First Meeting of Task Force 2 on Advance Transmission System Interconnections

21-22 August 2013
Thimpu, Bhutan

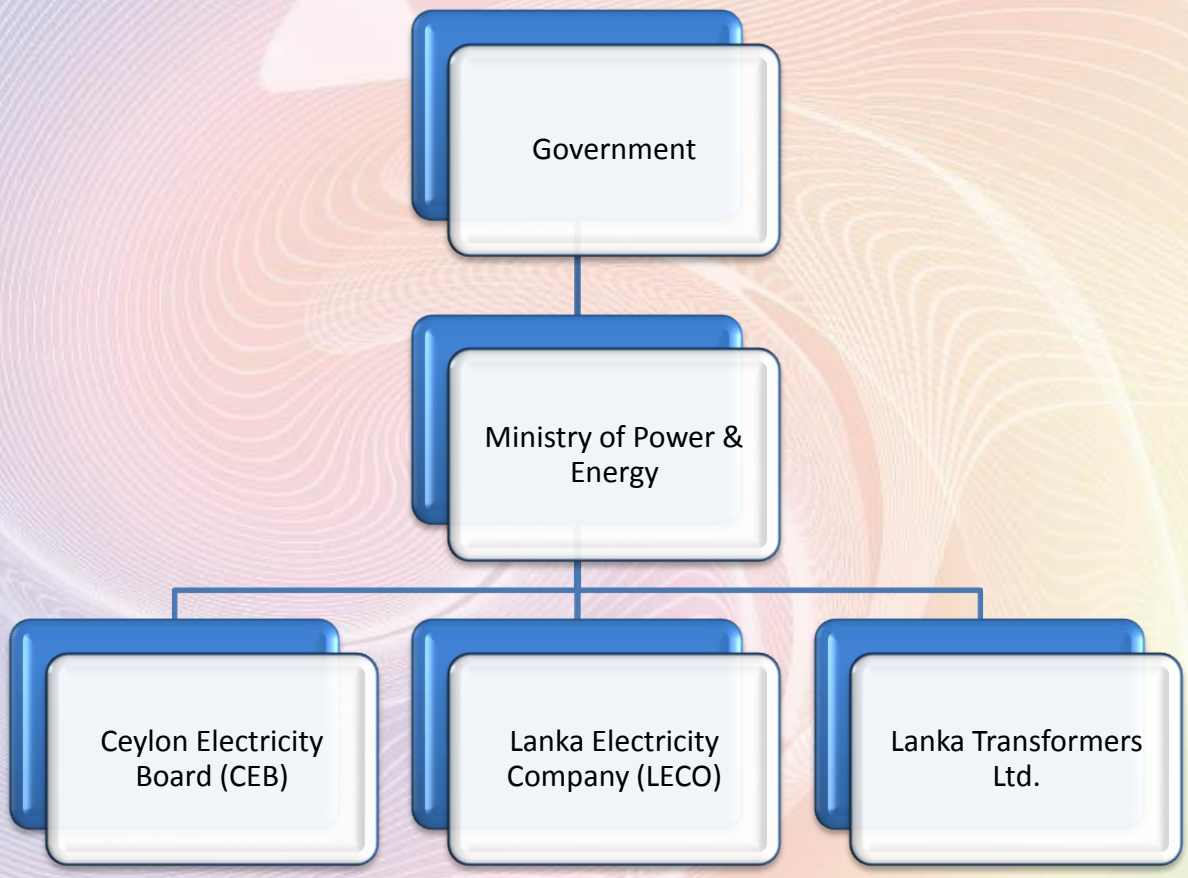
K.L.R.C.Wijayasinghe
Deputy Director
Ministry of Power and Energy
Sri Lanka

Sri Lanka

- Population : 20 million
- Area : 65610 sq km
- Population density : 326 persons/sq km
- Per capita GDP : 2267 US$
- GDP growth rate : 8.4%
- Literacy rate : 91.3%
- Life expectancy : 70 yrs (M), 78 yrs (F)

Overview of Energy Sector

- Hydro, Wind, Biomass, Solar - only indigenous resources
- No proven oil, gas or coal resources
- Large hydro resources developed to a great extent


Government
Ministry of Power & Energy
Ceylon Electricity Board (CEB)
Lanka Electricity Company (LECO)
Lanka Transformers Ltd.

