



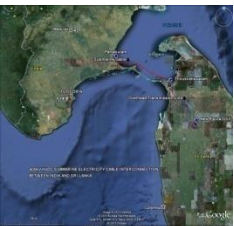
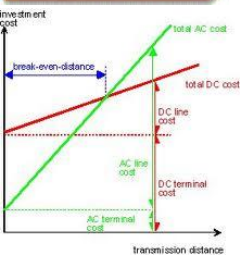
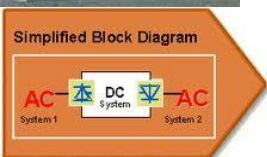
# Status of Sri Lanka Cross Border Interconnection with India & Expected Benefits



South Asia Regional Workshop on  
Competitive Electricity Markets

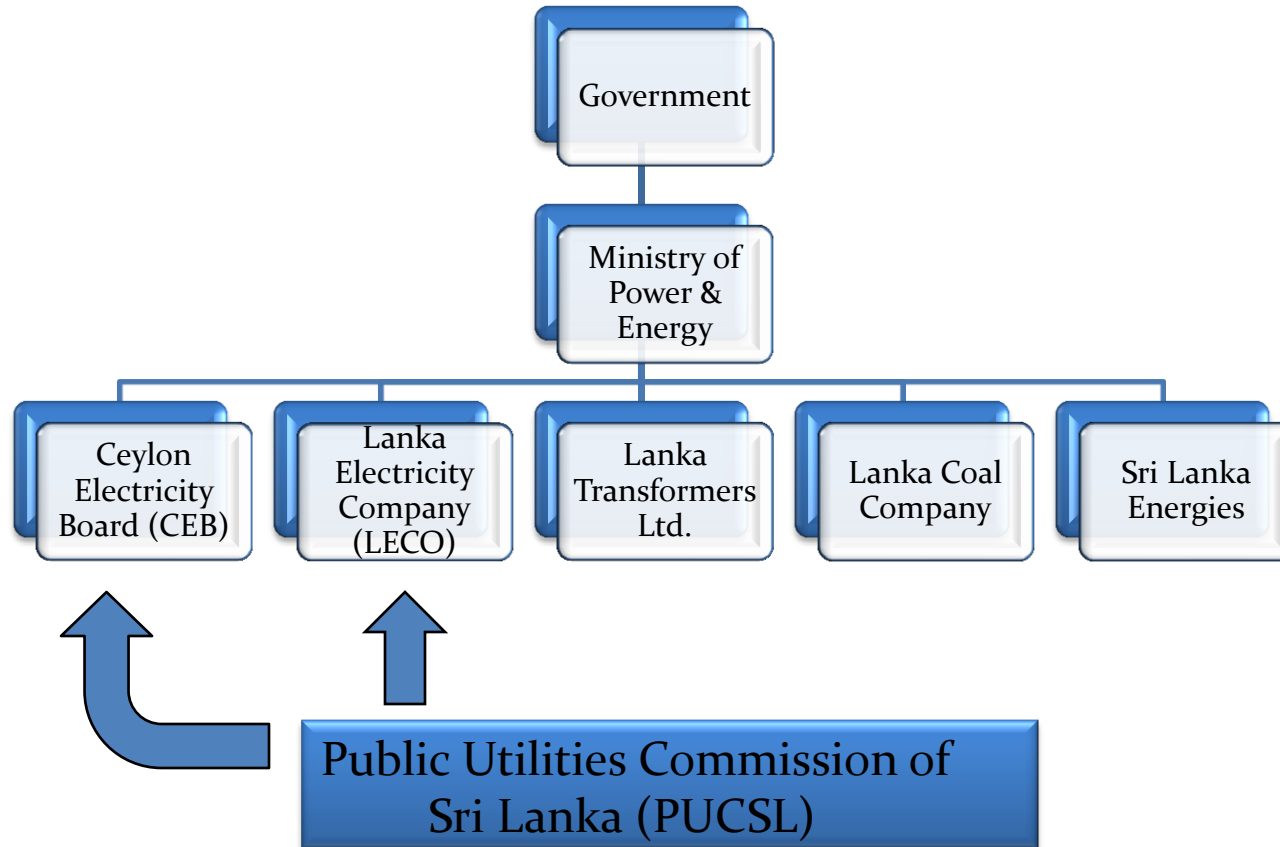
March 19, 2014

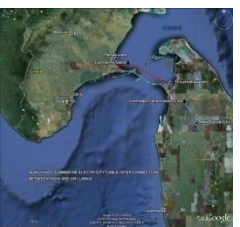
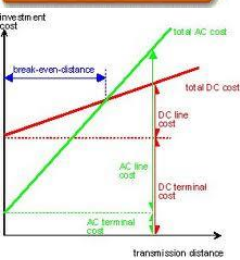
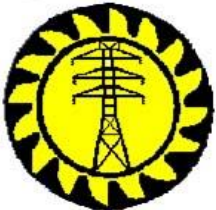
Colombo



**Kamani Jayasekera**  
**Deputy General Manager**  
**(Transmission & Generation Planning)**  
**Ceylon Electricity Board**  
**Sri Lanka**

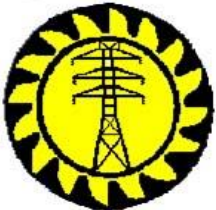
# Structure of the Sri Lankan Power Sector





