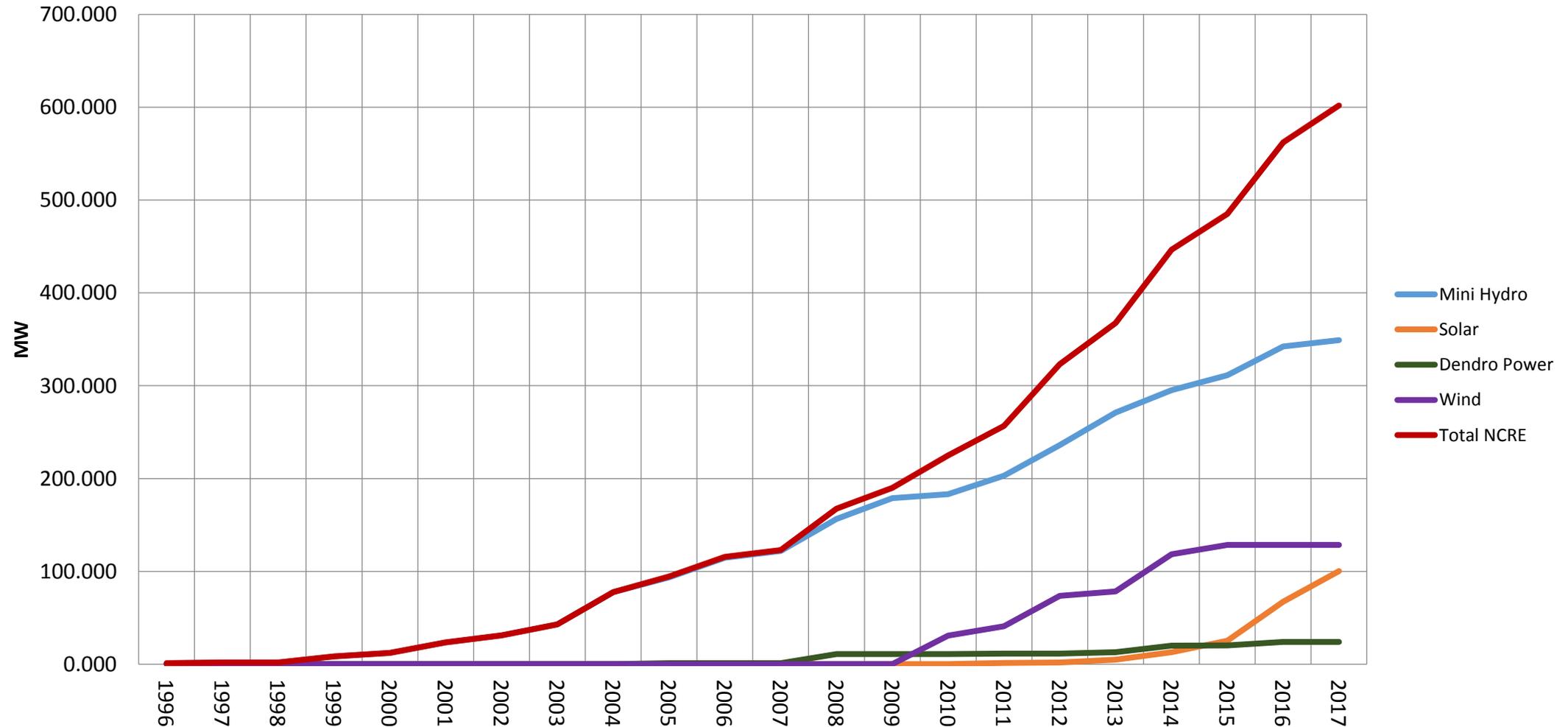
- Hybrid renewable power plants in four selected islands off the Jaffna mainland, namely Eluvativu, Analaitivu, Nainativu and Delft were introduced through a loan/grant package offered by ADB .
- These islands were served by CEB-owned diesel generating plants, through a distribution network that covers most parts (not all parts) of each island.
- The fuel cost incurred in producing electricity and other maintenance costs and overheads exceed LKR 50 per kWh, which is about three times the national average cost of supply of electricity.
- Reliability and quality of power supply was poor.



