DA AFGHANISTAN BRESHNA SHERKAT

د افغانستان برښنا شرکت

DABS OVERVIEW
ENERGY STATISTICS,
GOALS AND ACTIVITIES

Afghanistan Energy Sector

Afghanistan Energy Infrastructure, generation, transmission and distribution were almost destroyed over the past three decades due to the war and conflicts.

The government of Afghanistan corporatized the National electricity service department Da Afghanistan Breshna Mossasa (DABM) into an independent state owned utility.

As such, all assets, staff and other Rights and Obligations of (DABM) were transferred to Da Afghanistan Breshna Sherkat (DABS) on May 2008.

DABS System Statistics

- Sources of Electricity
  - Imported 66%
  - Hydro 30%
  - Thermal 4%
- Total Staff above 6,000 employees
- DABS serves 34 Provinces and 786,302 customers
- The availability of power in Afghanistan has improved significantly over the last two years
- The challenge is now to improve commercial performance

Afghanistan Cross Border Exchange Overview

A) Afghanistan Cross Border Exchange

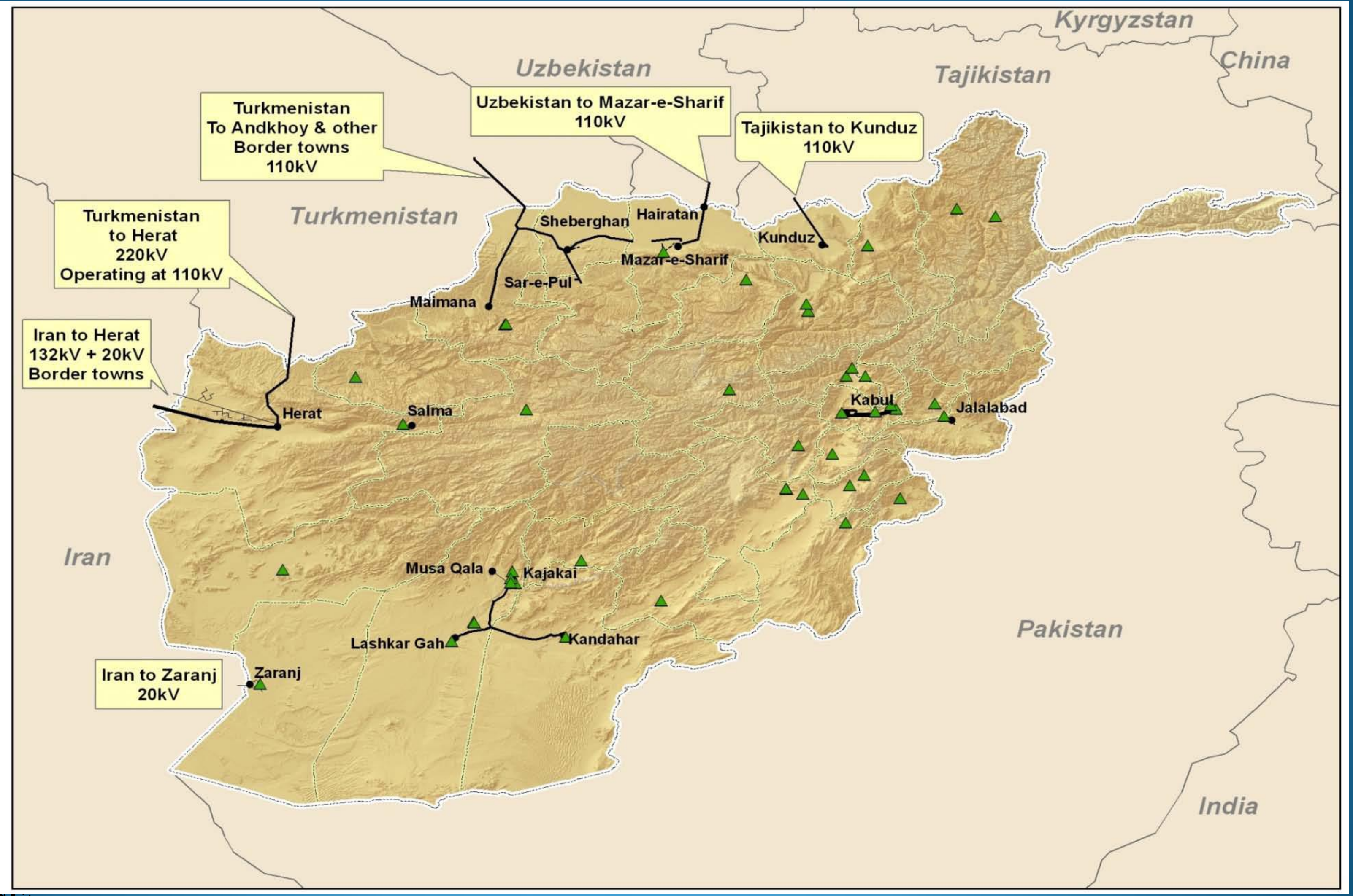
B) Central Asia - South Asia (CASA -1000)

Afghanistan Cross Border Exchange

Afghanistan Imports Power from the following countries:

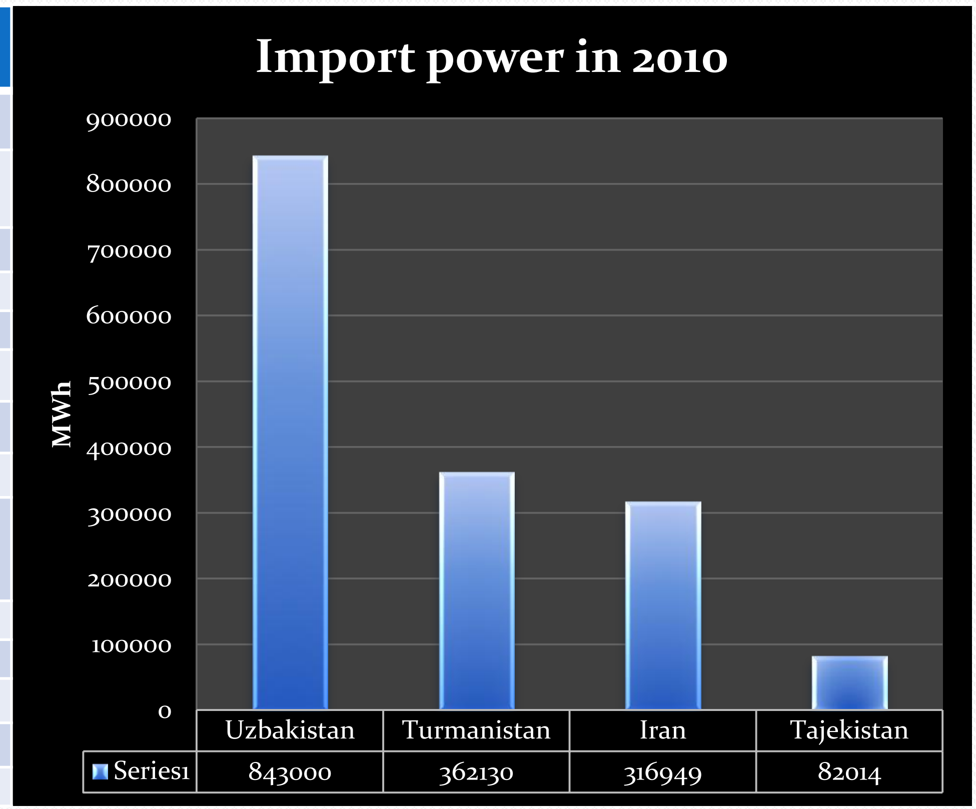
- Tajikistan
- Turkmenistan
- Uzbekistan
- Iran

Existing Cross Border Transmission

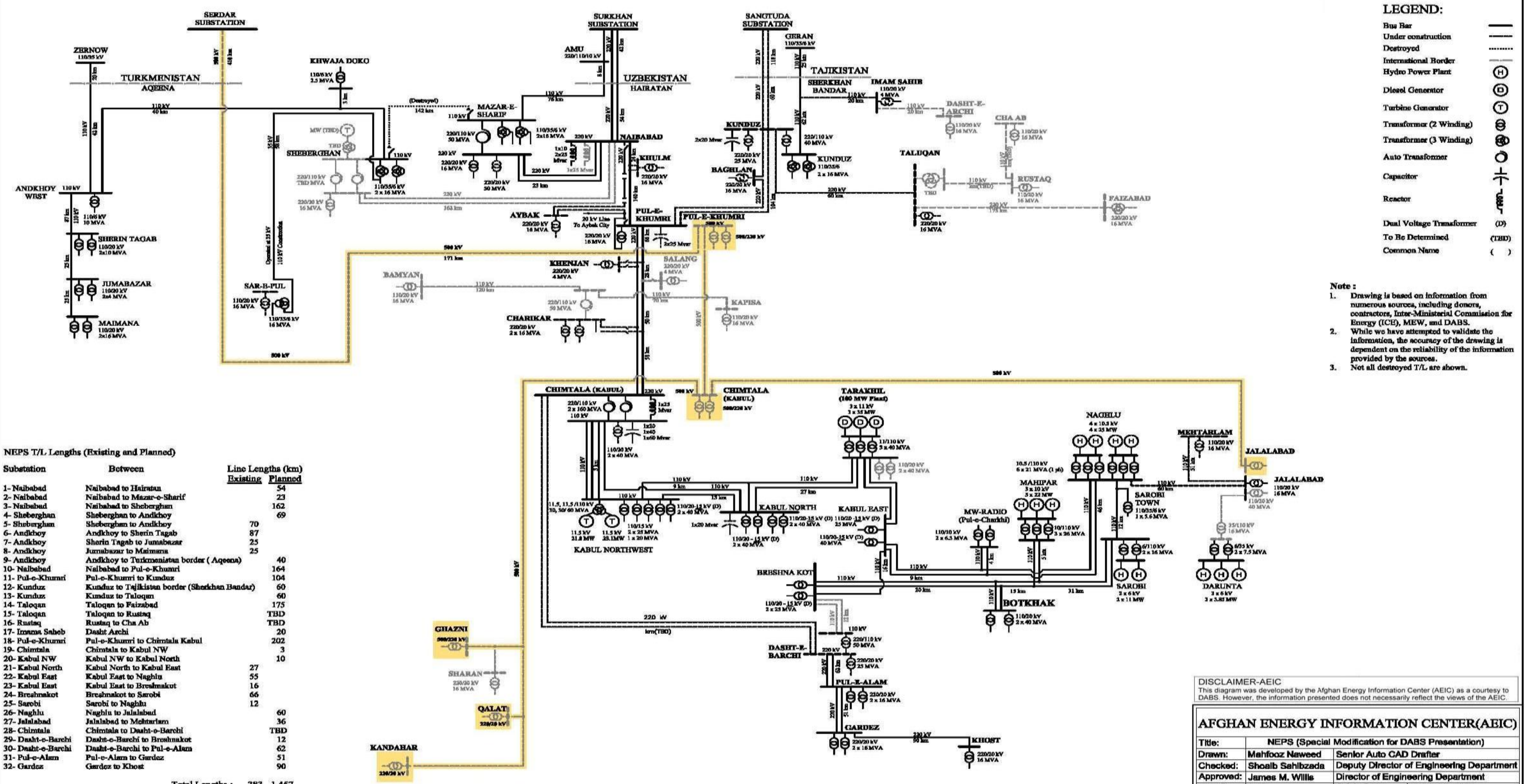


Afghanistan power Import from neighboring country)

Uzbakistan		220Kv	**843000**	**MWh**
Turmanistan			**362130**	**MWh**
	Andkhoi	110Kv	158599	MWh
	Aqina	6Kv	264	MWh
	Heart	110Kv	194971	MWh
	Turghondi	10Kv	8297	MWh
Tajekistan			**82014**	**MWh**
	Kundoz	110Kv	97114	MWh
	Sheek Khan bandar	10Kv	2900	MWh
Iran			**316949**	**MWh**
	Heart	132Kv	267396	MWh
	Islam Qala	20Kv	3920	MWh
	Nimroz	20Kv	45633	MWh
Total			**1604093**	**MWh**



(NEPS & SEPS) سیستم انتقال برق شمال شرق و جنوب شرق افغانستان



NEPS T/L Lengths (Existing and Planned)

Substation	Between	Line Lengths (km) Existing	Line Lengths (km) Planned
1- Naibabad	Naibabad to Hairatan		54
2- Naibabad	Naibabad to Mazar-e-Sharif		23
3- Naibabad	Naibabad to Sheberghan		162
4- Sheberghan	Sheberghan to Andkhoy		69
5- Sheberghan	Sheberghan to Andkhoy	70	
6- Andkhoy	Andkhoy to Sherin Tagab	87	
7- Andkhoy	Sherin Tagab to Jumabazar	25	
8- Andkhoy	Jumabazar to Maimana	25	
9- Andkhoy	Andkhoy to Turkmenistan border (Aqeena)		40
10- Naibabad	Naibabad to Pul-e-Khumri		164
11- Pul-e-Khumri	Pul-e-Khumri to Kunduz		104
12- Kunduz	Kunduz to Tajikistan border (Sherkhan Bandar)		60
13- Kunduz	Kunduz to Taloqan		60
14- Taloqan	Taloqan to Faizabad		175
15- Taloqan	Taloqan to Rustaq		TBD
16- Rustaq	Rustaq to Cha Ab		TBD
17- Imama Saheb	Dasht Archi		20
18- Pul-e-Khumri	Pul-e-Khumri to Chimtala Kabul		202
19- Chimtala	Chimtala to Kabul NW		3
20- Kabul NW	Kabul NW to Kabul North		10
21- Kabul North	Kabul North to Kabul East	27	
22- Kabul East	Kabul East to Naghlu	55	
23- Kabul East	Kabul East to Breshnakot	16	
24- Breshnakot	Breshnakot to Sarobi	66	
25- Sarobi	Sarobi to Naghlu	12	
26- Naghlu	Naghlu to Jalalabad		60
27- Jalalabad	Jalalabad to Mehtarlam		36
28- Chimtala	Chimtala to Dasht-e-Barchi		TBD
29- Dasht-e-Barchi	Dasht-e-Barchi to Breshnakot		12
30- Dasht-e-Barchi	Dasht-e-Barchi to Pul-e-Alam		62
31- Pul-e-Alam	Pul-e-Alam to Gardez		51
32- Gardez	Gardez to Khost		90
	Total Lengths :	383	1,457

DISCLAIMER-AEIC
This diagram was developed by the Afghan Energy Information Center (AEIC) as a courtesy to DABS. However, the information presented does not necessarily reflect the views of the AEIC.

AFGHAN ENERGY INFORMATION CENTER(AEIC)

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Dwg #:	1 of 1	Origin Date:	March 14, 2011
Rev Date:	March 16, 2011	Rev #: 01	Scale: NTS

CENTRAL ASIA – SOUTH ASIA ELECTRICITY TRANSMISSION AND TRADE (CASA - 1000)

CASA 1000: Background

- Initiative to transfer power from central Asia to South Asia
- Establishment of CASAREM (Central Asia South Asia Regional Electricity Market)
- CASA-1000 project is anchor project under CASAREM
- Under this project
  - 1,300 MW will be exported from Kyrgyzstan and Tajikistan
  - to Afghanistan and Pakistan
- Project objective:
  - Establishment of financially viable electricity market between Central Asia and South Asia

CASA 1000: Background

- Current project status:
  - Techno-Economic Feasibility Study has been completed by SNC Lavalin
  - Awaiting approval from member countries
- Expected Start Date:
  - 7 months after approval of feasibility study by member countries
  - This will allow for tender float and evaluation
- Expected completion Date:
  - 40 months after award of Turn Key project
- Estimated Cost in USD:
  - EPC 734 million
  - Owner's Engineer 15 million

CASA 1000: Project Cost and Funding

Activity	Estimated Cost in USD
EPC	734 million
Owner's Engineer	15 million
Contingency (10%)	74 million
Network Rehabilitation Cost	34 million
TOTAL	857 million

- Funding not available at the moment
- World Bank and Islamic Development Bank (IDB) intend to provide funding

THANK YOU

Introduction

Afghanistan, the Kyrgyz Republic, Pakistan, and Tajikistan have been pursuing the

development of electricity trading arrangements and the establishment of a Central Asia -

South Asia Regional Electricity Market (CASAREM). The initial plan was to export power in

the range of 1,000 to 1,300 MW from the Kyrgyz Republic and Tajikistan to Pakistan and

Afghanistan

Continue.....

Introduction

. It was envisaged that the major share of the export will be used by Pakistan,
while around 300 MW will be imported by Afghanistan. Pakistan has also expressed interest
in increasing imports over the medium to long term beyond the initial power requirements of
1,000 MW.
SNC-Lavalin was commissioned to prepare a feasibility study, in two phases, for the
regional interconnection. The final Phase 1 report was submitted in December 2007 and the
Phase 2 report, in January 2009.

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Since these initial reports were issued, there have been significant changes in market

conditions that could have an impact on the cost of the project. Also, detailed work has been done by other consultants in the respective countries that information and allow now can provide additional a further assessment of the feasibility of the project.

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The present study is an update of the initial feasibility study, with the addition of certain new elements such as the assessment of the optimal size of the interconnection.

In addition to this size optimization, this study updates the assessment of import and export potentials using the latest available data, the update of the economic analysis, cost estimates and schedule, a review of the HVDC line routing and existing transmission network in the countries, and an identification of major risks.

Advantages of CASA for Afghanistan

- Improving of Energy demand for Afghanistan
- Reliability of electricity grid
- Transit fee
- Work opportunities
- Others

"Transitioning the South Asian Energy Market: Advancing Low Carbon Growth Through Regional Cooperation and Cross-Border Energy Trade" Organized by USEA & STELCO

Bhutan – India Exchange


Tashi Dorjee, Chief Engineer

Department of Energy, MoEA

July 11 – 13, 2011

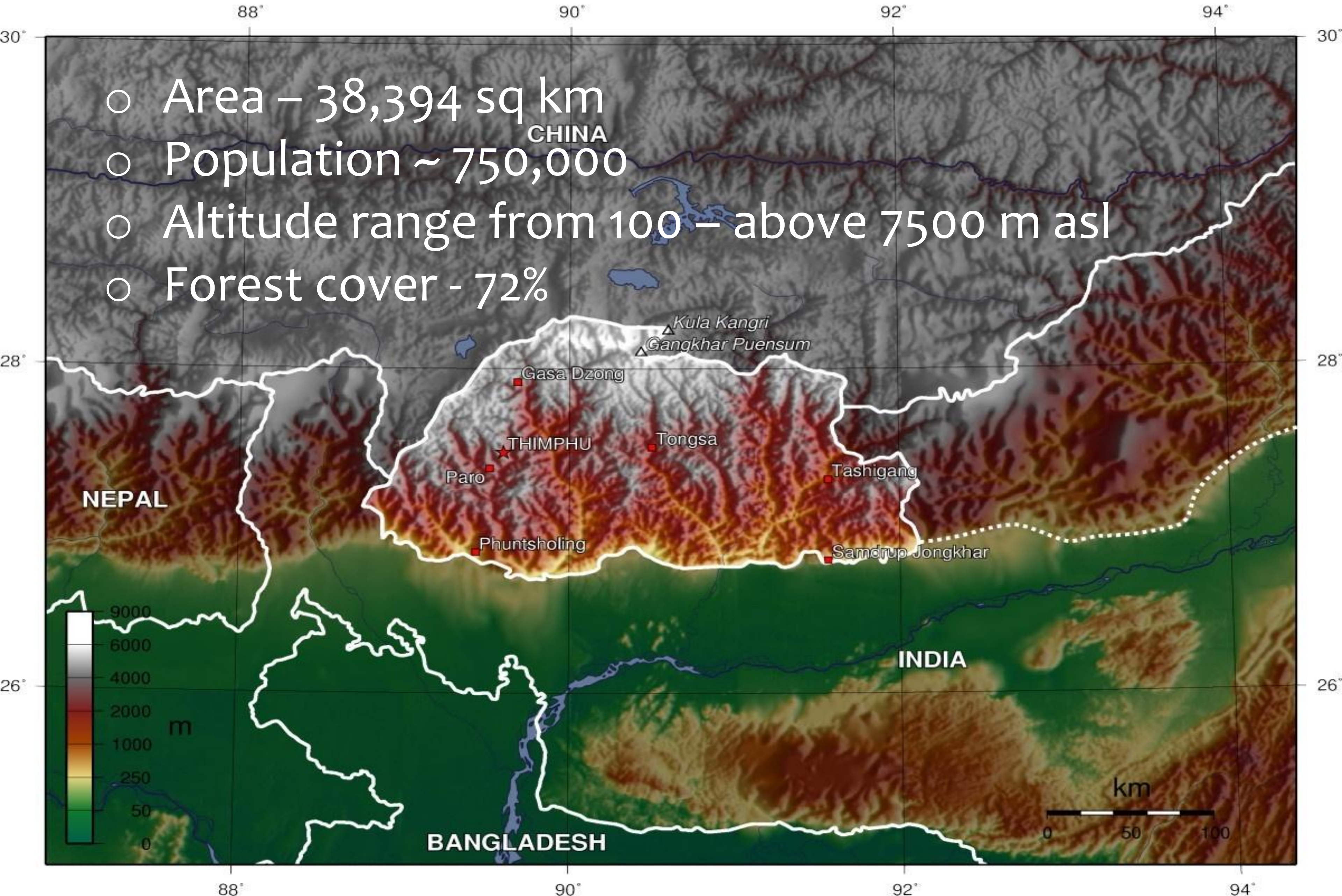
Male, Maldives

Presentation Outline

1. Bhutan – Salient Features
2. Hydropower Potential & Status of Development
3. Bhutan-India Power Sector Cooperation
4. Power Supply-Demand Scenario
5. Opportunity for Trans-Boundary CDM Benefits
6. Future Prospects for Cooperation between Bhutan & India

1. Bhutan – Salient Features

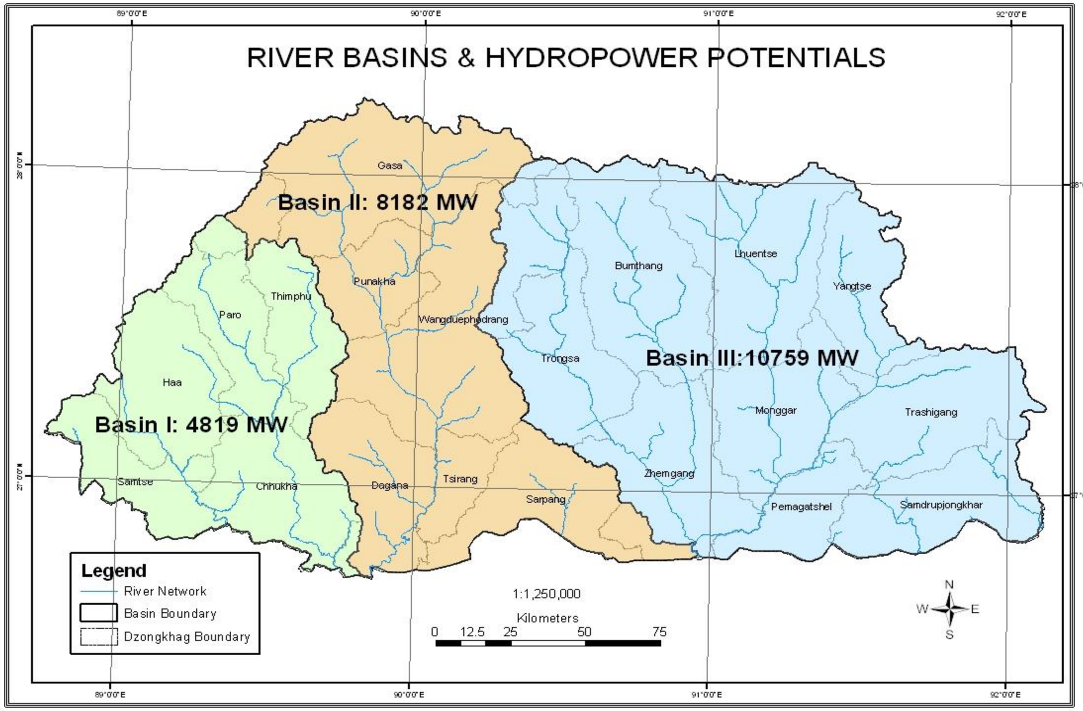
- Area – 38,394 sq km
- Population ~ 750,000
- Altitude range from 100 – above 7500 m asl
- Forest cover - 72%



