



**SAARC  
ENERGY  
CENTRE**  
*Energy for Peace & Prosperity*

# **System Operation and Settlement Mechanism**

## **Cross Border Trade/Regional Power Market in South Asia**

10-11 December, 2017  
Dhaka, Bangladesh

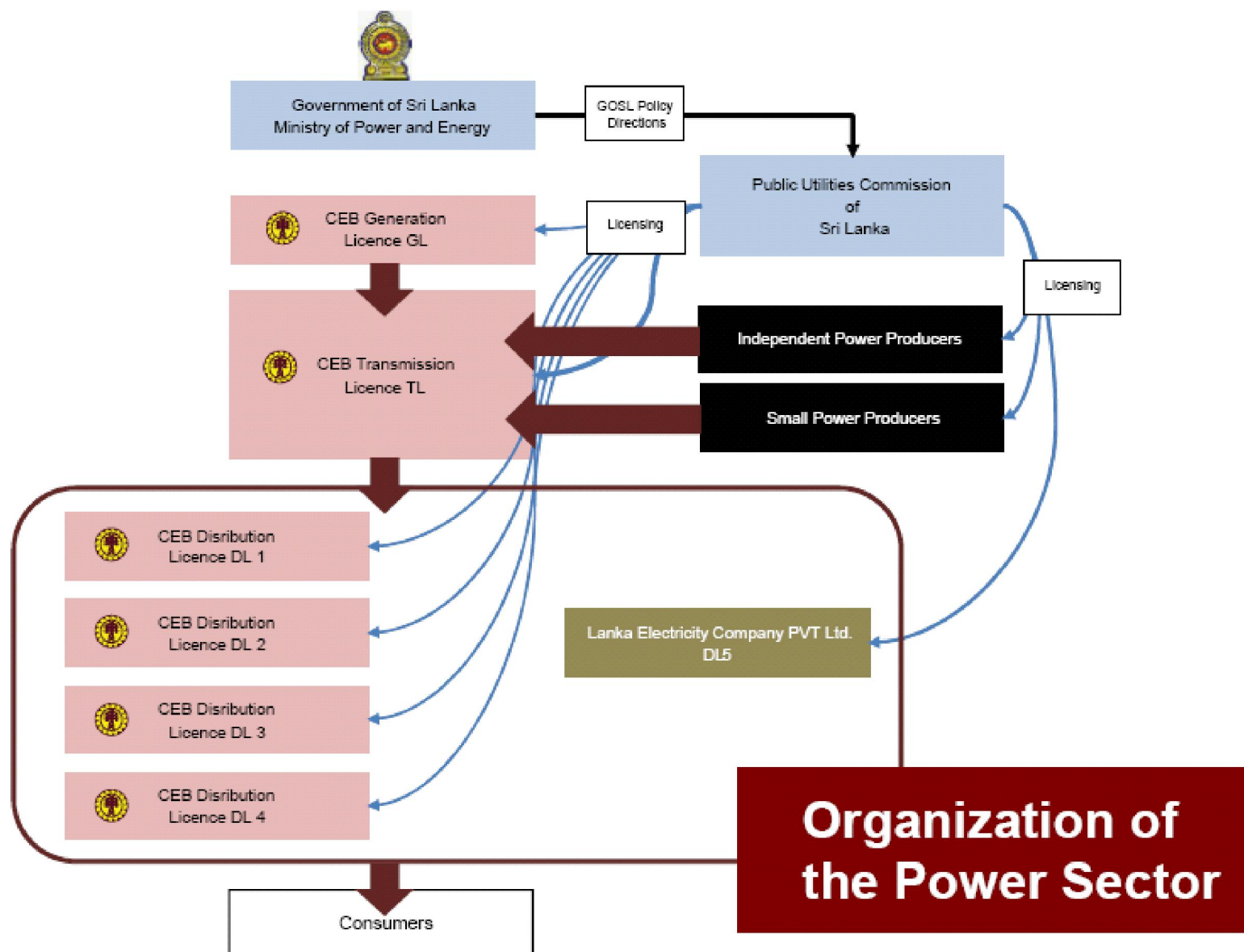
**Present By:**

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*Electrical Engineer(Energy Marketing)*

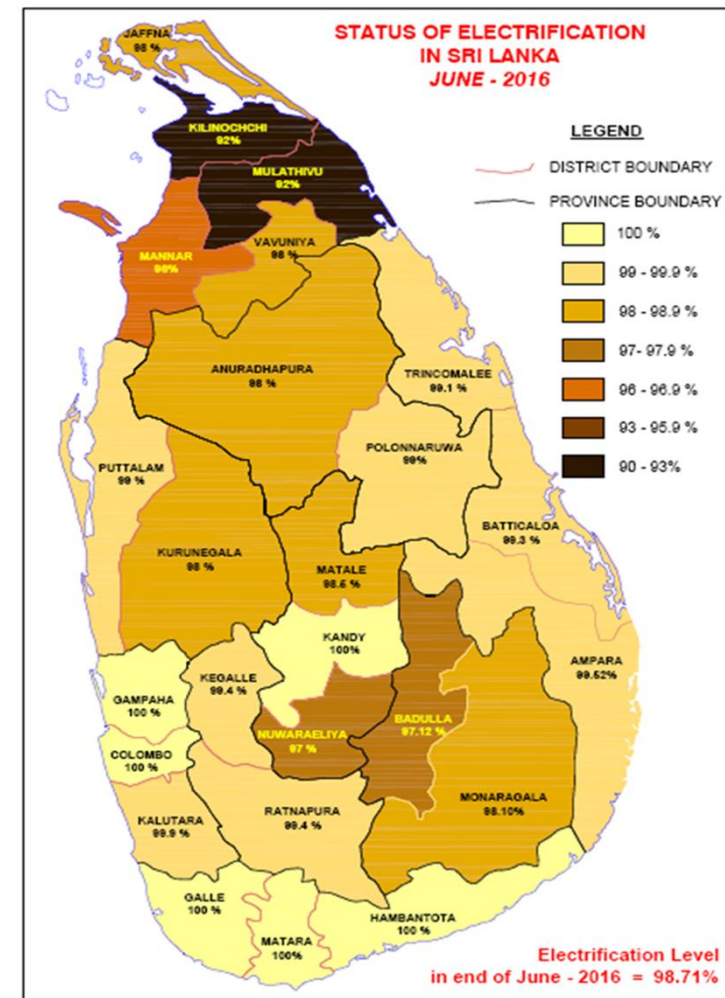


**CEYLON  
ELECTRICITY  
BOARD** *Enrich Life through Power*



# SRI LANKAN POWER SECTOR 2016

|                                |             |
|--------------------------------|-------------|
| ❖ Installed capacity           | 4018 MW     |
| ❖ Peak Demand                  | 2483 MW     |
| ❖ Electricity Generated        | 14249 GWh   |
| ❖ System Losses                | 10.28 %     |
| ❖ Elec. Consumption per Capita | 603 kWh     |
| ❖ Level of Electrification     | 98.71%      |
|                                | (June 2016) |