# System Capacities for Island

<b>Component</b>	<b>Eluvativu</b>	<b>Analaitivu</b>	<b>Delft</b>	<b>Nainativu</b>
Solar PV	64 kW	200 kW	400 kW	250 kW
Wind	21kW	60 kW	160 kW	-
Battery Storage	134 kWh	200 kWh	400kWh	300 kWh
Converter	134 kWh	200 kW	400 kW	250 kW
Diesel Genset 1	30 kW	100 kW	200 kW	150 kW
Diesel Genset 2	-	100 kW	350 kW	300 kW
<b>Number of Consumers</b>	<b>150</b>	<b>208</b>	<b>949</b>	<b>751</b>

# Grid connected Renewable Energy Capacity (Excluding Major Hydro)



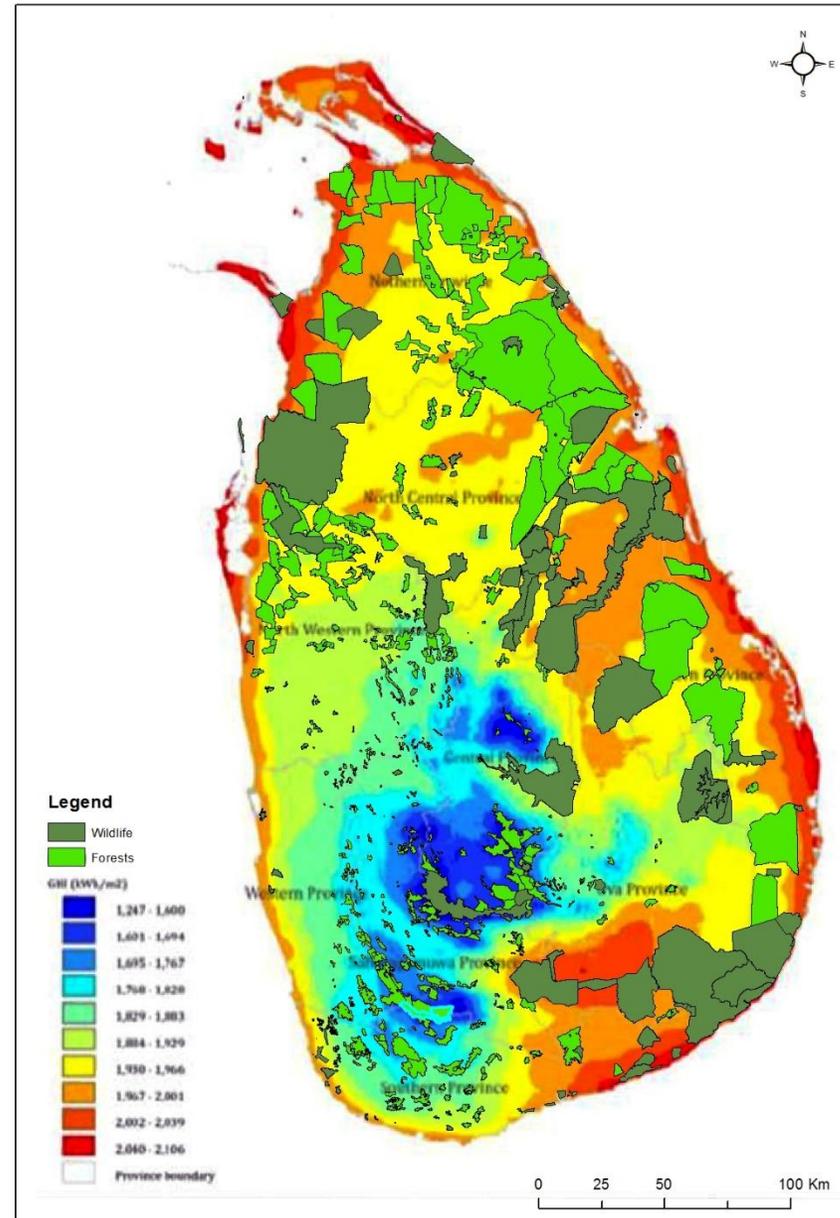
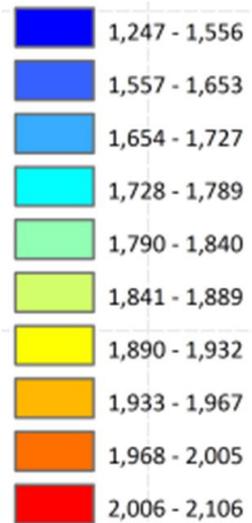
# **Challenges in Deployment of Solar PV**

# Challenges in Deployment of Solar PV

- Limitations on availability of lands for large scale solar projects
- Impacts on the transmission grid
  - additional spinning capacity (to support intermittency)
  - additional reserve capacity
  - implications in tariff due to additional investment required for above
- Impacts on the electricity distribution network
  - Line capacity, power quality issues

