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und Energie



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Exportinitiative Energie

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05.09.2017

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Ceylon Electricity Board

Sri Lanka

Grid Integration in Sri Lanka





Overview

- Country Overview – Sri Lanka
- Power Sector Overview
- Current Status of Non Conventional Renewables
- Historical Growth of NC Renewables
- Wind Development and Issues
- Future Plans
- Tendered Projects

Sri Lanka - General



Location



Geography



Electricity

Sri Lanka - Overview

- Location - Island in Indian Ocean
- Population – 21.2 million
- Area – 65,610 km²
- Population Density - 335 persons / km²
- Annual Population Growth - 1.1%
- Life Expectancy - 75 Years
- Literacy Rate - Avg. 93.2 (Male:94.1 . Female:92.4) Years
- GDP per Capita - 3,835 US\$
- GDP per capita real growth - 4.4%
- Exchange Rate (Ann. Avg) - 145.60 LKR/USD, 197.15 LKR/EUR
- Exchange Rate (Current) - 152.84 LKR/USD, 181.50 LKR/EUR

Overview – Power Sector

Installed Capacity	– 3,200 MW (approx)
Capacity Mix	– Hydro 40% Thermal 60%
Energy Mix	– Renew 33% Thermal 67%
Peak Demand	– 2,453 MW
Energy Generation (net)	– 14,148 GWh
Energy Sales	- 12,785 GWh
Trans. & Dist. Losses	– 9.63 %
Electrification Level	– 99.3 % (estimated)
Per capita Elect. Consumption	– 603 kWh
HV Transmission Voltages	- 220 kV, 132kV
MV Distribution voltages	- 33 kV, 11kV
Distribution Voltage (LV)	- 400 V/ 230V
Frequency	- 50 Hz

Capacity (Dispatchable) – Approx.

- Thermal
 - Coal - 825 MW (CEB) -Nett
 - Oil Fired - 1000 MW (CEB 500 : IPP 500 MW)
- Total Thermal - 1825 MW
- Total Major Hydro - 1350 MW (CEB)

Total - 3225 MW approx.

+ Temporary 120MW IPP

+ Emergency Thermal 60MW

+ NCRE 558MW

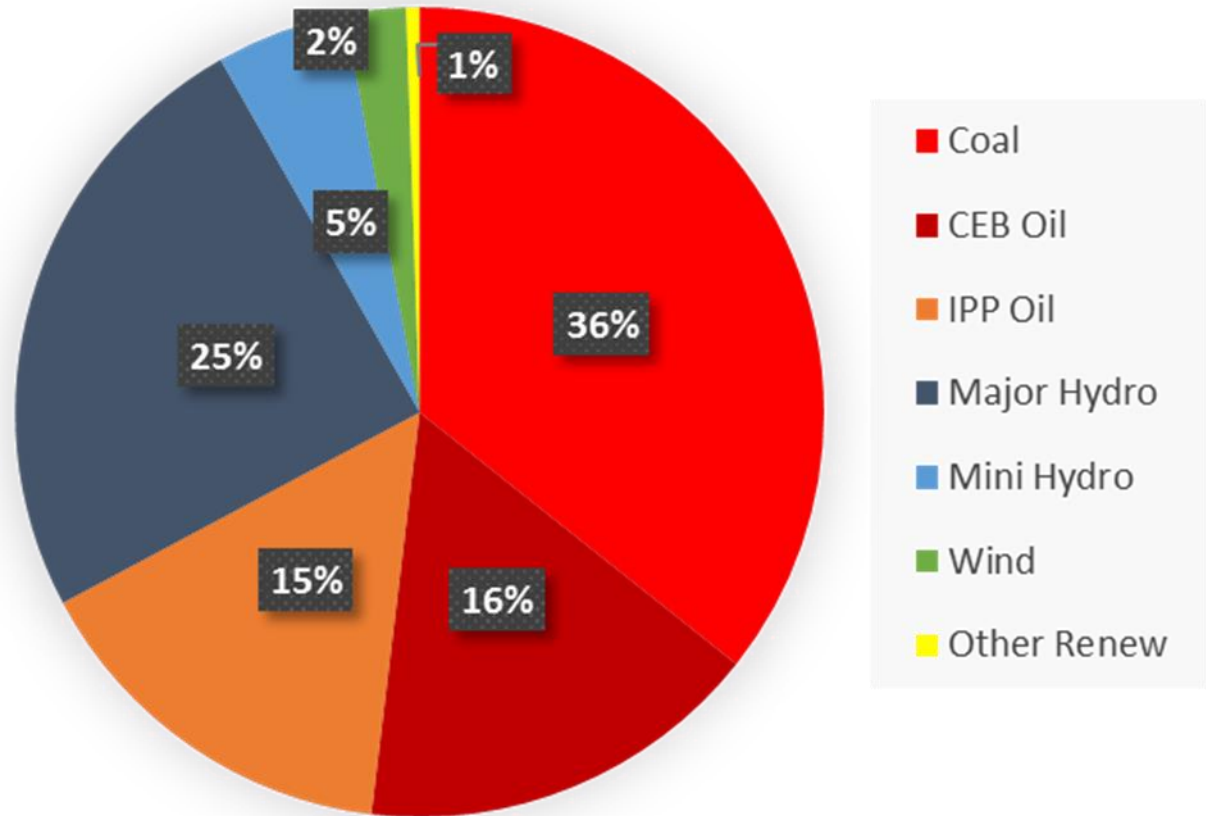
Commissioned NCRE Projects

Description	Project Type	No. of Projects	Capacity (MW)
Commissioned Projects	Mini Hydro Power	181	353.744
	Wind Power	15	128.450
	Biomass-Agricultural & Industrial Waste Power	4	13.080
	Biomass – Dendro Power	5	11.020
	Solar Power	8	51.360
	Total - Commissioned		213

