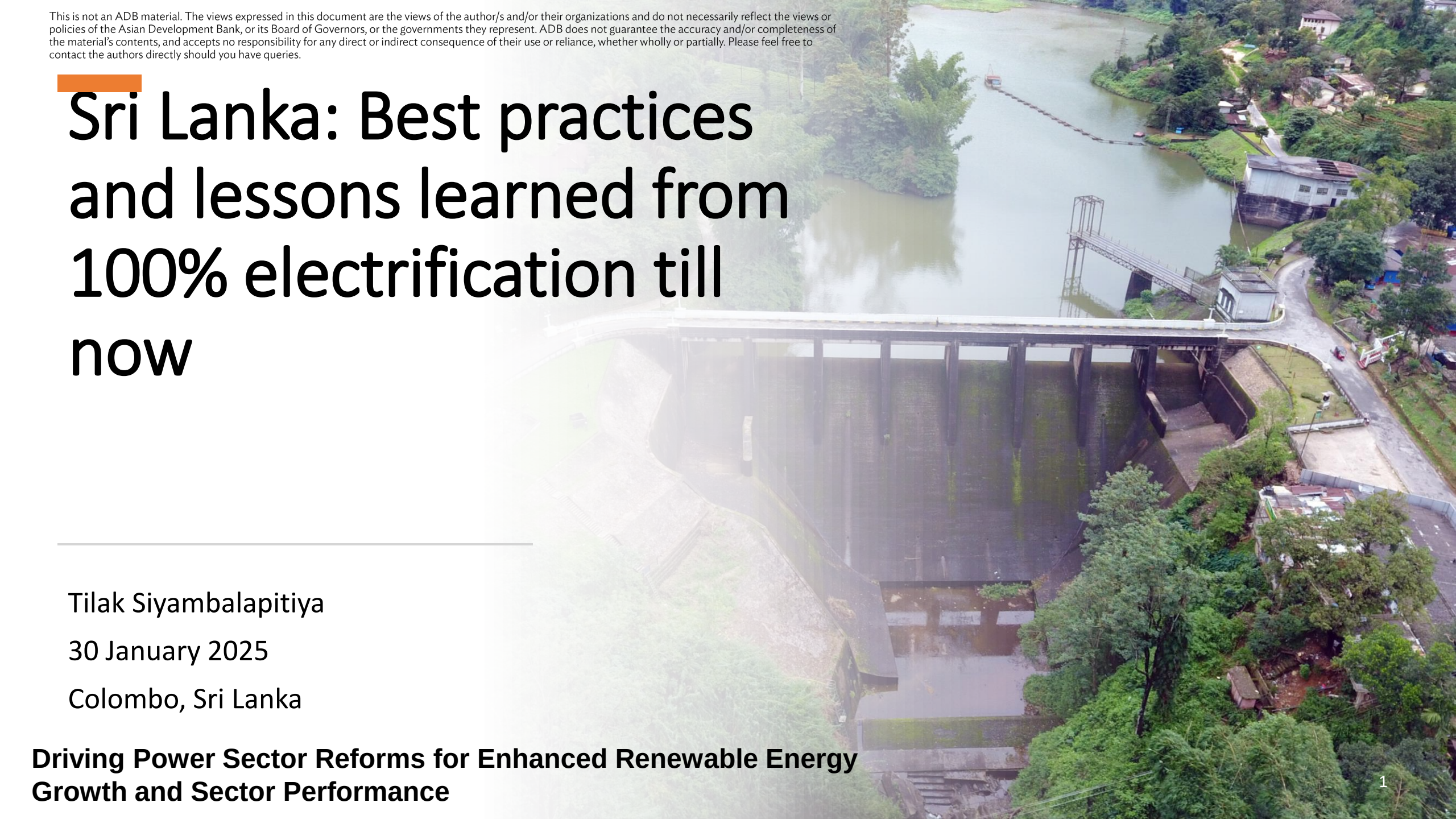
Sri Lanka: Best practices and lessons learned from 100% electrification till now