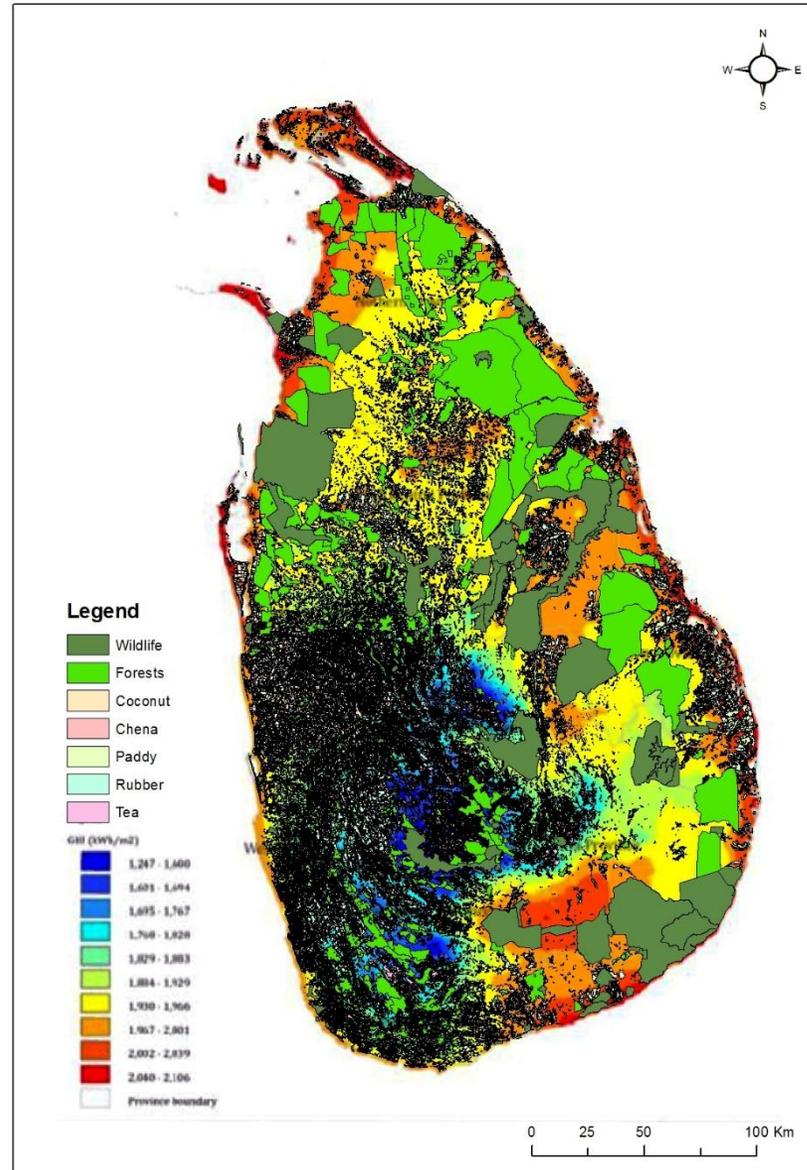
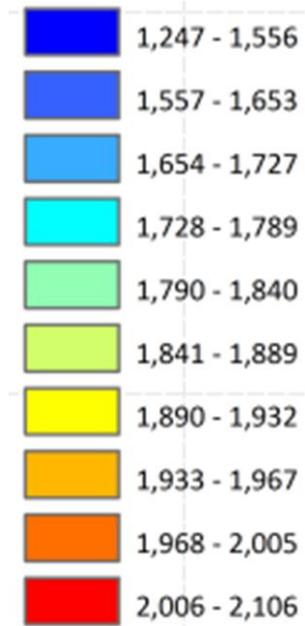
# Forest Cover and Wild Life Sanctuaries

Spatial distribution of annual average Global Horizontal Irradiation (kWh/m<sup>2</sup>/year)



# Forests, Wild Life Sanctuaries and Land Use in Agriculture

Spatial distribution of annual average Global Horizontal Irradiation (kWh/m<sup>2</sup>/year)