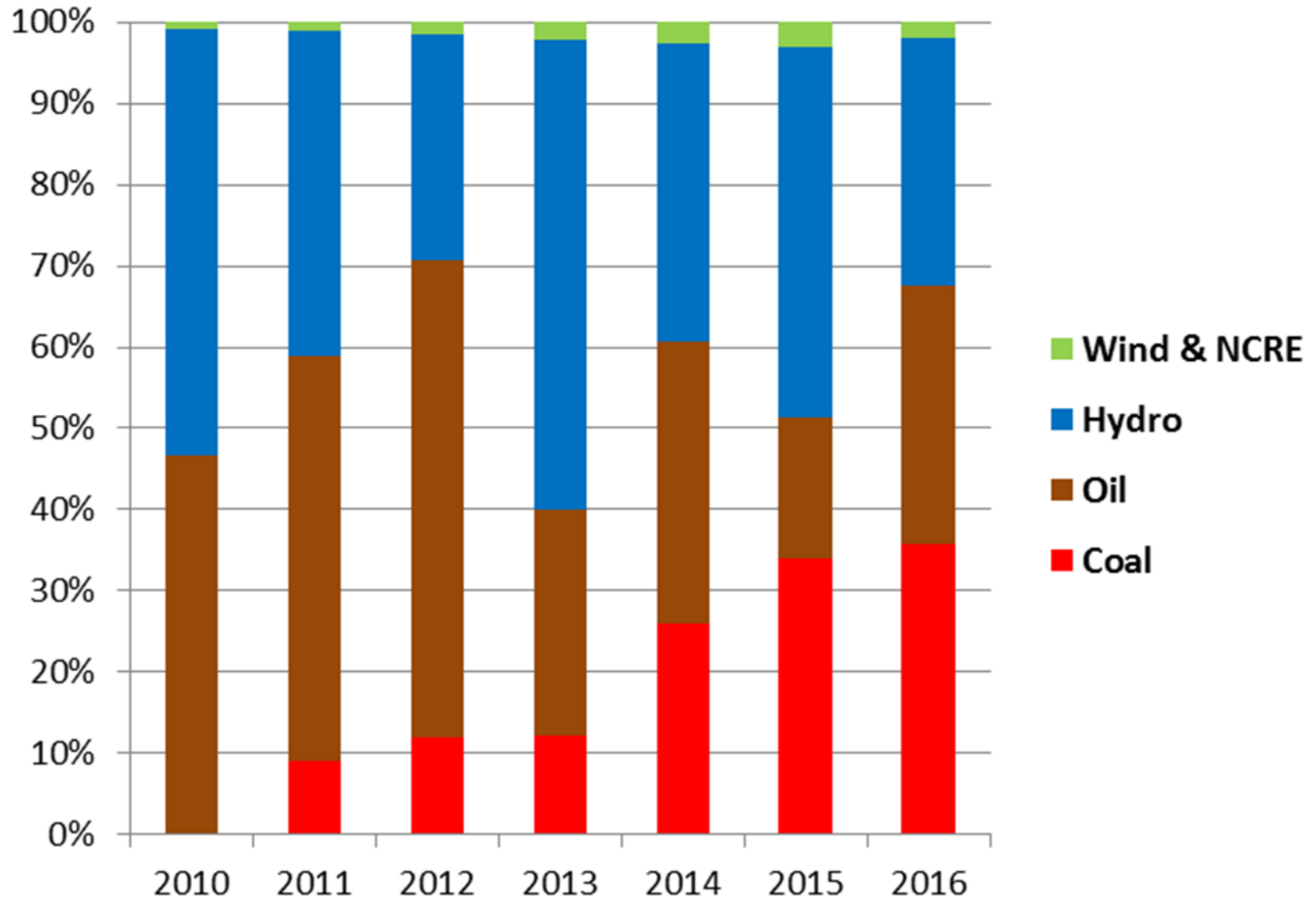
NCRE – Non Conventional Renewable Energy – (and below 10