# Overview of Energy Sector

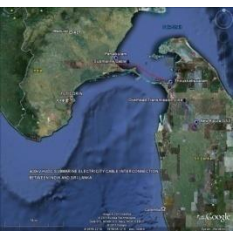
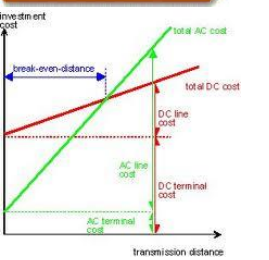
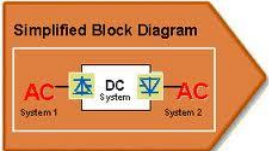
- Hydro, Wind, Biomass, Solar - indigenous resources
- Large hydro resources developed
- Gas reserve indications positive
- No proven oil or coal resources



# Electricity Data for 2012



- Installed capacity - 3334 MW
- Peak Demand - 2146 MW
- Electricity Generated - 11800 GWh
- Generation Mix - Hydro 28% Thermal 72%
- Capacity Mix - Hydro 46% Thermal 54%
- System losses - 11%
- Load Factor - 62.8%
- Access to Electricity - 94%
- Elec. Consumption per Capita - 515 kWh
- Avg. Cost per unit (at selling point) - 22.13 Rs/kWh
- Avg. selling price - 15.56 Rs/kWh



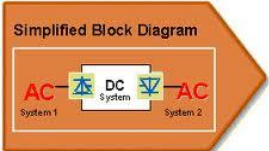


# Capacity of the Power System

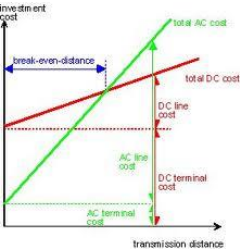
- Hydro 1355 MW
- Thermal 1590 MW



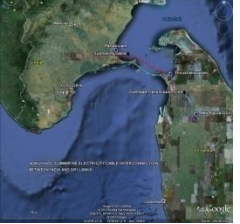
CEB - 828 MW - Coal fired steam 300MW  
Diesel fired CCY 165MW  
Diesel fired GT 195MW  
HO fired diesel engines 168MW



IPP - 762 MW - Diesel fired CCY 163MW  
FO fired CCY 270MW  
HO fired diesel engines 329MW

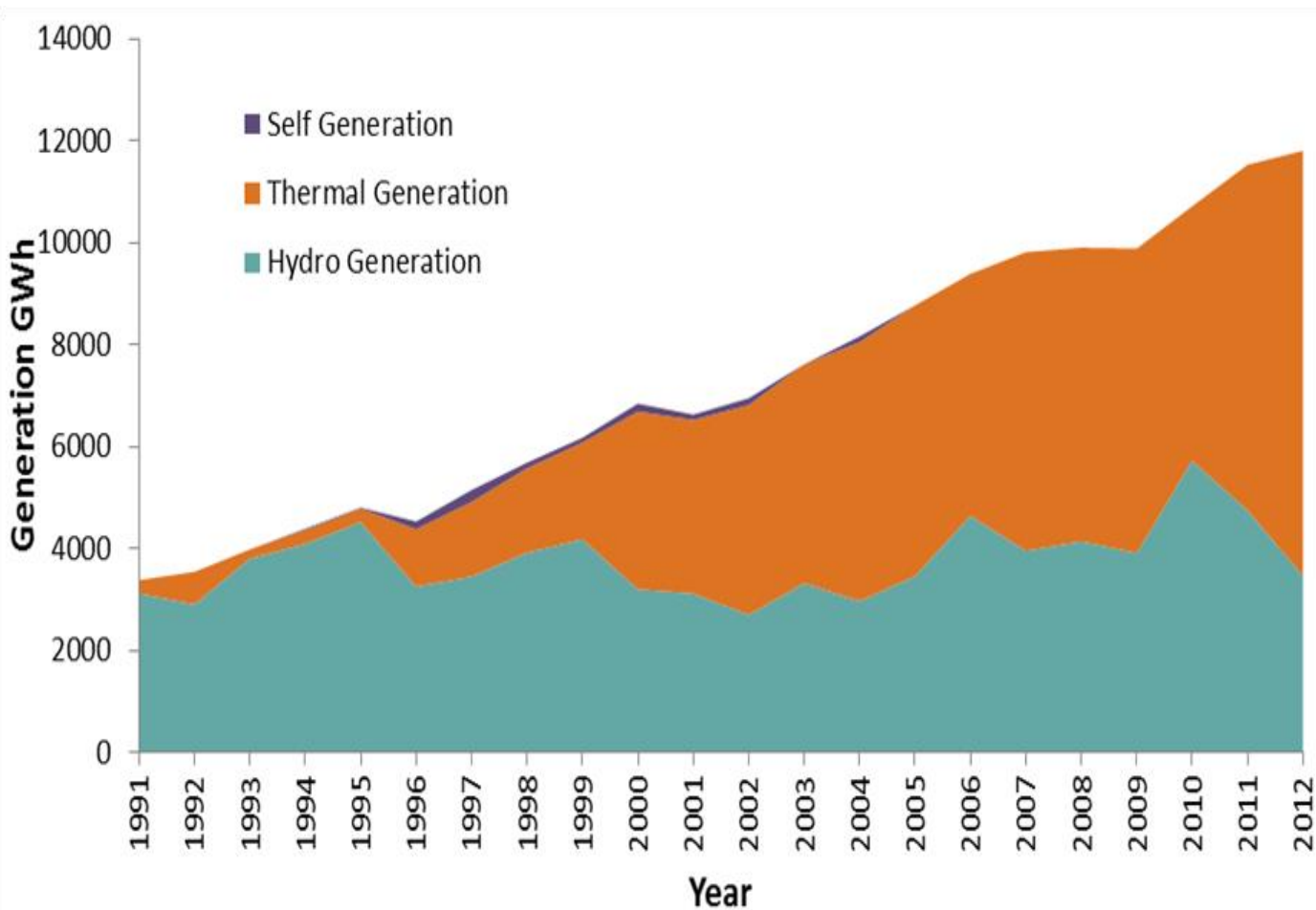
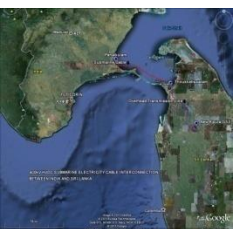
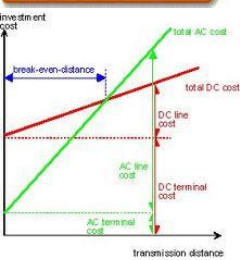
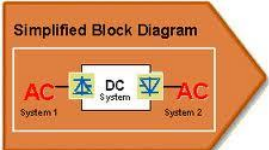