2. Hydropower Potential & Development Status

The steep and rugged Himalayan mountains and fast running rivers lend themselves to huge hydropower potential

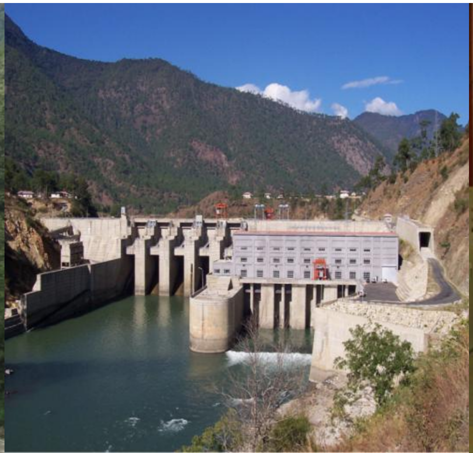
- ❑ 30,000 MW potential
- ❑ 23,760 MW (76 sites of >10 MW) techno-economically viable for development

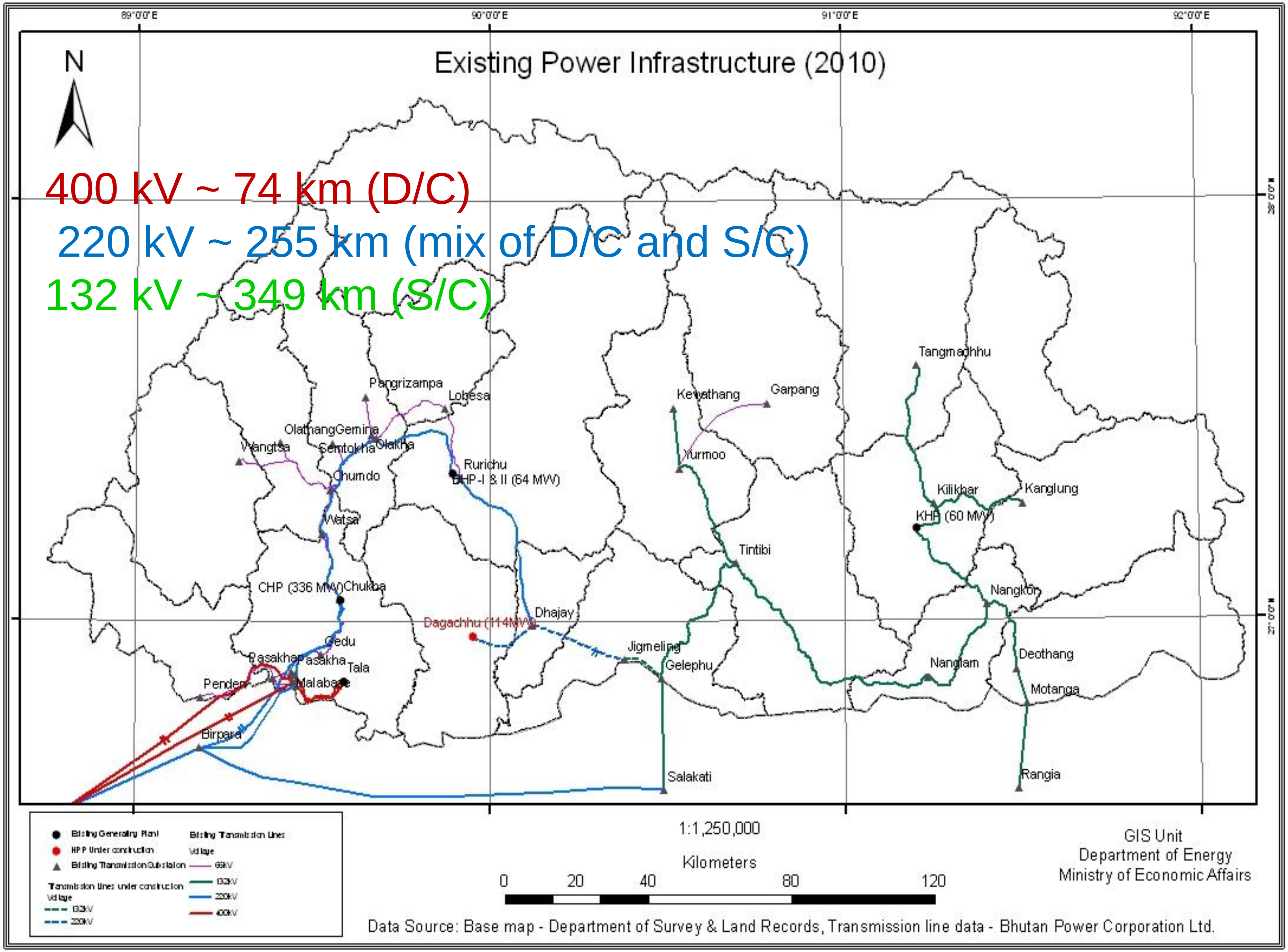


Sl.No.	River-basins	Area (km^2)	Schemes	Potential (MW)	Energy (GWh)
1	Amochhu (Basin I)	2,400	6	2,060	9,656
2	Wangchhu (Basin I)	4,689	10	2,740	11,139
3	Punatsangchhu (Basin II)	10,355	19	8,099	25,495
4	Mangdechhu/Manas-West (Basin III)	7,392	17	3,889	18,322
5	Drangmechhu/Manas-East (Basin III)	9,207	20	6,692	33,422
6	Jaldhaka, Mau, Nyeraamari, Dhansiri	2,750	4	280	1,213
7	Others	1,601			
	Total	**38,394**	**76**	**23,760**	**99,247**

Development Status and Existing Power Infra.

- ✓ Total installed capacity (> 60MW) = 1480 MW
- ✓ Mini/micro hydels developed so far = 8.168 MW (23 nos.)
- ✓ Total hydropower developed = 1488.168 MW (5% of potential)

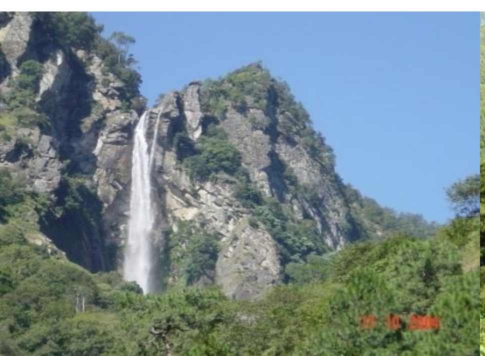





Existing Power Infrastructure (2010)
400 kV ~ 74 km (D/C)
220 kV ~ 255 km (mix of D/C and S/C)
132 kV ~ 349 km (S/C)
N
89°0'0"E
90°0'0"E
91°0'0"E
92°0'0"E
28°0'0"N
27°0'0"N
Tangmachhu
Pangrizampa
Lobesa
Kewathang
Garpang
OlathangGemina
Wangtsa
Semtokha
Olakha
Yurmoo
Rurichu
BHP-I & II (64 MW)
Chumdo
Kilikhar
Kanglung
KHP (60 MW)
Watsa
Tintibi
CHP (336 MW)
Chukha
Nangkor
Dhajay
Dagachhu (114MW)
Gedu
Jigmeling
Deothang
Pasakha
Pasakha
Tala
Gelephu
Nanglam
Pemden
Malabase
Motanga
Birpara
Salakati
Rangia
Existing Generating Plant
HPP Under construction
Existing Transmission Substation
Transmission lines under construction
Voltage
132kV
220kV
Existing Transmission Lines
Voltage
66kV
132kV
220kV
400kV
1:1,250,000
Kilometers
0
20
40
80
120
GIS Unit
Department of Energy
Ministry of Economic Affairs
Data Source: Base map - Department of Survey & Land Records, Transmission line data - Bhutan Power Corporation Ltd.

Salient Feature of Bhutan’s Hydropower:

- ✓ Run-of-the river development with minimal socio-environmental impacts
- ✓ Benign environment (political, social & physical/techno-economic)
- ✓ Catchments well conserved (~72% under forest cover)
- ✓ Backbone of Bhutanese economy (~45% of national revenue and 19% of GDP)




3. Bhutan - India
Power Sector Cooperation

3.1 Hydropower Projects under Operation:

1. Mini/Small Hydels (8 Nos. ~ 5.50 MW)
2. Chukha (336 MW)
3. Kurichhu (60 MW)
4. Tala (1020 MW)

Small/Mini Hydropower Plants:

- 1961: 1st Indo-Bhutan Agreement signed on implementation of 27 MW Jaldhaka hydroelectric project in W. Bengal.
- 1967: 1st mini hydroelectric plant of 360 kW built in Thimphu.
- By 1974: 5 more small hydroelectric plants of about 3090 kW installed.
- 1987-1992 : two mini hydel of 1500 kW and 600 kW developed.

Mini/Small hydels for domestic consumption.

1) Chukha Hydropower Plant (336 MW,1865 GWh)

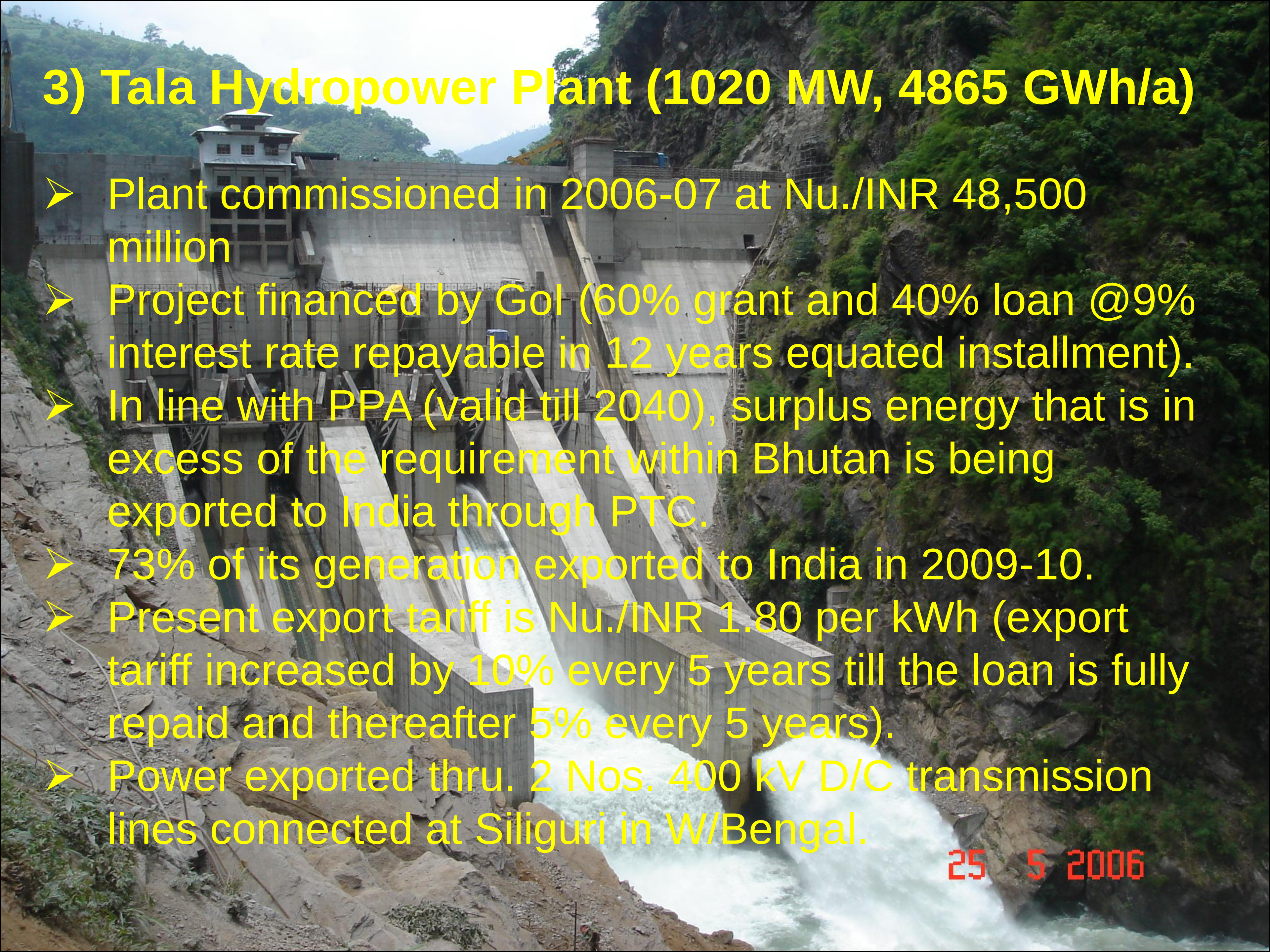
- Plant commissioned in 1986-88 at Nu./INR 2465 million
- Project financed by GoI (60% grant and 40% loan @5% interest rate payable in 15 years).
- Loan liquidated in 2007.
- In line with PPA (valid till 2017), surplus energy that is in excess of the requirement within Bhutan is being exported to India through PTC.
- 85% of its generation exported to India in 2009-10
- Present export tariff is Nu./INR 2.0 per kWh (export tariff to be reviewed after every four years).
- Power exported thru. three 220 kV circuits connected to Indian Grid at Birpara in W/Bengal.

2) Kurichhu Hydropower plant (60 MW, 400 GWh)

- Plant commissioned in 2001-2002 at Nu./INR 5640 million
- Project financed by GoI (60% grant and 40% loan @10.75% interest rate repayable in 24 equated installments).
- In line with PPA (valid till 2027), surplus energy that is in excess of the requirement within Bhutan is being exported to India through PTC.
- 48% of its generation exported in 2009-10.
- Present export tariff is Nu./INR 1.80 per kWh (export tariff increased by 10% every 5 years till the loan is fully repaid and thereafter 5% every 5 years).
- Power exported thru. 132 kV transmission lines connected at Rangia and Salakati in Assam.

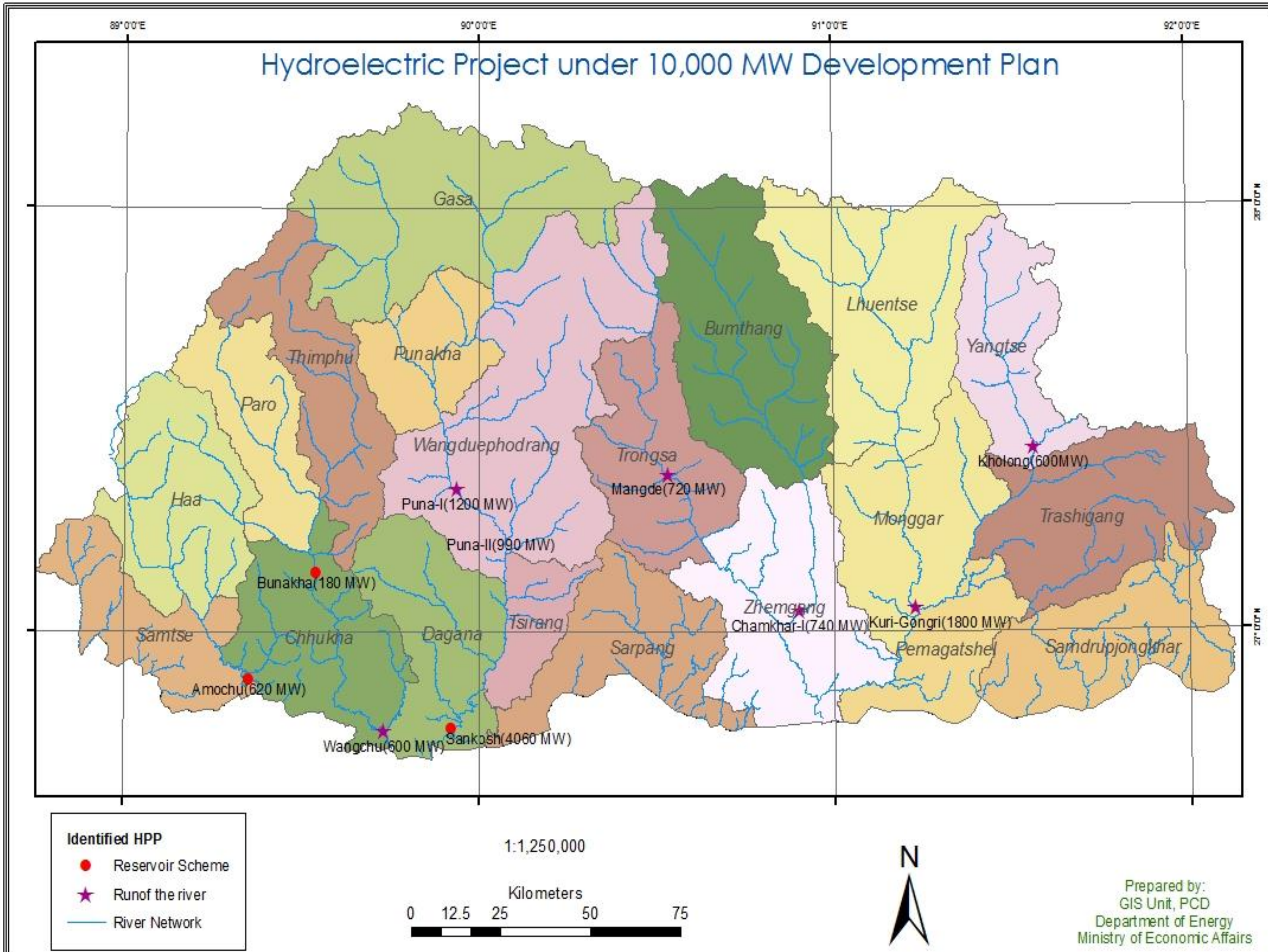
3) Tala Hydropower Plant (1020 MW, 4865 GWh/a)

- Plant commissioned in 2006-07 at Nu./INR 48,500 million
- Project financed by GoI (60% grant and 40% loan @9% interest rate repayable in 12 years equated installment).
- In line with PPA (valid till 2040), surplus energy that is in excess of the requirement within Bhutan is being exported to India through PTC.
- 73% of its generation exported to India in 2009-10.
- Present export tariff is Nu./INR 1.80 per kWh (export tariff increased by 10% every 5 years till the loan is fully repaid and thereafter 5% every 5 years).
- Power exported thru. 2 Nos. 400 kV D/C transmission lines connected at Siliguri in W/Bengal.



3.2 Collaboration for Development of a Minimum Capacity Addition of 10,000 MW by 2020

- ✓ Umbrella Agreement between RGoB and GoI (2006) ~ Target of 5000 MW by 2020 and trade in electricity to be thru. public and private sector participation.
- ✓ Target of 5000 MW doubled to 10,000 MW by 2020 through a Protocol to 2006 Umbrella Agreement signed in 2009 which amongst other, incorporates mechanism to fast track implementation of projects under 10,000 MW plan through Empowered Joint Group (EJG).
- ✓ EJG formed in March 2009 to accelerate identification of projects, DPRs and implementation of projects under the 10,000 MW target by 2020.
  - 10 projects identified and agreed upon totaling about 11,500 MW. Investment volume ~ Nu./INR 500,000 million.
  - 3 projects totaling about 3000 MW under construction and 7 projects under advance stage of DPR preparation.


Hydroelectric Project under 10,000 MW Development Plan
89°0'0"E
90°0'0"E
91°0'0"E
92°0'0"E
Gasa
Thimphu
Punakha
Paro
Haa
Wangduephodrang
Trongsa
Bumthang
Lhuentse
Yangtse
Monggar
Trashigang
Zhemgang
Samtse
Chhukha
Dagana
Tsirang
Sarpang
Pemagatshel
Samdrupjongkhar
Puna-I(1200 MW)
Puna-II(990 MW)
Mangde(720 MW)
Kholong(600MW)
Bunakha(180 MW)
Chamkhar-I(740 MW)
Kuri-Gongri(1800 MW)
Amochu(620 MW)
Wangchu(600 MW)
Sankosh(4060 MW)
Identified HPP
Reservoir Scheme
Runof the river
River Network
1:1,250,000
Kilometers
0 12.5 25 50 75
N
Prepared by:
GIS Unit, PCD
Department of Energy
Ministry of Economic Affairs

Projects under Construction

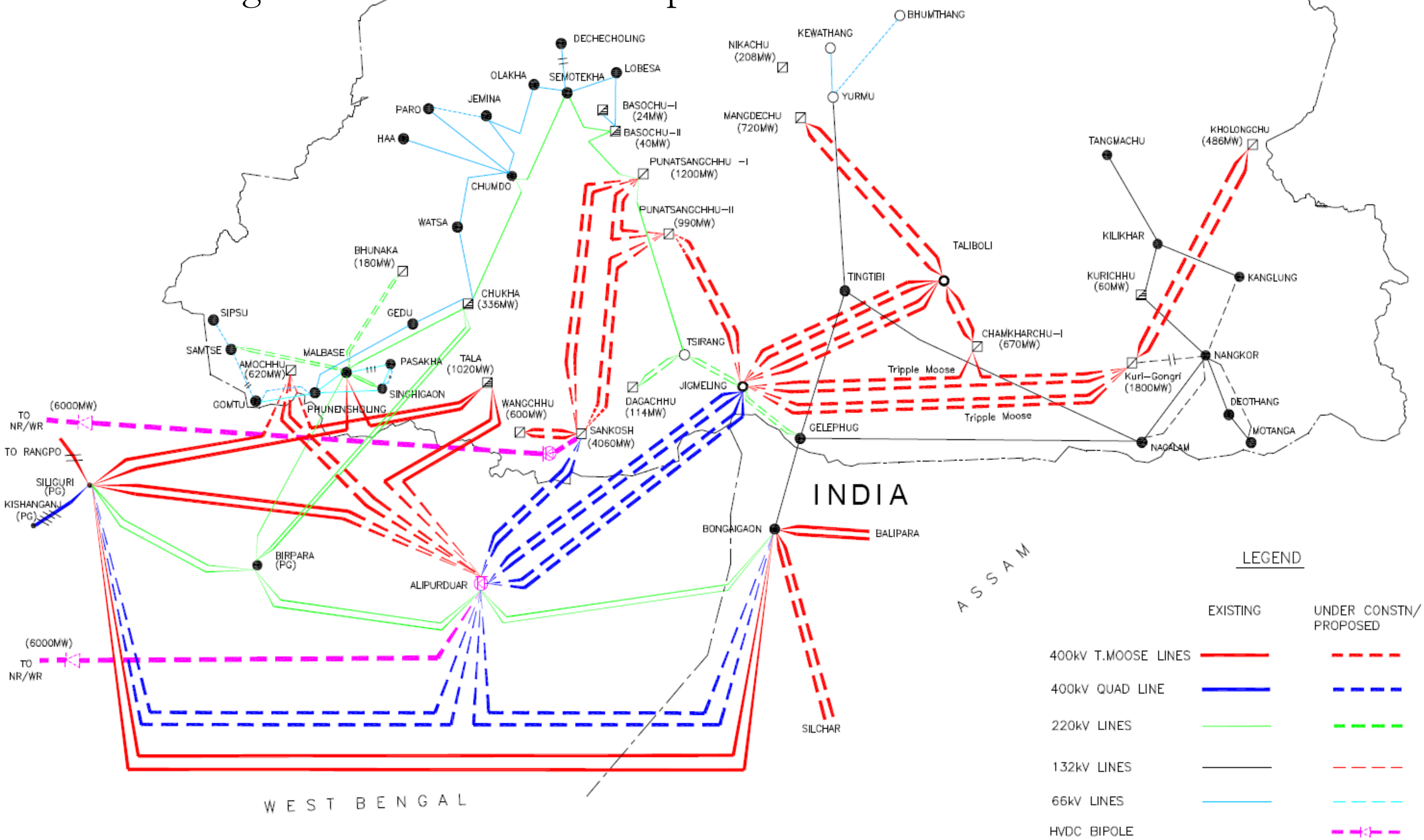
Sl. #	Project	Capacity (MW/GWh)	Remarks
1	Puna-I	1200/5671	- Project cost: Nu/INR 35,148 million (2006 PL) - Financed fully by GoI: 40% grant and 60% loan at 10% interest rate repayable in 12 equated annual installment. - Construction started in 2008 and scheduled for commissioning in 2015.
2	Puna-II	990/4151	- Project cost: Nu/INR 37,778 million - Financed fully by GoI: 30% grant and 70% loan at 10% interest rate repayable in 30 equated annual installment. - Construction started in 2010 and scheduled for commissioning in 2016/17.
3	Mangdechhu	720/2924	- Project cost: Nu/INR 28,963 million - Financed fully by GoI: 30% grant and 70% loan at 10% interest rate repayable in 30 equated annual installment. - Construction started in 2011 and scheduled for commissioning in 2017.