Tilak Siyambalapitiya

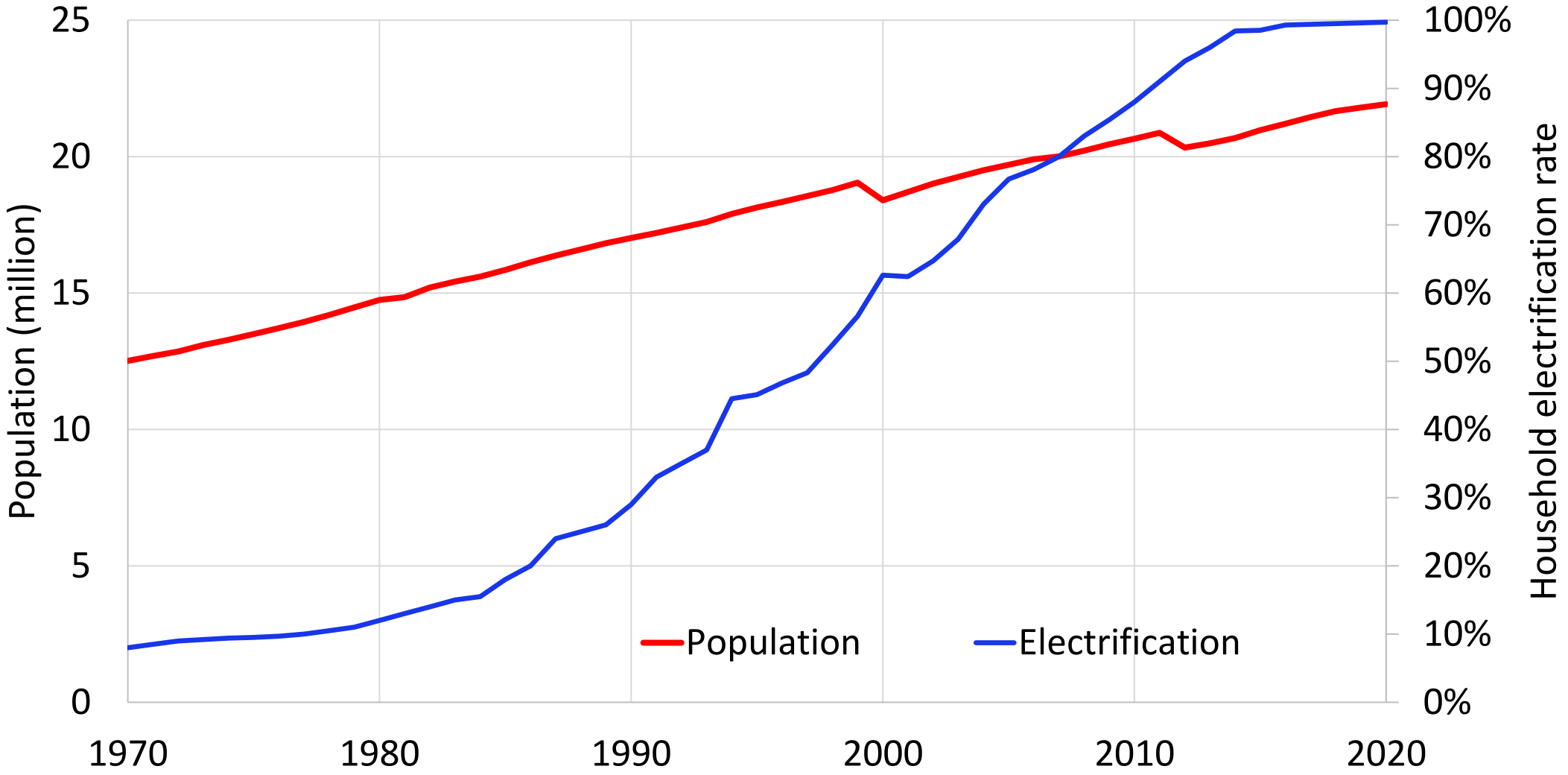
30 January 2025

Colombo, Sri Lanka

Driving Power Sector Reforms for Enhanced Renewable Energy Growth and Sector Performance