- Non Conventional Renewable Energy - 388 MW  
(Approx. Mini hydro 277MW, Bio mass 18.5MW, Wind 91.5MW, Solar 1.5MW)



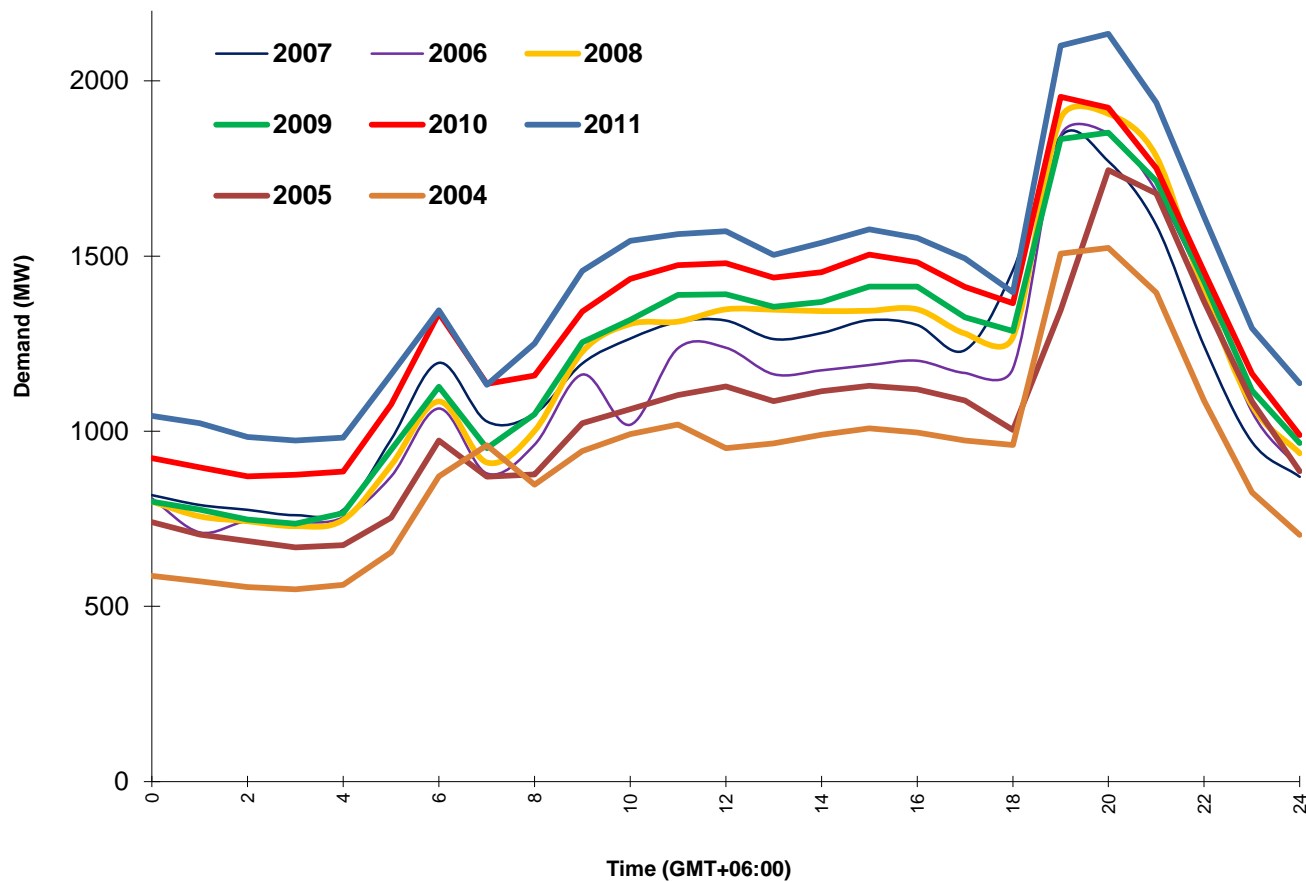
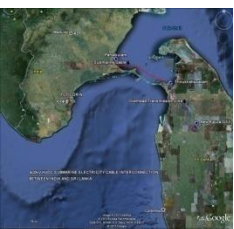
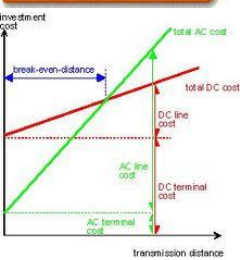
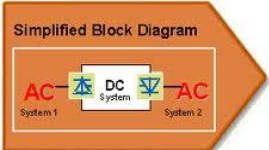