Overview Generation Share - 2016

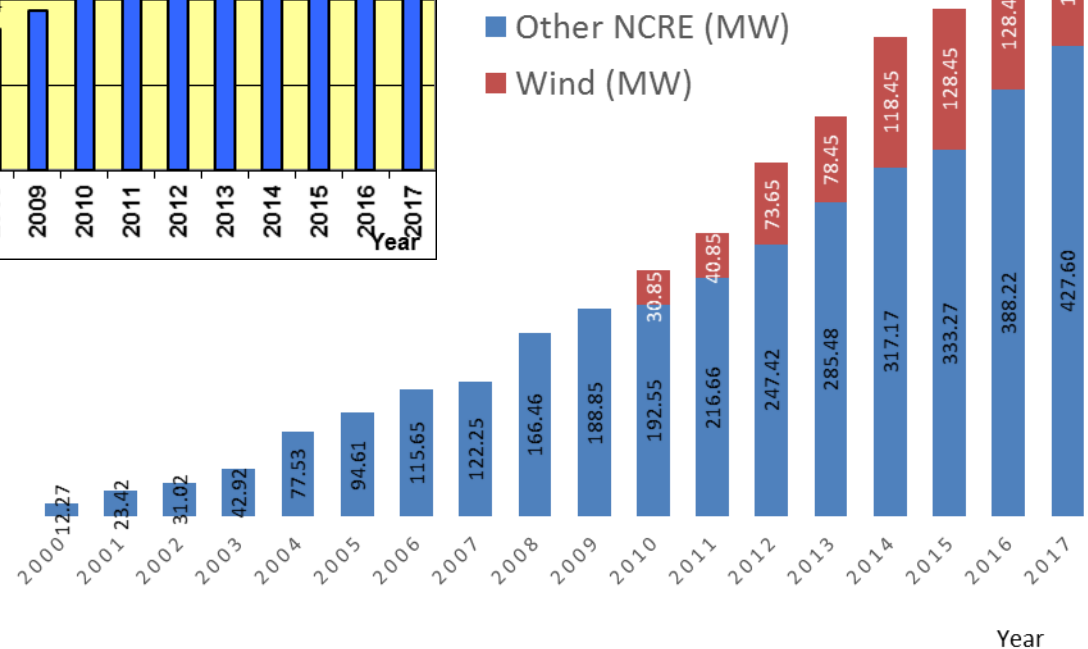
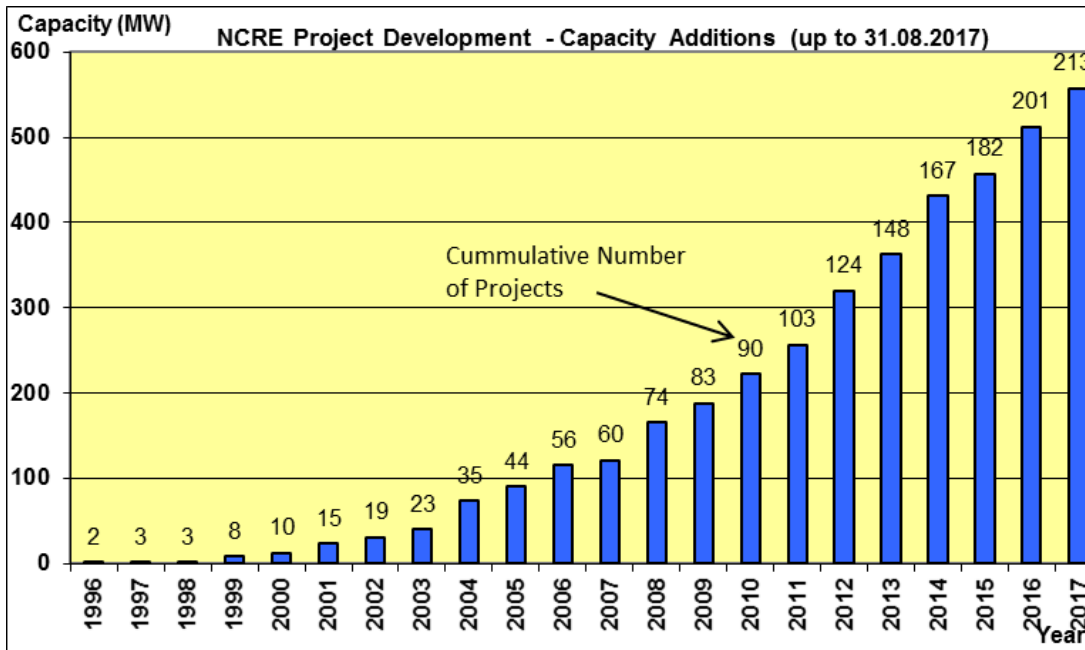
Source	GWh
Coal	5047
CEB Oil	2297
IPP Oil	2164
Major Hydro	3481
Mini Hydro	739
Wind	344
Other Renew	76
Total	14148