# SRI LANKAN POWER SECTOR 2016

## Installed Capacity in MW

### CEB Own Power Plant

**Hydro** **1,384**

**Thermal Oil** **604**

**Thermal Coal** **900**

**Other Renewable Energy** **3**

### Private Power Purchase

**Mini-Hydro** **342**

**Thermal** **611**

**ORE –Wind** **128**

**ORE –Other** **45**

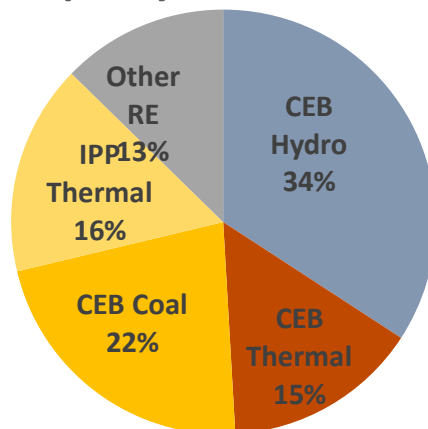
**TOTAL Installed Capacity 4018 MW**



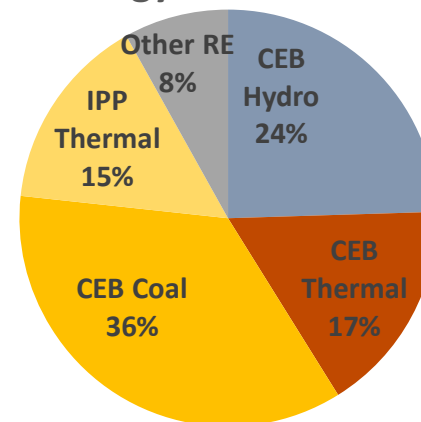
# SRI LANKAN POWER SECTOR 2016

## Capacity Mix and Energy Mix

Capacity Share in 2016



Energy Share in 2016



| Plant Name         | Capacity (MW) | Annual Energy (GWh) |
|--------------------|---------------|---------------------|
| CEB Hydro          | 1390          | 3498.7              |
| CEB Thermal - Coal | 900           | 5066.8              |
| CEB Thermal - Oil  | 606           | 2360.2              |
| IPP Thermal        | 652           | 2163.8              |
| Other RE           | 516           | 1158.1              |

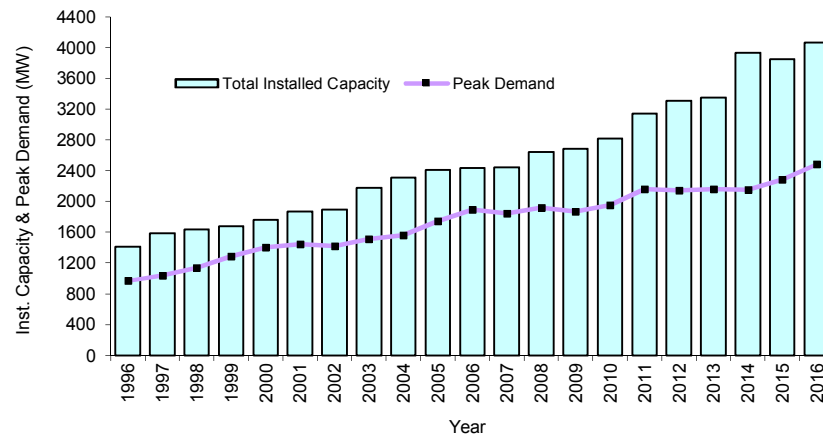


# SRI LANKAN POWER SECTOR 2016

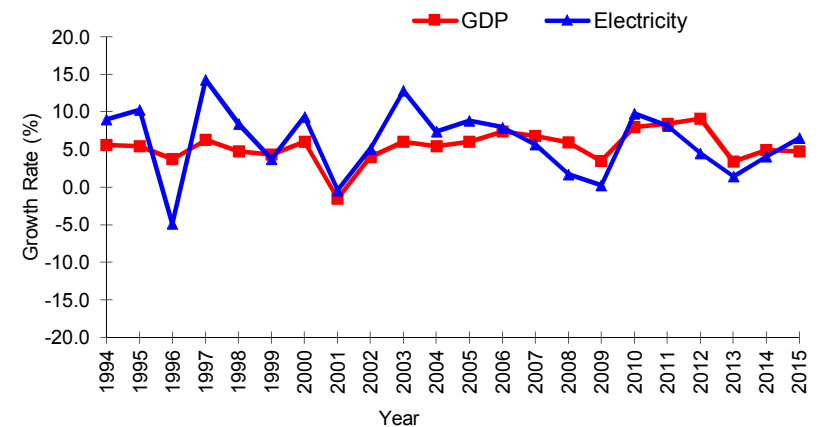
|                                              |                      |
|----------------------------------------------|----------------------|
| <b>Transmission and Distribution Losses</b>  | <b>9.63%</b>         |
| <b>Load Factor</b>                           | <b>65.67%</b>        |
| <b>Avg. Cost per unit (at selling point)</b> | <b>18.09 Rs./kWh</b> |
| <b>Avg. selling price</b>                    | <b>16.18 Rs./kWh</b> |
| <b>Recoded Maximum peak Demand</b>           | <b>2453 MW</b>       |