Basics achieved ahead of others in South Asia

Sri Lanka Achieved 100% Electrification by 2016

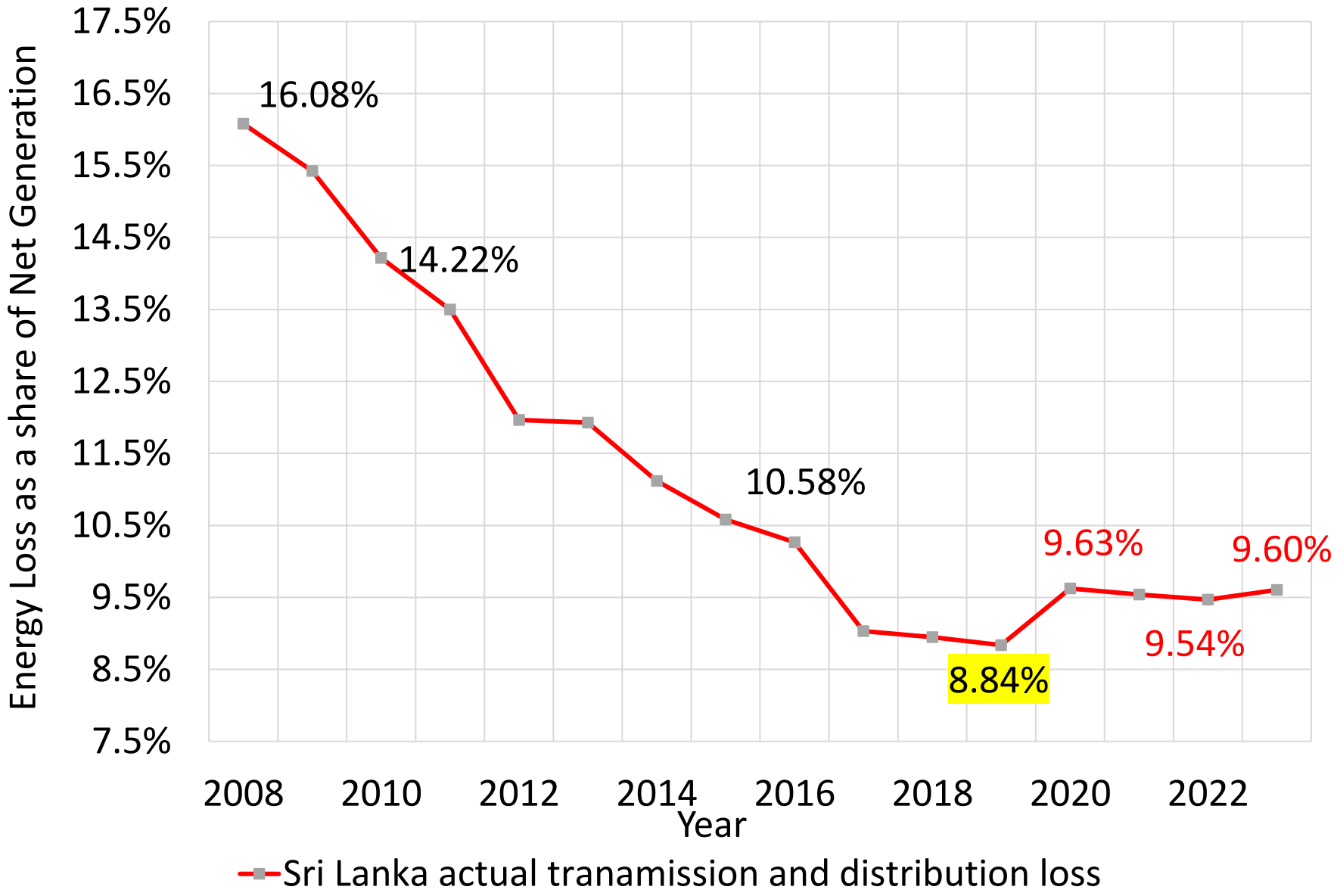


Source: Sri Lanka Energy Balance, SLSEA

The National Energy Policy 2008 stated: 6% of households will remain offgrid; hence provided only with standalone rooftop solar PV with battery