Projects under DPRs Study

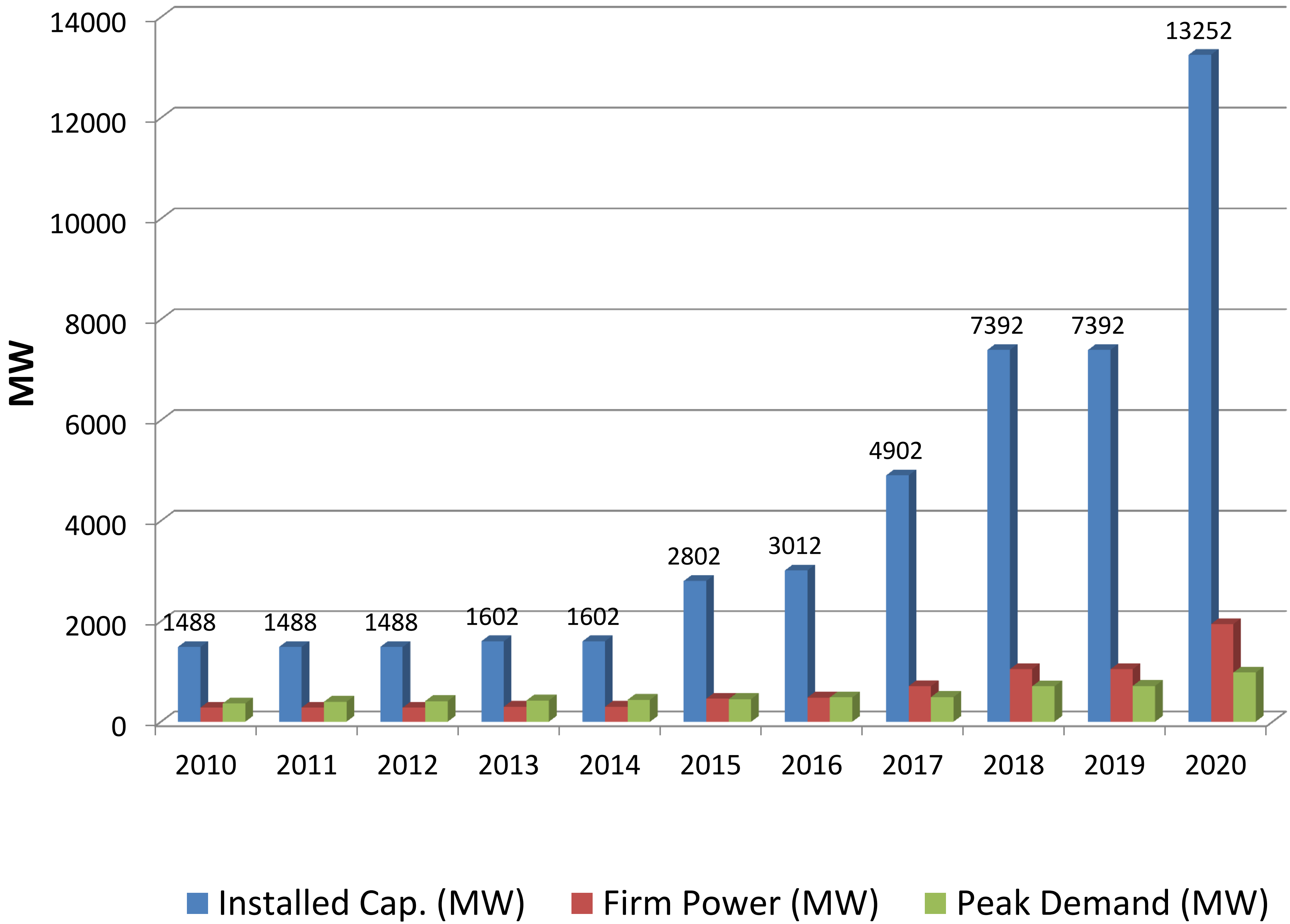
Sl. #	Projects	Capacity (MW/GWh)	Submission Date of Final DPRs	Start Date of Construction	Agreed Dev. Mode
4	Sankosh Storage	4060/7100	Mar. 2011	2012/13	IG
5	Kuri-Gongri	1800/6800	Dec. 2011	2013/14	IG
6	Amochhu Storage	620/3375	Sept. 2011	2012	IG
7	Bunakha Storage	180/688	Mar. 2011	2012	JV
8	Kholongchu	600/2500	June 2011	2012	JV
9	Chamkharchu-I	720/3208	Dec. 2011	2012	JV
10	Wangchhu	600/2415	Dec. 2011	2012	JV

Transmission Grid Network by 2020

NTGMP Study - Provide comprehensive and integrated roadmap for construction of transmission system in Bhutan for smooth evacuation of surplus power to India and meeting domestic demand with optimized RoW and costs.



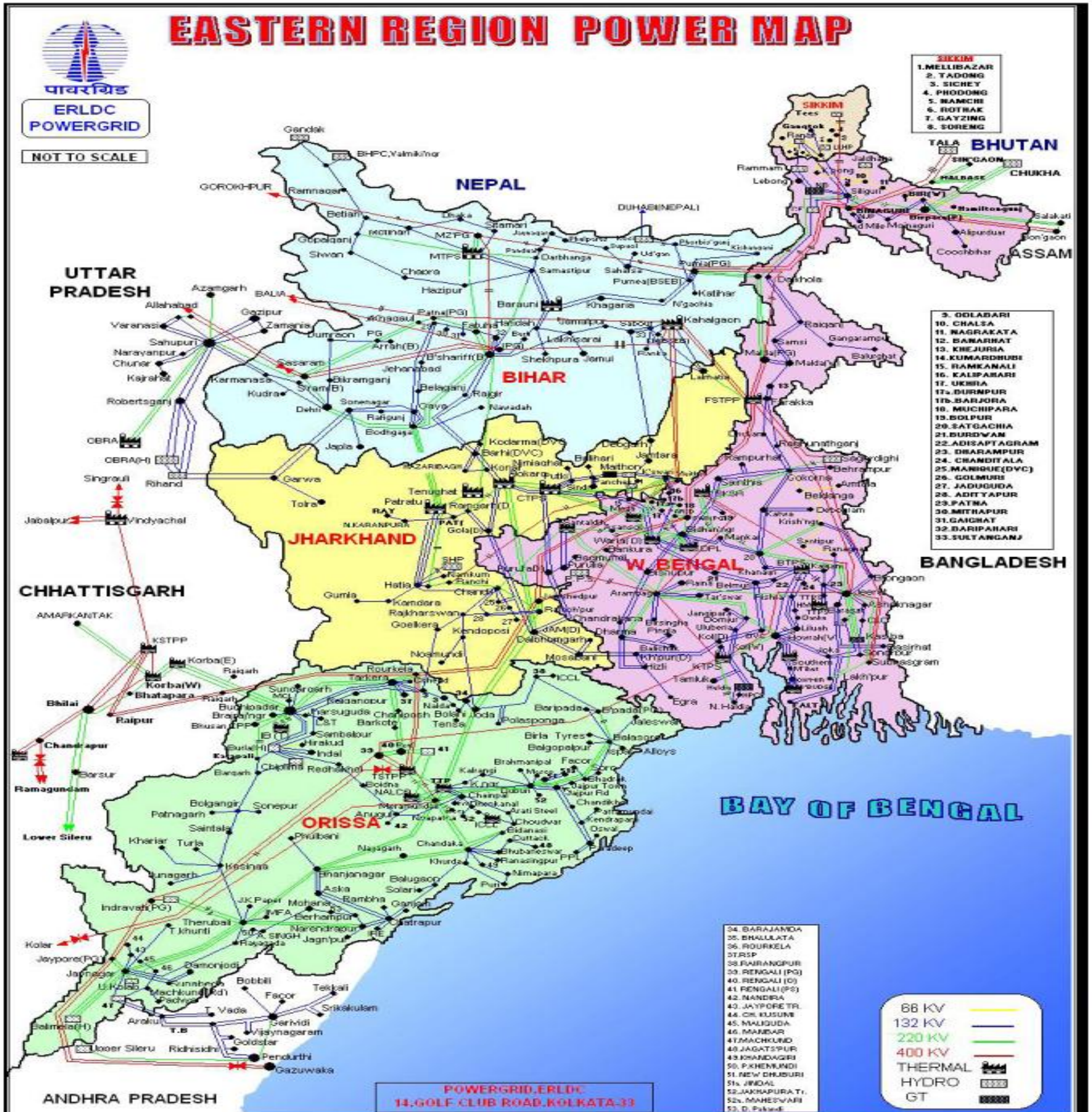
4) Power Supply-Demand Scenario


MW
14000
12000
10000
8000
6000
4000
2000
0
1488
1488
1488
1602
1602
2802
3012
4902
7392
7392
13252
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Installed Cap. (MW)
Firm Power (MW)
Peak Demand (MW)

5) Opportunity for trans-boundary CDM benefits to promote low carbon growth

Opportunity/scope to contribute to low carbon growth through regional cooperation and cross-border energy trade

- ✓ Electricity generation in Bhutan ~100% hydro.
- ✓ As on date >75% of hydroelectricity exported to India which displaces/defers fossil fuel based generation.
- ✓ RGoB and GoI thru. 2006 Umbrella Agreement has agreed to support each other in developing projects under CDM and any other international mechanisms, using Indian baseline.
- ✓ Dagachhu HEP (114 MW) registered as CDM project with UNFCCC based on Indian baseline (1st transboundary CDM project approved by CDM EB).
  - Annual energy ~ 500 MU,
  - Baseline: Bhutan + Eastern Indian regional grid with emission factor of 1.004 t.CO_2e/MWh
  - Avg. quantum of CERs ~ 0.50 million per year


EASTERN REGION POWER MAP
ERLDC
POWERGRID
NOT TO SCALE
NEPAL
BHUTAN
UTTAR PRADESH
BIHAR
JHARKHAND
W. BENGAL
CHHATTISGARH
ORISSA
ANDHRA PRADESH
BANGLADESH
ASSAM
SIKKIM
BAY OF BENGAL
66 KV
132 KV
220 KV
400 KV
THERMAL
HYDRO
GT
POWERGRID.ERLDC
14.GOLF CLUB ROAD.KOLKATA.33

- CDM process for Puntsangchhu-I HEP (1200 MW) is being undertaken. PDD validation underway.
- CDM process for all 9 projects under 10,000 MW programme by 2020 will also be undertaken.
- Total CERs from 10 projects under 10,000 MW plan by 2020 would yield about 40 million t.CO2e per annum (Dagachhu EF).
- Other medium projects promoted by DGPC will also be promoted under CDM process.

6. Bhutan – India
Future Prospects for Cooperation

- 30,000 MW hydropower potential (~43% developed by 2020, remaining ~17,000 MW).
- Both countries desirous of continuing to cooperate in hydropower projects for mutual benefits (Win-Win situation for both countries):
  - For India: renewable, clean, reliable and relatively cheap energy supply to drive her growing economy.
  - For Bhutan: Source of much needed revenue for sustainable socio-economic development.




THANK YOU FOR YOUR
KIND ATTENTION.

INDIAN ENERGY EXCHANGE

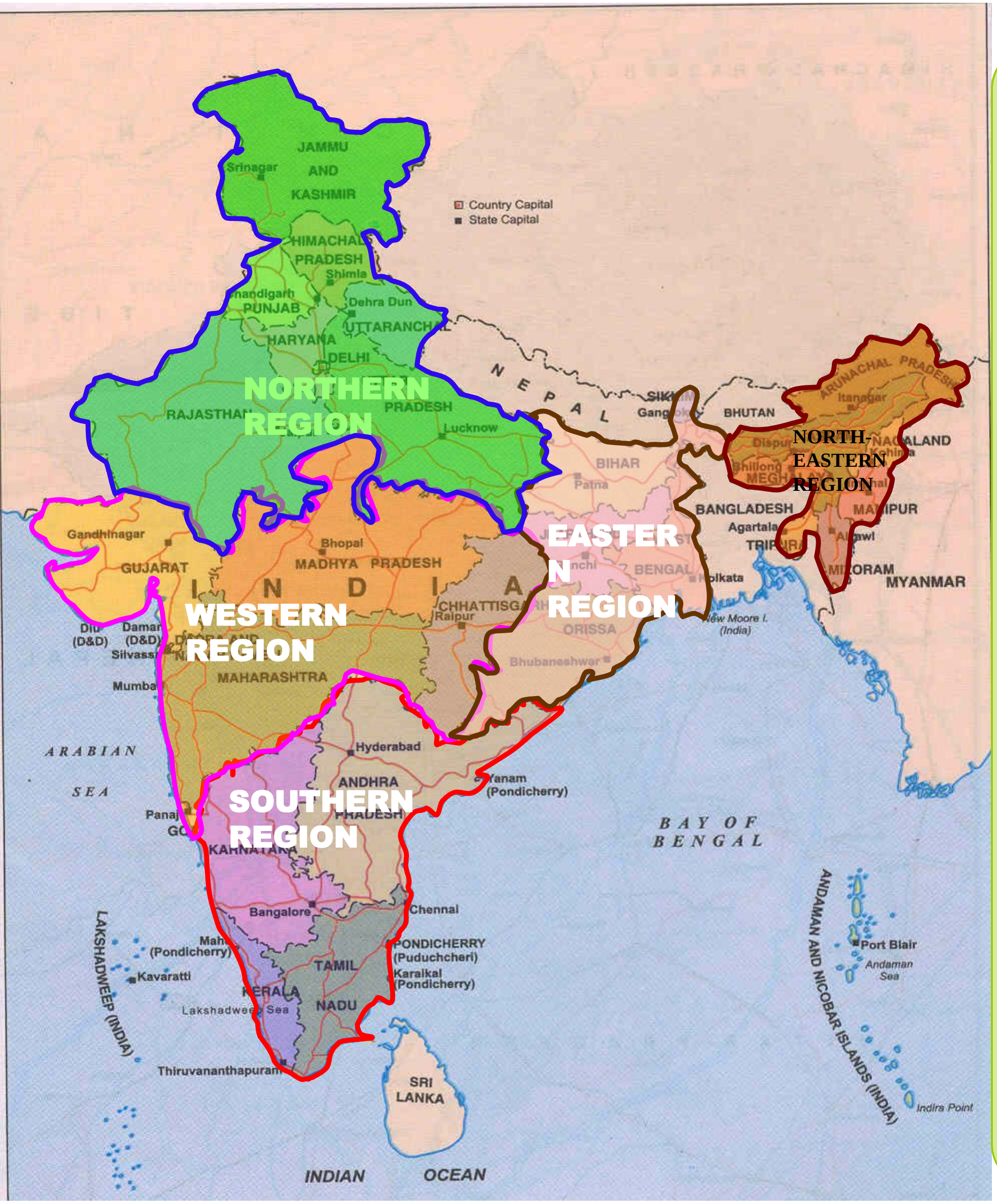
India's No. 1 Power Exchange

India-Bangladesh Exchange

Mr. Rajesh K Mediratta

Sr. VP (BD)

India



Per Capita Consumption

~800 kWh

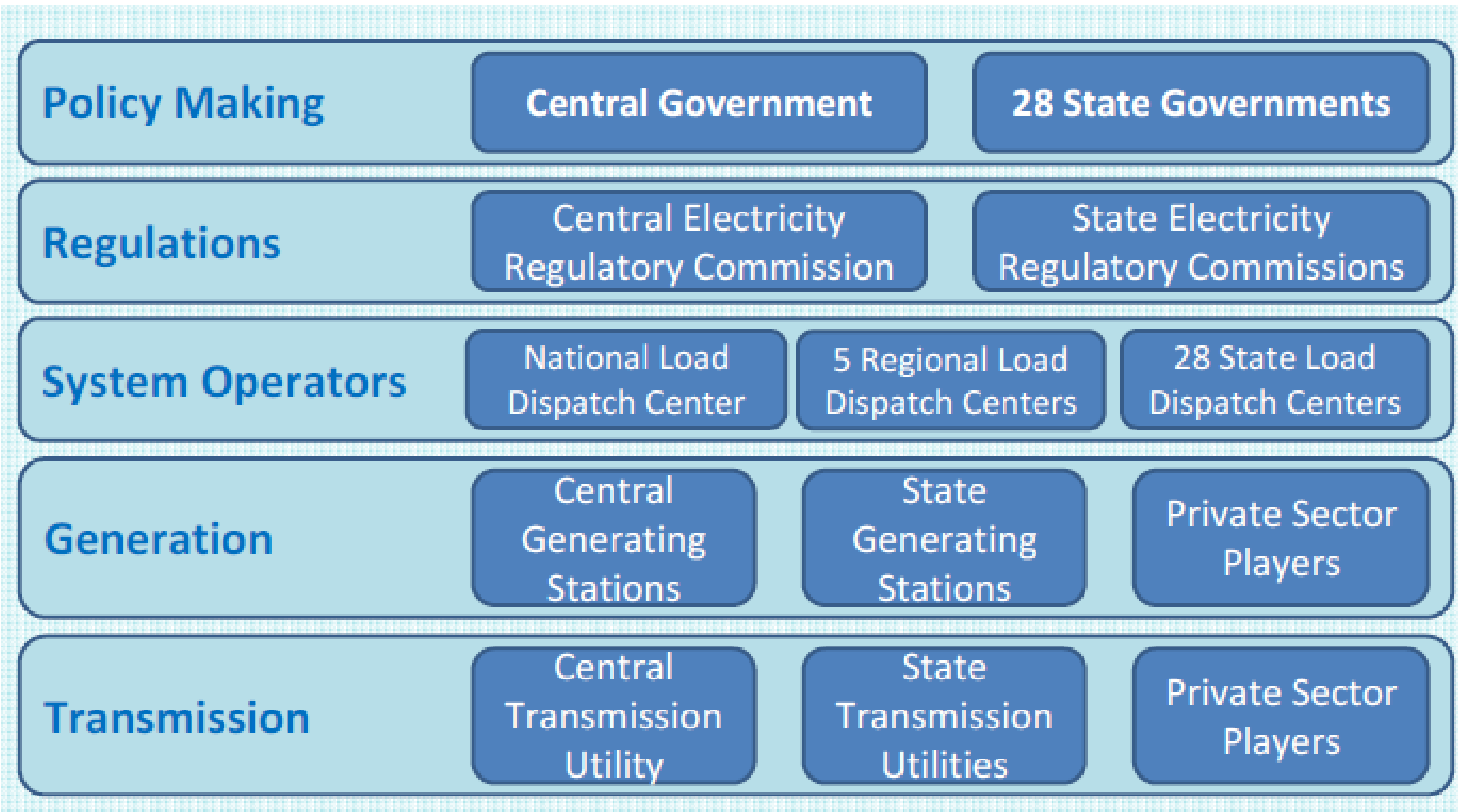
Indian power sector – an overview

- **One of the largest interconnected power network in the world**
  - Comprising 28 independent TSOs
  - 4th largest in Asia and 6th largest in the World in terms of installed capacity
- **Generation Capacity**
  - 1.362 GW in 1947
  - 165 GW in August 2010
  - Expected to be 800 GW by 2030
- **Energy deficit of about -10.8% and peak demand deficit of -12.2%**
- **Large sections of populations yet to have access to power**
  - Only 86% villages have electrification
  - Only 33% rural households have access
- **Impetus to include Renewable Energy in mainstream**

Source: CEA, NLDC

*Deficit numbers for July 2010

Policy and Regulatory structure



Need for Interconnection

INDIAN ENERGY EXCHANGE
India's No. 1 Power Exchange

- Use DIVERSITY
  - Demand Diversity
  - Time Diversity
  - Events – Religious, Political, Sports, national festivities
  - Weather Changes
  - Load profile and consumer mix
  - Capacity Mix

Power Sector Statistics

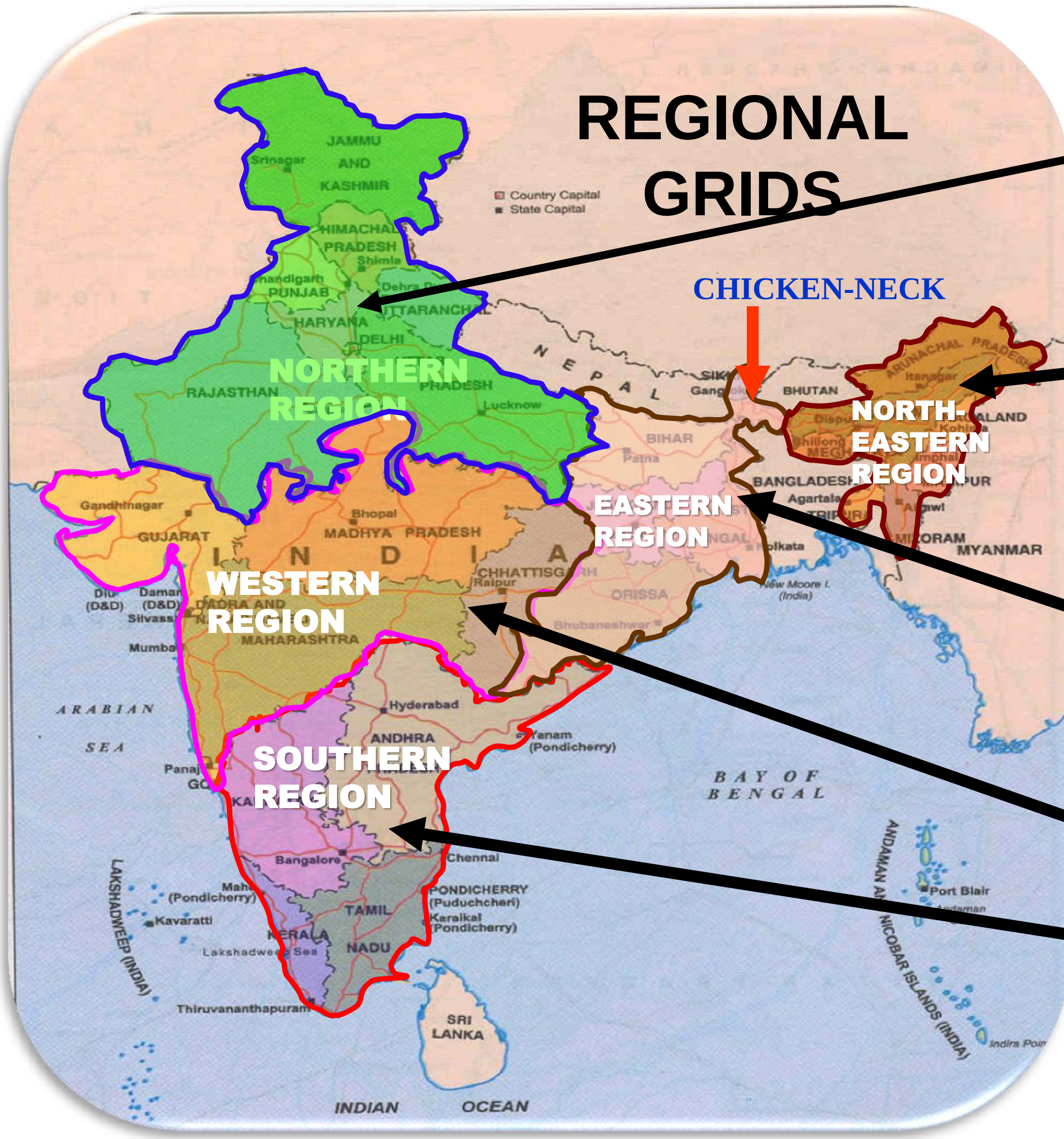
	INDIA	Bangladesh
Area	3287240 Sq Kms	144000 Sq Kms
Population	1028 Million (Urban 30%, Rural 70%)	158 million (Urban 28%, Rural 72%)
Installed Capacity	175 GW	6.8 GW
Peak Demand	120 GW	6765 MW
Demand Met	110 GW	4500 MW
Peak Deficit	12.9%	29.5%
Overall Deficit	10.3%	20%
Per Capita Consumption	1000 KWh	236 KWh
Target Capacity Addition 2011	78577 MW	2157 MW