# SRI LANKAN STATISTICS –POWER SECTOR

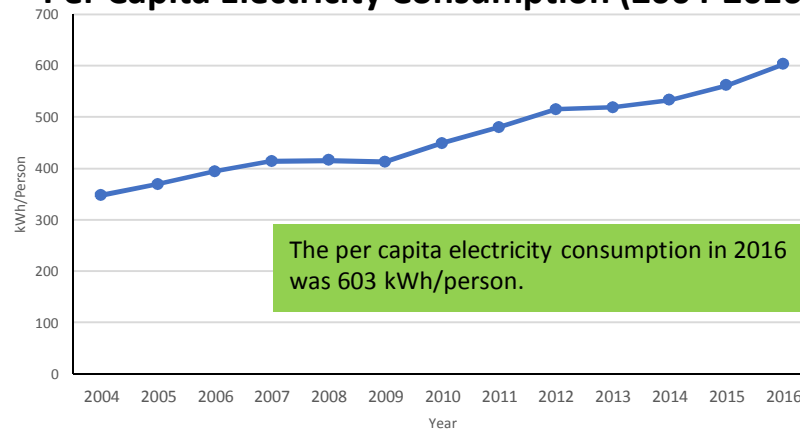
## Installed Capacity and Peak Demand



## GDP Growth % & Elec. Demand Growth %

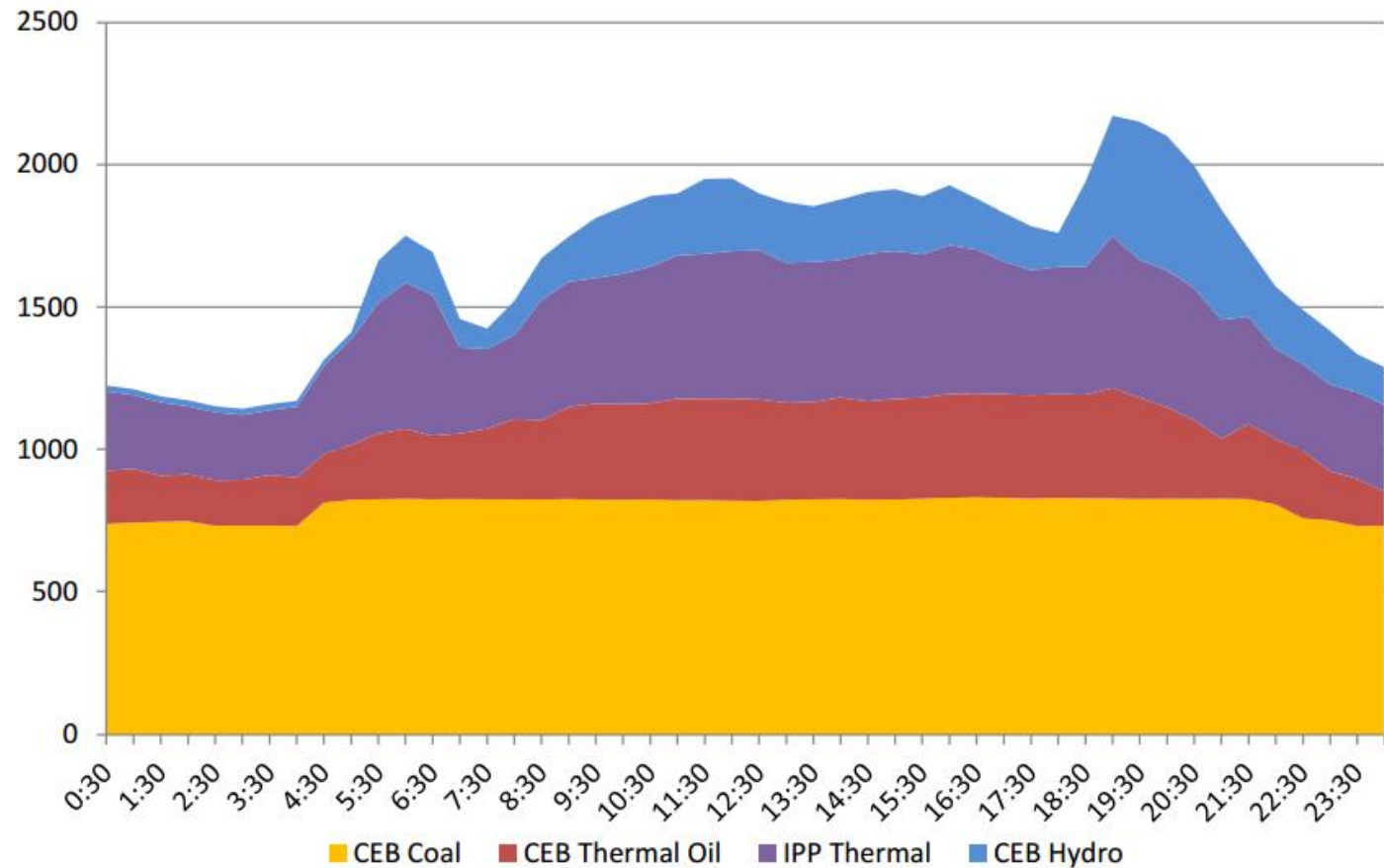


## Per Capita Electricity Consumption (2004-2016)



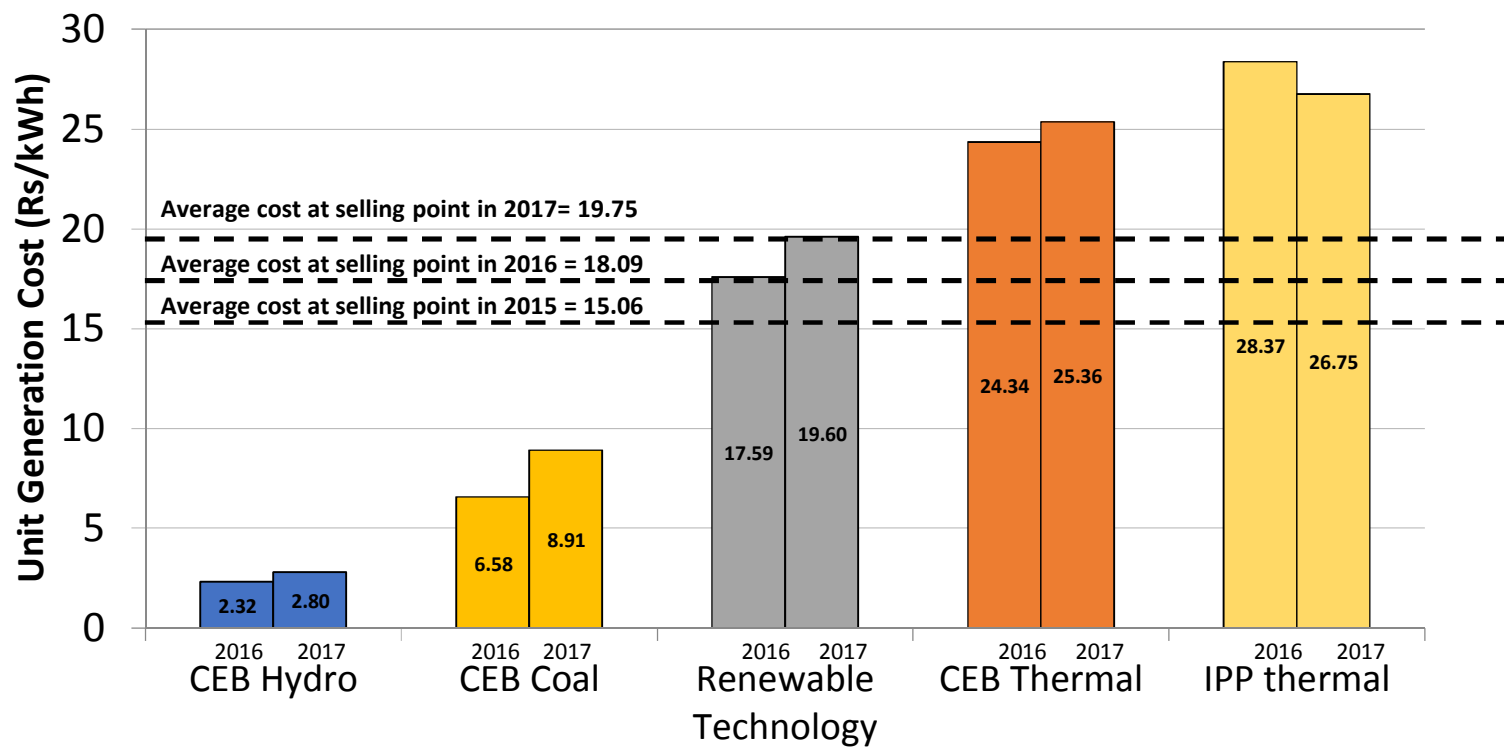
# Typical Load Curve of Sri Lanka

Daily Load Curve as at 08<sup>th</sup> March 2017





# Actual Average Unit Cost of Electricity Generation 2016/2017 Nov



**Average Selling Price in 2017 Nov (Rs/kWh ) 16.12**

**CEB Coal price excludes financial cost**



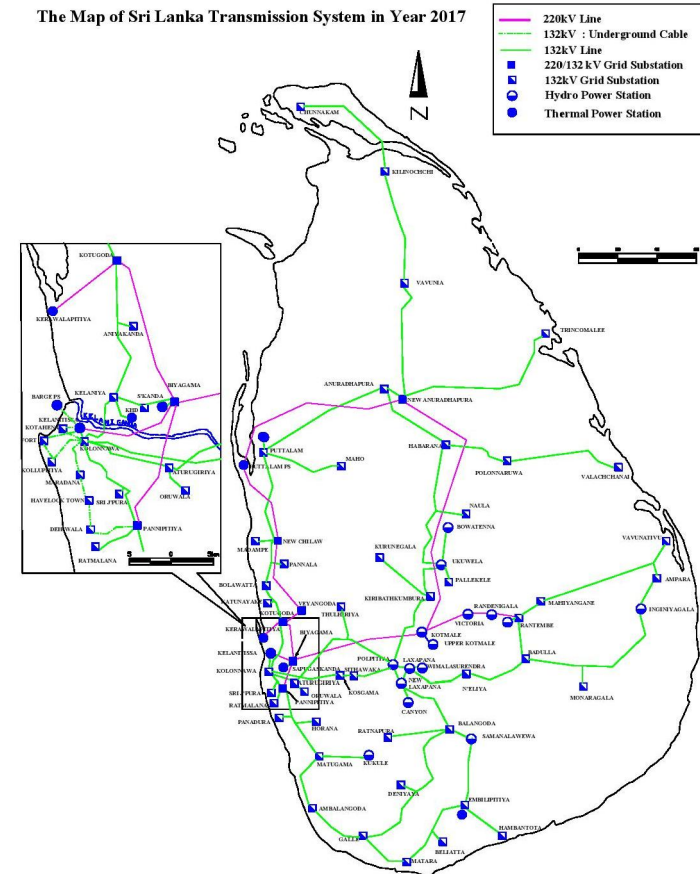
# Present Transmission Network

| Description             | Number of GSS | Total Capacity (MVA) |
|-------------------------|---------------|----------------------|
| <b>Grid Substations</b> |               |                      |
| 132/33 kV               | 55            | 4222                 |
| 220/132/33 kV           | 4             | 1600/380             |
| 220/33 kV               | 1             | 75                   |
| 132/11 kV               | 5             | 369                  |
| 220/132kV               | 4             | 1405                 |

| Transmission Lines     | Length (km) |
|------------------------|-------------|
| 220 kV, Double circuit | 582         |
| 220 kV, Single Circuit | 20          |
| 132 kV, Four Circuit   | 4           |
| 132 kV, Double Circuit | 1842        |
| 132 kV, Single Circuit | 415         |
| 132 kV UG cable        | 50          |

|                        |          |
|------------------------|----------|
| Reactive Power Sources |          |
| Capacitors (BSC)       | 310 Mvar |