Overview - Generation Share

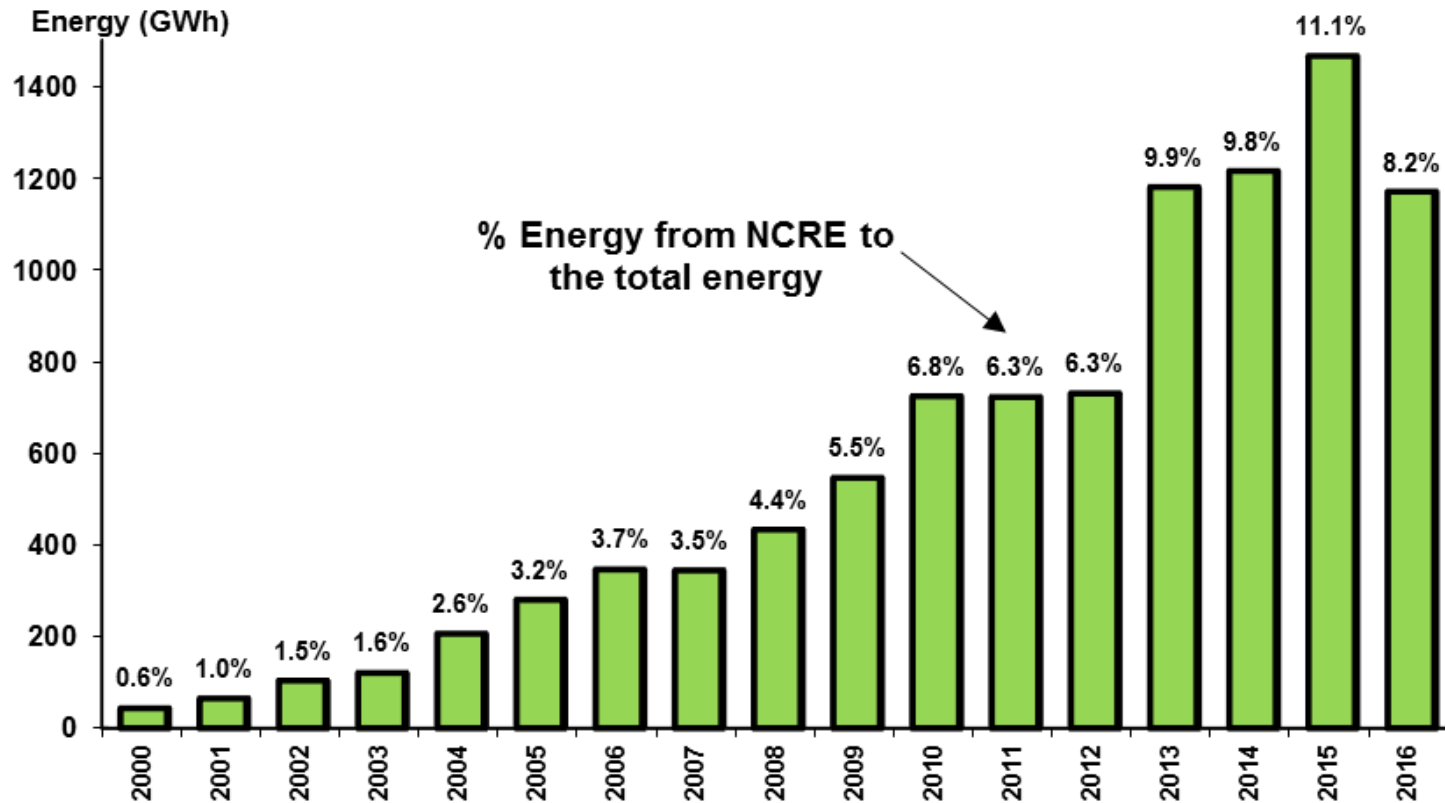


NCRE Development (Capacity & Projects)



Wind is Seasonal

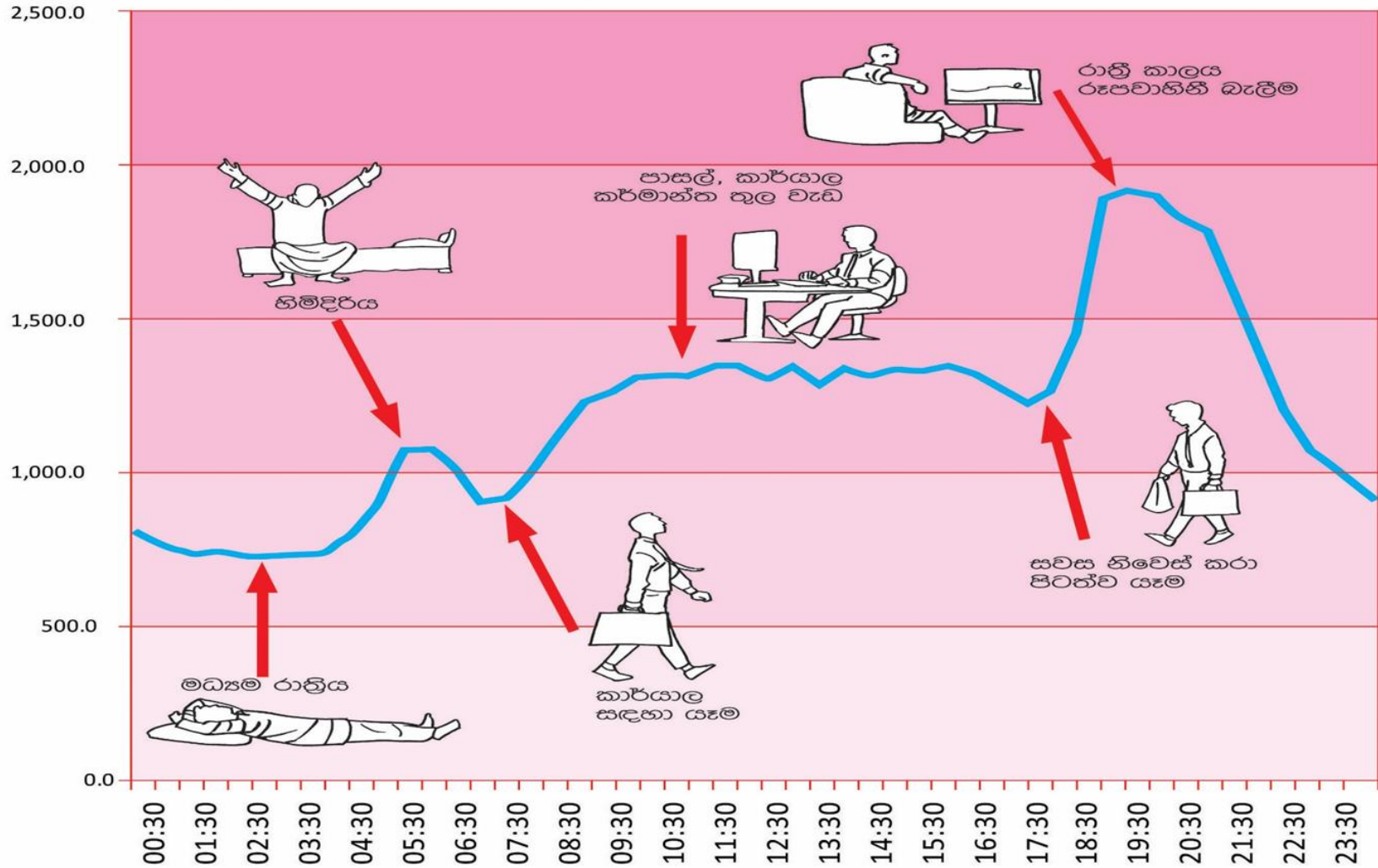
Contribution from NCRE to Electricity Generation