Electricity Sector Data

- Installed capacity - 2900 MW
- Peak Demand - 2163 MW
- Energy Generated - 10714 GWh
- Energy Mix - Hydro 42%
  - Thermal 57%
- Demand growth - 6.5%
- System losses - 13.5%
- Load Factor - 62%
- Access to Electricity - 92%
- Per Capita Elec. Consumption - 449 kWh

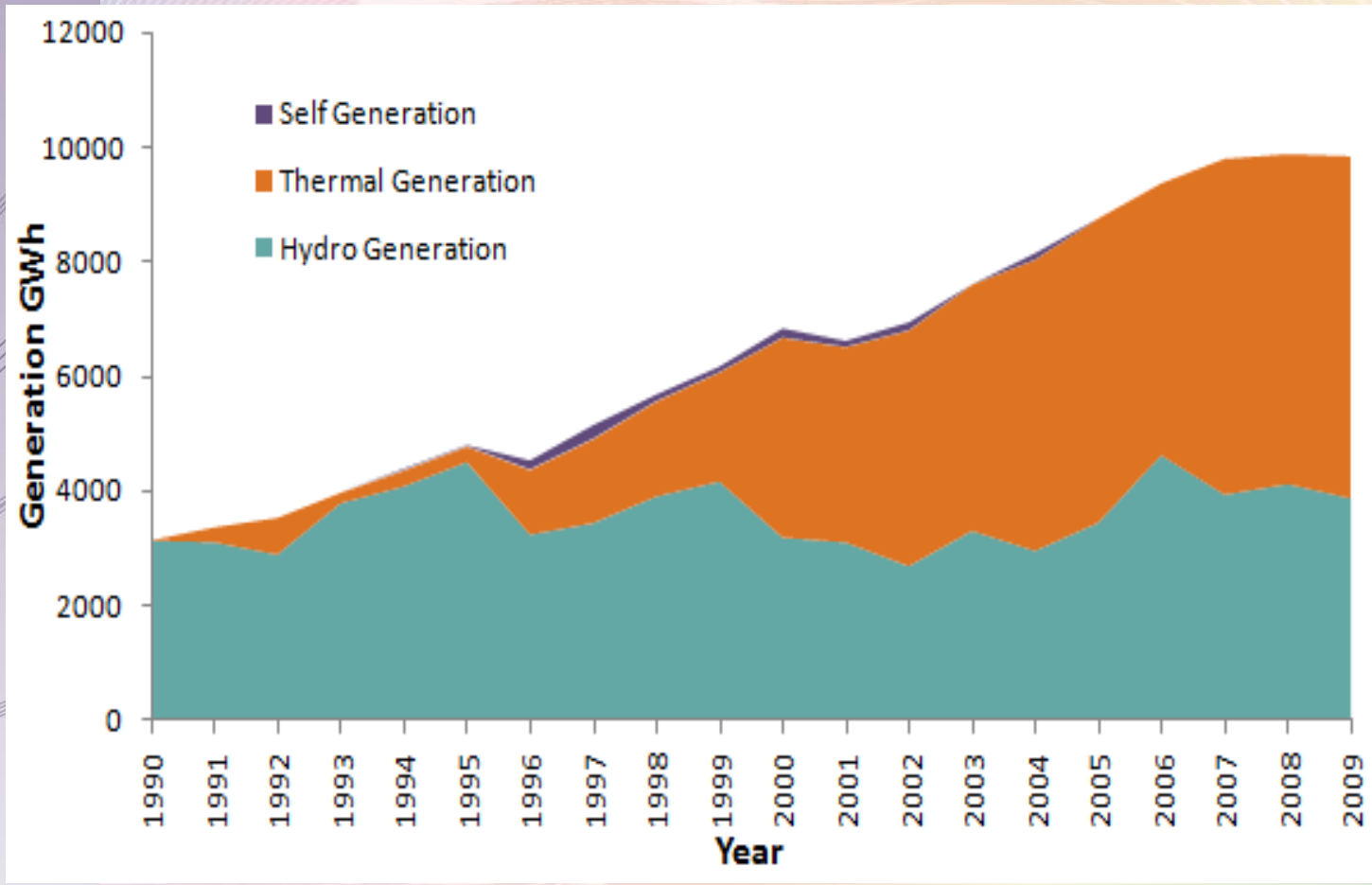
Capacity of the Power System

- Hydro 1205 MW
- Thermal 1695 MW

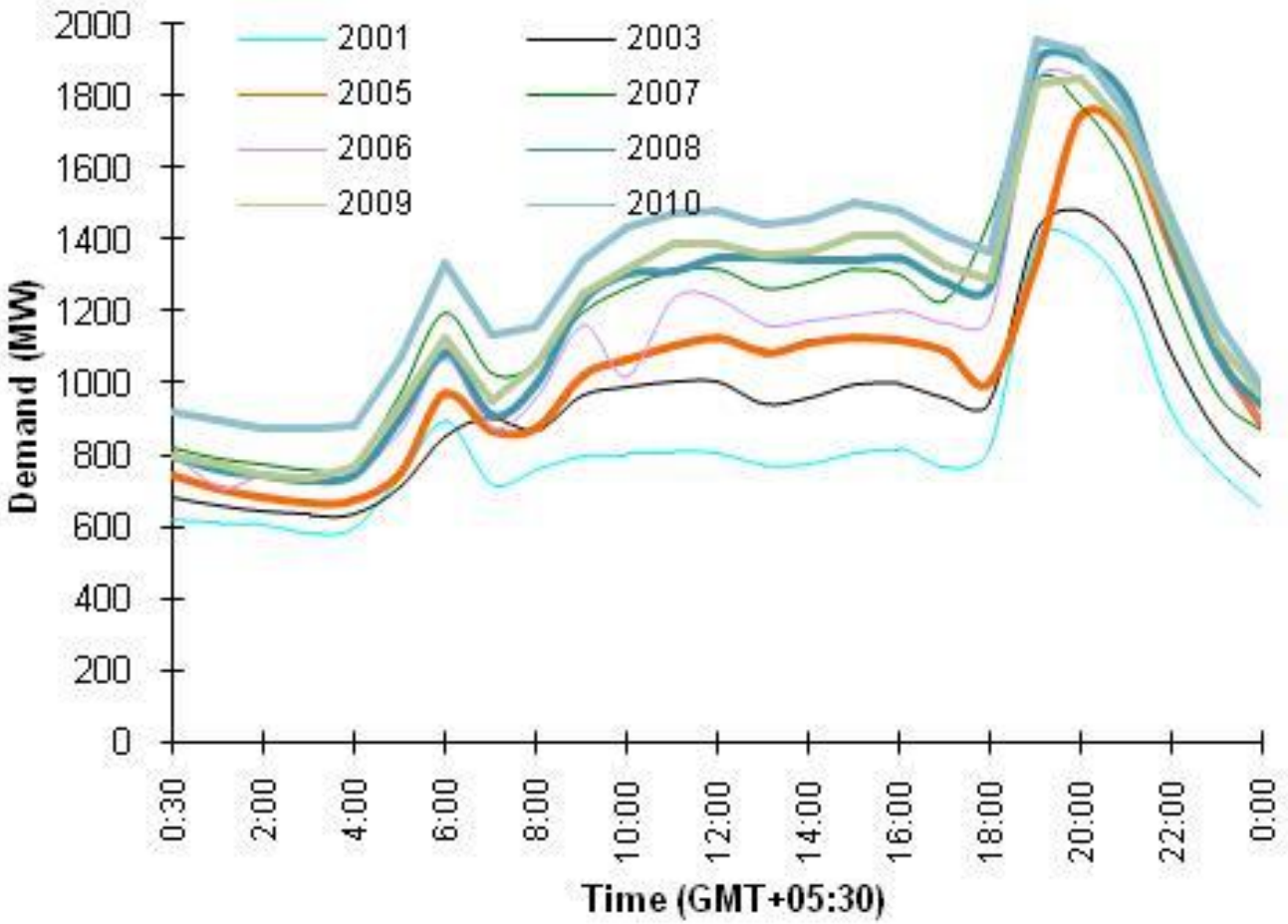
  (CEB :845, IPP: 850)
- Non Conventional Renewable Energy : 225 MW

  (approx Mini hydro 185MW, Bio mass 10MW, wind 30MW)

Hydro Thermal Share



Daily Load Curve



Generation Expansion Plan

YEAR	RENEWABLE ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
2011	-	*1x315 MW Puttalam Coal (Stage 1)*	-
2012	*150 MW Upper Kotmale*	75 MW Gas Turbine	20 MW ACE Power Matara
2013	-	*24MW Northern Power* **35 MW Gas Turbine**	20 MW ACE Power Horana 22.5 MW Lakdanavi
2014	-	*2x315 MW Puttalam Coal (Stage II)*	85 MW Kelanitissa Gas Turbines
2015	*35 MW Broadlands* *120 MW Uma Oya* **49 MW Gin Ganga**	-	100MW ACE Power Embilipitiya 100 MW Heladanavi 60 MW Colombo Power
2016	-	-	-
2017	-	**2x250 MW Trinco Coal Power**	-
2018	-	-	51MW Asia Power 20 MW Northern Power
2019	-	**1x250 MW Trinco Coal Power**	72 MW Sapugaskanda Diesel
2020	-	**1x250 MW Trinco Coal Power**	-

