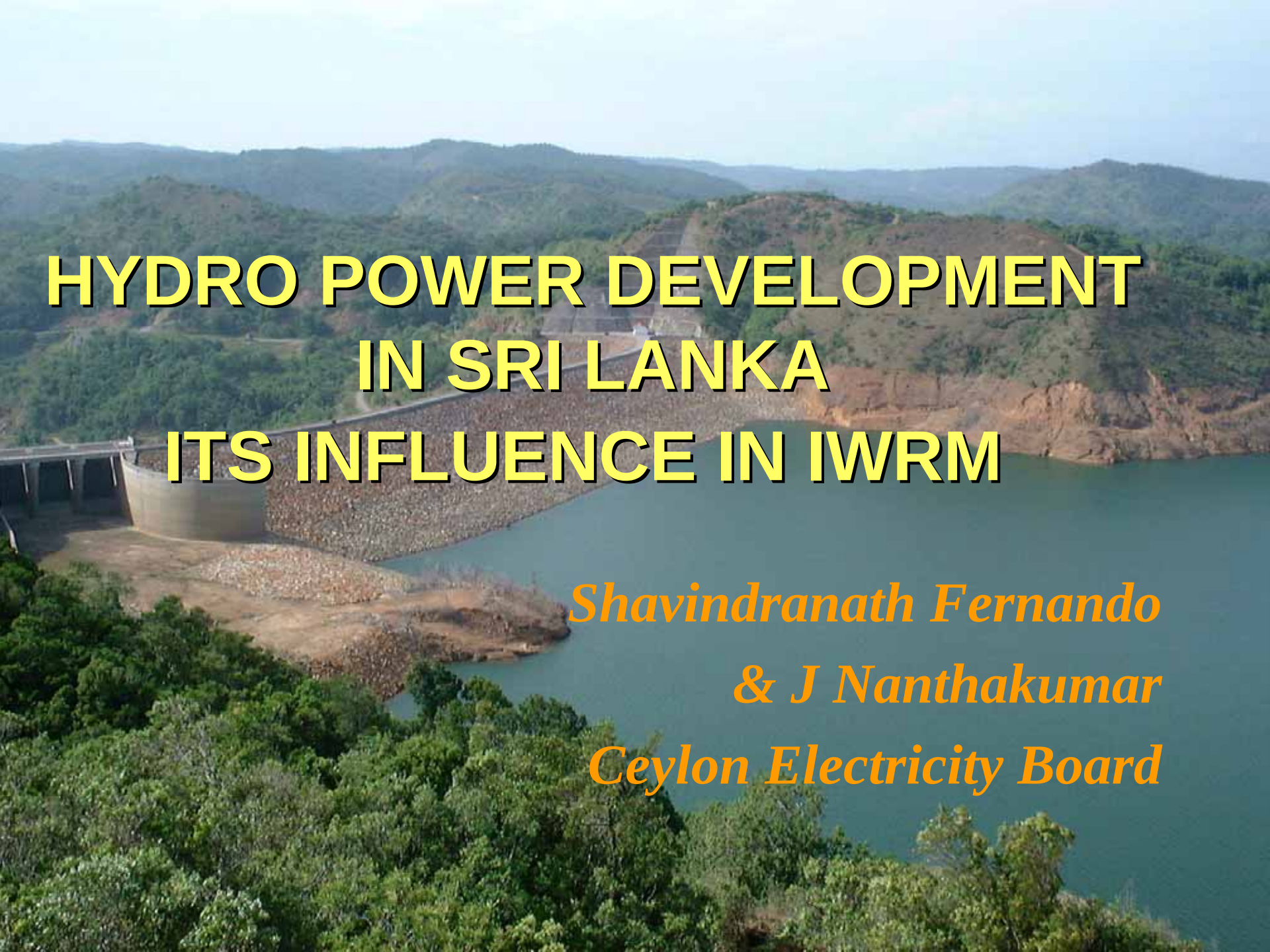

HYDRO POWER DEVELOPMENT IN SRI LANKA ITS INFLUENCE IN IWRM

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& J Nanthakumar
Ceylon Electricity Board

Why - IWRM

- Water is a vital resource for human survival and economic development
- As populations and economies grow, water demand increases while the availability of the resource remains constant.
- Shortages engender water use conflicts, both in terms of quantity and quality.