However, Sri Lanka went in for 100%

Successfully Reduced Technical and Commercial losses to 8.8%



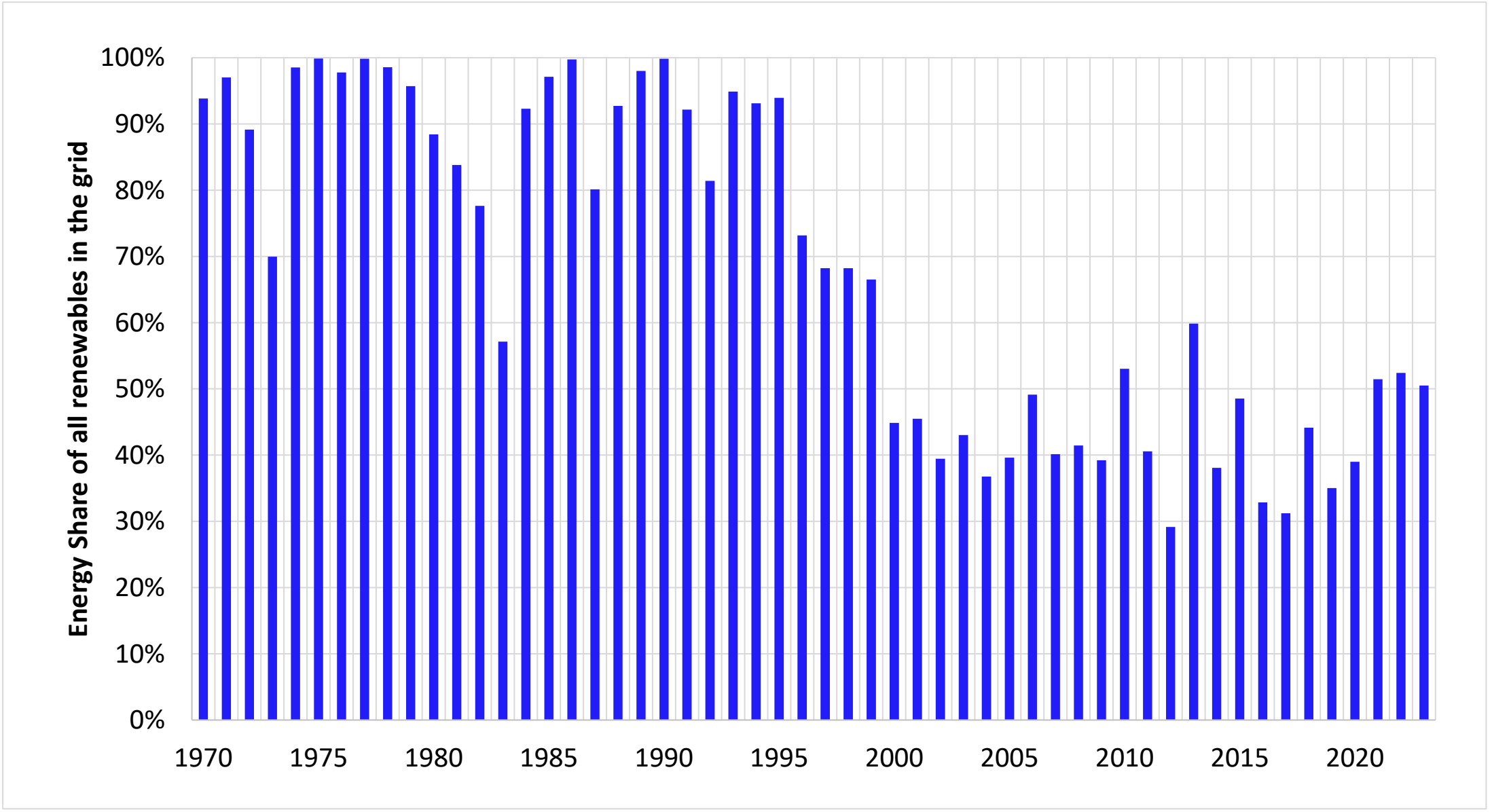
The National Grid is 70 years old

Commenced with Laxapana Hydropower Plant

Laxapana power plant: Completed in stages 1950-1972

Victoria reservoir and power plant: Built 1984

Share of Renewables in the Grid declined while the country accelerated toward 100% electrification



Why did Sri Lanka's renewable energy share drop in the 1990s?

- End of major hydropower development
- Other hydropower projects (eg: Kukule, Upper Kotmale, Broadlands delayed for decades, but finally built)
- Other forms of renewable energy were either too expensive or technology still being developed
- Rapid growth in electrification: Sri Lanka reached 100% electrification in 2016; growth in other sectors
  - In 1990, only **29%** of households had electricity

Private-sector led renewable energy-based generation has been successful, but ……

A Private-sector led renewable energy development program commenced in 1996

- The Small Power Producer (SPP) Program
  - **First milestone**: Introduced Standardised, non-negotiable agreement and tariffs in 1996; 100% purchase and price guarantee
  - **Second milestone**: Prices paid moved from "avoided costs" to "cost-reflective" for new contracts from 2007
  - **Now:** About 330 such SPPs in operation, 775 MW, provided about 16% of energy in 2023
  - **Outlook**: New small hydro, biomass and waste to energy projects in progress, but very slow. Wind and solar PV now moving on to competitive bidding

A Minihydro Power Plant: Over 210 such power plants are in operation

Courtesy: Vidullanka PLC

Nineteen Wind Power Plants are Operational

Puttalam 2010: Completed 1.25 MW wind turbine

Mannar 2020: Completed 3.4 MW wind turbine

Net metered Connection of renewable energy-based generation commenced in 2008

- Net metered renewable energy at customer premises allowed from 2008
  - Buy-back prices introduced from 2016
  - about 1200 MW already in operation (solar roof tops), provided **16% of capacity**, but **5% of energy** in 2023.
  - Economics and role of rooftop solar PV widely misunderstood
  - Moving to competitive bidding shortly