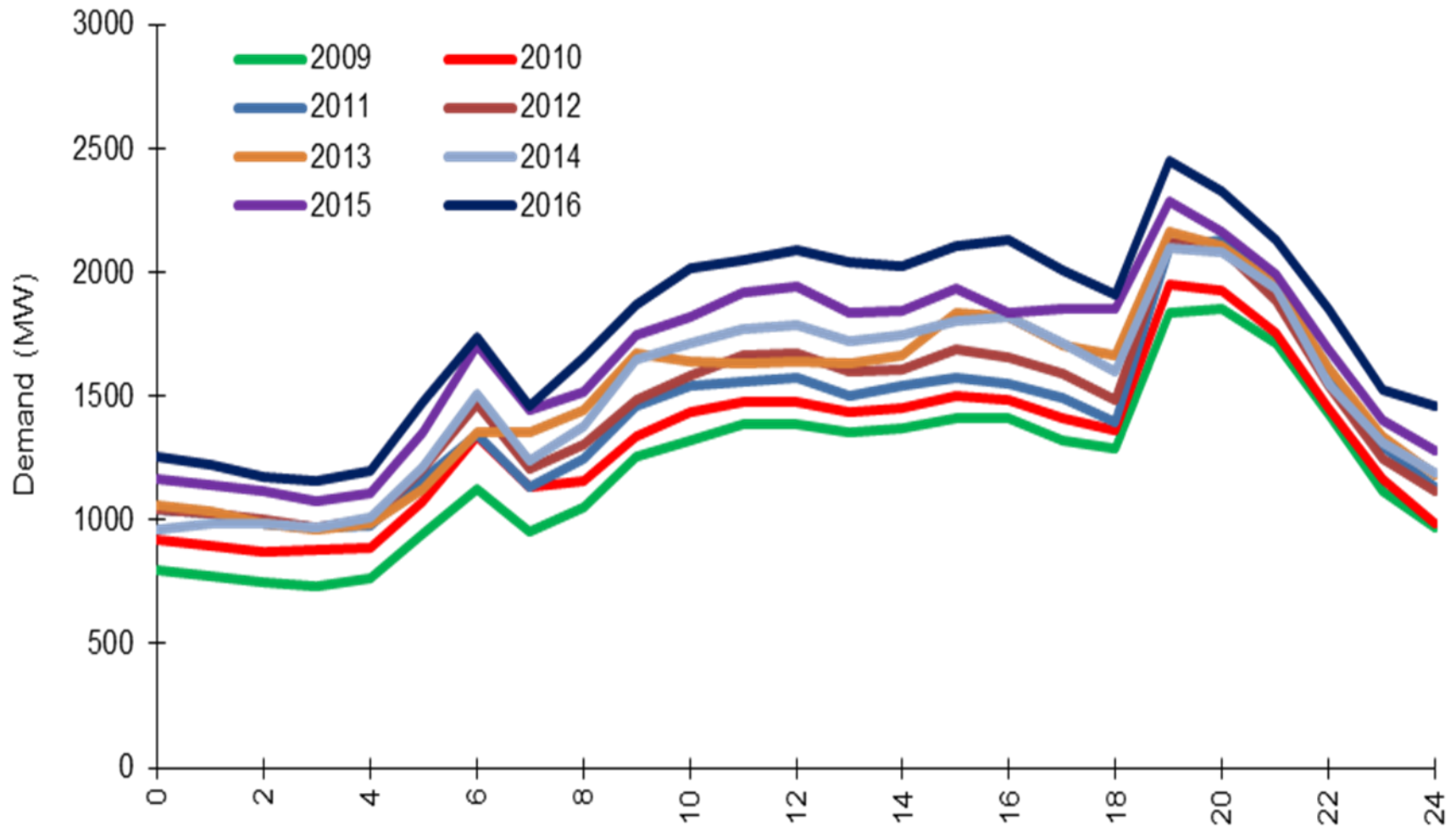
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Energy (GWh)	280	346	344	435	546	727	722	730	1178	1215	1466	1170

Note : Does Not include Major Hydro

Demand Variation During a Day



Daily Demand Curve – Over the Years



Institutions in the Sector

Ministry of Power & Renewable Energy

- Represent the government / policy making / fund control

Ceylon Electricity Board (CEB) – Government owned board

- Transmission monopoly, Hydro & Thermal Generation, Distribution

Government owned companies / CEB subsidiaries

- LECO – Distribution of electricity (urban coastal belt in the West)
- LTL – Transformer production / Power Generation / EPC contracting – project

IPP

- Private thermal power producers selling power to CEB on long term (take or pay) specific contracts

Other Private generators

- Supplying NCRE (non conventional renewable energy) to CEB on SPPA (Standard Power Purchase Agreements) – Below 10 MW