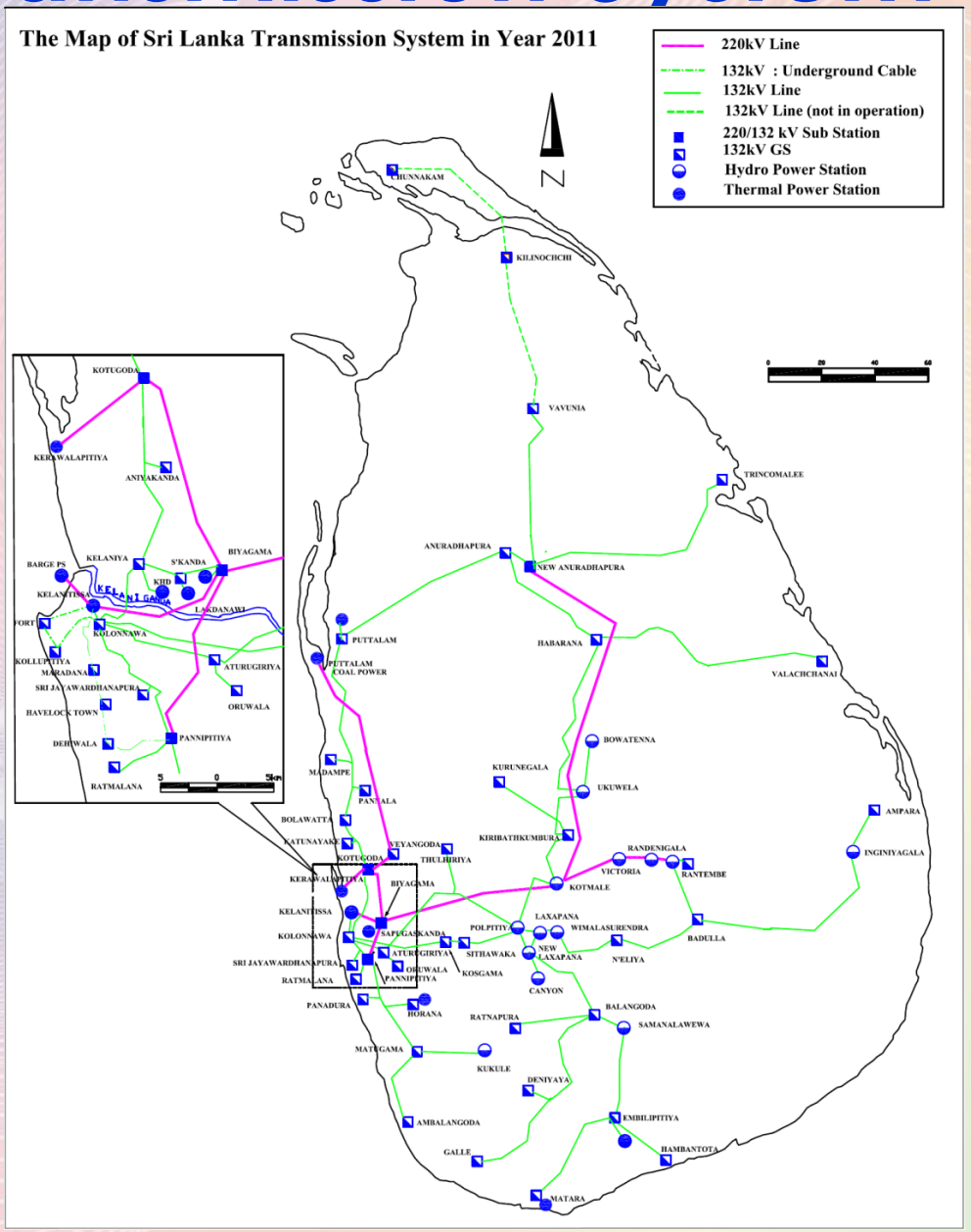
Present Transmission Network

- Transmission voltage levels
  - 132kV
  - 220kV

- Transmission Lines
  - 220kV 350 km
  - 132kV 1765 km

Grid Substations	No.	MVA
132/33 kV	43	2793
220/132/33 kV	5	2100
220/132 kV	1	105
132/11kV	4	306