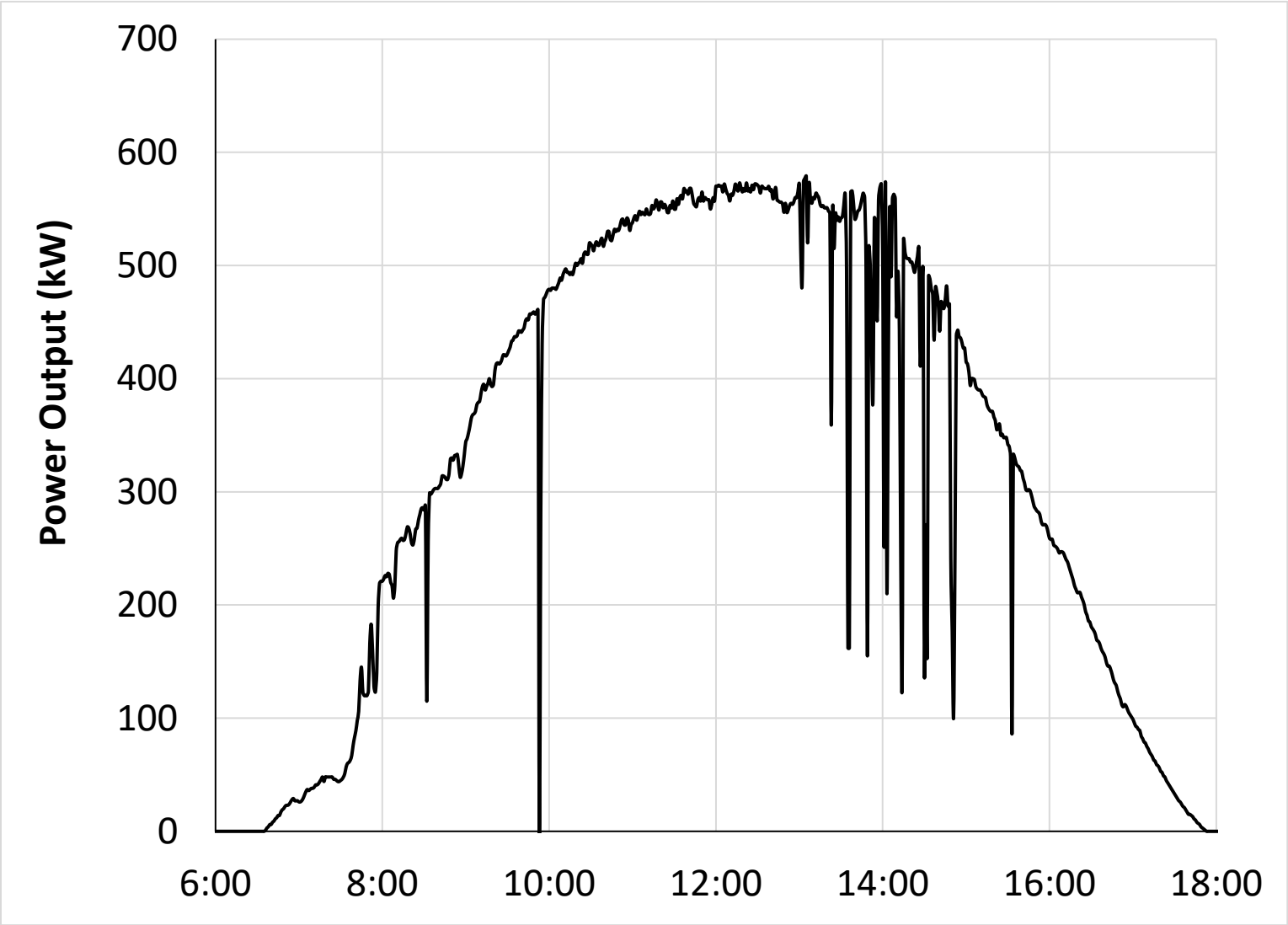
Challenges with Existing Renewable Energy Power Plants

Engineering and commercial

Renewable-based Generation has:

- Linkages to other users of the resource: Hydropower
- Seasonality and interannual variations: wind and hydropower
- Intermittency: solar power and wind power
- Supply-chain uncertainty: Biomass
- Limited contributition to power system stability
  - Biomass; Good contribution
  - Hydropower: Smaller contribution
  - Wind, solar PV: zero contribution

Intermittency: Solar power



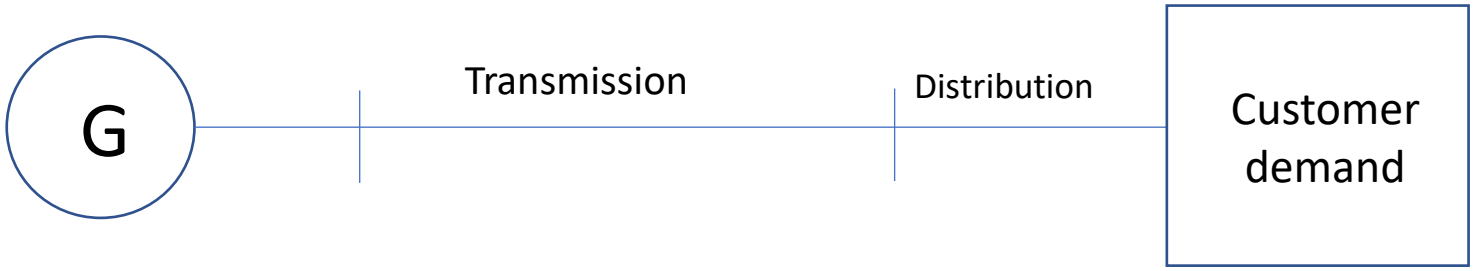
Output of the 740 kW Hambantota solar park, on a "good' day

An electric power system should be resilient

What is resilience?