# Hydro Thermal Share





# Load Curve





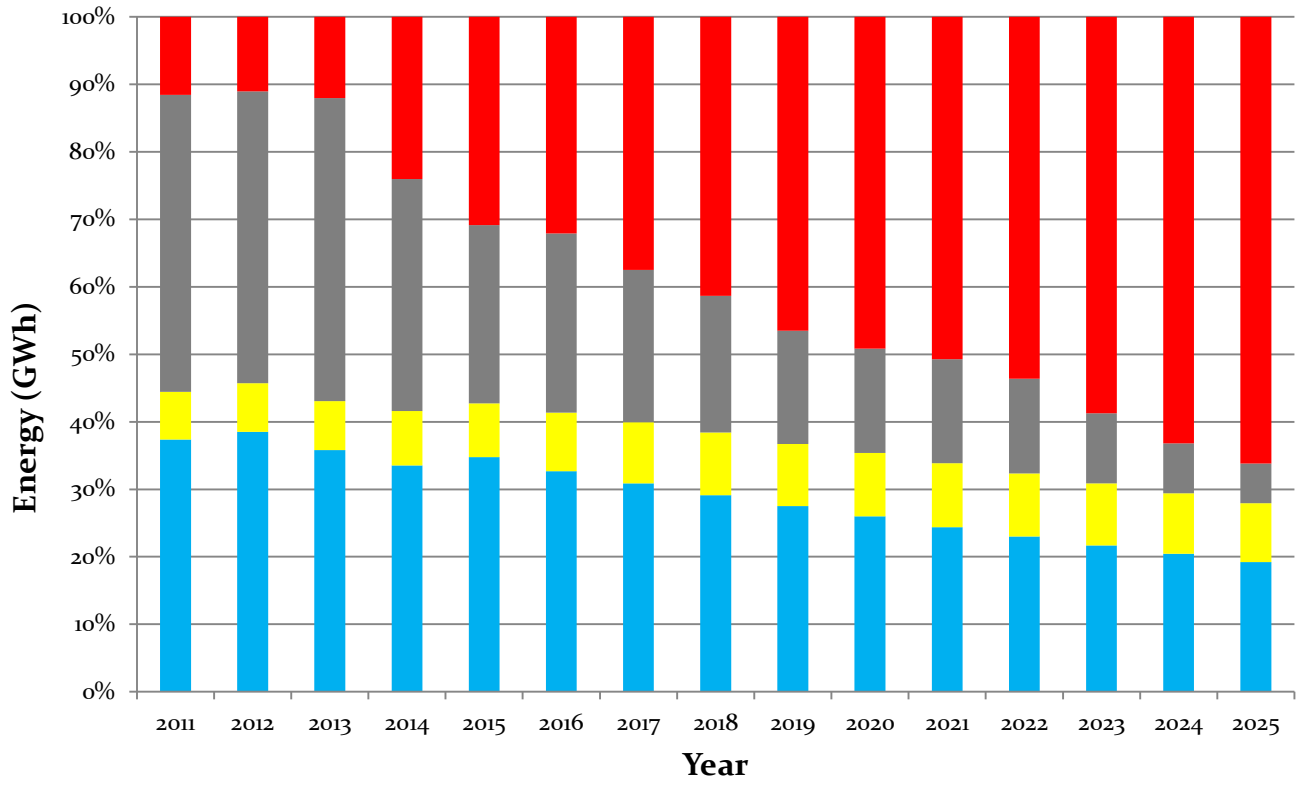
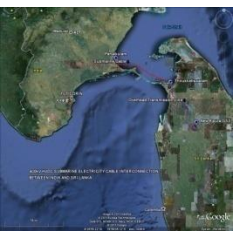
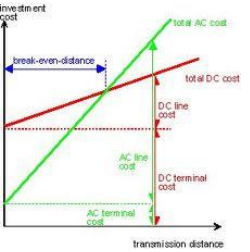
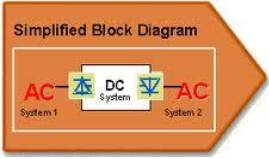
## Generation Expansion Plan 2013 - 2032

YEAR	RENEWABLE ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS	LOLP %
2013	-	-	4x5 MW ACE Power Matara 4x5 MW ACE Power Horana 4x5.63 MW Lakdanavi	1.821
2014	-	4x5 MW Northern Power** 3x8 MW Chunnakum Extension** 1x300 MW Puttalam Coal (Stage II)		1.357
2015	-	1x300 MW Puttalam Coal (Stage II) <b>3x75 MW Gas Turbine</b>	6x16.6 MW HeladanaviPuttalam 14x7.11 MW ACE Power Embilipitiya 4x15 MW Colombo Power	1.228
2016	35 MW Broadlands 120 MW Uma Oya	-	-	1.017
2017	-	<b>1x105 MW Gas Turbine</b>	-	1.483
2018	<b>27 MW Moragolla Plant</b>	<b>2x250 MW Trincomalee Coal Power plant</b>	4x5 MW Northern Power 8x6.13 MW Asia Power	0.399
2019	-	<b>2x300 MW Coal plant</b>	5x17 MW Kelanitissa Gas Turbines 4x18 MW Sapugaskanda diesel	0.080
2020	-	-	-	0.247
2021	-	<b>1x300 MW Coal plant</b>	-	0.162
2022	<b>49 MW Gin Ganga ***</b>	<b>1x300 MW Coal plant</b>	-	0.085

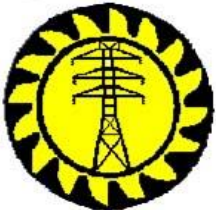




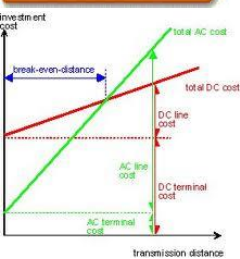
# Percentage Share of the Energy Balance