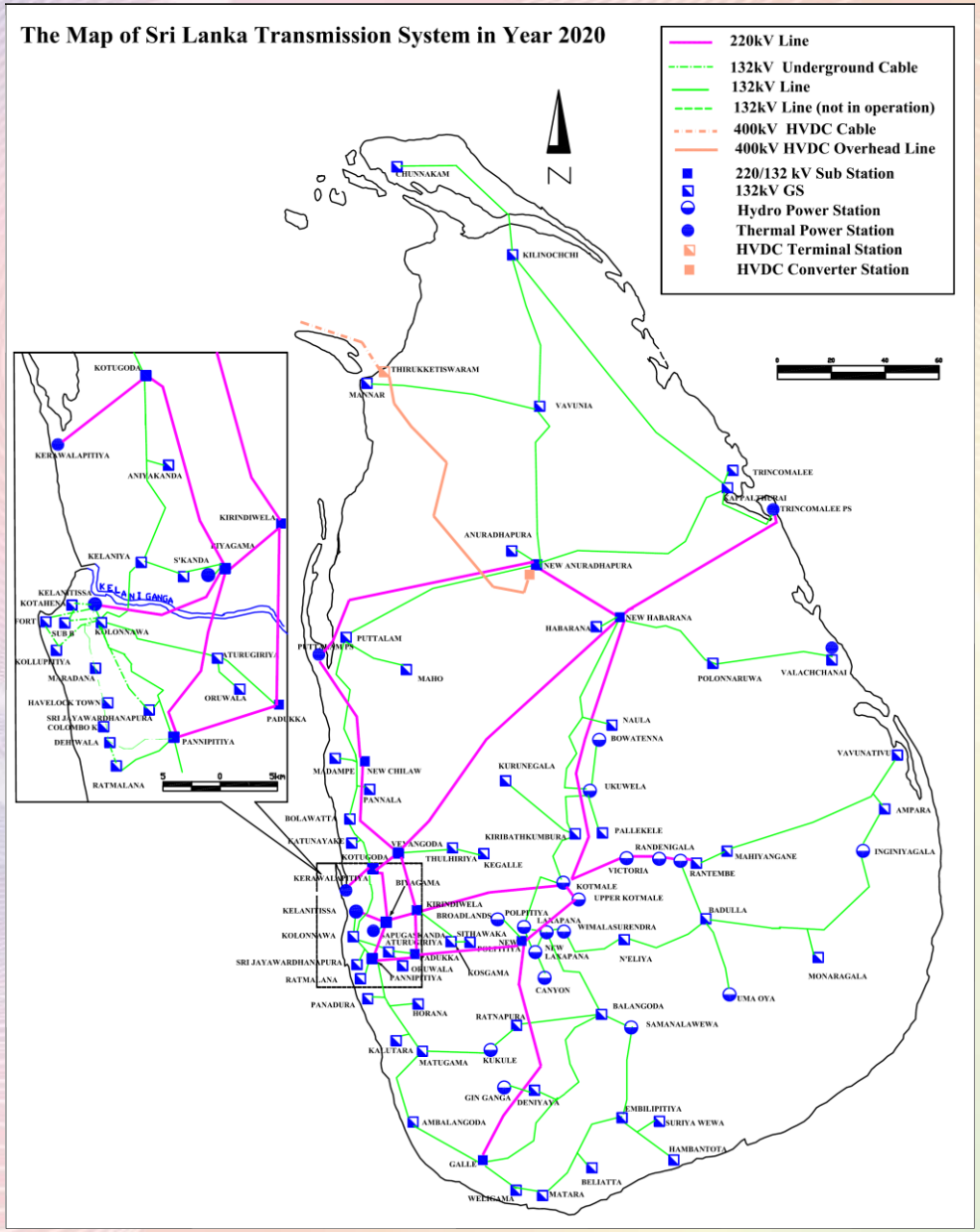
Present Transmission System



TRANSMISSION EXPANSION PLANNED UPTO 2020

Grid Substation	No./Capacity
132/33 kV	64/4839
220/132/33 kV	7/3050/710
220/33 kV	2/140
132/11 kV	7/526
220/132 kV	7/3210
Transmission Lines	Route Length (km)
220 kV	1097
132 kV	2550
Reactive Power	MVAr
Capacitors	