The Map of Sri Lanka Transmission System in Year 2017



as at 31st December, 2016

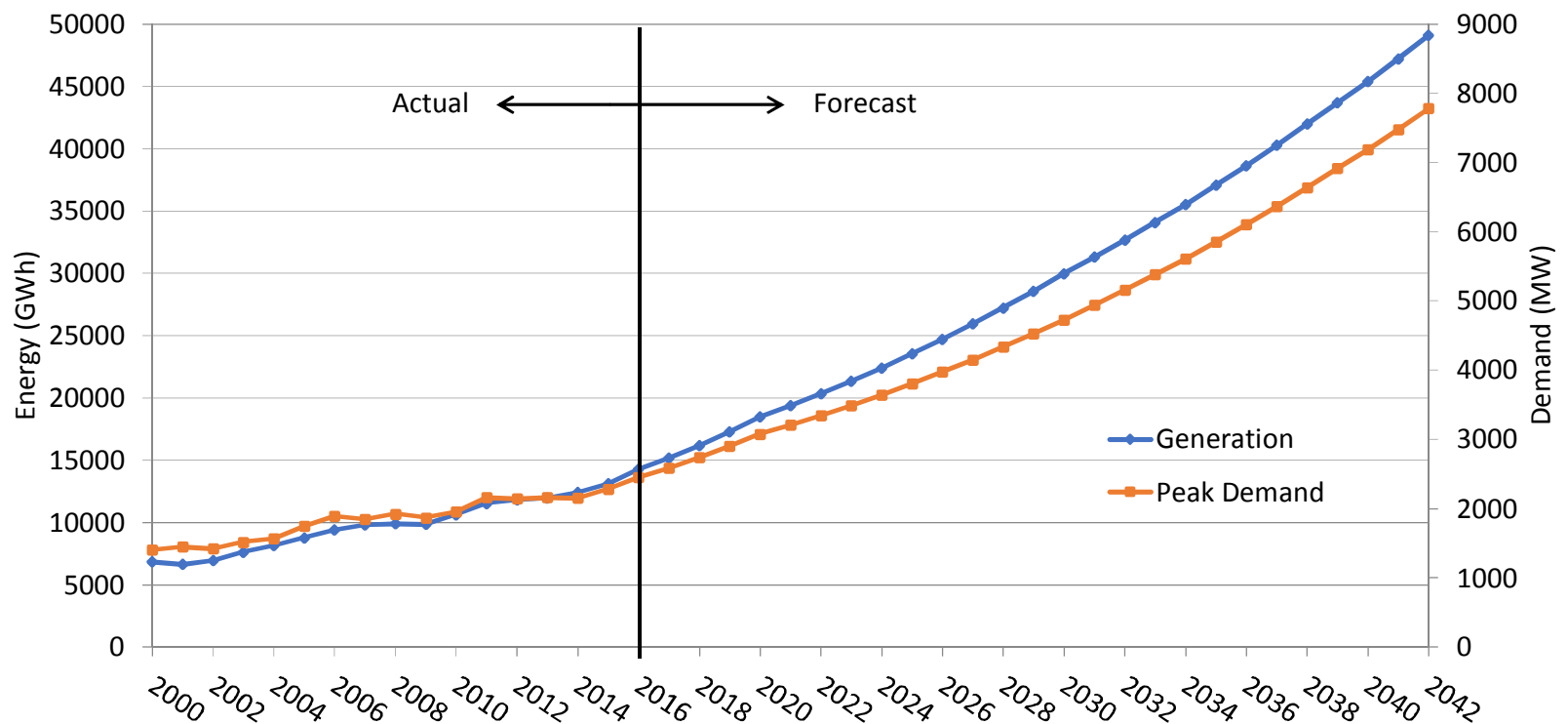


# Operation Criteria

- Frequency
  - Normal Condition : 50.5 to 49.5Hz ( $\pm 1\%$ )
  - Under Emergency : 52 to 47Hz
- Voltage
  - 220/132kV :  $\pm 10\%$
  - 33kV :  $\pm 2\%$
- Max. Dispatch Unit Size : 25% of Demand

# LONG TERM GENERATION EXPANSION PLAN 2018-2037

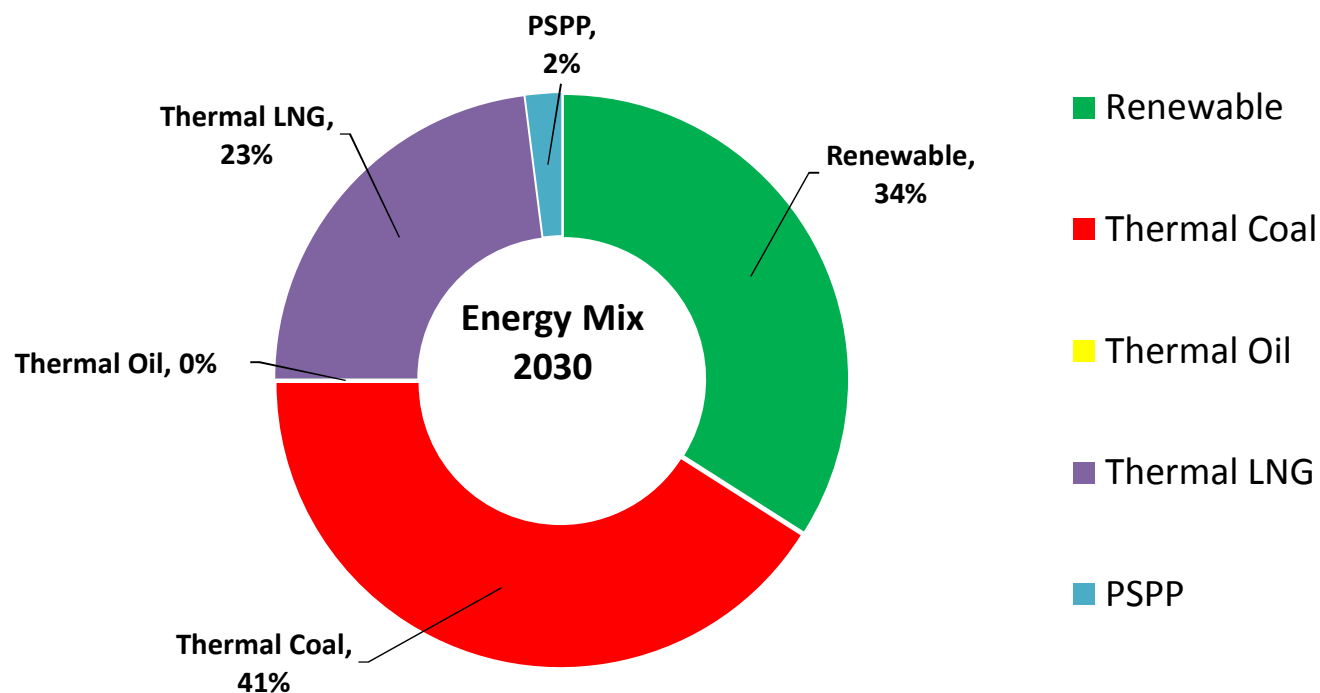
## Energy and Peak Demand – Actual/Forecast



# LONG TERM GENERATION EXPANSION PLAN 2018-2037

## Base Case Energy Mix by 2030

(Revised Base Case LTGEP 2018-2037 as per Oversight Committee on Energy)







# LONG TERM GENERATION EXPANSION PLAN 2018-2037

## Generation Planning Capacity Additions

During the planning horizon of next 20 years:

|                                                                            |                |
|----------------------------------------------------------------------------|----------------|
| <b>Thermal Based Power Plants<br/>(Coal/LNG/GTs/Reciprocating Engines)</b> | <b>4500 MW</b> |
|----------------------------------------------------------------------------|----------------|

|             |        |
|-------------|--------|
| Major Hydro | 240 MW |
|-------------|--------|

|              |        |
|--------------|--------|
| Pumped Hydro | 600 MW |
|--------------|--------|

|                                                                 |         |
|-----------------------------------------------------------------|---------|
| Other Renewable Energy (Wind, Solar,<br>Mini Hydro and Biomass) | 2800 MW |
|-----------------------------------------------------------------|---------|