Source: www.cap-net.org

Why - IWRM

- The basis of Integrated Water resources Management (IWRM) is that different uses of water are interdependent.
- Integrated management means that all the different uses of water resources are considered together.
- Deliberate management of resources is needed to ensure long term sustainable use.

Source: www.cap-net.org

The International Conference on Water and Environment, Dublin, Ireland, January 1992.

A meeting in Dublin in 1992 gave rise to four principles that have been the basis for much of the subsequent water sector reform.

Source: www.cap-net.org

The International Conference on Water and Environment,

- Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment
- Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.

Source: www.cap-net.org

The International Conference on Water and Environment,

- Women play a central part in the provision, management and safeguarding of water.

- Water has an economic value in all its competing uses and should be recognised as an economic good.

Source: www.cap-net.org

Hydro Power Development in the Country

- Hydropower is a natural indigenous and a ***renewable*** resource.
- Development of hydroelectricity should consider the ***interactions*** between electricity generation and other users of water
- Hydro Power can be commercially exploited for ***economic*** benefits.
- Hydro Power has been used over the years to provide motive power and electricity to a resource constrained country.

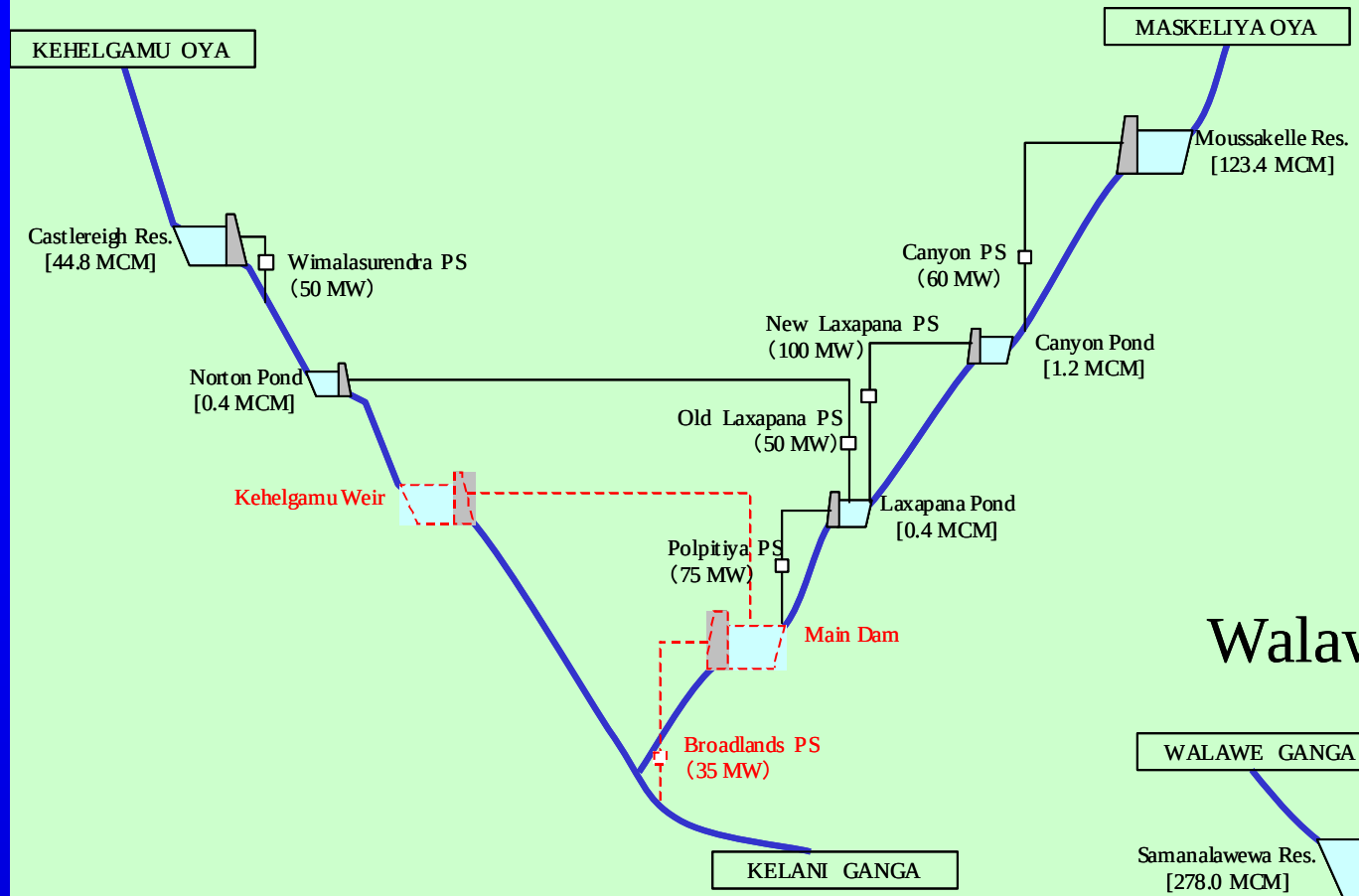
Historic Development of Hydro Power in Sri Lanka