■ Coal     
 ■ Petroleum     
 ■ NCRE     
 ■ Major Hydro



# Present Transmission Network

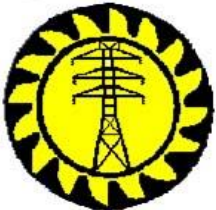


- Transmission voltage levels
  - 132kV
  - 220kV
  
- Transmission Lines
 

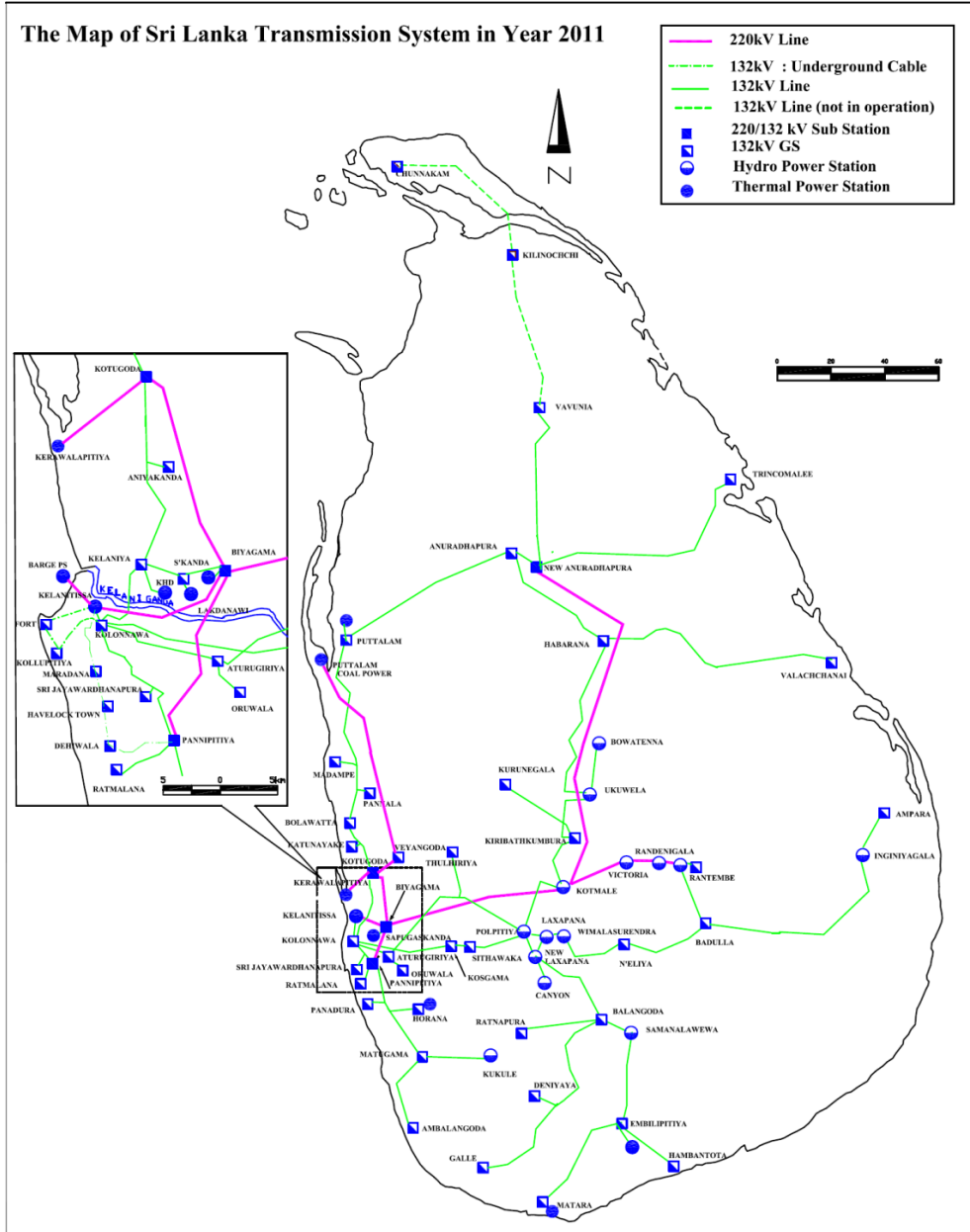
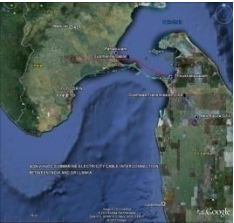
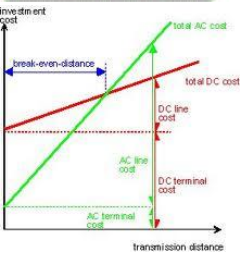
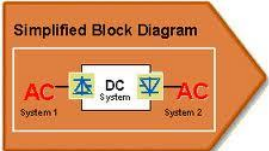
■ 220kV	501 km
■ 132kV	1791 km
  
- Grid Substations
 

	No.	MVA
■ 132/33 kV	47	3138
■ 220/132/33 kV	5	2100
■ 220/132 kV	2	105
■ 132/11kV	5	306





# Present Transmission



# **India - Sri Lanka Electricity Grid Interconnection**



# Trans-border Electricity Exchange

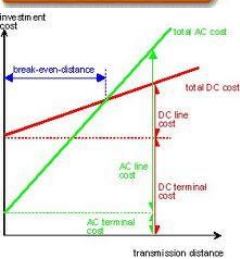
- South Asia Region is very rich in energy resources which are unevenly distributed among the countries of the region.



- The advantages of a South Asian Regional Electricity grid are appreciated by almost all countries in the region.