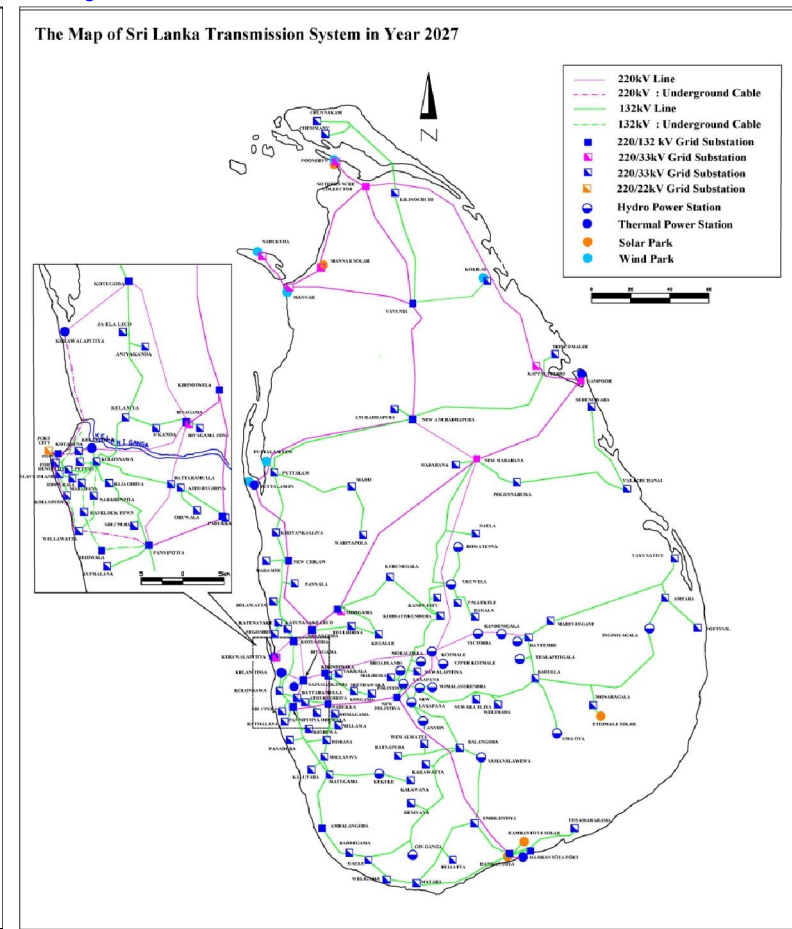
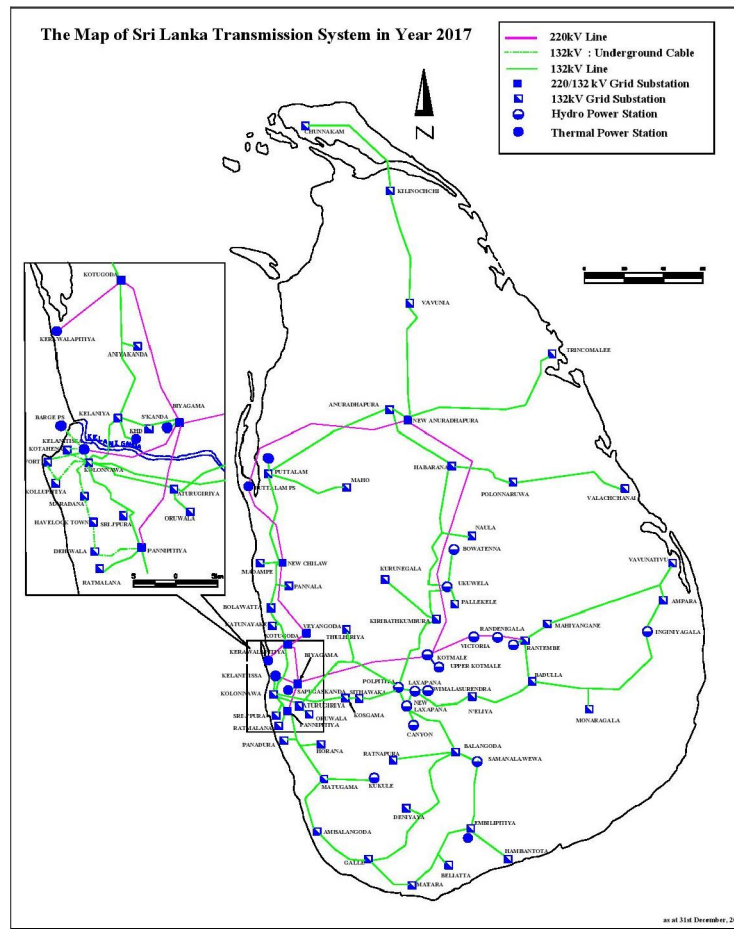
| Wind    | Solar   | Mini Hydro | Biomass |
|---------|---------|------------|---------|
| 1200 MW | 1300 MW | 220 MW     | 100 MW  |

# Transmission Network Improvement

2017



2027



# Future Options-conventional Generation

## HVDC Link Between Sri Lanka and India

- Technical and Economical feasibility studies are carried out between CEB and Power Grid India to interconnect two Networks by DC link.
- Project to be expedite as soon as the completion of the Feasibility Studies.





# HVDC Link Between Sri Lanka and India

## Background

Scope of work for feasibility study of the project was :

*2x500MW HVDC terminal stations each at Madurai-New (India) and Anuradhapura-New (Sri Lanka) along with HVDC bipole line: 360km*

- Overhead Line (India): Madurai (New) to Panaikulam: 130km
- Submarine Cable: Panaikulam (India) to Thirukketiswaram (SL): 120km
- Overhead Line (SL): Thirukketiswaram to Anuradhapura (New): 110km

The tentative costing of above option was estimated to be  
USD 1031 Million for conventional HVDC and  
USD 1110 Million for VSC based HVDC  
at Feb 2012 price level.





# HVDC Link Between Sri Lanka and India

Further, to reduce the cost of the interconnection, a revised route was considered with reduced length of the Submarine Cable (40km) with following scope:

*2x500MW HVDC terminal stations each at Madurai-New (India) and New Anuradhapura (Sri Lanka) alongwith HVDC bipole line: 370km*

- Overhead Line (India): Madurai (New) to near Dhanushkodi: 180km
- Submarine Cable: Dhanushkodi (India) to Talaimannar (SL): 40km
- Overhead Line (SL): Talaimannar to Anuradhapura (New): 150km

The tentative costing of revised option was estimated to be  
USD 515 Million for conventional HVDC and  
USD 564 Million for VSC based HVDC  
at Apr 2016 price level.