- Introduction of Electricity to Sri Lanka
  - **M/s. Baustead Brothers Ltd in 1895**
- Establishment of Department of Government Electrical Undertakings (DGEU) in 1928
- Establishment of CEB
  - **Act of Parliament on 1st November 1969**
- Nuwara Eliya received its first public mini hydro scheme in the early 20th century

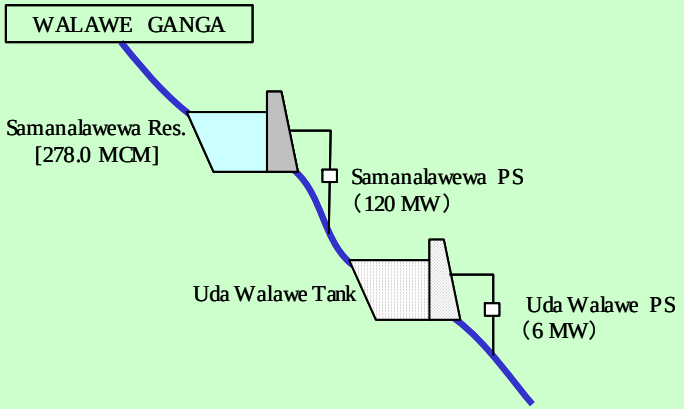
Historic Development of Hydro Power in Sri Lanka Cont…

- Over 500 Micro hydro schemes existed in tea estates since last decade of the 19th century
- The first major hydro electricity scheme
  - **Aberdeen/Laxapana Scheme proposed by Eng. D. J. Wimalasurendra in 1924 realized only in 1950.**
- Kelani River tributaries (Kehelgamu Oya and Maskeli Oya)
  - **335 MW of power**
  - **1450 GWh per annum**

Laxapana Complex



Walawe Basin



Salient Features of Laxapana Complex

- Electrical Energy for the Country
- Flood Control
- Ensuring Water Supply to Colombo and Suburbs during drought
- Other local users

Coordination during drought

- During the drought period the water supply intake located at Ambatale gets salinity intrusion. To flush the salinity hydro power is generated jeopardising system supply security
- CEB and NWSDB closely monitor and carry out the above releases on the request of NWSDB

Coordination during Flood

- Irrigation Department monitors the Flood level at Nagalagama Street along the Kelani River. Colombo and the outskirts are liable to get inundation.
- Emergency Coordination Team gets activated comprising officials from various institutions to coordinate and control flood.