Power System Parameters

INDIAN ENERGY EXCHANGE
India's No. 1 Power Exchange

	INDIA	Bangladesh
Normal range of frequency	49.5-50.2 Hz	49.5-50.5 Hz
Highest Voltage	800kV	230kV
Hydro Potential	>50000MW	None
Thermal(Coal)	>300GW	Very minimal
Dependence on imported fuels	Less	High

Diversity in Indian System



Northern Region
- Deficit Region
- Snow fed - run-of -the -river hydro
- Highly weather sensitive load
- Adverse weather conditions: Fog & Dust Storm

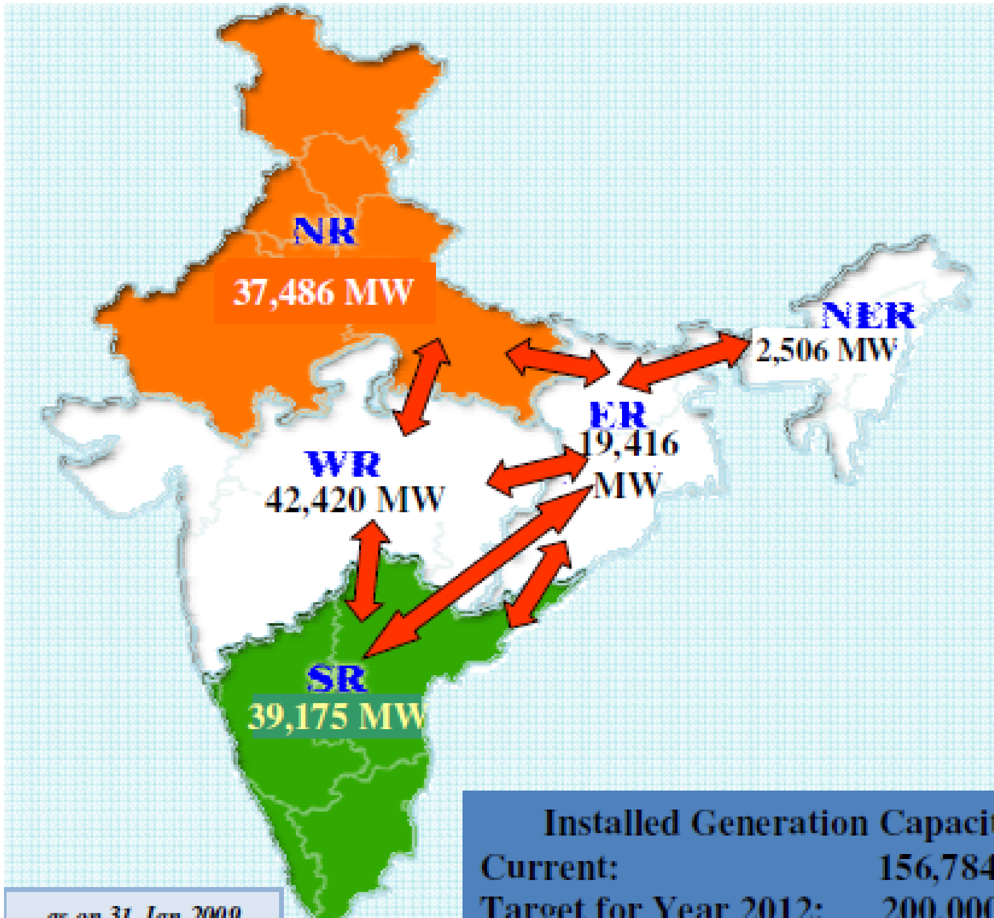
North-Eastern Region
- Very low load
- High hydro potential
- Evacuation problems

Eastern Region
- Low load
- High coal reserves
- Pit head base load plants

Western Region
- Industrial load and agricultural load

Southern Region
- High load (40% agricultural load)
- Monsoon dependent hydro

Regional Grids and Capacities



Installed Generation Capacity

Current:	156,784 MW
Target for Year 2012:	200,000 MW

as on 31-Jan-2009
Source:

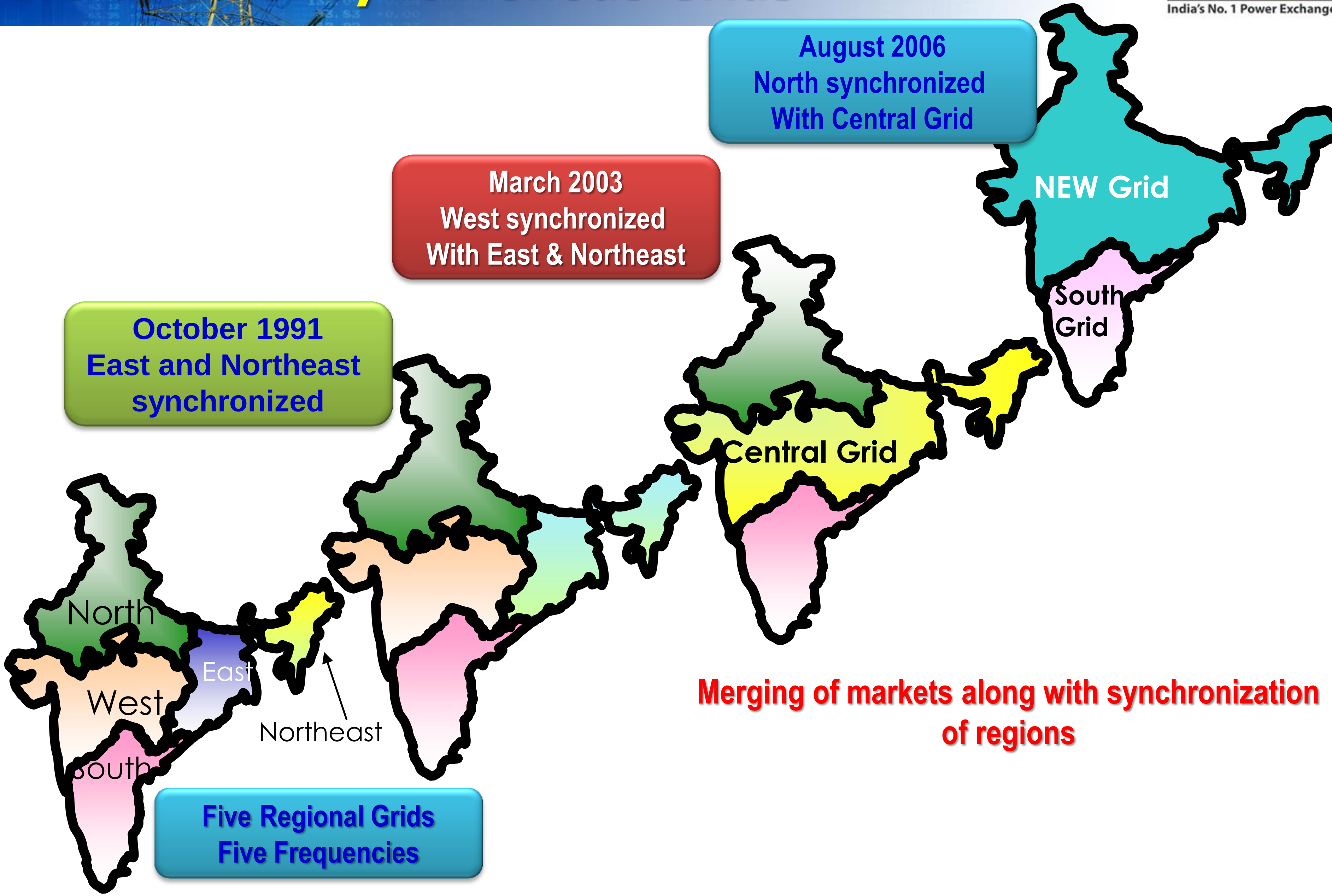
Inter regional Link	MW capacity
NER-ER	1,240
ER-NR	6,020
ER-SR	1,120
ER-WR	1,760
SR-WR	1,680
WR-NR	2,080
Other 132 KV Links	200
Talcher Kolar HVDC Bipole	2,500
Total	17,000
Target for 2012	37,700

Evolution of Synchronous Grids

October 1991
East and Northeast
synchronized

March 2003
West synchronized
With East & Northeast

August 2006
North synchronized
With Central Grid



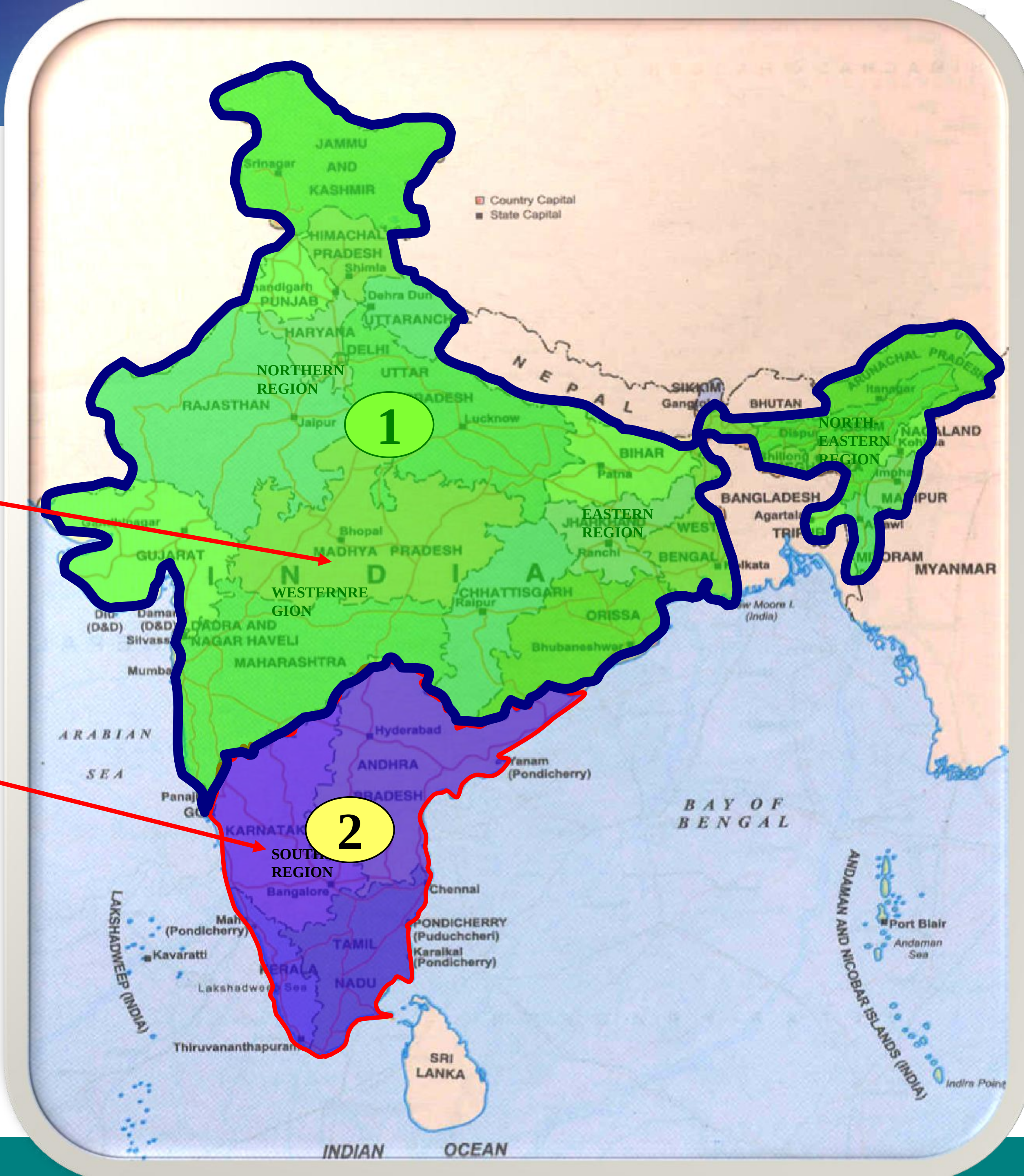
Five Regional Grids
Five Frequencies

Merging of markets along with synchronization of regions

The 'Electrical' Regions

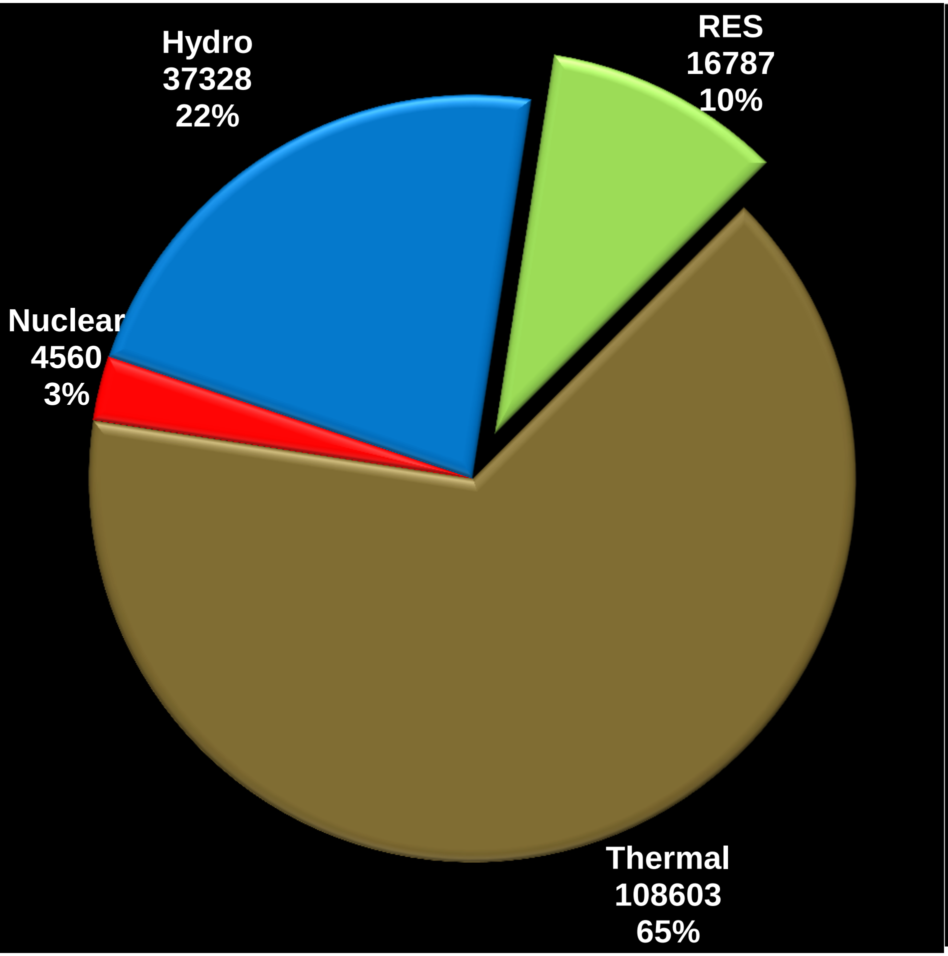
'N-E-W' Grid

SOUTH Grid

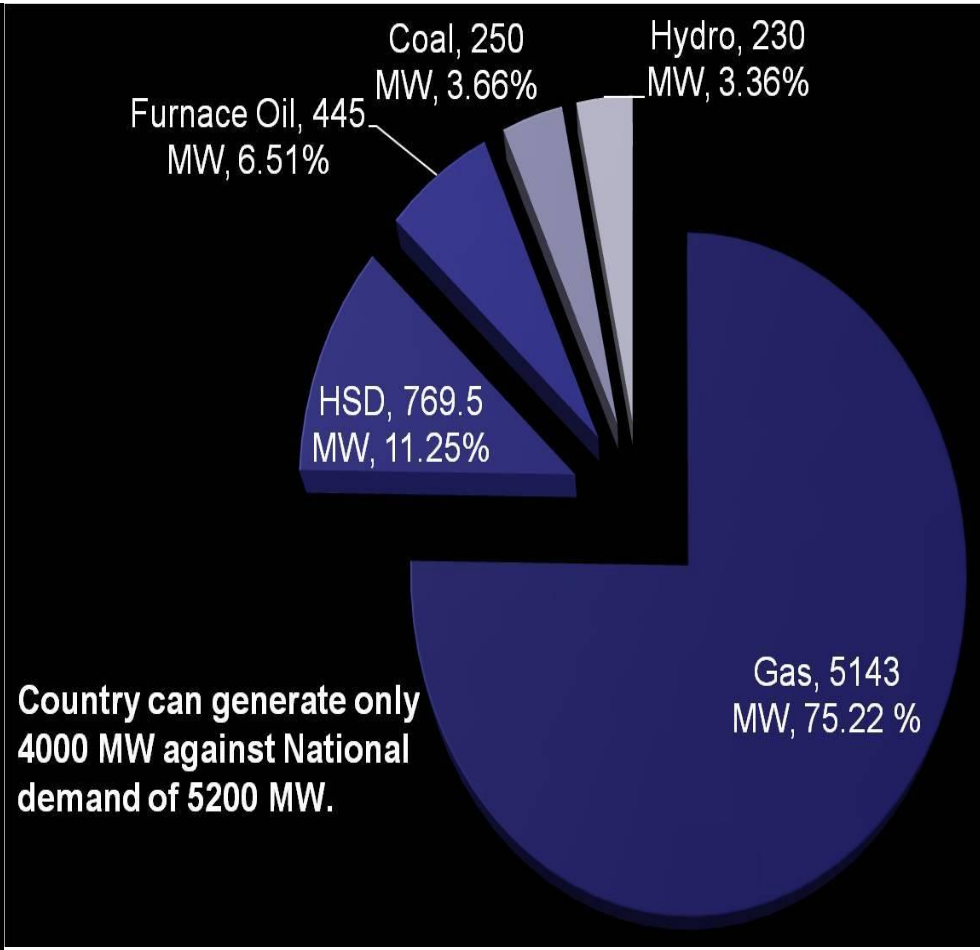


India Bangladesh Installed Capacity

India

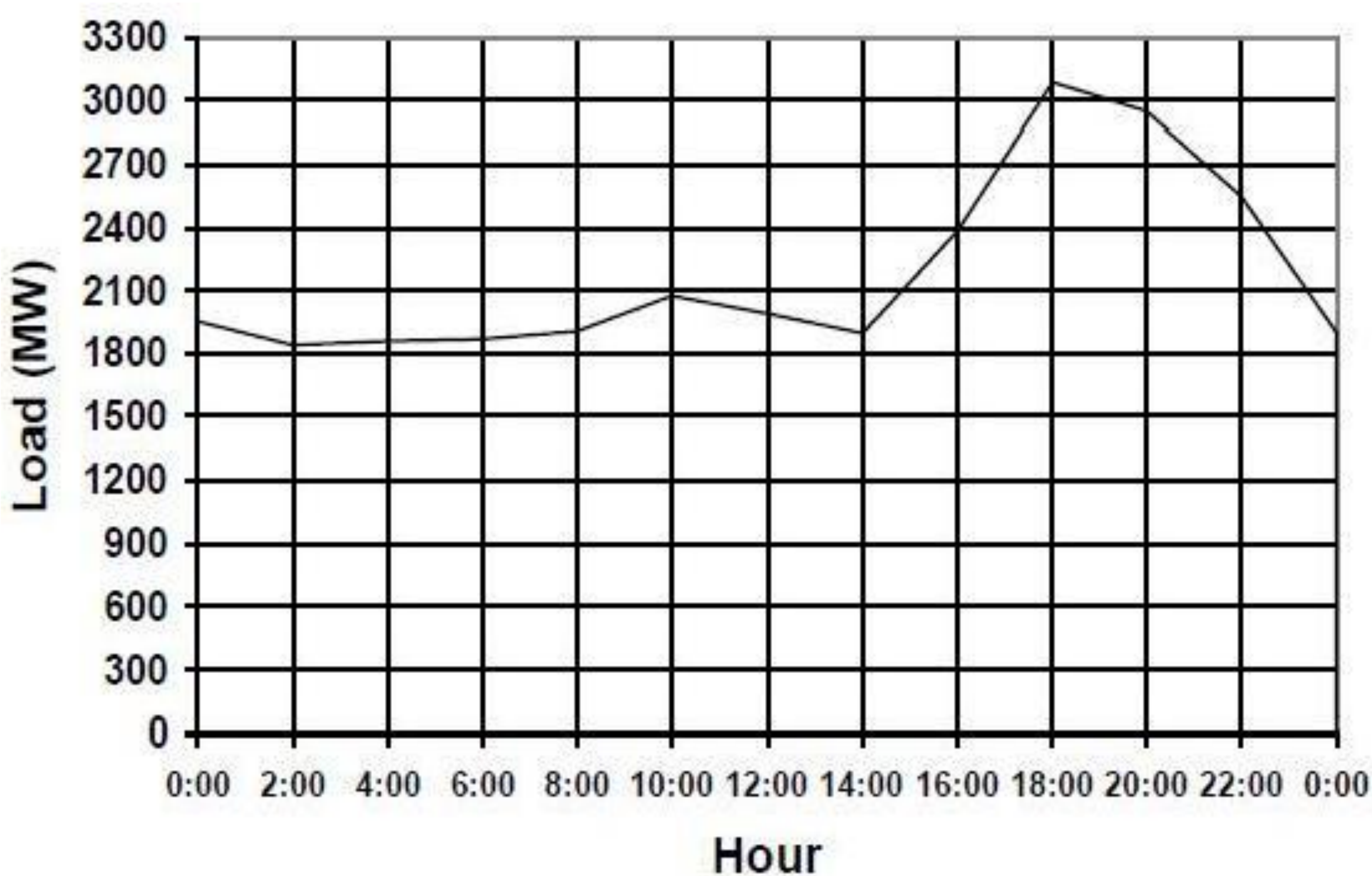


Bangladesh



Sample Daily Energy Curve of Bangladesh

INDIAN ENERGY EXCHANGE
India's No. 1 Power Exchange



Benefits from Interconnection

- Instant Help to Contingent Systems
- Savings on Operating Costs
- Utilisation of Cheaper Generation
- Optimal use of Resources
- Contributes to the quality of electricity supplied to customers as well as reduces environmental damage.
- Reducing losses in the power system is often more cost effective than constructing more generation capacity.