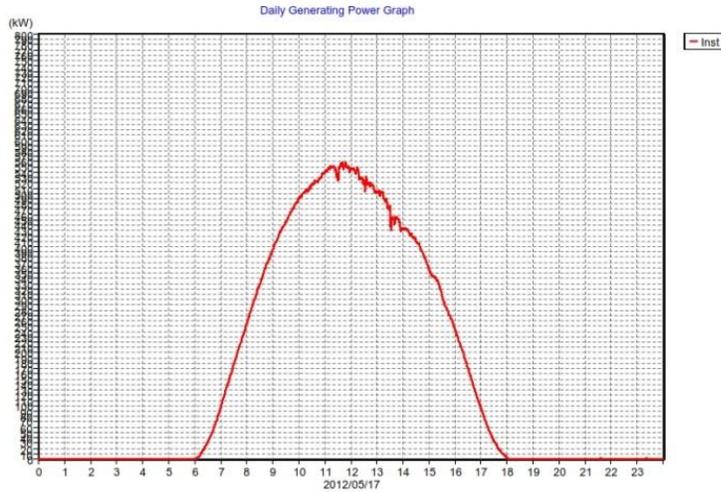


# Challenges in Deployment of Solar PV

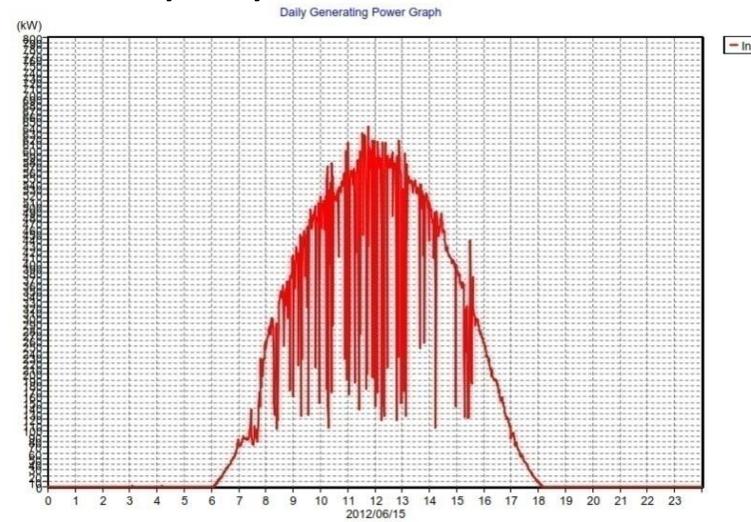
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# Generation Pattern at Various Weather Conditions