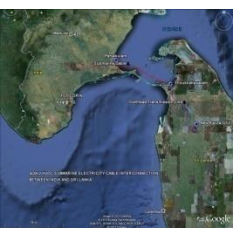
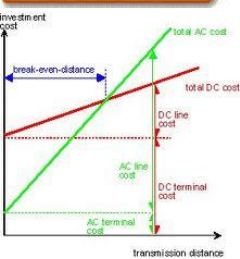


- For Sri Lanka to get access to a South Asian Regional Electricity Grid, the only feasible connection is with India through a HVDC marine cable. This interconnection would be different from any other electricity interconnections planned in the South Asia Region.





# Benefits and Opportunities for Sri Lanka



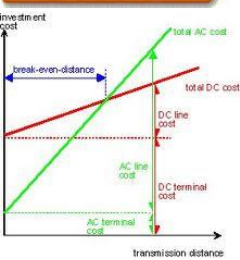
- Opportunity to enter into India Power Exchange for energy trading
- Access to electricity from cheaper sources of power generation in the South Asia Region
- Reduction in operational cost through better resource management
- Meeting growing power demand with imported power
- Improved load profile - valley filling
- Improved system reliability and security





# Background

- 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
- Bilateral discussions by Secretary, Ministry of Power and Energy Sri Lanka and Secretary Ministry of Power, India in Dec 2006.
- Cabinet of Ministers approved in principle in Dec 2006, to study the feasibility of power interconnection and to appoint a Steering Committee Co- Chaired by Secretaries of Power Ministries and to appoint a Task Force for technical, commercial, regulatory and legal aspects.



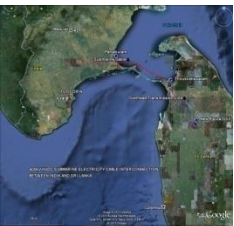
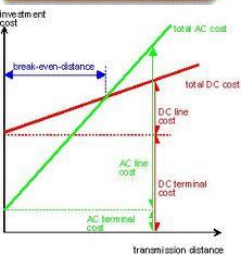




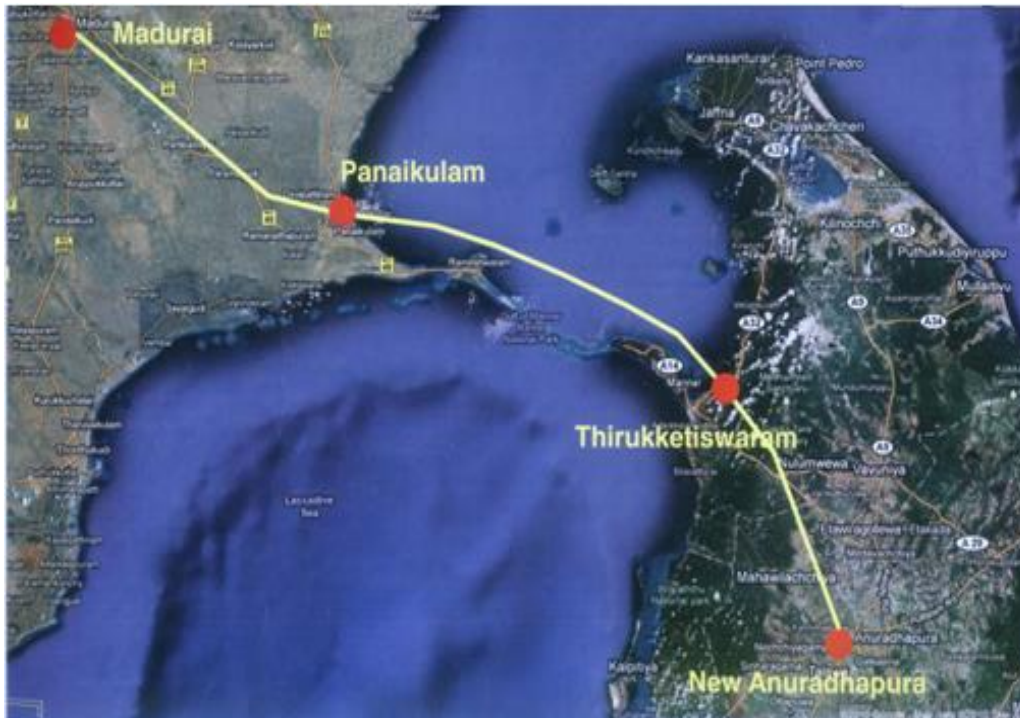
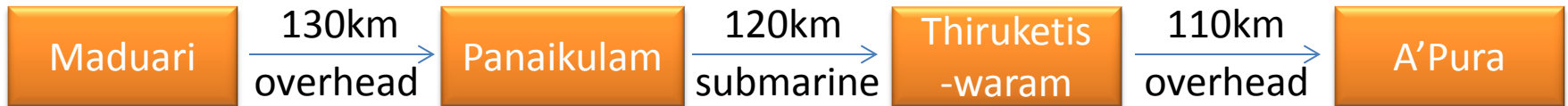
# Background Conts.