- ✓ robustness and flexibility
- ✓ redundancy to allow for continuity of supply
- ✓ Smartness: its intrinsic adaptability, controllability and in-built capacity for recovery
- ✓ Fast recovery: ease of system repair and preparedness

A power system has to be in dynamic equilibrium all the times. Power generation should match the customer demand plus network losses, at all times.



$P_G = P_D + losses$

eg: 2600 MW of generation= 2530 MW of demand + 70 MW of losses [an exact match]

Sri Lanka's Power System in Weak ! Hence it is not SMART

- Even minor disturbances cause frequency excursions and load shedding. The traditional approach to strengthen is to raise inertia (larger, faster generators) and more spinning reserve
- On this front, Sri Lanka missed the bus !
- Rest of the world was building larger, stronger, faster generators ….
- Sri Lanka stuck to hydropower development (for all the good reasons), ended up with a weaker power system

Regulatory reforms have failed to deliver

Regulatory Reforms have not worked: Economic regulation by PUCSL since 2010

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
PUC- approved cost of supply (LKR/kWh)	16.91	14.95	21.32	22.12	16.84	18.89	18.27	21.47	20.64	21.59	20.60	22.05
PUC-approved price of electricity (LKR/kWh)	13.15	13.91	13.91	19.71	18.94	16.29	16.63	16.71	16.77	16.82	16.81	16.81
PUC-approved sales forecast (million units)	9,121	9,666	10,427	10,949	10,949	11,271	12,049	13,360	14,683	15,093	15,040	15,268
Resultant annual financial loss to electricity sector (LKR billion)	34.3	10.1	77.3	26.4	-23.0	29.3	19.8	63.6	56.8	71.1	57.0	80.1
Cumulative regulatory cash shortfall (LKR billion)	34.3	44.4	121.7	148.1	125.1	154.4	174.1	237.7	294.5	365.6	422.6	502.6

Regulatory reforms have failed to deliver

Summary of costs for 1H 2025 (regulator)

	LKR million		
	Variable: Energy	Fixed: Capacity	Fixed: other
Generation Energy	157,424		
Generation Capacity		31,408	
Transmission capacity		10,586	
Distribution capacity		42,174	
Finance costs			7,728
Total	**157,424**	**84,168**	**7,728**

Summary of costs for 1H 2025 (regulator)

	Rs/kWh sold			
	Variable: Energy	Fixed: Capacity	Fixed: other	Total
Generation Energy	19.65			19.65
Generation Capacity		3.92		3.92
Transmission capacity		1.32		1.32
Distribution capacity		5.26		5.26
Finance costs		-	0.96	0.96
Total	**19.65**	**10.51**	**0.96**	**31.12**

Forecast sales 8,012 GWh

	LKR million	
Total income at the tariff that prevailed	242,297	
Total income after 20.08% reduction	193,644	
National average selling price		**24.17**

Challenges

- **Technical**: Keep the grid stable, raise power quality
- **Renewables**: Growth, at the correct price
- **Regulation**: To come back to the track, even at this late hour
- **Cost and price of electricity**: equal, at LKR 25 per kWh

The Greatest Challenge: True Cost and True Price

Cost item	Cost in LKR per kWh sold	
	True forecast Jan-Jun 2025	Possible Target 2030
Generation energy	21.88	14.50
Generation capacity	3.96	4.50
Transmission	1.53	1.25
Finance	0.97	0.25
Distribution	5.51	4.50
Total	33.85	25.00