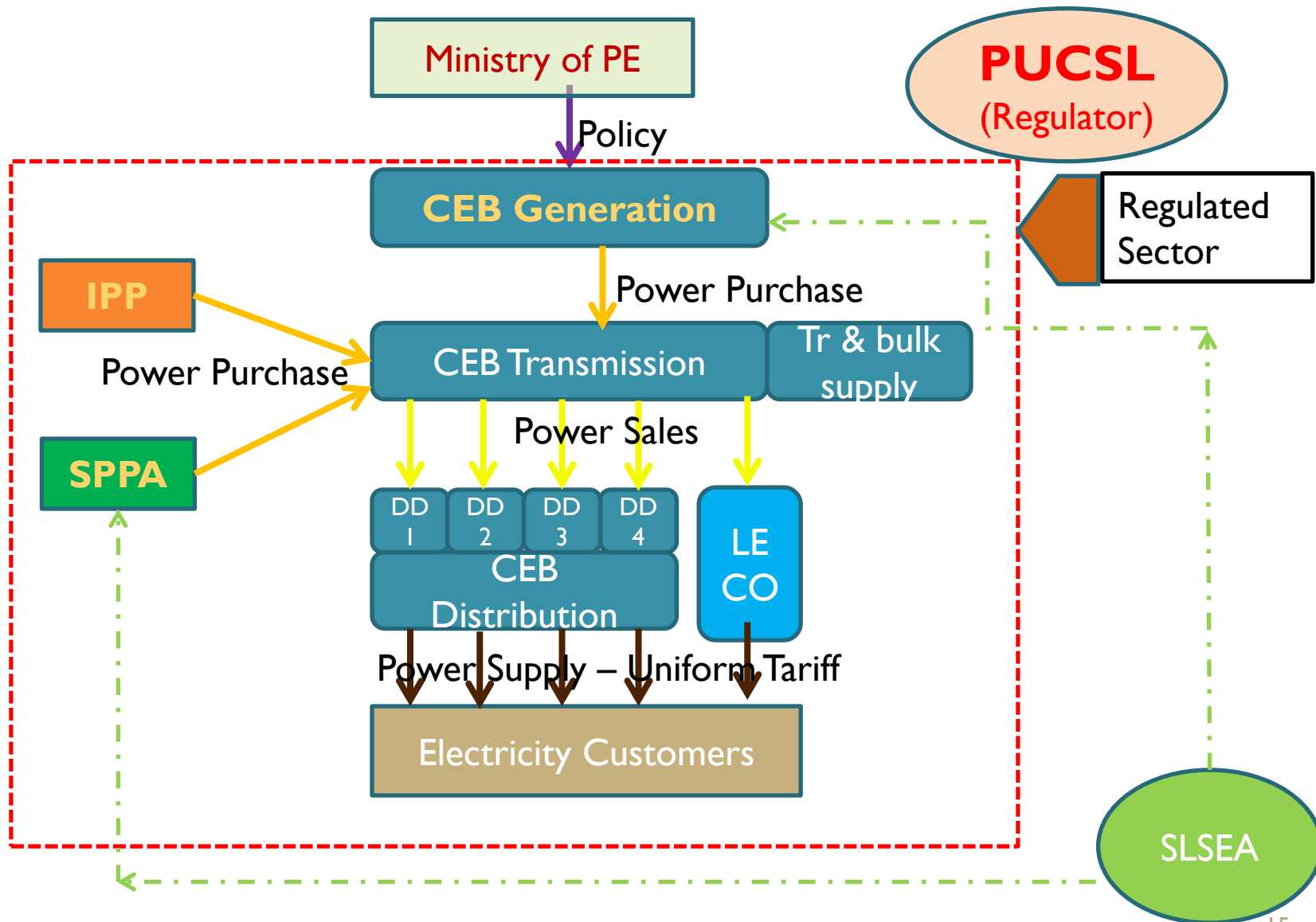
Sri Lanka Sustainable Energy Authority (SLSEA)

- Develop indigenous renewable energy resources and to implement energy efficiency and conservation etc.

PUCSL (Public Utilities Commission of Sri Lanka) - Regulator



Institutions in the Sector



Wind Development - Current

- At Present 15 Projects (All below 10MW)
- 11 Projects in Puttalam (104.8MW)
- 2 Projects in the Central Hills (3.85MW)
- 2 Projects in the North
- First agreement in 2008
- First commissioning in 2010
- Starting 3 Tier Feed in Tariff in the Range of LKR 20-25 first come first served basis
- Connected at 33kV level (or through a collector Grid Sub)
- Grid level constrains and concern on Grid stability stopped LOI in 2010
- Several studies on grid limitations carried out – internal and by consultants
- Policy decision to tender Wind & Solar – First tendering of Wind in 2015/16






Wind Power Projects – Structure (Existing Projects)

- Approval & Permits from SEA and PUCSL - regulator
- Standard PPA with CEB, Tariff differs according to Technology
- No sovereign guarantee, tariff in Rupees
- Agreement for 20 years from date of commercial operation
- Land also to be found and obtained by the developer
- All approvals (environmental, etc) to be obtained by the developer
- Transmission connection has to be obtained by developer from CEB and the cost also by the developer
- Energy meter located at the P Plant generally at HV level
- Reading taken monthly jointly & to be paid within a month
- No major disputes regarding payment

Wind Power – Technical Aspects

- All Power plants below 10MW has to follow the “CEB Guide for Grid Interconnection of Embedded Generators, Sri Lanka”
- It has the total process / procedure for Grid Interconnection
- Also the different technical operational process (eg. Synchronising / earthing etc.
- Different protections required for embedded generators. Eg.:
 - Islanding, RoCoF, Over & Under Volatage, NVD – Neutral Voltage Displacement, Intertripping
- Addendum recently issued to the Guide specially for Wind plants
 - Applicability of LVRT capability
 - Remote Monitoring & Controlling option for the system operator