- A MOU on Feasibility Study for India- Sri Lanka Electricity Grid Interconnection was signed among GOSL, GOI, CEB and Power Grid Corporation of India Limited (PGCIL) on 9<sup>th</sup> June 2010.
- Executing Agencies; CEB and PGCIL are jointly carrying out the feasibility study



# Line Route



- High voltage direct current (HVDC), operating at  $\pm 400$  kV
- Total interconnection capacity will be 1000 MW

# Wholesale Markets in India and Sri Lanka

- **Indian Wholesale Power Market**
  - bilateral long-term contracts are dominant
  - Two power markets are in operation
  - Only 12% of demand served through day ahead and real-time (frequency based, UI) short term market
  - Total generating capacity is inadequate to serve the demand
  - At times, utilities shed loads when purchase price of electricity in day-ahead and UI market is above a pre-agreed threshold
- **Sri Lanka does not have an operational power market**
  - CEB operates as the single buyer
  - Meets customer demand at all times

# Potential for Power Exchange Contracts

- **Short term contracts**

- Monthly average prices reported in Indian short term market are in the range of 6.68 to 9.52 UScts/kWh (capacity + energy)
- monthly average purchase prices forecast for Sri Lanka are in the range of 6.50 to 13.46 UScts/kWh (energy only)
- During peak hours, Sri Lanka can make use of the lower cost Indian short term market
- During off peak, the excess coal based generation in Sri Lanka could be sold to the Indian short term market

- **Long term contracts**

- Owing to economies of scale, Sri Lanka signing up with an Indian UMPP could be cheaper than building own plants
- Similarly, if Sri Lanka can build an UMPP, it can also serve the Indian base load, owing to the persistent shortfall in India

# Power Transfer Costs

- **Following costs will further reduce any apparent benefits of power exchange between India and Sri Lanka**
  - Investment and operational costs of the interconnection
  - transmission fees of about 0.52 UScts/kWh require to be paid to the Indian grid for transfers within southern grid (based on current regulatory determinations in India)
  - energy loss attributed to power transfers between India (southern region) and Sri Lanka (Anuradhapura) amounting to at least 6%

# Legal and Regulatory Issues

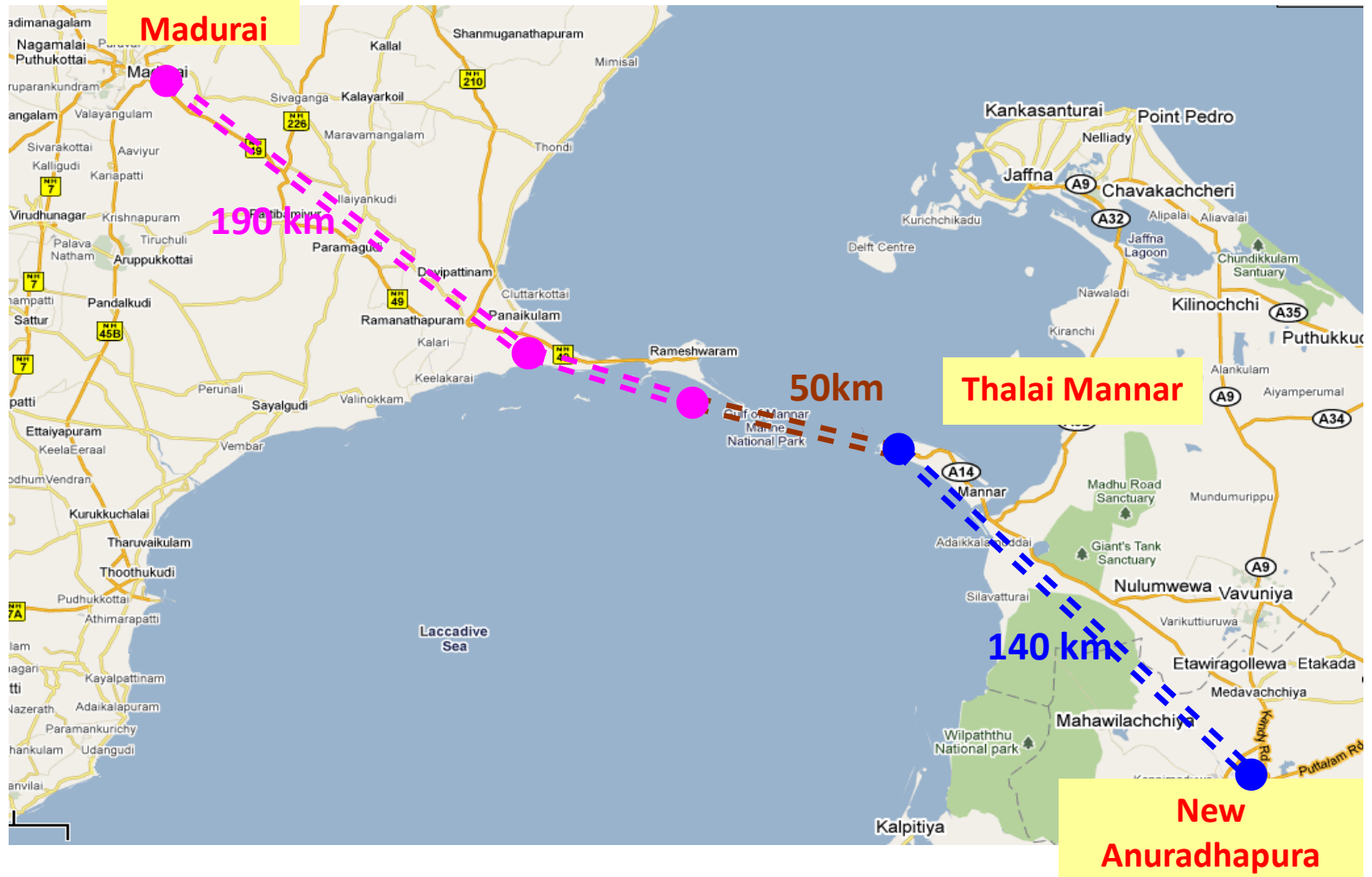
- CEB needs to be empowered to enter into cross-border power transfers
- The Transmission and Bulk Supply license held by CEB is required to be amended
- Dispute resolution in the Sri Lanka Electricity Act requires to be further strengthened
- CEB Act has to be amended to enable the functions of trader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