# HVDC Link Between Sri Lanka and India





# HVDC Link Between Sri Lanka and India

## Current Status

- Studies are carrying out for following Three Options

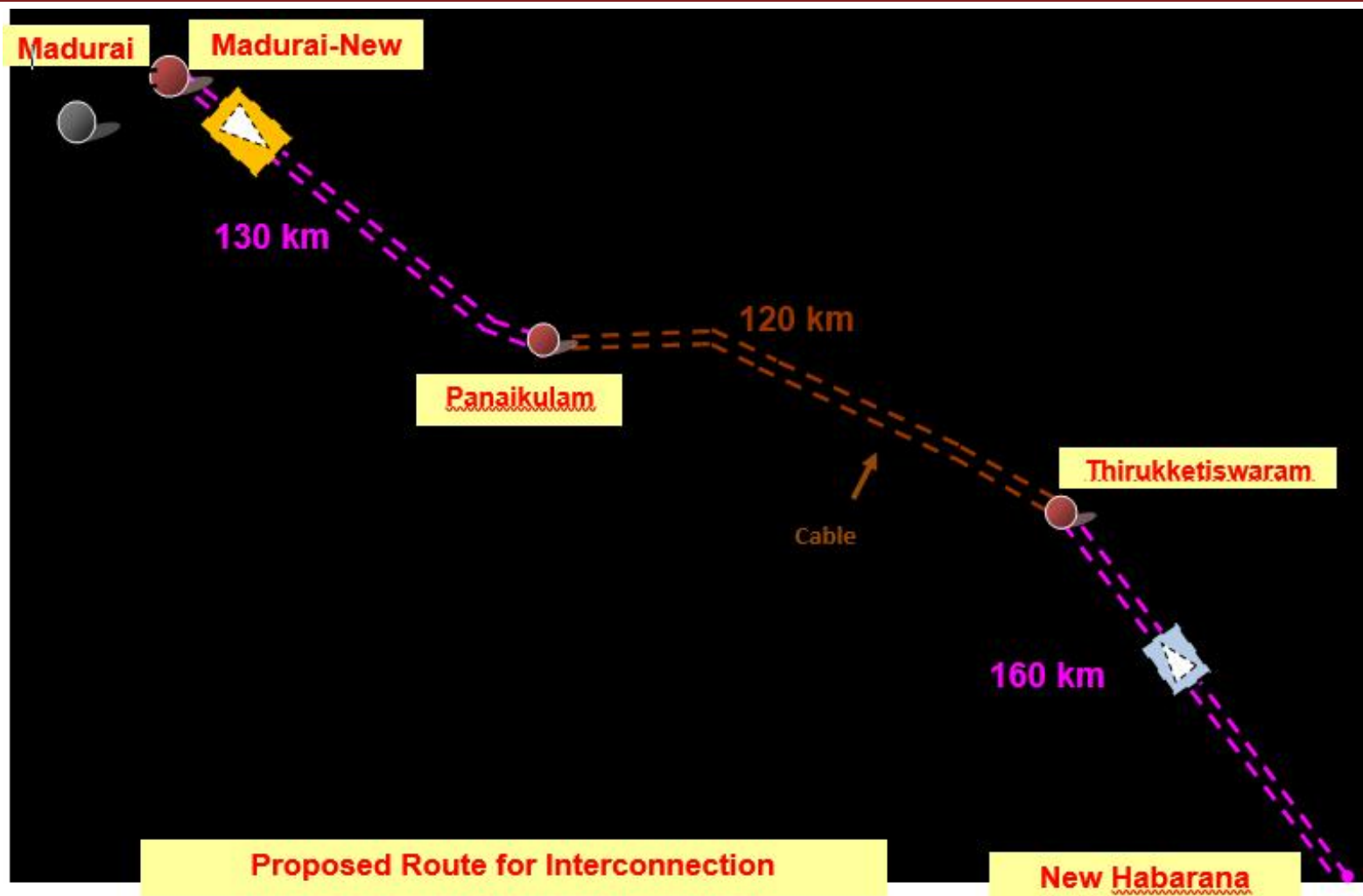
### ***Option 1:***

*2x500MW HVDC terminal stations each at Madurai-New (India) and New Habarana (Sri Lanka) along with HVDC bipole line: 410km*

- 1. Overhead Line (India): Madurai(New)\* to Panaikulam: 130km*
- 2. Submarine Cable: Panaikulam (India) to Thirukketiswaram (SL): 120km*
- 3. Overhead Line (SL): Thirukketiswaram to New Habarana: 160km*