Earlier Initiatives

- No existing Connections with any country

1998 : First Initiative

- MoU signed between India-Bangladesh
- 1999 : Follow-Up meeting for technical reliability for 150 MW
  - 220kV Shahjibazar(B)-Kumarghat(I)
  - 220kV Ishurdi/Bheramara (B)-Krishnanagar /Farakka (WB-I).
  - 132kV **Siliguri** (WB-I) - **Tetulia** (B)

Status : No results

Proposed Interconnections

INDIAN ENERGY EXCHANGE
India's No. 1 Power Exchange

Proposed Interconnections :

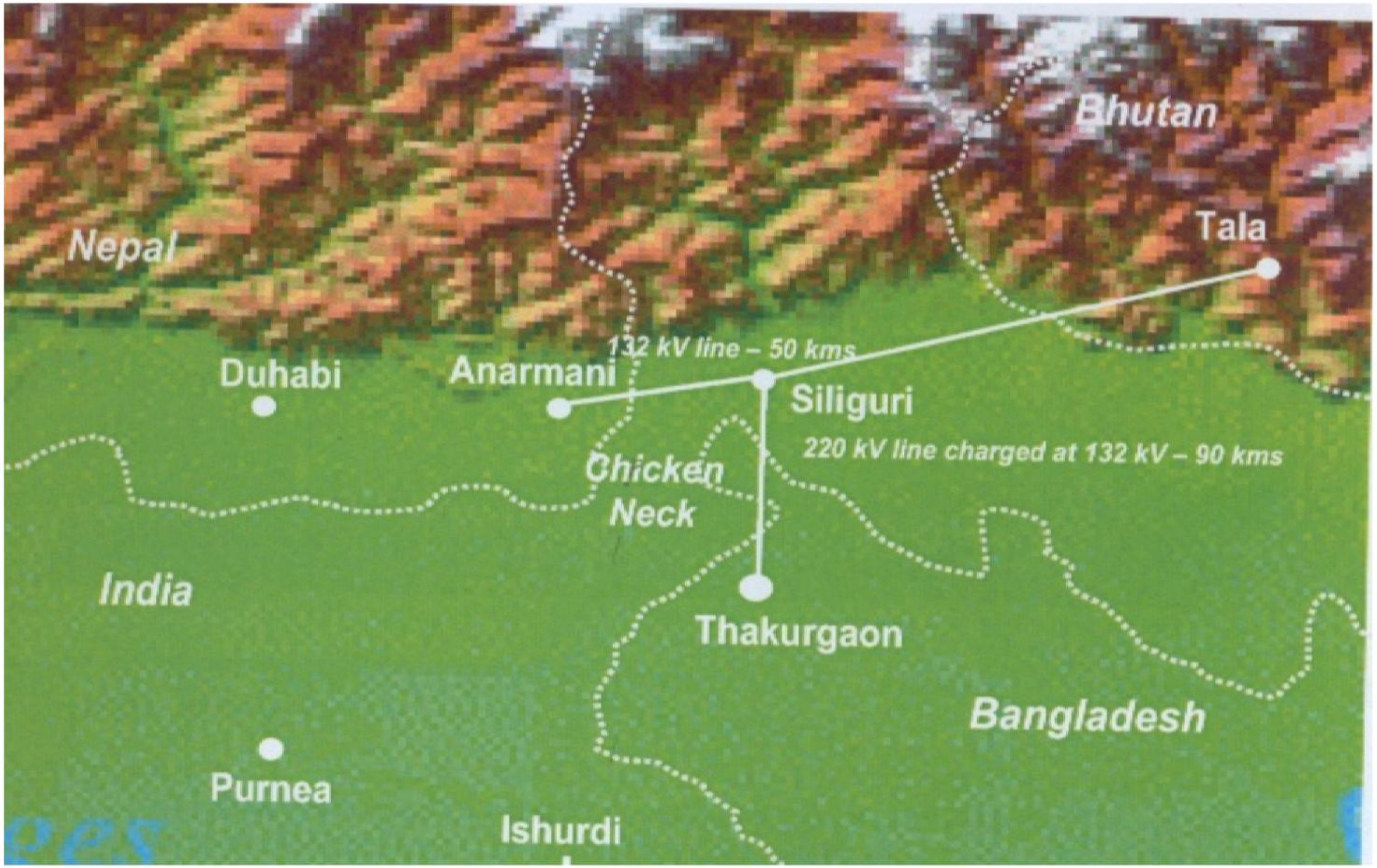
1-2 Krishnagar-Bheramara

3-4 Kumarghat-Shahjibazar

5-6 Siliguri-Tetulia

Earlier Initiatives

- A Four-nation Grid Interconnection near the "Chicken - neck "area
- India,Bhutan, Bangladesh and Nepal



Current Initiatives

- The Bangladesh-India cooperation formally initiated in November 2009
- A draft MOU was formally signed on 11th January 2010 for
  - (i) Exchange of power
  - (ii) Grid connectivity between the two countries

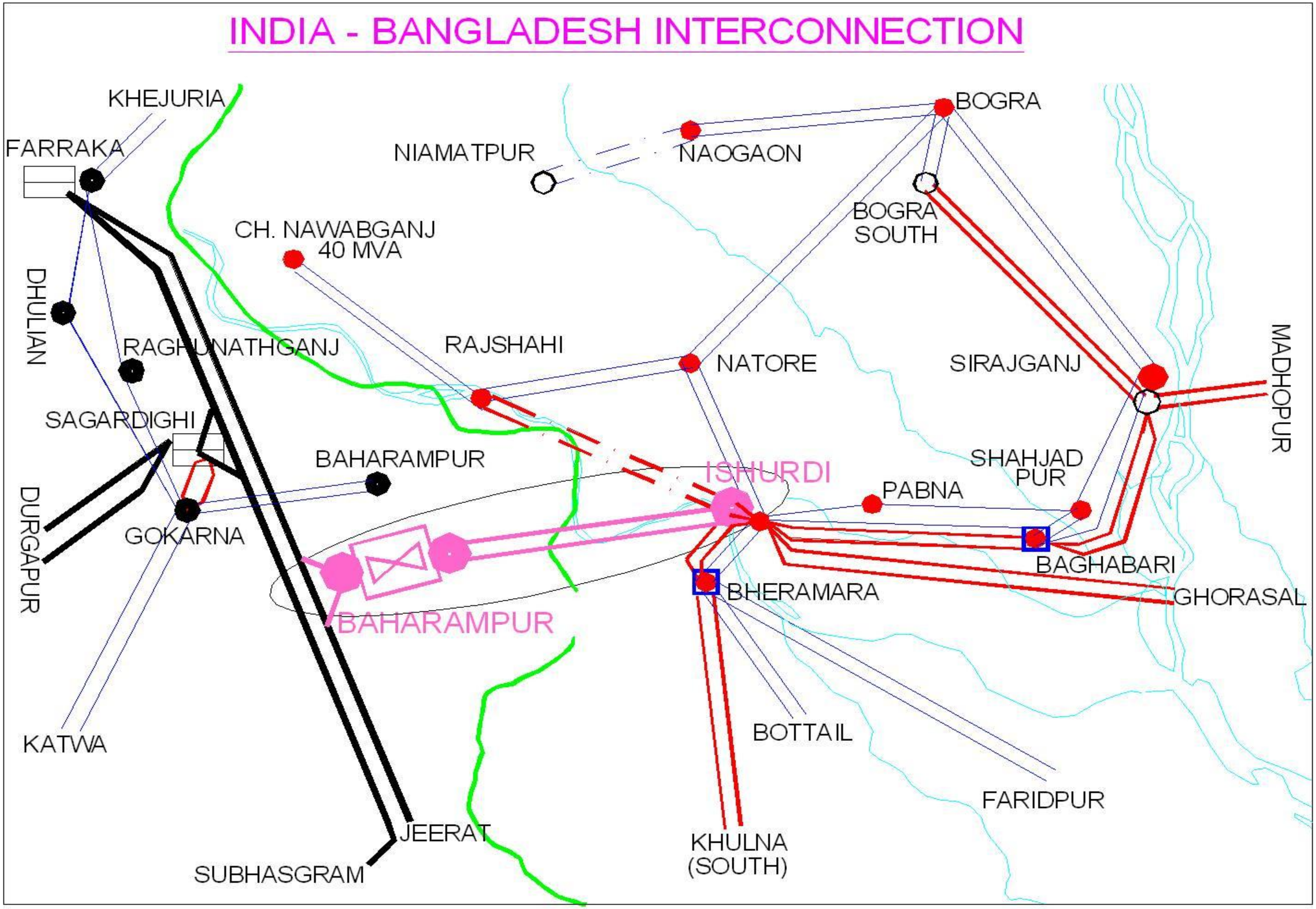
Indian portion:

- Baharampur (India)-Bheramara (Bangladesh) 400 kV D/C line (Indian portion)-85km
- Loop-in and loop-out of Farakka -Jeerat 400 kV S/C line at Baharampur (India)-3km
- Establishment of 400 kV switching-station at Baharampur (India)

Bangladesh portion

- Baharampur (India)-Bheramara (Bangladesh) 400 kV D/C line (Bangladesh portion)-40km.
- Loop-in and loop-out of Ishurdi-Khulna South 230 kV D/C line at Bheramara (Bangladesh)-5km
- Establishment of 500MW HVDC back to back station and 230 kV switching-station at Bheramara (Bangladesh)

India Bangladesh Transmission Lines



Current Initiatives

- The transmission line connecting India and Bangladesh for supplying 250 MW electricity is expected to be completed by 2013.
- Status: Agreement iexpected to be signed in March,2011 s yet to be signed.

Other Initiatives

- Planned to import power to Bangladesh from Tripura, India by establishing a Grid Interconnection with NE India.
- NTPC to set up a new power plant to supply 250 MW power to Bangladesh by 2013

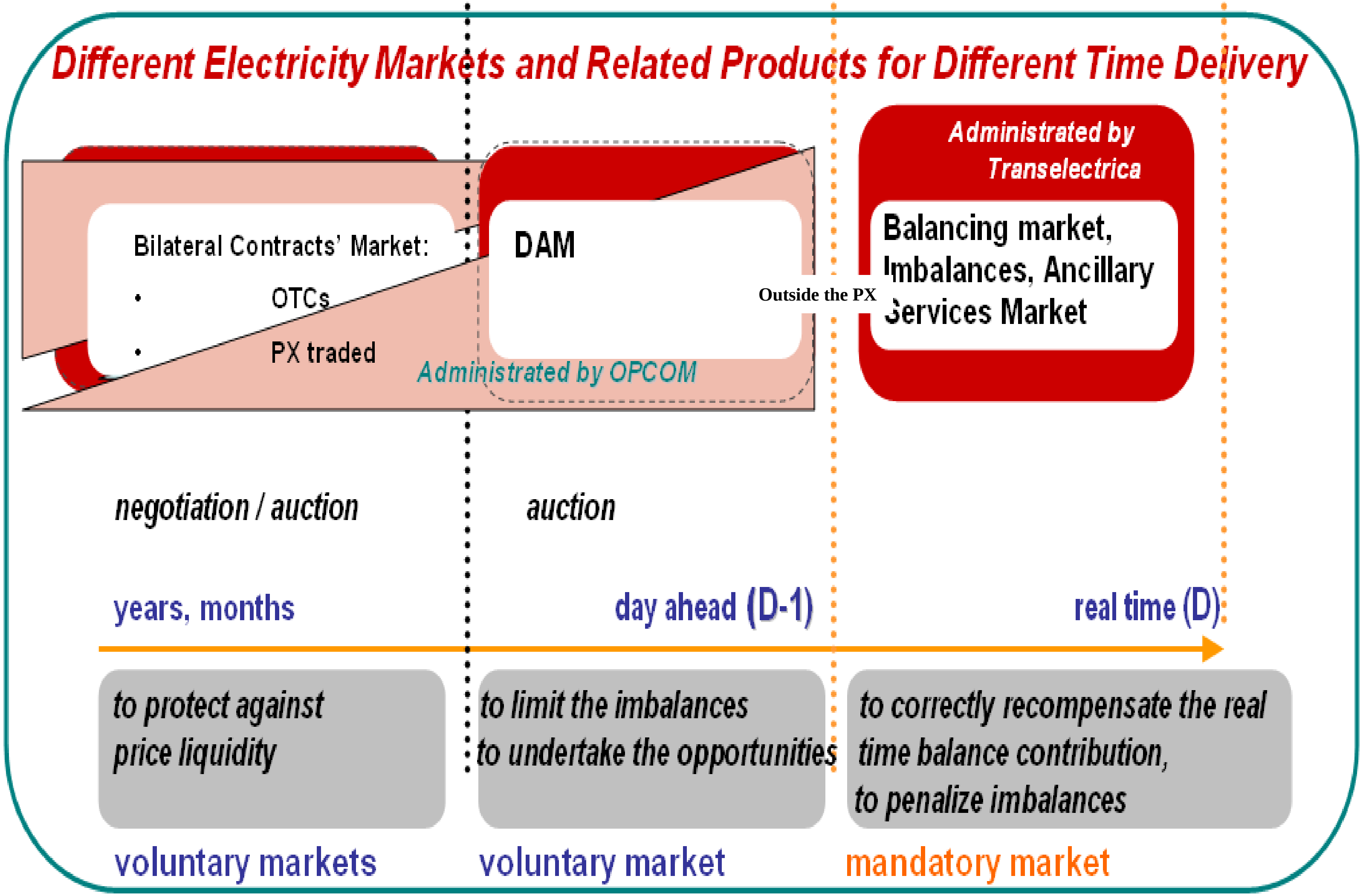
Way Forward…

- Present conditions are ripe for AC Interconnection
  - HVDC interconnection gives – controllability and system isolation
  - Indian system – much better frequency profile (49.5-50.2 Hz)
  - AC interconnection will give lot of stability
  - Complete Indian grid will be single synchronous region by 2014
  - Connecting 100GW system with 6GW will make Bangladesh mitigate reliability /frequency issue only proper islanding system will need to be developed

Way Forward…

- SAARC single Electricity Market
  - Single Day-Ahead Market for SAARC Market
  - Ministries from EA , Commerce. Energy to be made aware of such possibility
  - Examples around world:
    - NORDPOOL (4 countries)
    - SAPP(9 countries)
    - Central West Europe (CWE)Single Market
- Requires establishing Common minimum
  - Balancing & Settlement Rules across countries
  - Payment Security & Commercial terms
  - Grid connectivity standards
- Political Will to be aligned for Mutual Benefits of the Power Systems of countries

A voluntary power exchange … common platform

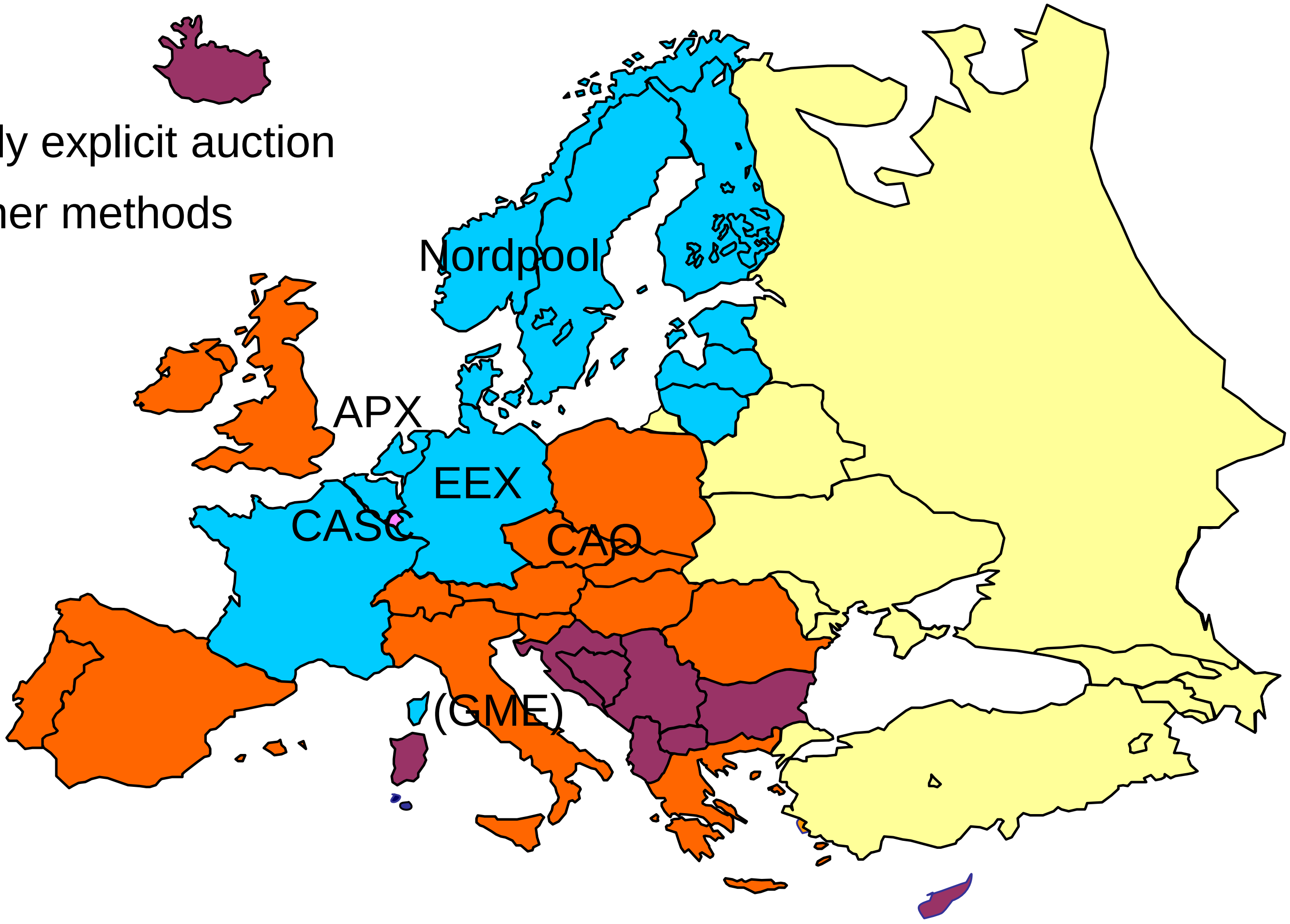


Common Market in Europe... 2010

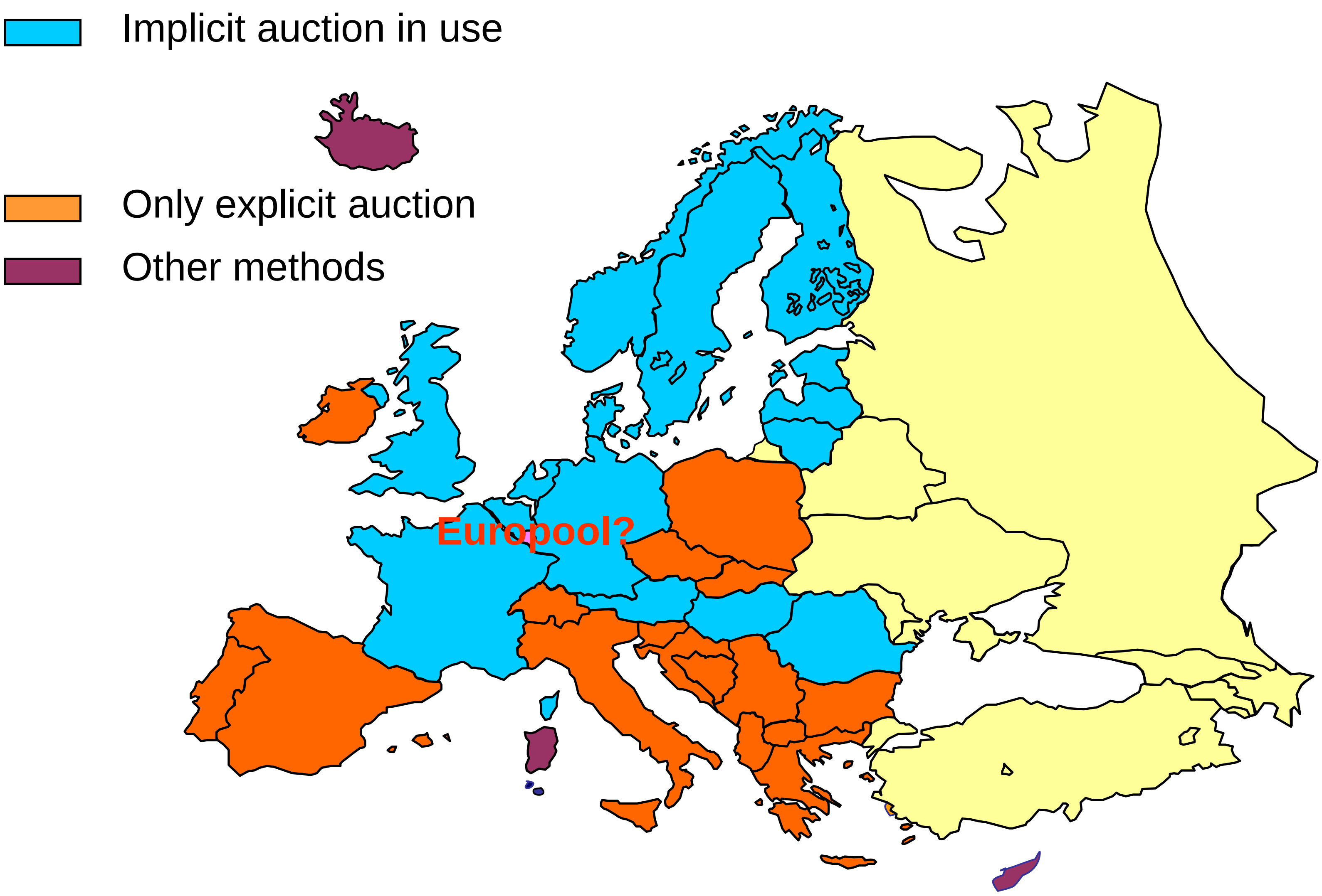
Implicit auction in use

Only explicit auction

Other methods



Common Market in Europe... 2015



Thank You !!!

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Promoters

Joint Equity Partners:

Technology :

Cross Border Power Exchange between Nepal and India

Er. T. M. Shakya

General Manager

Transmission and System Operation

Project Coordinator

Energy Access and Efficiency Improvement Project

Outline of Presentation

- Introduction
- Types of Cross Border Power Exchange between Nepal and India
  - River Treaties
  - Power Exchanges
  - Power Trading
- Existing Cross Border Facilities
- Proposed Cross Border Transmission Lines
- Major issues in Cross Border Power Trading
- Regional Power Grid
- Conclusion

Introduction

- Power Exchange Starting from 1960s
- Electrification of Villages in Border Areas
- Import from India
- Export to India
- Present Power Crisis in Nepal
- Potential for Power Trade between Nepal and India
  - Huge Hydropower Potential in Nepal
  - Power Deficit in India
- Cross Border Transmission Lines Facilitate Power Trade between Nepal and India
- Need for Regional Power Grid

River Treaties

- Koshi River Treaty
  - Signed on April 25, 1954 and Amended on Dec 19, 1966
  - Power Import from Kataiya P/S for Electrification of Border Areas.