# To achieve project viability

- The project must be structured as a 1x500 MW monopolar interconnection with no specific assets or commitments now to raise the capacity to 1000 MW
- If the project costs are further reduced by reconsidering the routing options, the 1x500 MW monopolar option has the potential to be viable
- Target project cost for a POWERGRID-CEB joint venture to be profitable is 372.4 MUSD (excluding customs duty and taxes), which at present is estimated to be 554 MUSD
- Both Sri Lanka and India be allowed participation in the wholesale market in each others' country, with full options and freedom to participate in the short-term, day-ahead and unscheduled interchanges market
- Sri Lankan power system shall relax its maximum load share condition and allow the interconnection to supply at the optimal capacity level

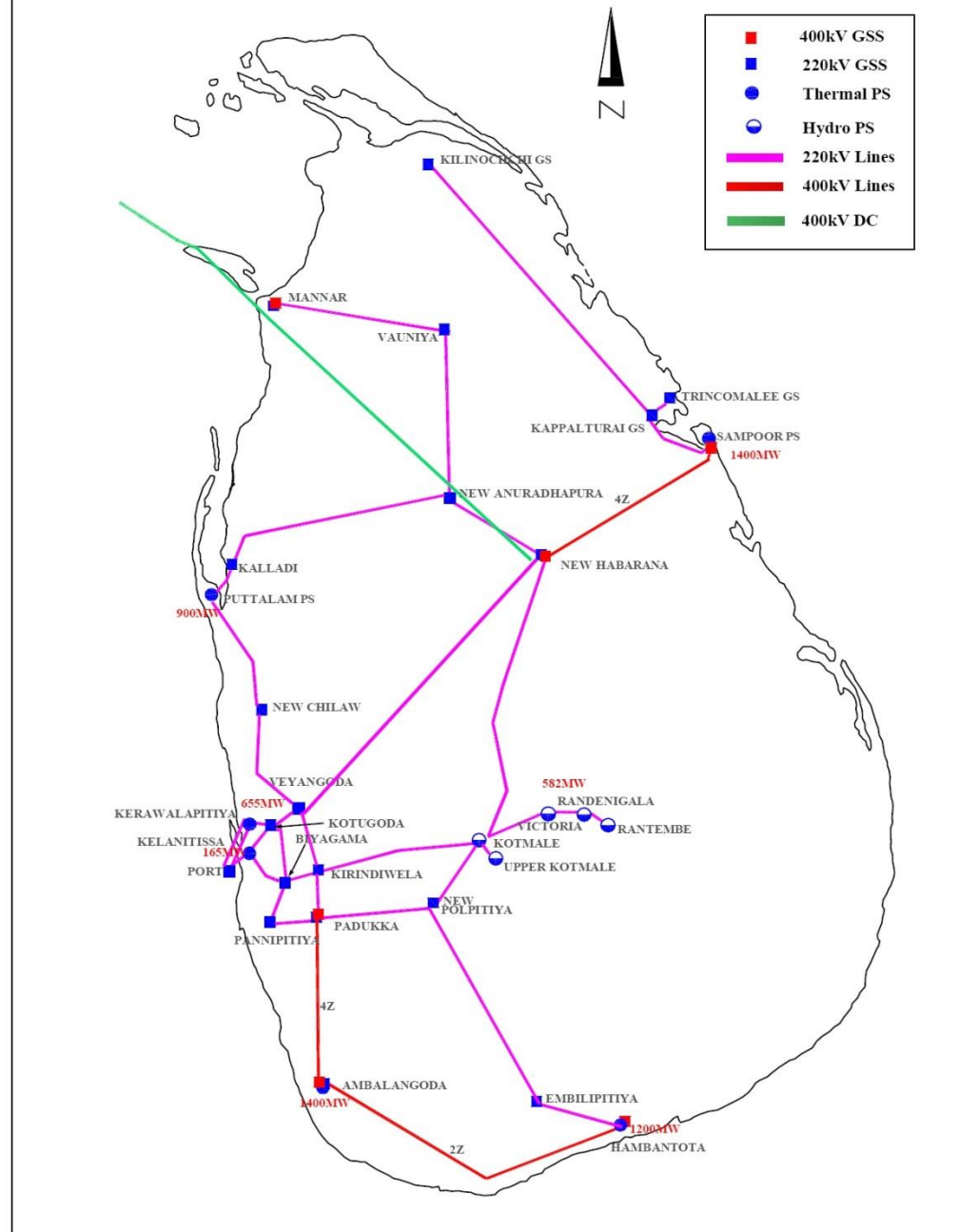


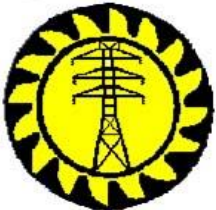
# Revised Electricity Grid Interconnection



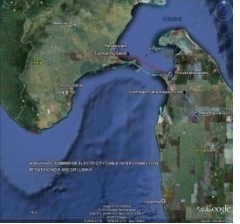
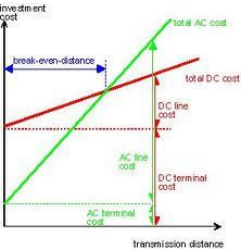
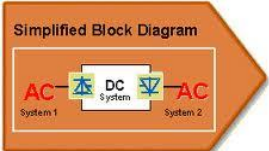
# 2032 Sri Lankan Transmission System

The Map of Sri Lanka Transmission System in Year 2032  
(400kV & 220kV Network)





# Thank You



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