# HVDC Link Between Sri Lanka and India





# HVDC Link Between Sri Lanka and India

## Current Status

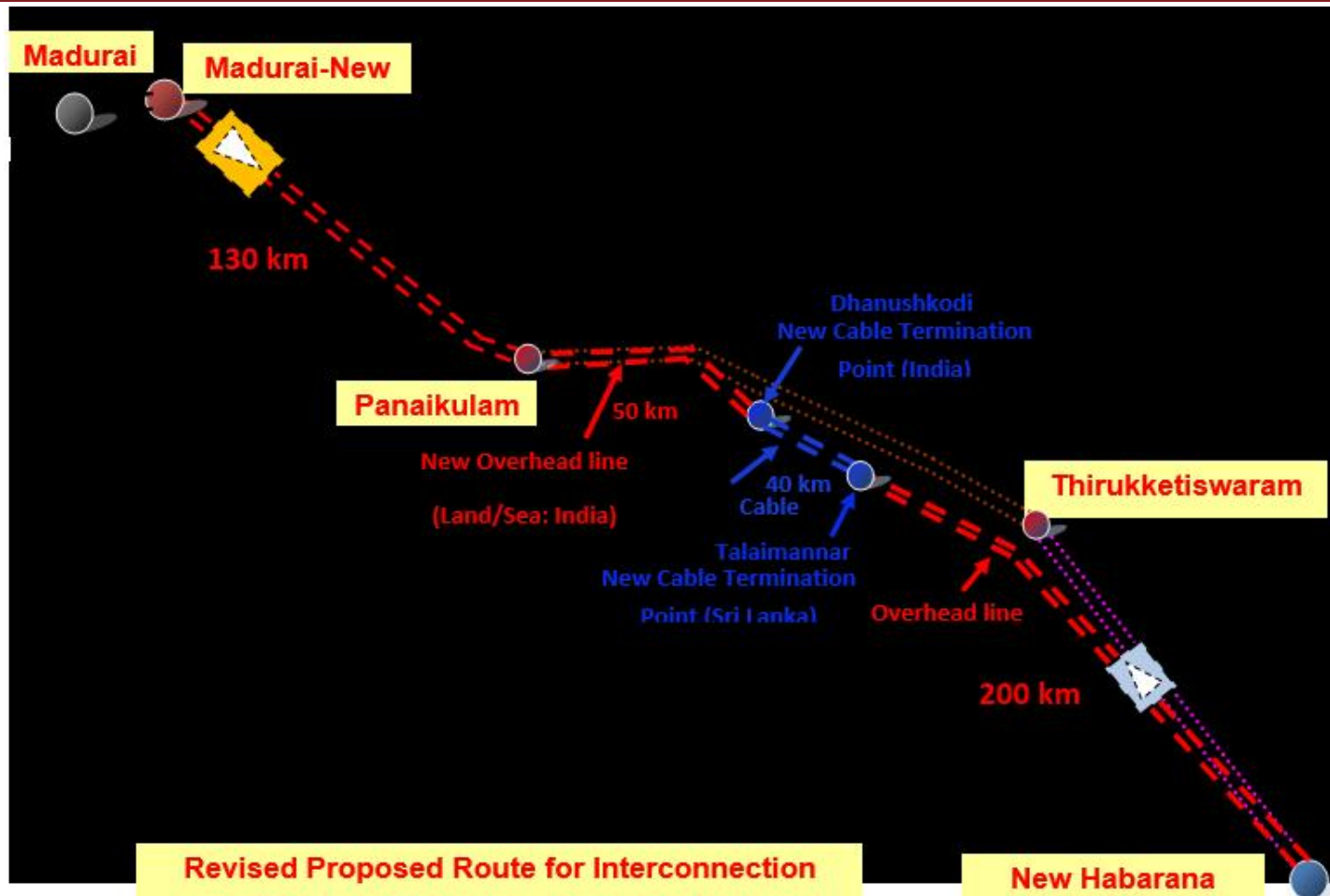
### ***Option2:***

*2x500MW HVDC terminal stations each at Madurai-New (India) and New Habarana (Sri Lanka) along with HVDC bipole line: 420km*

- 1. Overhead Line (India): Madurai (New)\* to near Dhanushkodi: 180km*
- 2. Submarine Cable: Dhanushkodi (India) to Talaimannar (SL): 40km*
- 3. Overhead Line (SL): Talaimannar to New Habarana: 200km*



# HVDC Link Between Sri Lanka and India







# HVDC Link Between Sri Lanka and India

## Current Status

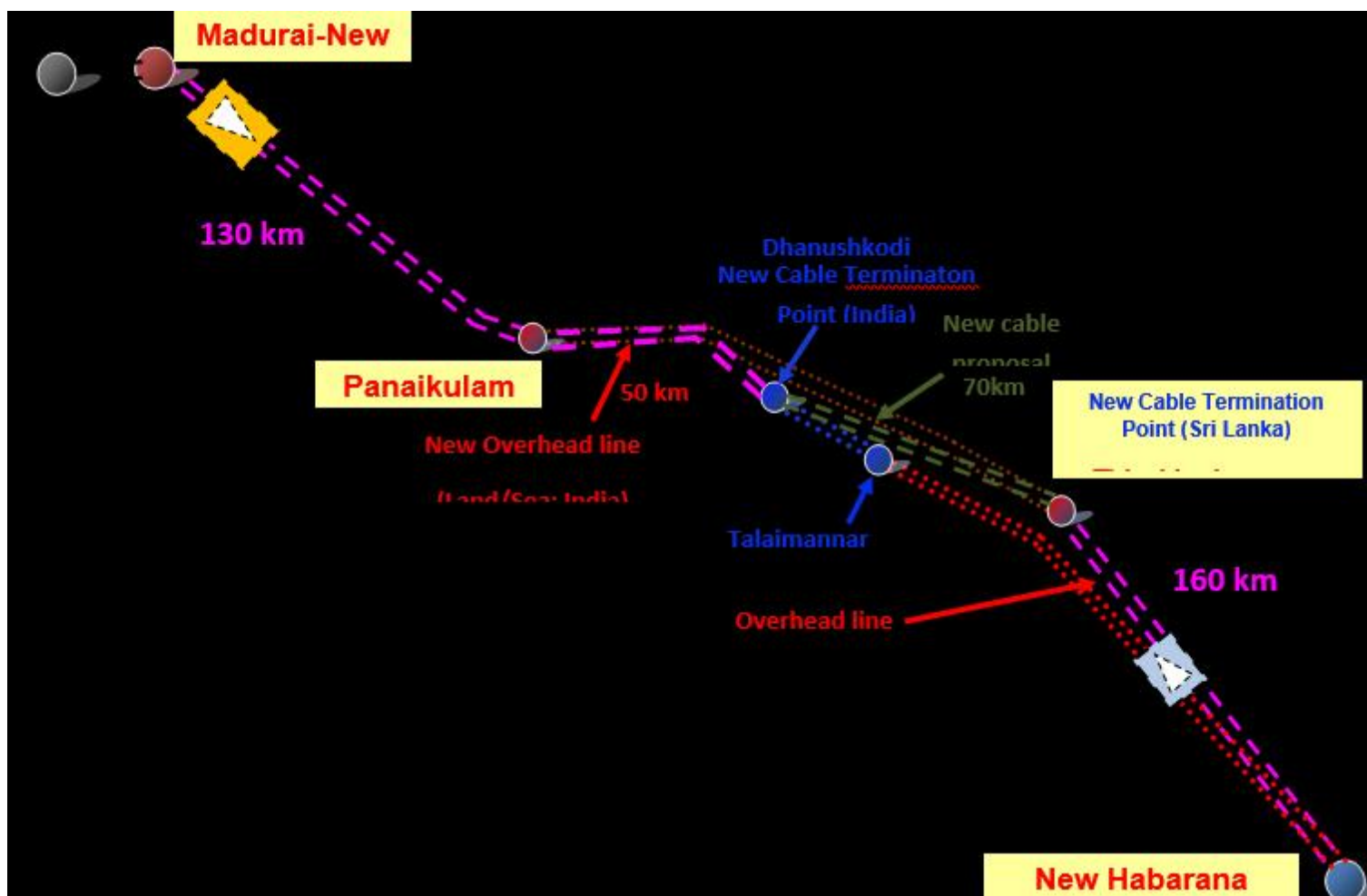
### ***Option 3:***

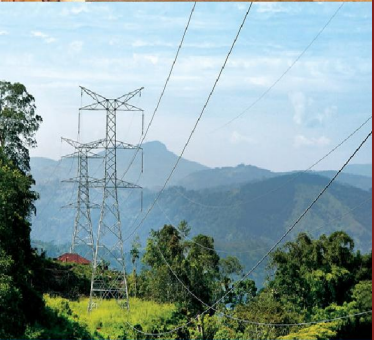
*2x500MW HVDC terminal stations each at Madurai-New (India) and Thirukketiswaram (Sri Lanka) along with HVDC bipole line: 410km (Map at Exhibit-4)*

- 1. Overhead Line (India): Madurai(New)\* to near Dhanushkodi: 180km*
- 2. Submarine Cable: Dhanushkodi (India) to Thirukketiswaram (SL): 70km*
- 3. Overhead Line (SL): Thirukketiswaram to New Habarana: 160km*



# HVDC Link Between Sri Lanka and India





Thank You..!