Sri Lanka Transmission System - 2020



TRANSMISSION PLANNING CODE

- Issued by Public Utilities Commission of Sri Lanka (PUCSL)
- Implements by Ceylon Electricity Board (Transmission Licensee)
- Investments approves by PUCSL with policy directions of Government

CROSS BORDER INTERCONNECTION LINKS PLANNED

Electricity Exchange Between India and Sri Lanka

- The transmission system between India and Sri Lanka will involve a submarine cable as the Indian Ocean separates India and Sri Lanka. This interconnection would be different from any other electricity interconnections planned in the South Asia Region.

- Asynchronous type ie HVDC interconnection is considered to be the best option for the interconnection of two grids.

History

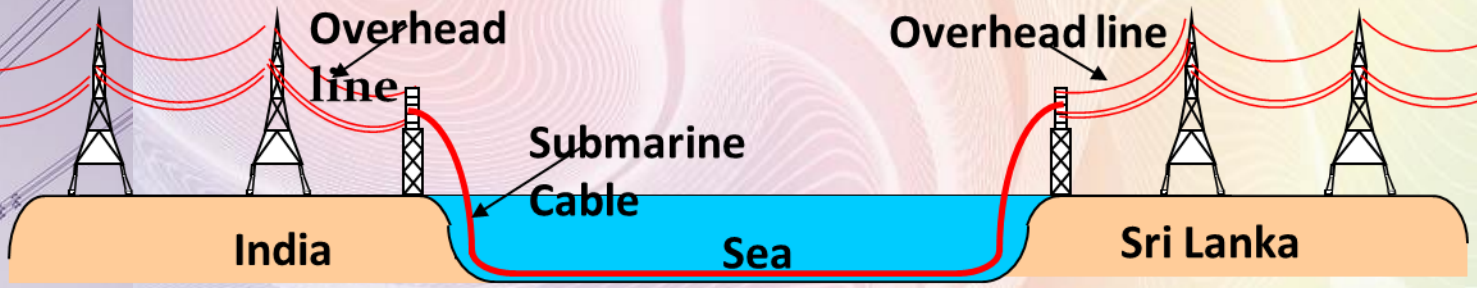
- Under consideration since mid 1970's
- Pre-feasibility study conducted with the assistance of USAID in 2002 by Nexant Inc.
- Review of the Pre-feasibility study with assistance of USAID in 2006 by Nexant/ Power Grid Corporation of India
- Considered under SAARC and BIMSTEC Regional Grid
- Feasibility Study is presently being conducted
  - ✓ A MOU on Feasibility Study was signed among GOSL, GOI, CEB and Power Grid Corporation of India Limited (PGCIL) on 9th June 2010.
  - ✓ Executing Agencies; CEB and PGCIL are jointly carrying out the feasibility study