- Gandak River Treaty
  - Signed on Dec 4, 1959 and Amended on April 30, 1964
  - 15 MW Surajpura Hydropower Plant
  - Gandak – Ramnagar 132 kV Transmission Line

- Mahakali River Treaty
  - 70,000 MWh of Free Energy from Tanakpur P/S
  - Maximum 16 MW
  - Monthly Quota for Power and Energy
  - Power Import from Tanakpur at 132 kV Level

Power Exchange

- Power Exchange Agreement Commenced in 1972 with an Exchange of 5MW
- Level of Exchange Increased to 50 MW
- Agreed in Principle for 150 MW Power Exchange in 6th PEC Meeting in 2001 but not yet implemented
- Indo – Nepal Power Exchange Committee (PEC) Setup in 1991 to Regulate Power Exchange
- Power Exchange Price of INR 4.10 at 33 kV Level. Escalation of 5.5% per annum. Power Exchange Price at 11 kV and 132 kV are 7.5% Additional and 7.5% Rebate on Price at 33 kV Level Respectivelyl
- 9th Power Exchange Committee Meeting held in New Delhi in 2009 and 10th Meeting to be Convened in Kathmandu

Power Trading

- Power Trading Agreement between India and Nepal on Feb 17, 1966
- Power Trading through Nodal Agency PTC India
- Power Trading Possible Through Central Grid Point Only
- Tanakpur only Center Grid Point at Present
- Maximum 20 MW Power Trading at Tanakpur
- Unscheduled Interchange (UI) at Tanakpur

Power Exchange Facilities between Nepal and India

- **At 132 kV Level**
  - **- Mahendranagar – Tanakpur**
  - **- Duhabi – Kataiya**
  - **- Gandak – Ramnagar**

- **At 33 kV Level**
  - **- Siraha – Jaynagar (3 MW)**
  - **- Birpur – Kataiya (10 MW)**
  - **- Jaleswar - Sursand (6MW)**
  - **- Birgunj – Raxaul (10 MW)**
  - **- Bhairahwa – Nautanawa (5MW)**
  - **- Koilabas – Lamhi (Not in Use)**
  - **- Nepalgunj – Nanpara (8 MW)**
  - **- Dhangadhi – Paliya**
  - **- Mahendranagar – Lohiahed**
  - **- Chandragadhi - Thakurgunj**

Power Exchange Facilities between Nepal and India

- **At 11 kV Level**
  - Gaur – India (Not in use)
  - Malangawa – Sonabarsha (Not in use)
  - Gandak – Balmikinagar
  - Biratnagar - Jogbani
  - Jhulaghat – Pithoragarh
  - Lali – Kandalchhina
  - Jauljibi – Dharchula
  - Huti - Dharchula

Cross Border Transmission Lines

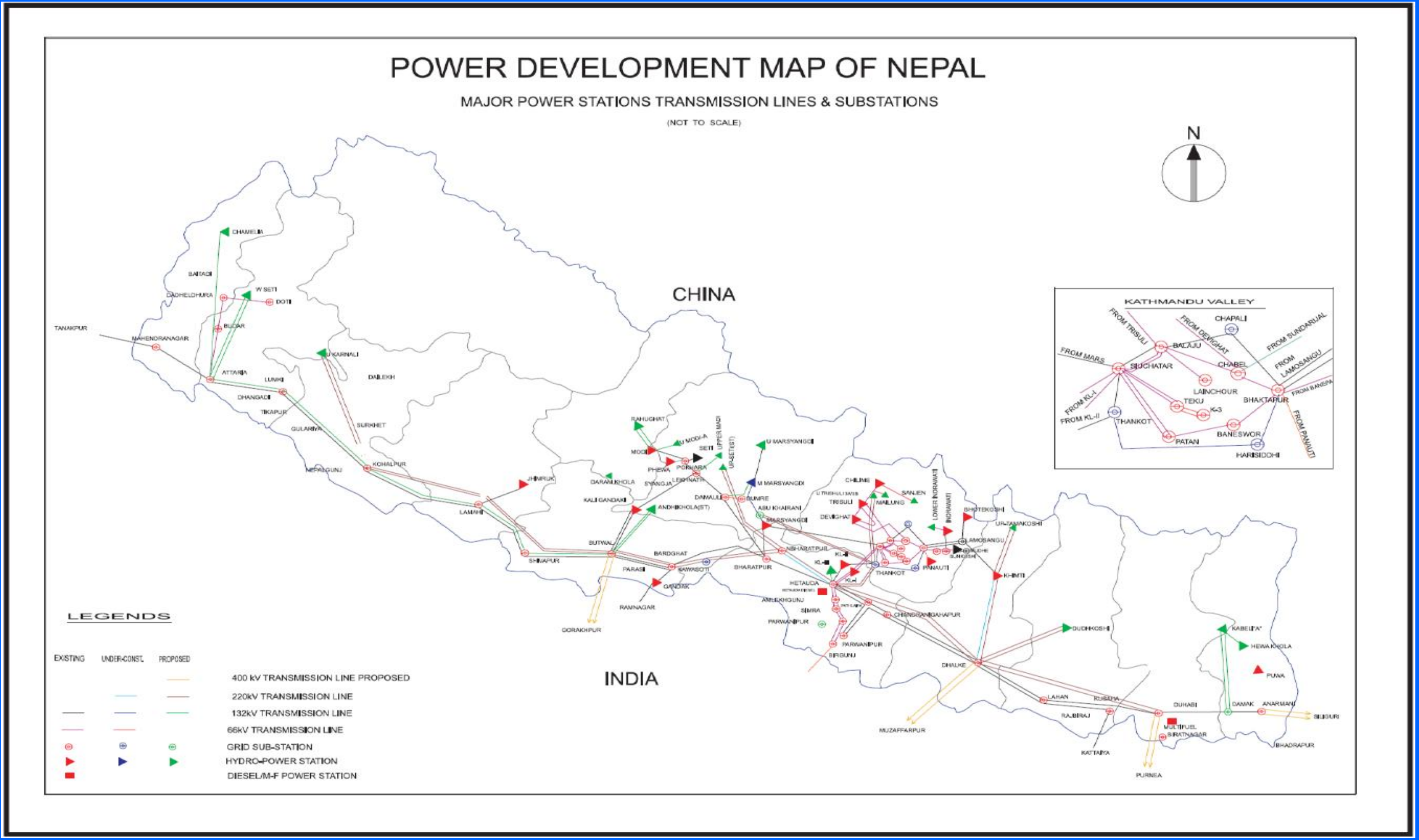
- **Initially Proposed Lines**

  - Dhalkebar – Sitamarhi 132 kV Transmission Line
  - Butwal – Anandanagar 132 kV Transmission Line
  - Birgunj – Motihari 132 kV Transmission Line
  - Anarmani – Siligurhi 132 kV Transmission Line

- **Revised Proposals**

  - Dhalkebar – Mujaffarpur 400 kV Transmission Line
  - Duhabi – Purnea 400 kV Transmission Line
  - Butwal – Gorakhpur 400 kV Transmission Line

Integrated Nepal Power System (INPS)



Dhalkebar – Muzaffarpur 400 kV Transmission Lines

- First Cross Border Line to be Constructed between Nepal and India
- To be Operated in Synchronous Mode
- Length – 140 km, 45 km in Nepal and 95 km in India
- To be Constructed in Commercial Modality
- Power Transmission Commission Nepal Pvt. Ltd (PTCN) a JV Company of NEA and IL&FS with Share Holding of PGCIL in Nepal owns Nepal Portion
- Cross Border Power Transmission Company Pvt. Ltd. (CBPTC) a JV Company of IL&FS, Power Grid and SJVNL with Share Holding of NEA in India owns India Portion

Dhalkebar – Muzaffarpur 400 kV Transmission Lines

- Detailed Feasibility Study done by Power Grid Corporation of India (PGCIL)
- Nepal Portion Costing US$ 20 Million to be Partially Financed from US$ 13.2 Million Line of Credit from Government of India and Commercial Loan
- India Portion Costing US$ 32 Million to be Financed from Commercial Loan
- Asian Development Bank Considering Due Diligence Study for Political Risk Guarantee for the Project
- Expected to be Completed by 2013/2014

Major Issues in Dhalkebar – Muzzafarpur 400 kV Transmission Line

- No Financial Closing Yet for the Project
- Power Sales Agreement (PSA) between NEA and PTC (150 MW for 25 Years)
- Implementation and Transmission Service Agreement (ITSA) between NEA and JV Companies
- Back to Back Transmission Service Agreement Between NEA and IPPs in Nepal
- Political Risk Guarantee (PRG). ADB Intending to Undertake Due Diligence Study
- Power System Synchronization and Power Flow

Regional Power Grid

- Need for SAARC Regional Power Grid

- Cross Border Power Trade and Regional Power Grid Helps
  - To Utilize Natural Resources for Regional Development
    - Nepal & Bhutan have High Hydropower Potential
    - India has Huge Coal Reserves
    - Bangladesh has Large Gas Reserves

  - To Improve System Load Factor Utilizing Load Diversity

  - To Enhance Efficiency and Reliability of Power Supply

  - To Lower Reserve Margin and To Benefit from Economies of Scale in Power Generation

  - To Reduce Carbon Growth and Protect the Environment

- World Bank, ADB and USAID Willing to Promote Regional Power Grid in South Asia

Conclusion

- **Nepal Inspite of Huge Hydropower Potential is Facing Acute Power Crisis at Present**

- **Dhalkebar – Muzaffarpur 400 kV Cross Border Transmission Line will Help to Mitigate Present Power Crisis in Nepal by Importing Power from India Initially and Facilitate Export to India Later When Nepal has Surplus Power**

- **Additional Cross Border Transmission Lines Required Between Nepal and India for Utilization of Anticipated Power Surplus in Nepal in the Years Ahead**

- **Need for Regional Cooperation for Regional Power Grid in South Asia**

- **Most Important Thing is the Political Will and Sincere Commitment from the Governments of the Respective Countries in the Region**

Thanks

For

Your Attention

TRANSITIONING THE SOUTH ASIAN ENERGY MARKET - ADVANCING LOW CARBON GROWTH THROUGH REGIONAL COOPERATION AND CROSS-BORDER ENERGY TRADE

USAID
FROM THE AMERICAN PEOPLE

SARI/Energy

USEA
United States Energy Association

STELCO
STATE ELECTRIC COMPANY LIMITED

"Clean Energy Development in Maldives"

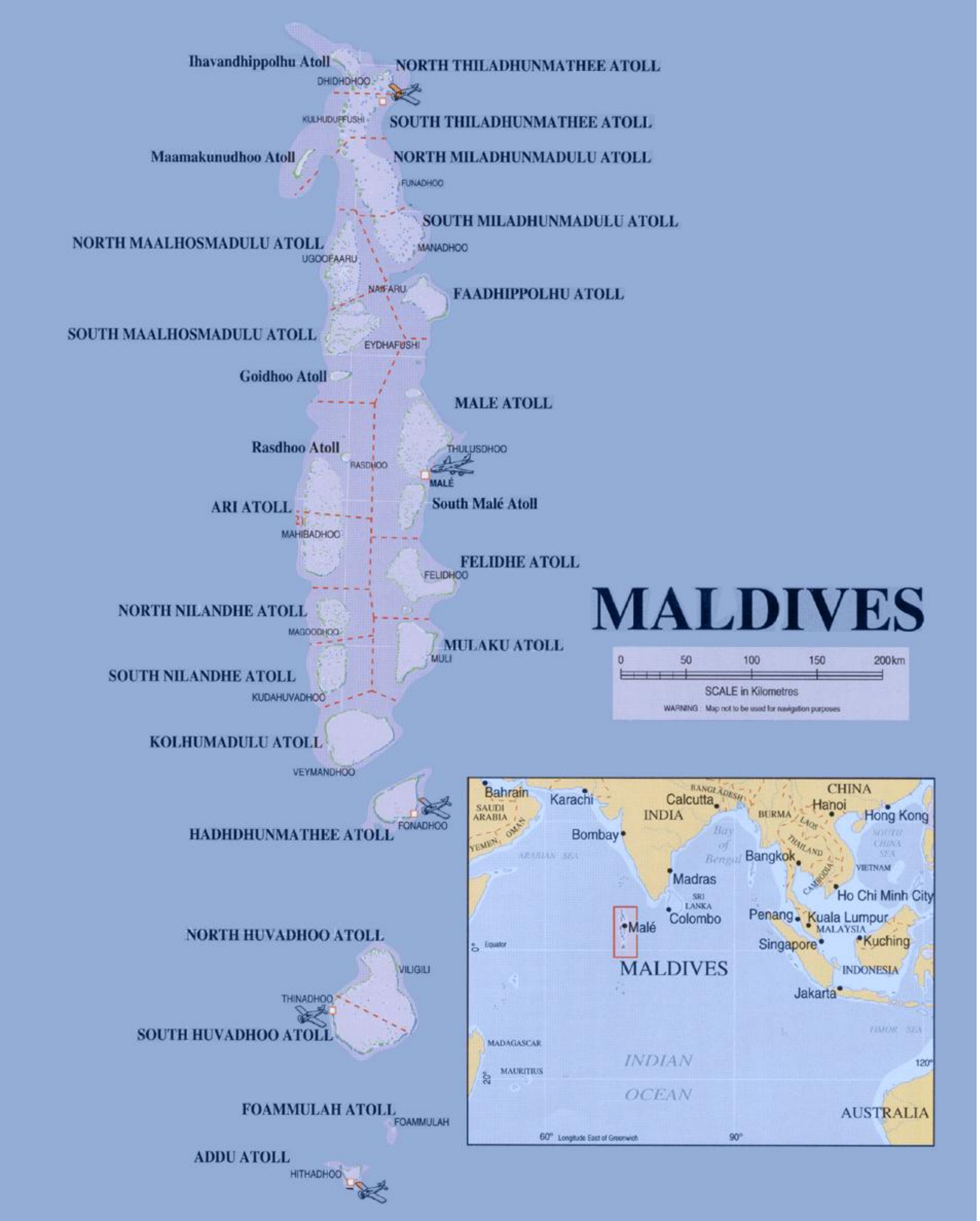
Ajwad Musthafa
Maldives Energy Authority
Ministry of Housing and Environment

11 July 2011

OUTLINE OF PRESENTATION

1 – Country Overview
2 – Energy Sector
3 – Energy Policy
4 – Resource potential and potential technologies
5 – Past, Ongoing and Planned RE projects
6 – Barriers and Challenges

1.Country Overview



Country Overview….

"In the not too distant past, the Maldives relied mainly on renewable energy sources.

All traditional fishing boats were sailboats and with these, the Maldivians very effectively caught the tuna fish which was their staple food.

The limited biomass on the islands, mainly from coconut trees, was used to cook their meals and the sun assisted in drying the fish.

Since the discovery of the Maldives as an attractive tourist destination a few decades ago, a rapid transition took place.

Now the dominant energy carrier in the Maldives is diesel fuel, which is used for transport, electricity generation and industrial operations." – *SMILES project*

Country Overview….

"Development process of the Maldives took flight in the late 1970s.

In the early stages effort was centralised in Male' for various reasons. Male' is close to the airport island.

The scattered nature of population distribution often made investments cost-inefficient in other outer islands.

Male' already had a population which gave economy of scale for vital services such as secondary education. As more people settled in Male', commerce, and employment opportunities expanded.

The introduction of tourism in the mid-seventies and the growth of this industry also have a strong bearing on this issue. The first resorts were built within easy reach of Male'." –from report published by Planning Ministry

Country Overview….

- Maldives consist of 1,190 islands.
- 199 Inhabited Islands.
- Total land mass of the country is about 300 km^2
- Size of the Islands range b/w (0.2 – 5)km^2
- Total population of Maldives is 300,000 plus
- Main economic activities are Tourism and Fishing
- No proven non renewable energy resources

Country Overview....

Vulnerabilities of Maldives

- Over 80% of land in Maldives below 1m from MSL
- 80% of critical infrastructure is 100m from shore
- Fisheries and tourism depends heavily on climate sensitive coral ecosystems

Country Overview….

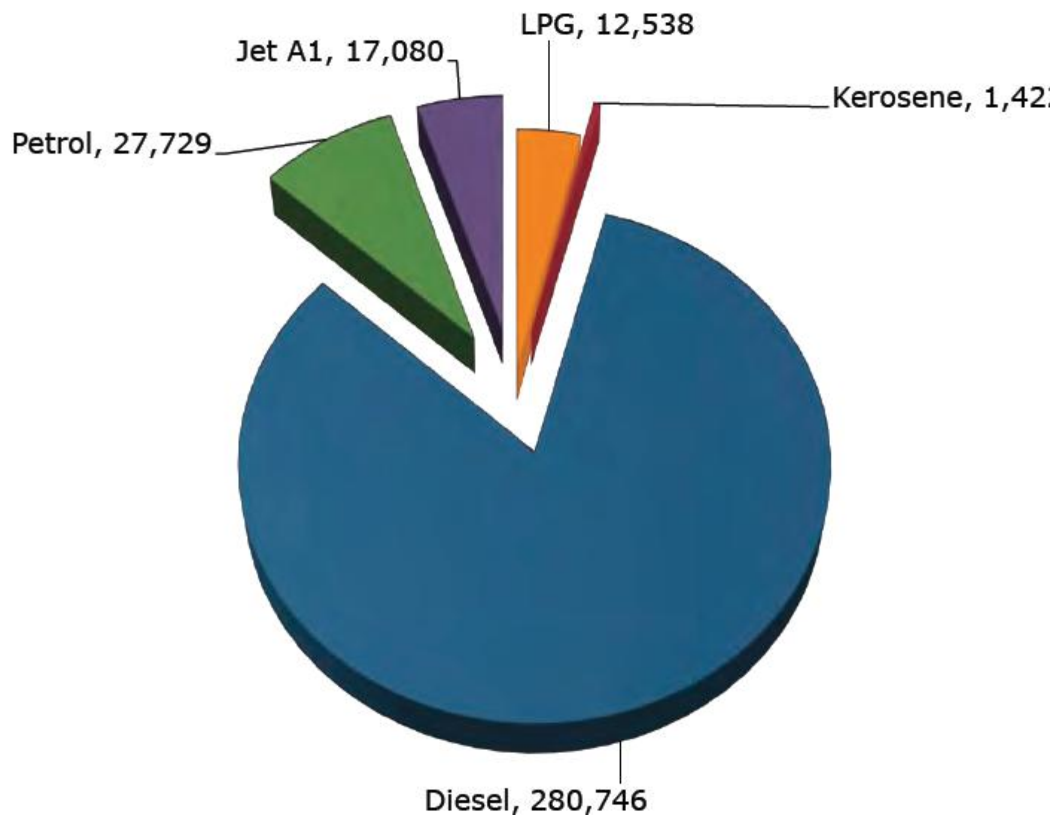
Impacts

- Land loss and beach erosion
- Infrastructure damage
- Economic impacts
- Food security
- Damage to coral reefs
- Water resources
- Human health

2 . Energy Sector

An overview of current energy consumption, energy efficiency measures, and available renewable resources in the Maldives

- Entirely depend on imported fossil fuel in meeting energy demand
- Fuel import bill is **16%** of GDP equivalent to US$ 0.24 billion (2010)
- Total primary energy consumption,2009 - **340,311** toe
- Total GHG emissions in 2009 was **1,030,157** tons of CO2 equivalent
- Large amount of imported diesel is used for **electricity generation** and **transportation**



Energy Sector….

- Diesel used for electricity generation is US$ 1/Liter
- The current price of electricity ranges from ~US$ 0.20 to ~US$ 0.60 per kWh plus fuel surcharge of ~ US$ 0.12 per kWh
- The lower prices are for larger systems operated by STELCO. For smaller systems, like those found on other islands, the prices are high due to small scale and operational inefficiency.
- Main three categories (approx 200 MW installed capacity)

Greater Male'