Historic Development of Hydro Power in Sri Lanka Second Major Thrust

- Six Major Hydro Power Stations Constructed with total installed capacity of 665 MW capable of generating around 2000 GWh per annum under average rainfall conditions.
- 150,000 Ha of irrigable land developed
- Major diversion at Polgolla.

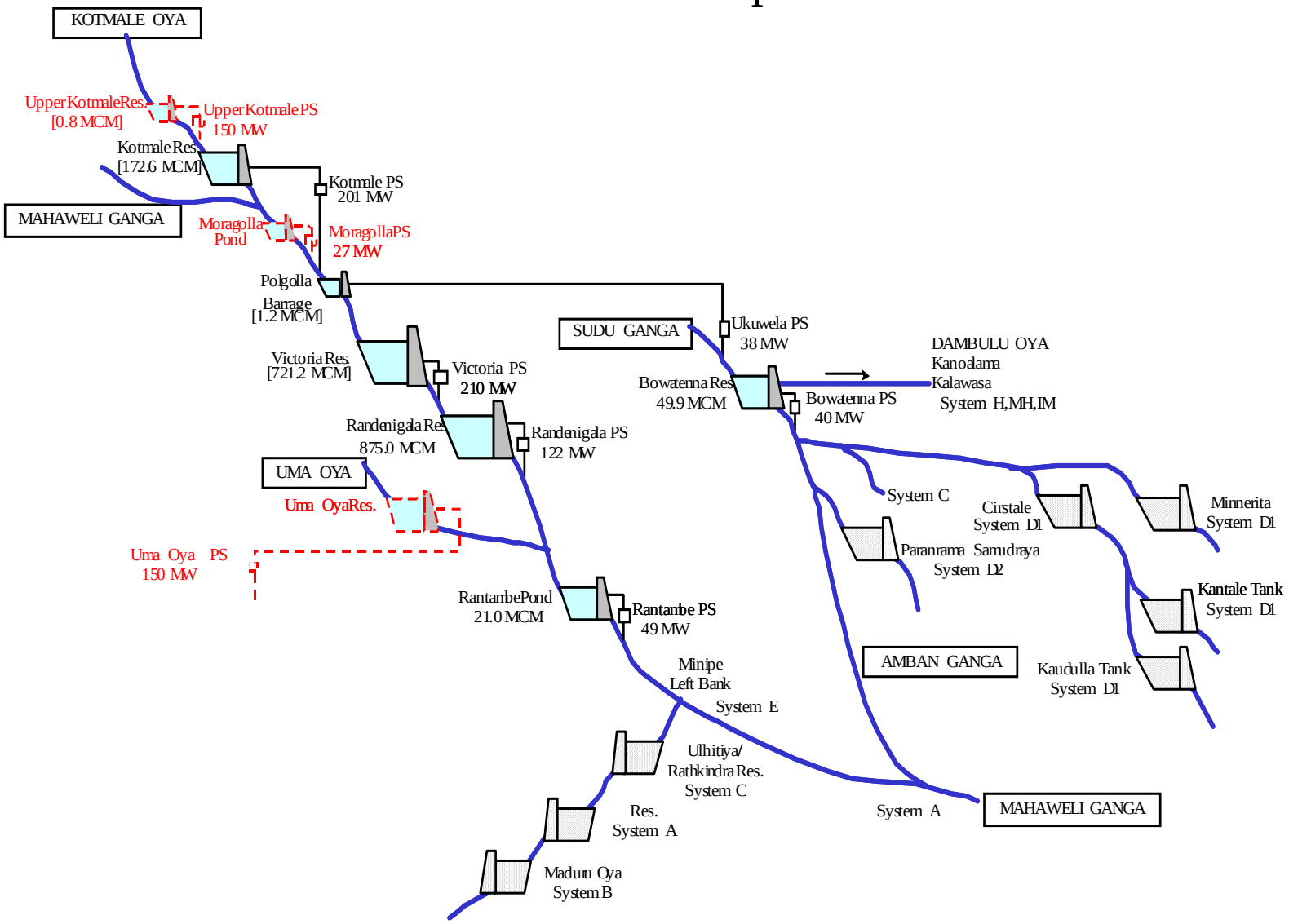
Historic Development of Hydro Power in Sri Lanka Second Major Thrust