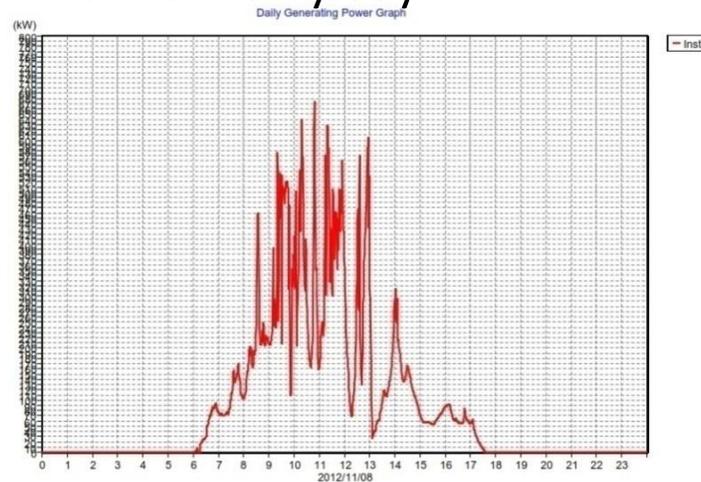
## Clear Sky



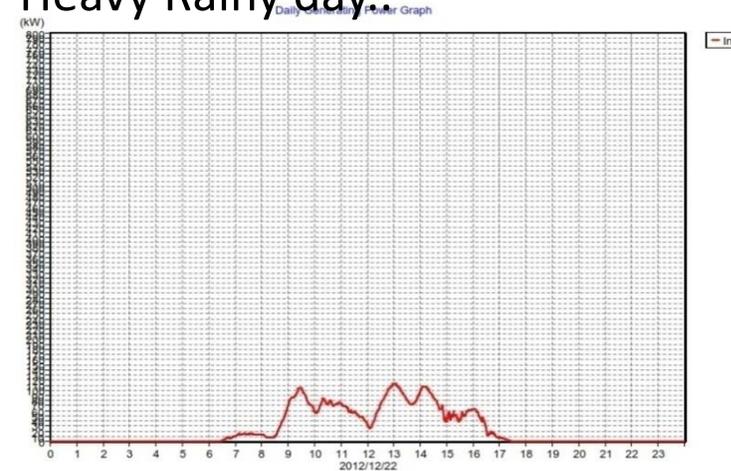
## Cloudy day



## Normal Rainy day..



## Heavy Rainy day.



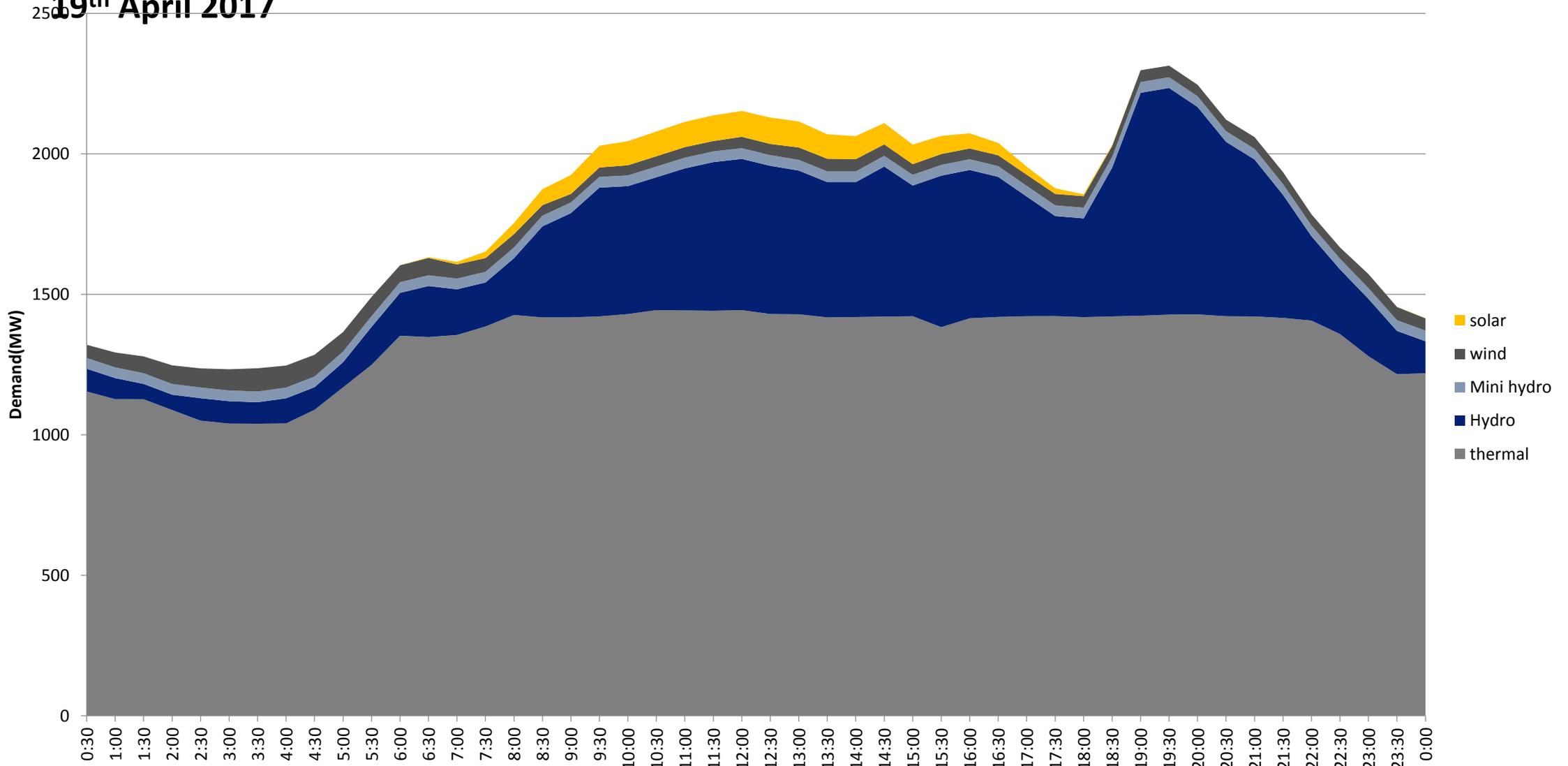
# **Future Plans**

# Future Plans

- Establishing a credit line for promotion of roof top systems
  - US \$ 50m ADB loan, estimated roof top solar PV capacity to be added 60 MW
- Develop 60 nos of 1 MW each distributed solar plants in 20 locations through open competitive bidding process.
- Establishing solar energy parks for large scale grid connected solar projects.

# Daily Load Curve

19<sup>th</sup> April 2017



**Thank You.**