~ 62 MW

Resorts

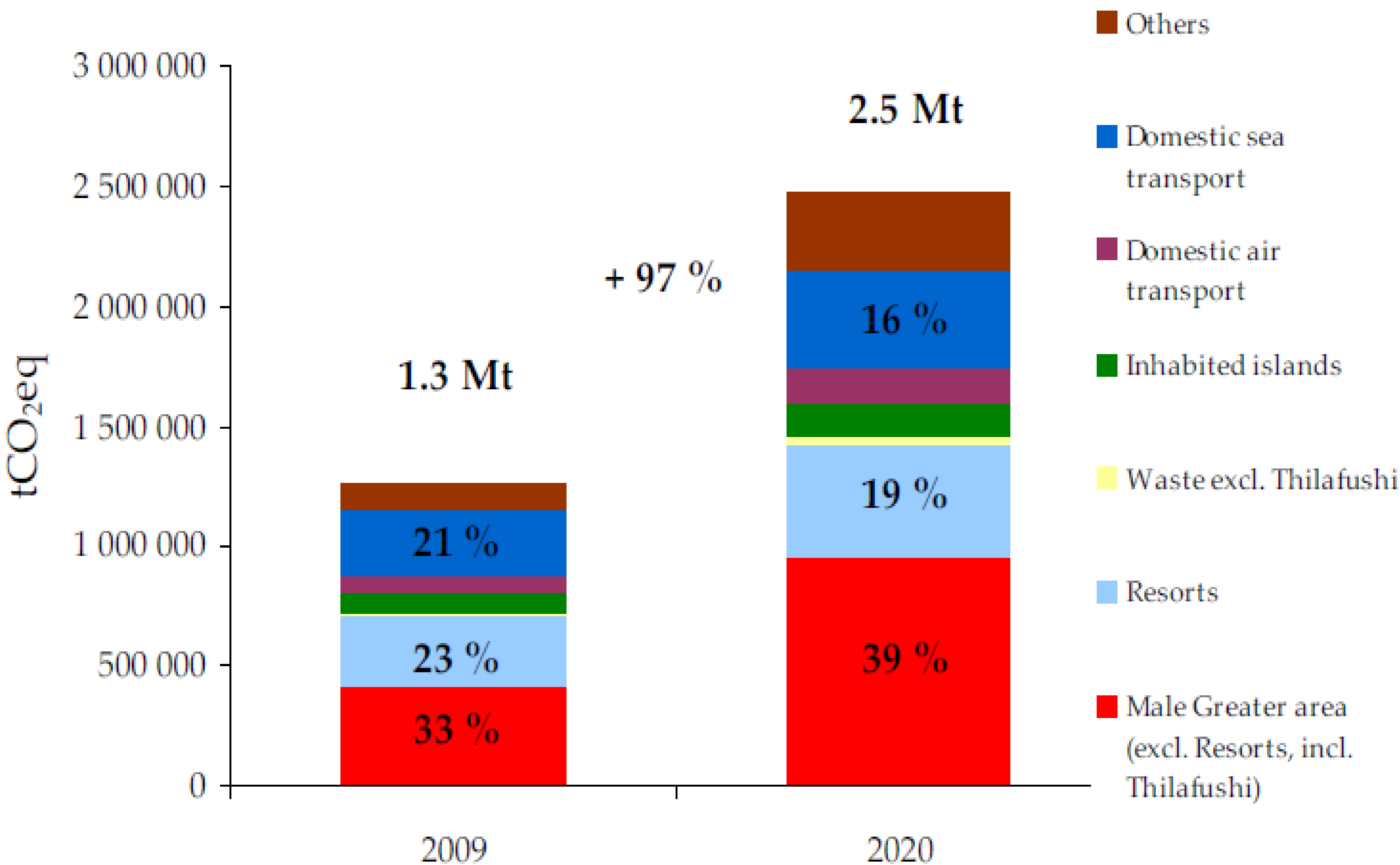
~ 100 MW

Other Islands

~ 55MW

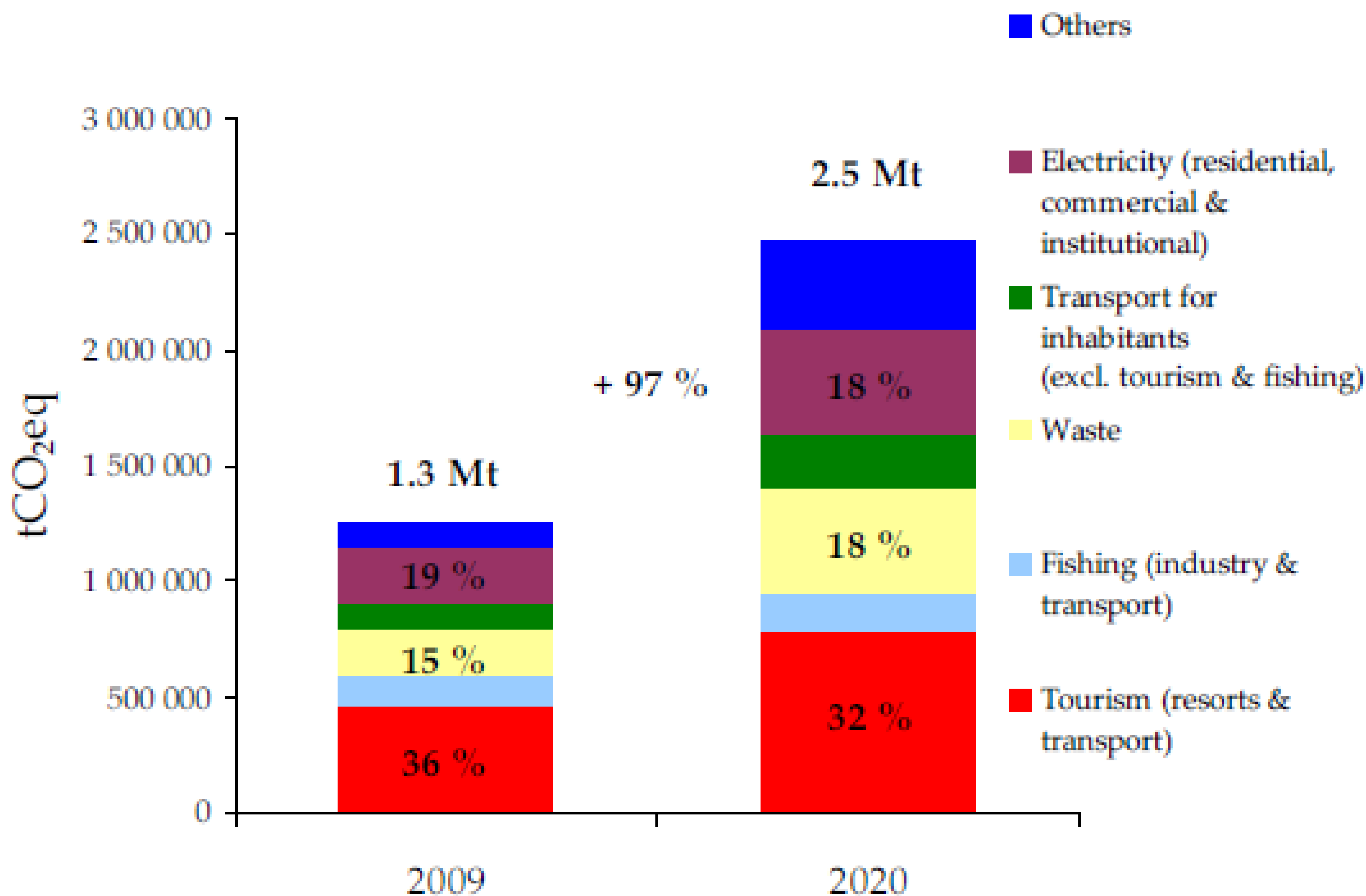
Energy Sector....

Emission by geographical sectors



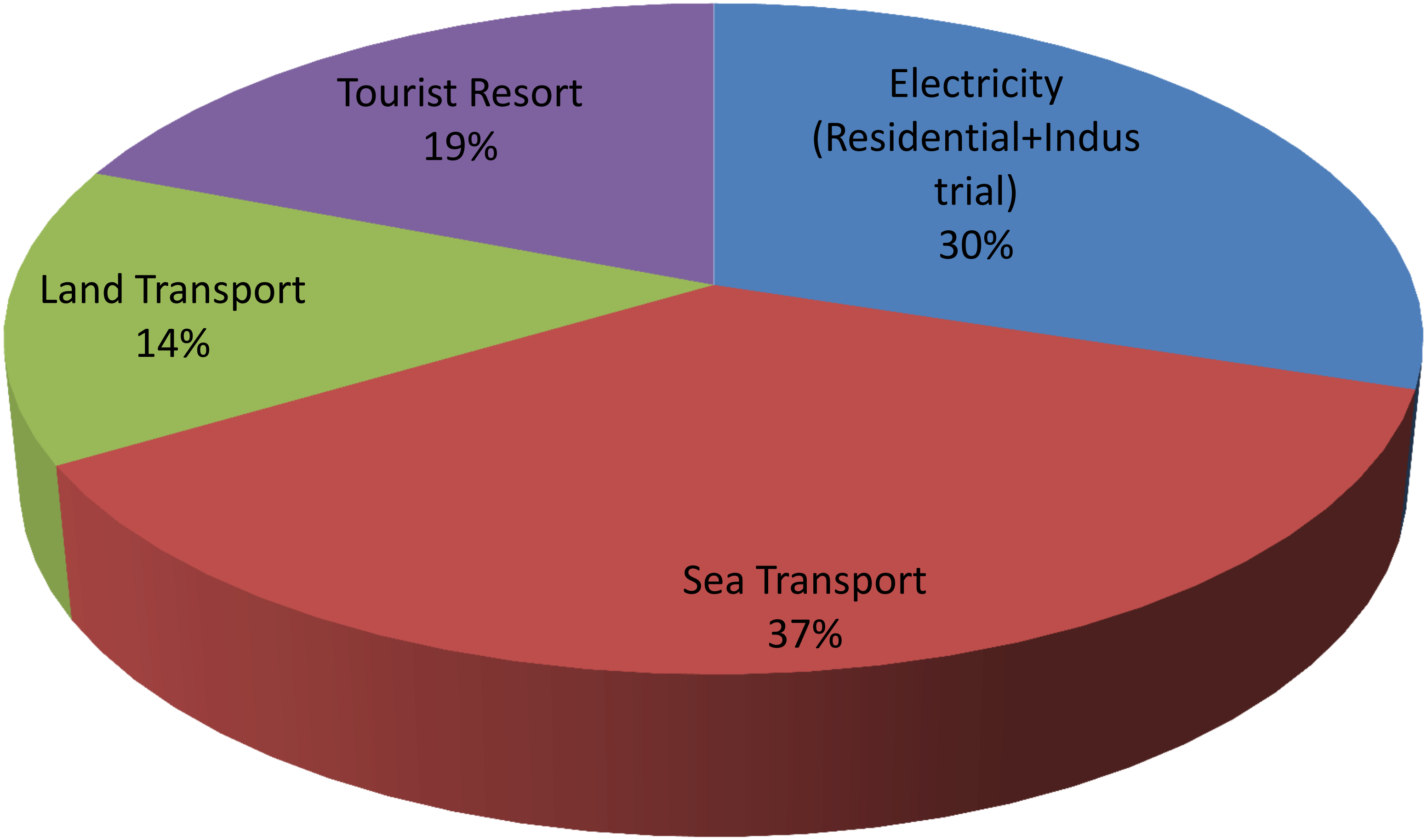
Energy Sector....

Emission by economic sectors

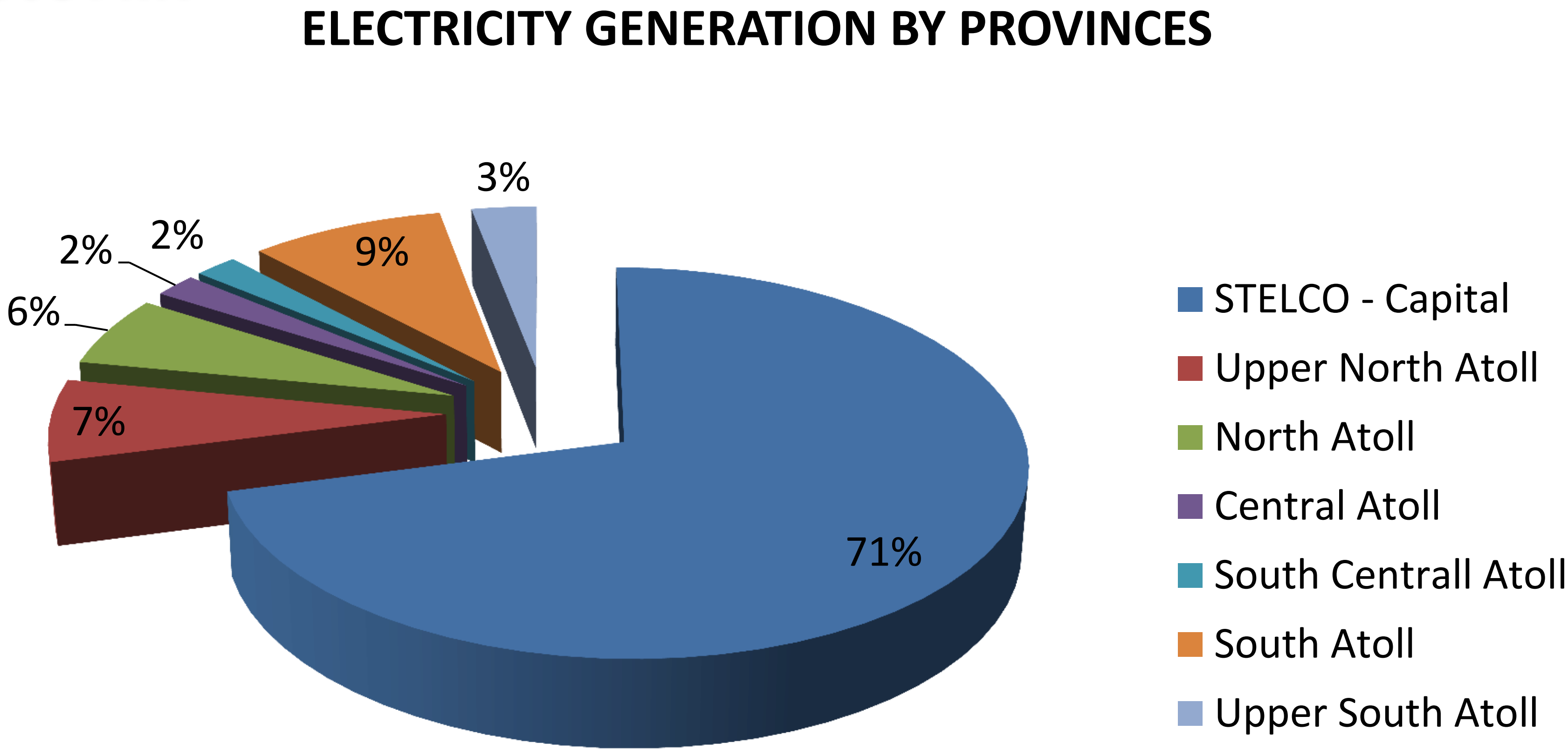


Energy Sector....

Energy Consumption by Sector, toe in 2009

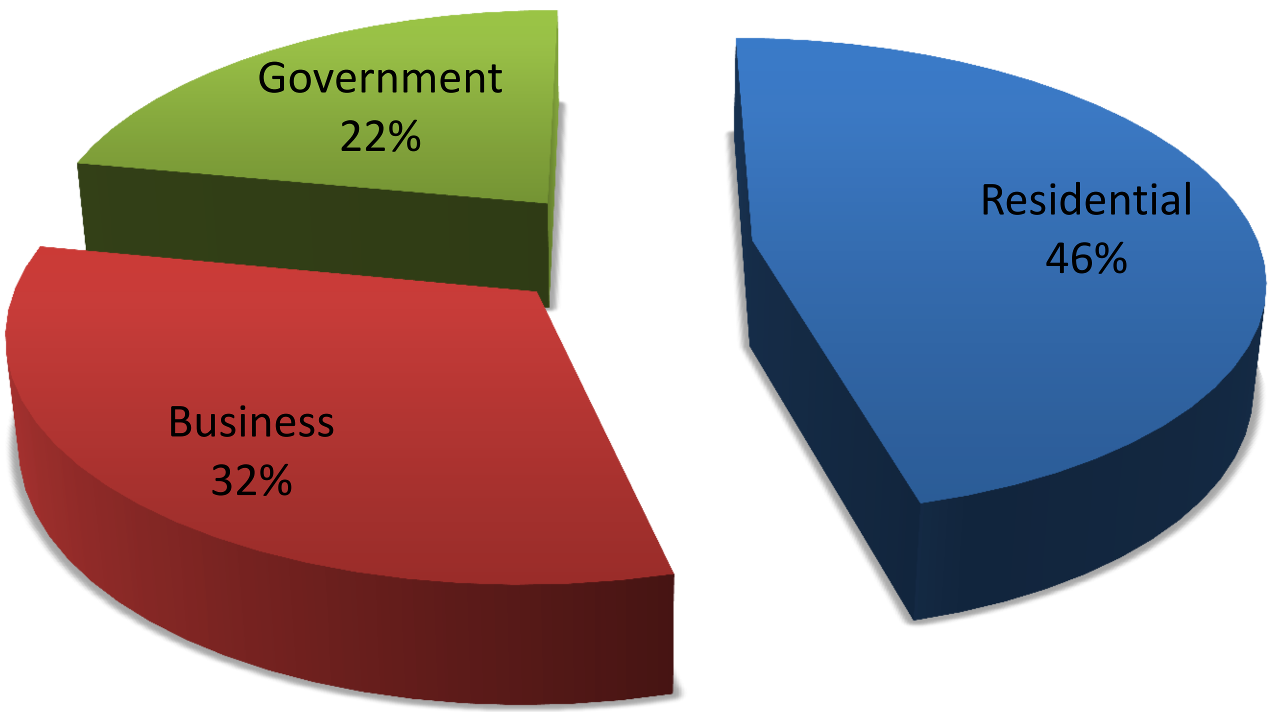


Energy Sector....



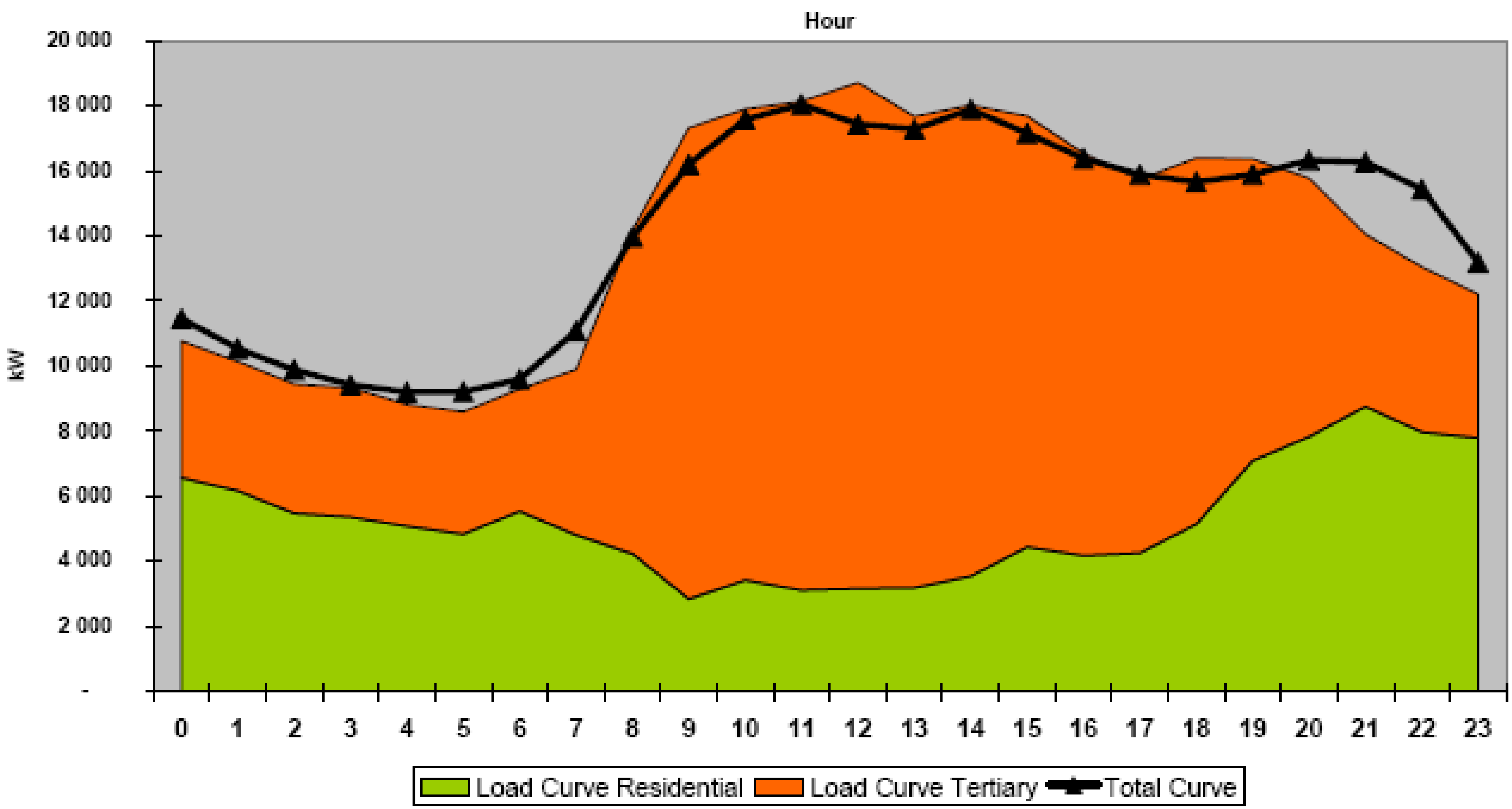
Energy Sector….

Electricity Consumed by Consumer Categories



Energy Sector….

Fig. 5 – Breakdown of the Load Curve by Sector

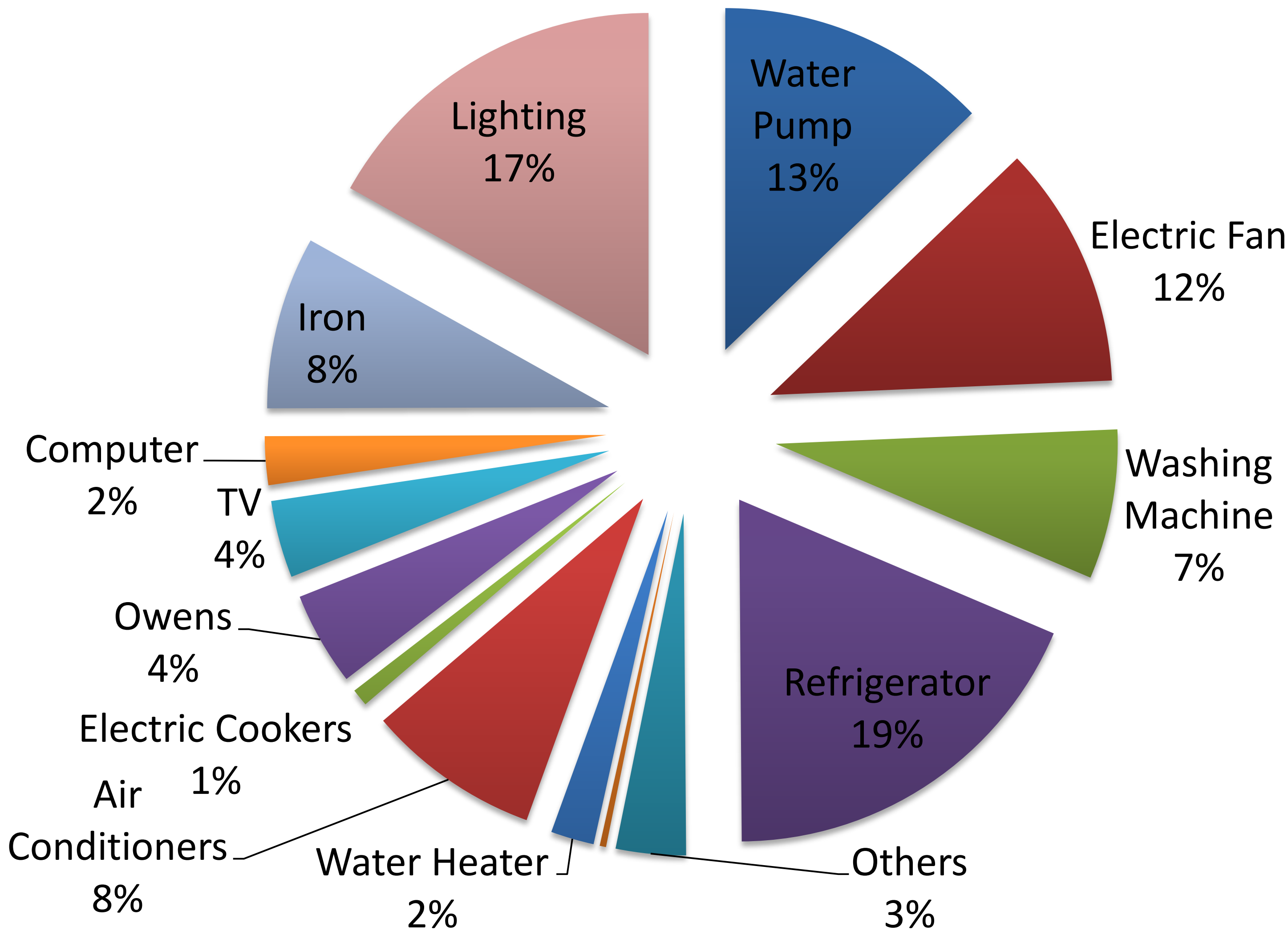


Energy Sector....

- Non-residential buildings are the principal electricity consumers
- Under the non-residential buildings, the highest consumers are the government buildings and those falling under the «business» category
- This pattern of consumption can be attributed to the dynamism of economic activities in the island and to the very high development of air conditioning in the non-residential buildings.

Energy Sector....