- Mahaweli river diversion at Polgolla
  - **Generating 38 MW at Ukuwela and water is sent to Bowatenna Reservoir. Direct irrigation water to Mahaweli H area (52,000 Ha). Water through Bowatenna (40MW) power station is sent to D and G irrigation areas. (46,000 Ha)**
- Down Stream Irrigation Requirement
  - **After generating power at Victoria (210 MW), Randenigala (120 MW) and Rantembe (50 MW), water is diverted at Minipe to B, C and A areas (52,000 Ha)**

Allocation of Water in the Mahaweli Scheme

- Water Management Secretariat of Mahaweli Authority of Sri Lanka coordinates with Irrigation, Ceylon Electricity Board and Water Supply & Drainage Board to allocate available water in an optimum Manner.
- Hydro power is non-consumptive user.

Mahaweli Complex



Hydro Power in Sri Lanka Other Developments

- Samanalawewa on Walawe River
  - Installed capacity of 120 MW
  - Commissioned in 1992
  - Capable of generating 390 GWh per annum
  - Approximately 25% of the inflow is released from Bottom outlet and also the leak for Irrigation purpose.

Hydro Power in Sri Lanka
Other Developments

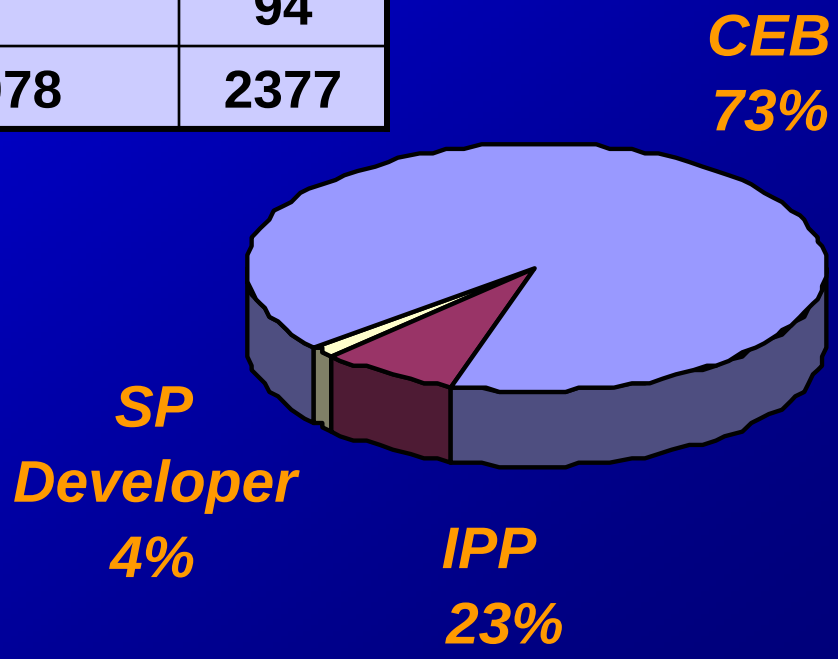
- Kukule Ganga Hydro power development.
  - **70 MW**
  - **303 GWh**
  - **Commissioned in Mid 2003**
- Kukule developed as a run of river scheme due to environmental and economic reasons thus depriving water to SEDZ.