	Case 1	Case 2	Case 3	Case 4	Case 5	
Generator type	All	All	See Case 3 description	All	See Case 5 description	Self-commutated static
Minimum captive load	L	L	L		L	
Maximum cumulative installed capacity	<0.5 x L	<0.8 x L	>0.8 x L		>0.8 x L	
Maximum site installed capacity	< 5 MW	< 5 MW	< 5 MW	> 5 MW		
Under and over voltage protection	•	•	•	•	•	
Under and over frequency protection	•	•	•	•	•	
Vector shift protection	*	•	•		•	
ROCOF protection		*				
“True” ROCOF protection			*			
NVD protection			•	*(1)		
Inter tripping				*		
Loss of Phase	•	•	•	•	•	•
Bundesministerium für Wirtschaft und Energie		MITTELSTAND GLOBAL	*	Durchführer	*	*
		EXPORTINITIATIVE ENERGIE			GERMAN ASIA-PACIFIC BUSINESS ASSOCIATION	

Summary of Protection Requirement for Embedded Generators



Future Plans

- Generation Expansion : According to the Long Term Generation Expansion Plan
 - A 20 year rolling plan revised every two years
 - Prepared based on Least Cost Principles
 - A legal requirement under the Electricity Act
 - No Procurement outside the Plan
- Transmission Expansion – According to the Long Term Transmission Plan
 - 10 Year rolling Plan
 - Take in to account the Generation Plan and the Medium Voltage Plans of the Distribution Divisions

Projected NCRE Development According to CEB Generation Plan

Table 5.7 – Projected Future Development of ORE (Assumed as Committed in Base Case Plan)

Year	Cumulative Mini hydro Capacity (MW)	Cumulative Wind Capacity (MW)	Cumulative Biomass Capacity (MW)	Cumulative Solar Capacity (MW)	Cumulative Total ORE Capacity (MW)	Annual Total ORE Generation (GWh)	Share of ORE from Total Generation %
2018	344	144	39	210	737	2103	13.0%
2019	359	194	44	305	902	2471	14.3%
2020	374	414	49	410	1246	3402	18.4%
2021	384	489	54	465	1392	3784	19.5%
2022	394	539	59	471	1463	4022	19.8%
2023	404	599	64	526	1592	4338	20.3%
2024	414	644	69	581	1708	4620	20.6%
2025	424	729	74	685	1912	5084	21.6%
2026	434	729	79	740	1982	5229	21.2%
2027	444	754	84	795	2076	5447	21.0%
2028	454	799	89	900	2242	5796	21.3%
2029	464	824	94	954	2336	6014	21.1%
2030	474	894	99	1009	2476	6365	21.2%
2031	484	929	104	1064	2580	6601	21.1%
2032	494	974	104	1119	2691	6844	20.9%
2033	504	1044	109	1173	2830	7193	21.1%
2034	514	1114	109	1229	2965	7509	21.1%
2035	524	1184	114	1283	3105	7860	21.2%
2036	534	1279	114	1338	3265	8252	21.4%
2037	544	1349	119	1442	3454	8670	21.5%