Proposed Interconnection Option

± 400kV HVDC line from Madurai to Anuradhapura

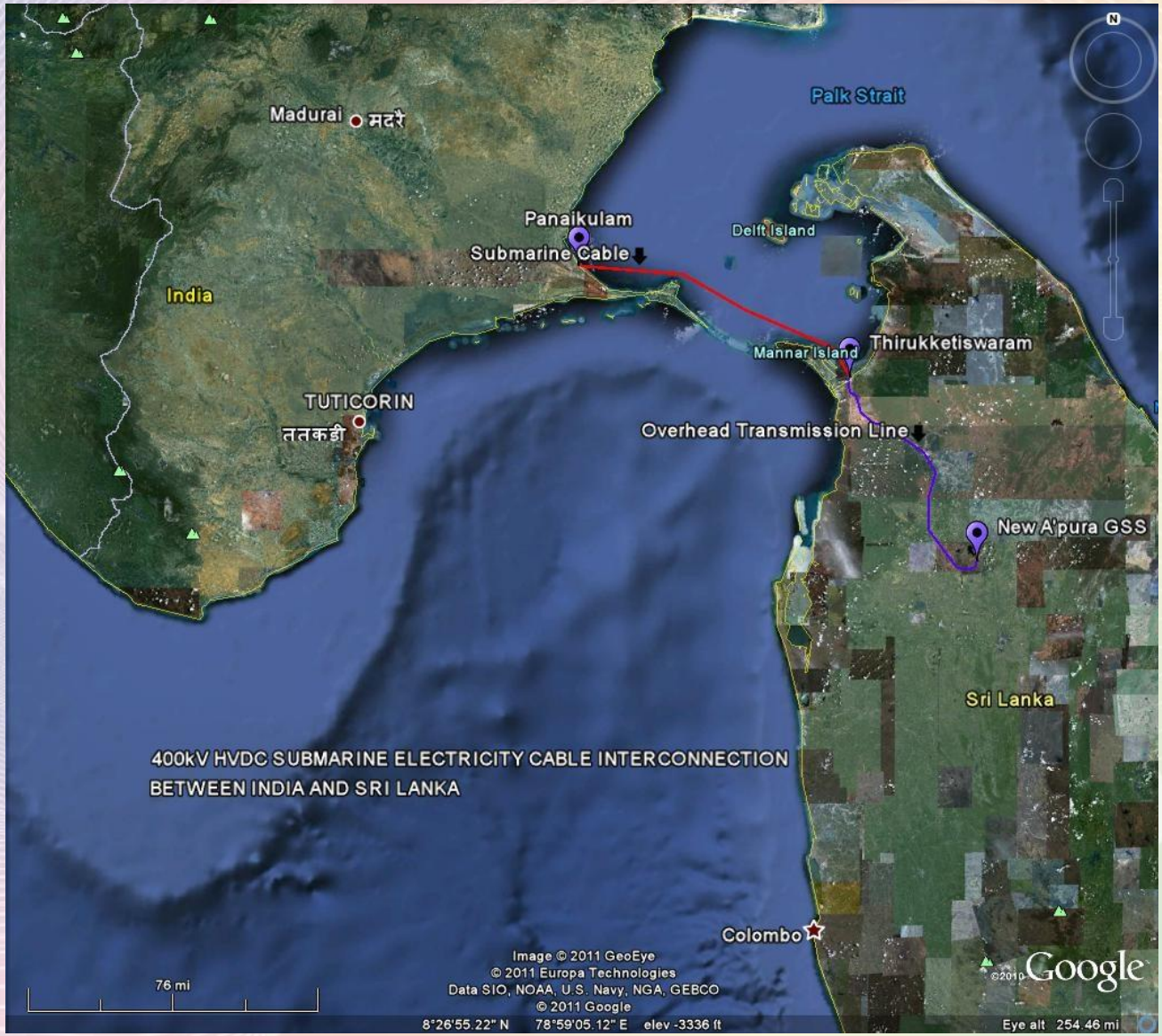
- **Part-I (Land Route - Indian Territory)**
  - Madurai to Indian Sea Coast Pannaikulam HVDC overhead line 150km
  - HVDC Terminal at Madurai
- **Part-II (Sea Route)**
  - India Sea Coast Pannaikulam to Sri Lankan Sea coast Thirukketiswaram, Mannar HVDC Submarine Cable 120km
- **Part-III (Land Route - Sri Lankan Territory)**
  - Sri Lankan Sea Coast Mannar to Anuradhapura HVDC overhead line 110km
  - HVDC Terminal at Anuradhapura