Historic Development of Small Hydropower

- Inginiyagala (14 MW) –Irigation related
- Udawalawe (6 MW) -Irrigation related
- Nilambe (3.2 MW)
- 97 MW of small hydro Power plants
  - owned and operated by the private sector under the Small Power Purchase Agreements

Sri Lanka Power System

	Hydro MW	Thermal MW	Total MW
CEB	1205	528	1733
IPP		550	550
SP Developer	94		94
Total	1299	1078	2377



Hydro Power Plants Under Development

- Under Construction **U**pper Kotmale HP
  - **River Basin – Mahaweli Ganga**
  - **150 MW**
  - **409 GWh**
  - **Expected in 2011**
- Salient features: Water releases to ensure aesthetic and ecological demands downstream

Future Candidate Hydro Projects

Plant	Interested parties to Construct
Ging Ganga 49MW	•A Cabinet decision has taken to develop as an IPP
Moragolla 27MW	•Feasibility by Kuwait Fund. • A Cabinet decision has taken to develop as an IPP
Broadlands 35 MW	•China National Electric Equipment Corporation •China National Machinary & Equipment Import & Export Corporation
Uma Oya 150MW	Govt. of Sri Lanka by a soft loan

Power System Planning Criteria

- Maximizing the use of the only indigenous natural resource for power generation

Hydropower

- Installation of adequate thermal base load capacity

meet the shortfall in hydropower

- Installation of gas turbines (GTs)

For peaking and run as and when required. GTs are cheaper to purchase but expensive to run

Integrated System Simulation Model (SYstem SIMulation)

- To simulate and optimise the combined operation of the existing and committed system to provide defined reliabilities of irrigation and electricity supplies at minimum cost.

- To evaluate the potential role of candidate hydro projects in a system context

SYSIM Methodology

- Use past 50 years hydrological data
- Simulate in a future system
  - Irrigation Demands
  - Power Demands
  - Irrigation system – tanks, canals etc.
  - Power system – reservoirs, plants
- Evaluate the hydro potential of the existing and future hydro plants

Assessment of hydro potential in Mahaweli is difficult due to

- the multi-purpose nature of the reservoirs - have to satisfy both irrigation and power demands
- seasonal variation - inflows to the reservoirs and irrigation demands fluctuate over the year

Operation of Hydro Thermal System

- Hydro - Thermal operations simulation is carried out to optimise the use of water by allocating water value to hydro storage
- Updated on a monthly basis at National Dispatch Center to decide on the hydro thermal share to meet electricity, subject to constraints imposed at weekly meeting held at WMS

Small Hydro Potential

Master Plan Study

- Undeveloped sites
  - **30 MW in 62 sites.**
- Irrigation projects
  - **Approximately 8 MW in around 290 sites**
- The rehabilitation / upgrading / extension of existing or disused small hydro projects
  - **50 MW in 140 Sites**

Other Studies

- CEB Study
  - **100 MW with a yield if 390 GWh**
- ITDG Study
  - **150 MW**

1996, 2001/2 Power Crises and Dependency of Hydro Power Generation

- Vulnerability of hydro Power generation on the vagaries of weather is a well understood phenomenon in power Generation Planning.
- Capacity additions are based on extremely dry weather conditions.
- Thermal plants are added to the system periodically to cater to meet any short falls in capacity.

1996, 2001/2 Power Crises and Dependency of Hydro Power Generation cont

- What in fact happened in 1996 and 2001/2002was the non-implementation of certain recommended thermal power plants in time since 1992.
- As such there was no adequate thermal back up available in 1996 and 2001/2 when dry weather occurred in 1996 and 2001/2.
- On the other hand it can be proved beyond doubt that if the required thermal generating plants were added to the system as recommended in 1992, this most devastating 1996 and 2001/2 power crises could have been avoided.

Conclusions

- Hydro Power planning takes into account multiple use of water such as irrigation, drinking water requirements, environmental aesthetical and ecological releases and uses optimisation techniques.
- Hydro power operation is done to met the demands posed by the generation requirement and other considerations such as irrigation, flood control and drinking water requirements.

Conclusions

- Pure economic evaluation of future Multi-purpose hydro project needs careful consideration as irrigation and drinking water requirement has less financial value compared to electricity
- Strong need of a Water regulator to coordinate all users of Water and to design and implement multi-purpose projects.