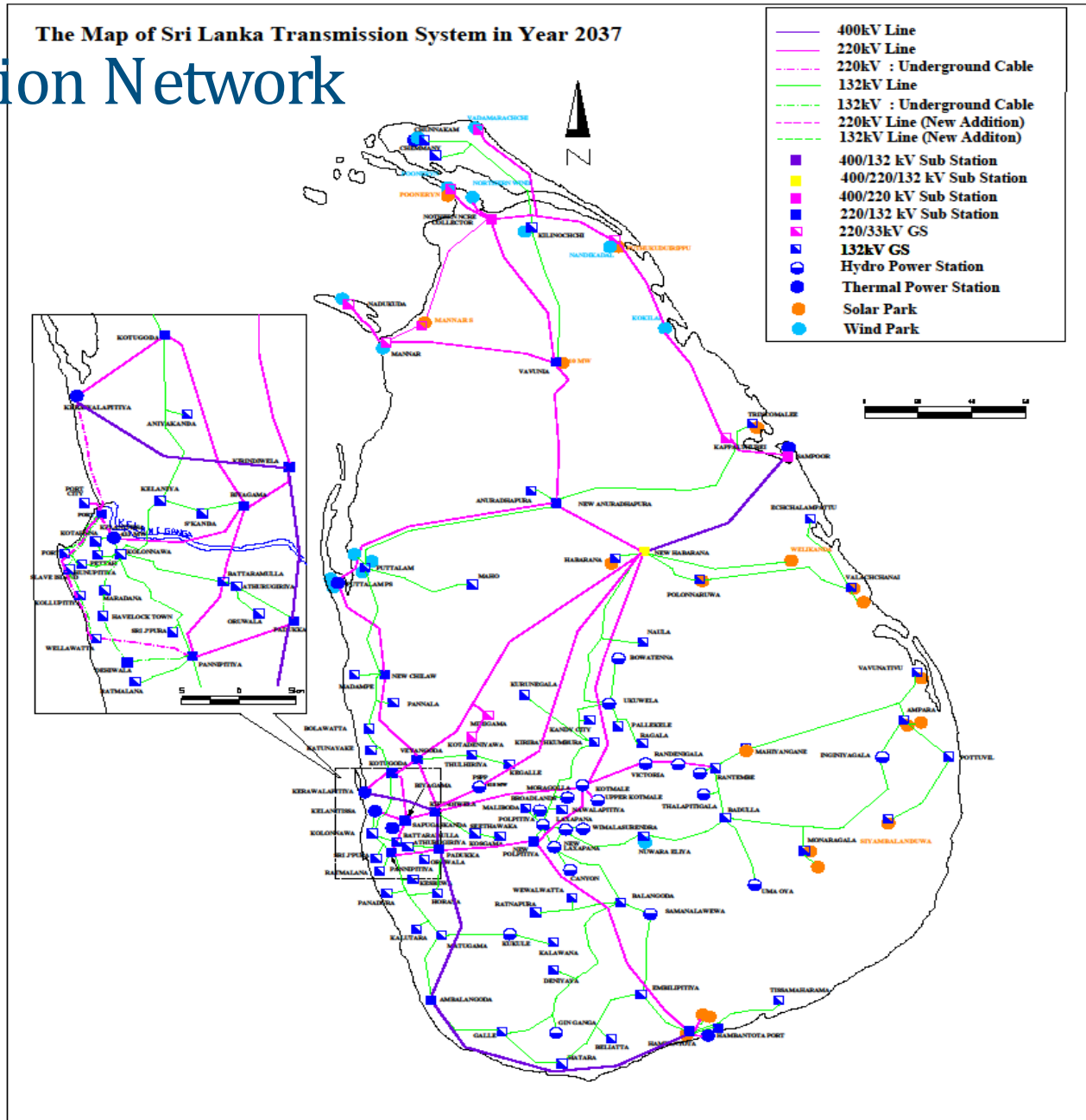
Projected Wind Development

Year	Total Wind MW	Wind Additions MW	Total New Addition MW	Planned Projects
2018	144	50	50	50MW Poonereyn?
2019	194	220	270	20MW Pooneryn?
2020	414	75	345	100 MW Mannar CEB 100 MW Pooneryn
2021	489	50	395	100MW Mannar II
2022	539	60	455	
2023	599	45	500	
2024	644	85	585	
2025	729	0	585	
2026	729	25	610	
2027	754	45	655	
2028	799	25	680	
2029	824	70	750	
2030	894	35	785	
2031	929	45	830	
2032	974	70	900	
2033	1044	70	970	
2034	1114	70	1040	
2035	1184	95	1135	
2036	1279	70	1205	
2037	1349			

- 2X10MW Tendered, Awarded, under implementation
- 100 MW Mannar Stage I – CEB Plant – EPC contract tender open
- 100 MW Mannar II CEB/ Pvt?
- 170MW Pooneryn to be tendered (Staggered)

Transmission Network 2037

The Map of Sri Lanka Transmission System in Year 2037



Tendered PP Project 2x10 MW

- Two 10MW Wind Projects tendered in 2015
- First NCRE projects to be tendered
- One ICB other NCB
- Land to be provided by CEB from identified two locations in North
- Both tenders won by the same local company
- Awarded Price – 12.29 LKR for both projects
- Evaluated on tariff to be paid (in LKR), an exchange rate correction of 80% would be given for the tariff at the time of SPPA signing
- Interconnection line of 1-2 km by developer to a Gantry
- CEB will develop the line from Gantry to Grid
- At present land issues being sorted out

Tender for 100MW Mannar Wind Farm of CEB

- ADB funded
- Single stage two envelope bidding
- Scope includes
 - Design, configuring, supply, installation, commissioning of the Plant
 - Operation & Maintenance for 3 years (minimum)The lowest evaluated Bid shall be decided by comparing the Evaluated Unit Generation Cost (in LKR/kWh) of each Bid calculated
- Semi dispatchability required with three operating modes
- Transmission infrastructure separately funded and under construction

Tender in the CEB Web - <http://www.ceb.lk/tenders>



The screenshot shows a web browser window displaying the CEB Tenders website. The browser address bar shows the URL <http://www.ceb.lk/tenders/#tab-1442556028882-2-1>. The page content is a table with the following details:

Tender ID	Start Date	End Date	Description	Details
CEB/EPT/SP/RFP 2	July 4, 2017	August 16, 2017	International Competitive Bidding (ICB) Request for Proposals for the establishment of Solar PV power plant on build, own and operate basis – Vavunathivu Solar PV Power Project (10 MWp)	<ul style="list-style-type: none">(1) Paper Advertisement (English) – Vavunathivu 10MW Solar PV Power Project(2) Paper Advertisement (Sinhala) – Vavunathivu 10MW Solar PV Power Project(3) Paper Advertisement (Tamil) – Vavunathivu 10MW Solar PV Power Project(4) Request for Proposals (RFP) document Volume I – Vavunathivu 10MW Solar PV Power Project(5) Request for Proposals (RFP) document Volume II – Vavunathivu 10MW Solar PV Power Project(6) Request for Proposals (RFP) document Volume III – Vavunathivu 10MW Solar PV Power Project(7) Guide for Grid Interconnection of Embedded Generators (December 2000) – Part 1(8) Guide for Grid Interconnection of Embedded Generators (December 2000) – Part 2(9) Addendum - Grid Connection Requirement for Large Scale Solar Power Plants

- Mannar 100MW Wind Farm
- Two 10MW Solar RFP from developers

Future Wind Projects

- IPP (Some could be CEB)
- Mainly in the North (Pooneryn) Area
- Transmission interconnection an absolute necessity
- Funding required for the transmission infrastructure as well
- Will be definitely tendered
- Whether to tender as 1 block (of 100MW) or as no. of blocks (10 OR 20MW) – not yet decided
- Technical requirements will be location and project specific
- Currency of the Tariff not decided – So far no Renewable resource paid in foreign currency

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CEYLON ELECTRICITY BOARD



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