Proposed Interconnection Option

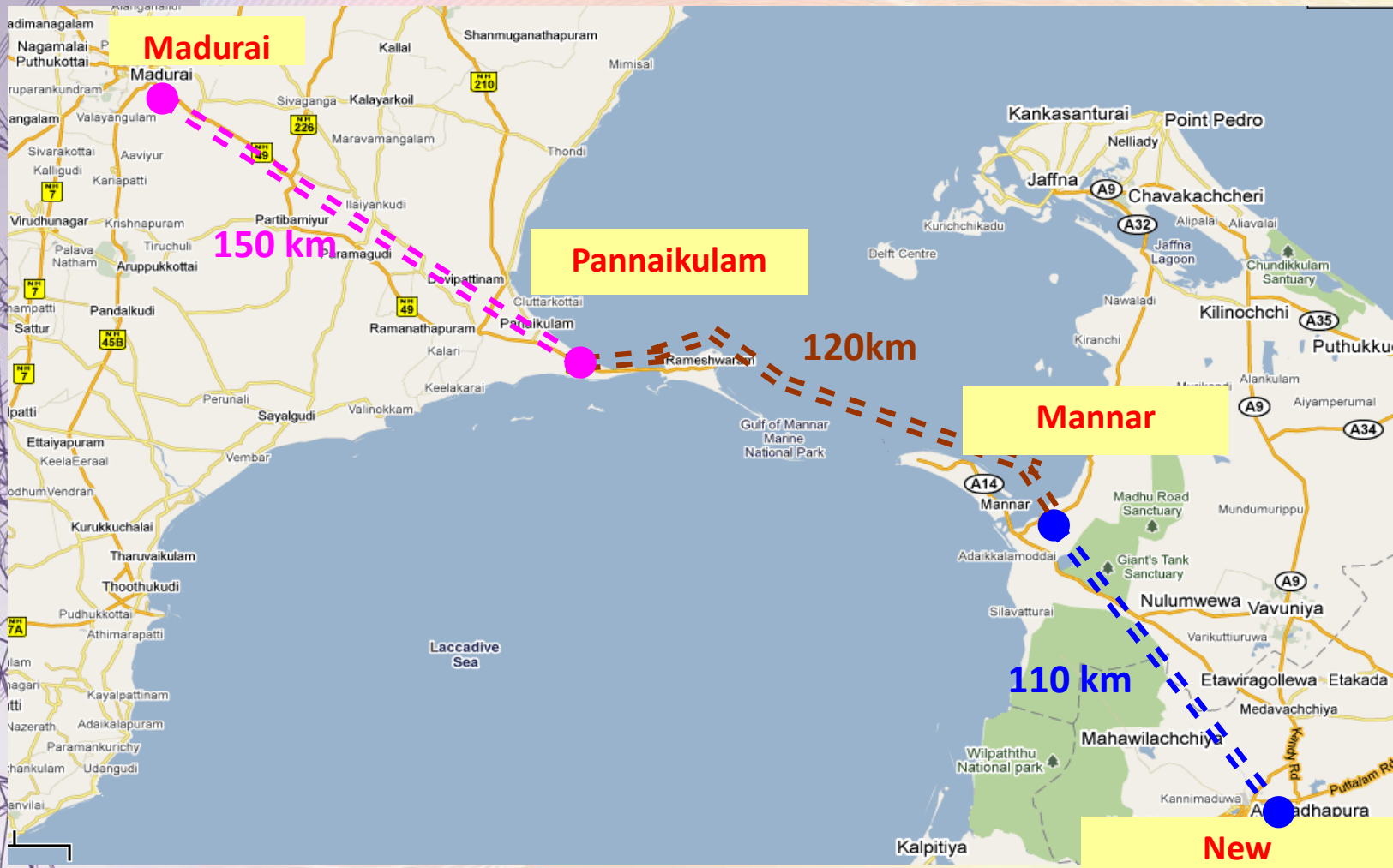


Transmission System in Submarine Cable

Interconnection option



Proposed Electricity Grid Interconnection



Envisaged Operation Issues for Cross-Border Electricity Trade in Sri Lanka

1. HVDC Technology is new to Sri Lanka - Operation and maintenance of 400kV HVDC interconnection is challenging
2. Marine cable is involved - unique feature in interconnections of South Asia Region
3. Differences in Laws and Regulations in the respective countries
4. Security of power supply
5. Tariff

Legal and Regulatory Issues

- CEB needs to be empowered to enter into cross-border power transfers
- The Transmission and Bulk Supply license held by CEB is required to be amended
- Dispute resolution in the Sri Lanka Electricity Act requires to be further strengthened
- CEB Act has to be amended to enable the functions of trader or broker, as relevant

POWER EXPORT/IMPORT - PLANNED

Studies for 2020 - Importing Option

- **Importing of 500 MW to Sri Lanka**
  - ✓ **Four scenarios**
    - I. Thermal Maximum Night Peak (TMNP)
    - II. Hydro Maximum Night Peak (HMNP)
    - III. Thermal Maximum Day Peak (TMDP)
    - IV. Hydro Maximum Night Peak (HMDP)

- **Importing of 1000 MW to Sri Lanka**
  - ✓ **Two scenarios**
    - I. Thermal Maximum Night Peak (TMNP)
    - II. Hydro Maximum Night Peak (HMNP)

Studies for 2020 - Exporting Option

- **Exporting of 500 MW to India**
  - ✓ **One scenario**
    1. **Off Peak loading condition (OP)**
- **Exporting of 1000 MW to India**
  - ✓ **One scenario**
    1. **Off Peak loading condition (OP)**

LAND ACQUISITION AND RIGHT OF WAY

Land Acquisition Act and Sri Lanka Electricity Act passed by the Parliament provide necessary provisions for acquisitions of lands and right of way transmission lines

Thanks