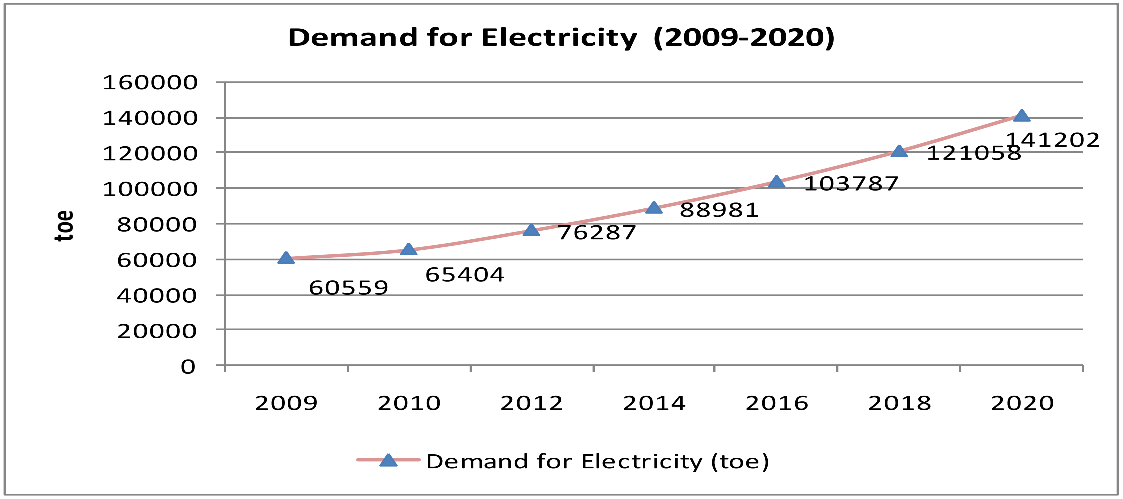
HOUSEHOLD ELECTRICITY CONSUMPTION

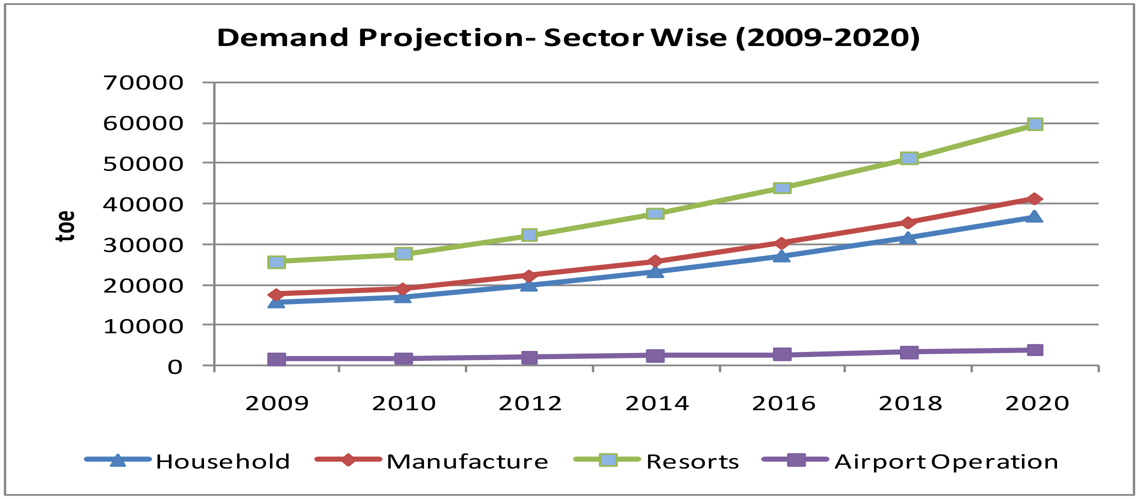


Demand Supply scenario of Electricity-Maldives

Electricity Demand-Future Scenario

- Demand for electricity shall double by 2020 from present demand level.
- Demand of electricity to grow by 8% till 2020





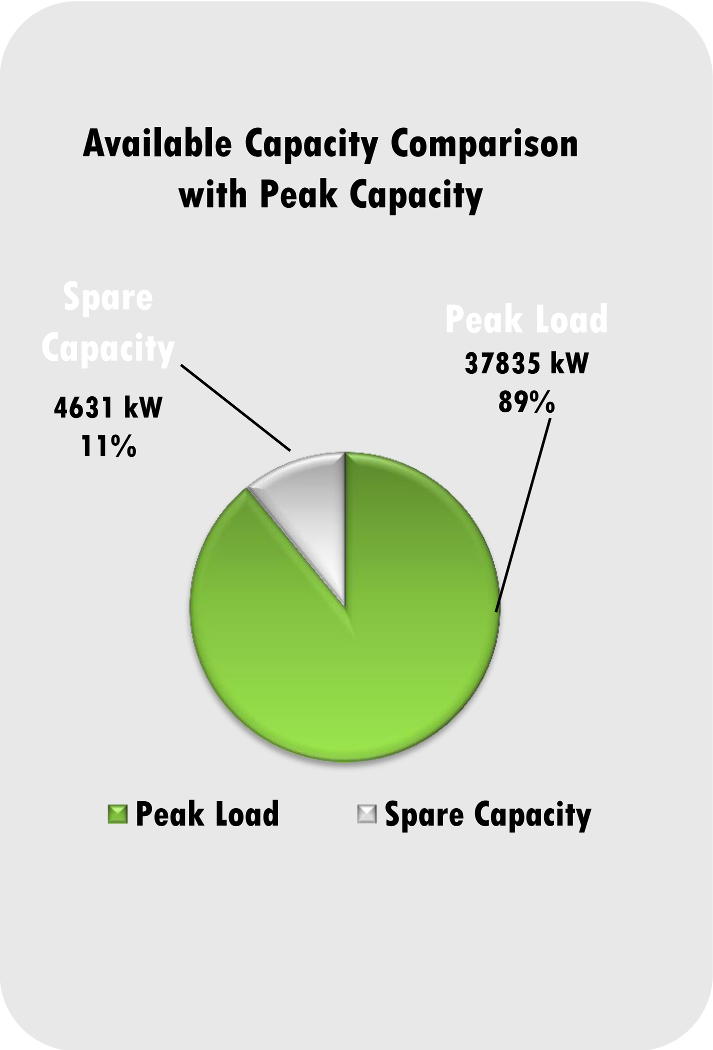
- Demand for the electricity from the resorts will increase significantly till 2020.
- Owing to high influx of the tourist the demand from resorts shall increase.

Ref: Energy Sector Investment roadmap for Maldives

PricewaterhouseCoopers Private Ltd

Energy Sector....

Available Capacity



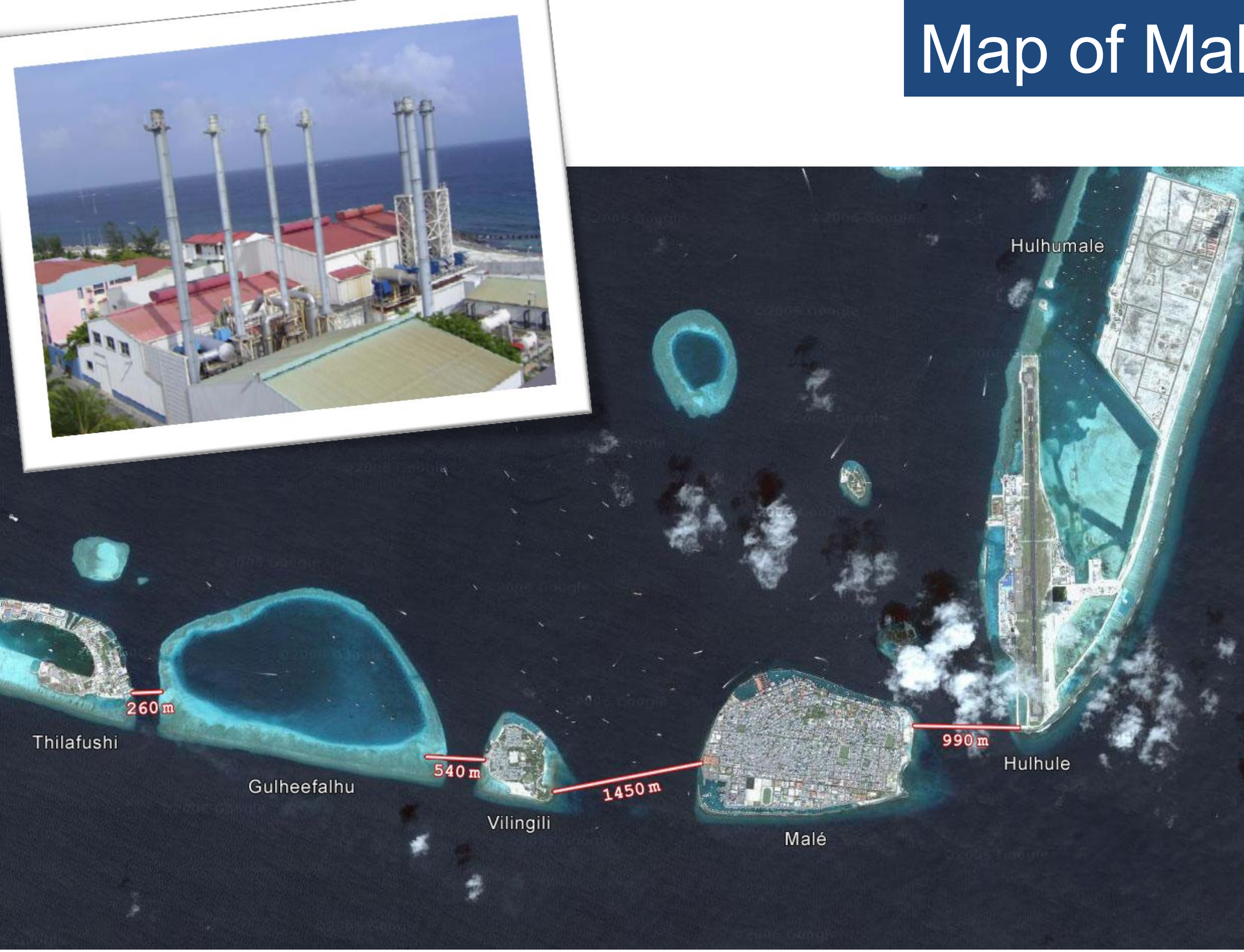
As there is no large spare peak capacity in the STELCO power plant, with current policy settings, planned substation ‘trips’ seem inevitable in Malé and unplanned black outs seem likely in near future

Energy Sector….

- It is believed in the absence of an integrated planning approach for the electricity sector, the peak electricity demand in Male’ is going increase at unmanageable rate.

- To meet this demand will require significant investment in new generating capacity.

Map of Male’ Regio



The possibility of expanding the power station to cater for this level of growth in the congested Malé island is also very limited as there is simply no land available.

Energy Sector....

- There is an urgent need for demand management in the island in order to slow down the need for expanding the power generating capacity and importing greater quantity of fossil fuels

2 . Energy Policy

- Provide a continuous, reliable and affordable energy supply to all islands
- **Achieving Carbon Neutrality by 2020**
- Strengthen the power sector privatization program
- Promote energy efficiency in electricity production, distribution and usage
- Enhance National Energy Security by Promoting Renewable Energy Technologies

Why Carbon Neutral Maldives?

- Showing the world that it is possible for a country to reach carbon neutrality is a demonstration of international leadership and a proof that low-carbon growth is possible.

- Imported fossil fuel generates more than 80 % of the Maldives’ emissions. The country spends over 240M$ per year importing fossil fuels – a figure equivalent to around 16 % of its GDP (2010).

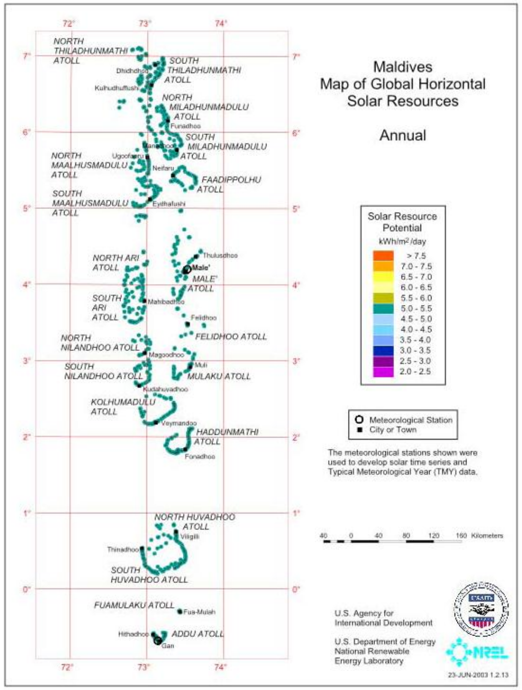
4 – Resource Potential and Potential Technologies

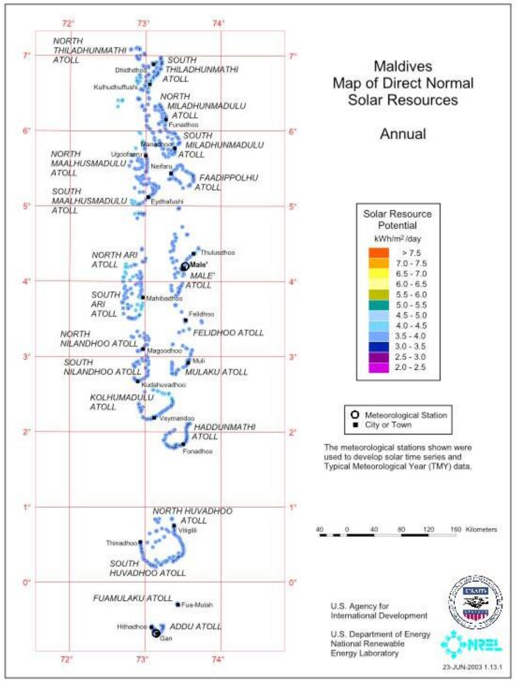
<u>Solar</u>

- ❑ Maldives is located in the Equator and receives abundant solar energy.

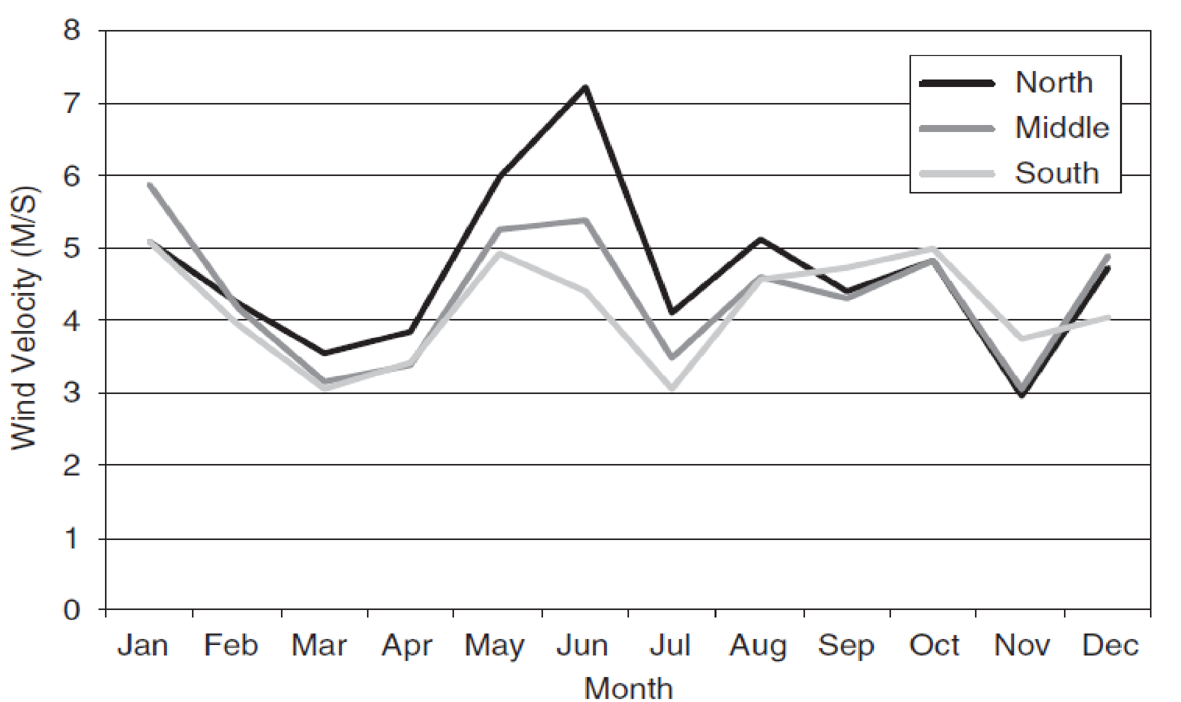
- ❑ Average Sunny Days Per Annum – **280 – 300** Sunny Days

- ❑ Daily Average Global Irradiation in Maldives is **4.5-6** kWh/m2/day





Resource Potential....



Resource Potential....

Existing technology usage

- Solar PV
  - Power generation (pilot systems, resorts)
  - Telecommunications
  - Navigation lights
- Solar Thermal
  - Water heating (Resorts and hotels)
- Wind
  - Power generation (pilot systems)

Resource Potential....

<u>Other resources and related technologies that need to be explored</u>

- Biomass
- Landfill
- Wave
- Tidal
- Current
- OTEC

Resource Potential....

Energy Efficiency

•Energy Conservation in Resorts

- Consume substantial portion of the total energy consumption
- Diesel Consumption: 4460 kg/ bed/ year
- Total Energy Consumption: 91,226 toe (year 2009)
- Breakdown of Energy Consumption:
  - Air conditioning: ~40 %
  - Freezing: ~10 %
  - Desalination: ~10 %
  - Lighting: ~10 %
  - Laundry: between 5 % and 20 %
- Installation of PMS, utilization of waste heat of DG, energy efficient ACs and lighting

•Energy conservation in Water Desalination

- Maldives Sewage and Water Company serves in Male, Hulhumale and Vilingili
- Energy consumption by these 3 islands is 1453 toe/ year (year 2009)
- Low Temperature Multi Effect Distillation (LT-MED) technology can be utilized which utilizes the waste heat from DG power stations as the sole heat source for desalination
- 40-50% of the potable water requirements of each island can be met using this technology
- This technology can give savings of around 850 toe / year of diesel oil per annum to MSWC for only 3 islands under its control
- This technology is already being used in Marshall Islands and in Nauru in the Pacific, and on the islands of Bonaire in the Caribbean Sea

Resource Potential....

Energy Efficiency

- Utilization of waste heat of DG sets
  - Every island has waste heat from DG sets
  - system can be installed for air conditioning from waste heat of DG sets
  - Well proven technology
  - systems based on waste heat are already being used in several places
  - Detailed study is required to access the requirements and technical feasibility

- Energy conservation Public building and households
  - Energy saving through labeling and standards in
    - Air conditioning
    - Refrigeration
    - Water pumping
    - Lighting

4 – Projects

Projects….

- <u>Adh. Mandhoo (2006)</u>
    - Solar-Diesel Hybrid
    - 12.8kWp PV panels + 108kWh battery + 2 x 32kW gensets
    - (EU,ADEME,UNDP)
    - grid tied and contributes to 50%

Projects….

- HA. Uligamu (2008)
  - 45kW Solar-Wind-Diesel hybrid system
  - PV(2.64kWp) + Wind (24 x1.8kW Skystream) + Diesel Gen (48kW) + Battery (96kWh)
  - Maldive Gas (Loan)
- M. Raiymandhoo (2008)
  - 45kW solar-wind-diesel hybrid system
  - PV (2.64kWp) + Wind (18 x 1.8kW Skystream) + Diesel Gen (32kW) + Battery (96kWh)
  - Maldive Gas (Loan)

Projects….

- Ga. Kondey (2008)
  - 25kW Solar-Wind-Diesel hybrid system
  - PV(5.28kWp) + Wind (6 x1.8kW Skystream) + Diesel Gen (18kW) + Battery (96kWh)
  - Maldive Gas (Loan)

- Goidhoo, R. Fainu (2007)
  - 3.5kW wind + 5kWp solar
  - Powering community centre
  - UNIDO grant

Projects….

- Project for Clean Energy Promotion in Male' (Ongoing – end 2012)
    - 395kWp Solar roof top PV
    - Total 5 sites
    - Grid connected feeding in
    - Govt. owned, operated by STELCO
    - Grant Aid– Japan
    - Project planned to be expanded to increase capacity up to 700kWp
- E8-ADB solar island (Formulating)
    - 40kWp for a small island
    - ADB-E8 funding.
- Large scale renewable projects in the pipeline

President Nasheed installing solar panels at his official residence, 2010

6 . Challenges

- In spite of many efforts and benefits of energy efficiency, RET implementation various barriers such as technical, financial, market and policy have constrained the implementation

- Lack of financing
  - High capital costs
  - Govt. subsidy to diesel and electricity
  - No proper financing mechanism established
  - The non availability of sufficient credit facilities and the difficulties in obtaining required finances for energy saving projects are strong deterrents to investments in energy efficiency in Maldives.

Challenges....

- Lack of proper institutional structure

  - In Maldives, the lack of effective national-level coordination and promotion of EEC and RET activities have been major constraint to achieving targets.

- Limited technical capacity

  - Limited manpower to assess, plan, implement , monitor RE technology development and implementation
  - The widespread educational opportunities in energy management and conservation are not available. In addition, the appropriate training facilities, trainers and auditors are lacking.

Challenges....

- Lack of resource data availability
  - Only limited data on wind and solar
  - Detailed assessment not made on other RE sources such as Ocean current, OTEC, landfill

- Lack of public info on RE, EEC options (for investors and public)
  - The main barrier to energy conservation is the lack of awareness among the public and industry managers of the potential gains from improved efficiency and RET implementation

- Lack of regulations
  - For energy and RE sectors
  - Transport
  - Maldives does not have policy in palace to mandate the conservation of energy by different segments of the economy.
  - All the equipment's are being imported and there is no policy on the minimum energy efficiency of these equipment.

Challenges....

- ❑ Limited private sector involvement
  - – Lack of awareness
  - – Lack of proper incentives
  - – Energy Service Companies
- ❑ Limited field demonstration of RETs
  - – O&M issues – lacking capacity
  - – Especially at rural areas

7 . Govt. Initiatives

- Develop energy sector investment plan
- Formulate Energy/RE Act(s) and Standards (energy efficiency act, RE act, building code …)
- Improve the coordination mechanisms within relevant agencies
- Enhance existing revolving fund for renewable energy applications and increase its utilization
- Develop sustainable financial mechanisms to promote renewable energy
- Promote energy efficiency and conservation by promoting Energy Services Companies and Public Awareness
- Duty exemption for RE and Energy Efficient technologies (especially electrical and RE powered vehicles)

7 . Govt. Initiatives

- RE feed-in tariff of 3.5MRf (~USD 0.23) per kWh of which gov't to provide 0.5MRf subsidy to utilities
- Eliminate inappropriate, inconsistent, and inadequate policies that favor conventional technologies (Shifting subsidies from conventional towards renewable energy will ensure that energy prices reflect both social and environmental costs as well as short-term production costs)
- Explore potential of new sources of renewable energies
- Explore cogeneration synergy between power generation and water desalination and use of RET for desalination
- Explore opportunities for grid interconnections
- Energy Labeling
- Scaling up renewable energy installations

Thank You

INDIAN ENERGY EXCHANGE

India's No. 1 Power Exchange

Meeting Portfolio Obligation through trading Renewable Energy and RECs…

By:

Rajesh K. Mediratta

Sr.VP (Business Development)

In this Presentation…

- Legislative Policy and Regulatory Development
- Indian Power Scenario
- Meeting RPO through FiT and REC
- REC Mechanism
- Way Forward

Legislative Policy and Regulatory Development

Regulatory Policy development…1/3

Policy / Regulation	Year	Key Focus
Electricity Act	2003	**1.** Sector Reorganization and competitive Market **2.** Consolidate the laws relating to generation, transmission, distribution, trading and use of electricity **3.** Promotion of efficient and environment friendly policies
National Electricity Policy	2005	**1.** Overall Sector Development **2.** The Central Government shall, from time to time, prepare the national electricity policy and tariff policy in consultation with the State Governments and the Authority
Tariff Policy	2006	Performance Based Regulation
The National Action Plan for Climate Change (NAPCC)	2008	**1.** 5% renewable energy purchase for FY 2009-10 at national level under central RPO framework **2.** Increase in RPO obligation by 1% each year for next 10 years

Regulatory Policy development …2/3

Policy / Regulation	Year	Key Focus
REC RPO Regulation	2010	1. Regulations for the development of market in power from Non Conventional Energy Sources by issuance of transferable and saleable credit certificates 2. Mechanism and Features 3. Role of State agency , Central Agency , Eligibility action in case of default
Model REC regulation	2009	1. Defining the framework to develop REC regulation in the respective states
Floor and Forbearance Price order	2010	1. Mechanism to determine the floor and forbearance price

Regulatory Policy development …3/3

Section 86. (Functions of State Commission) : --

(1) The State Commission shall discharge the following functions, namely:-

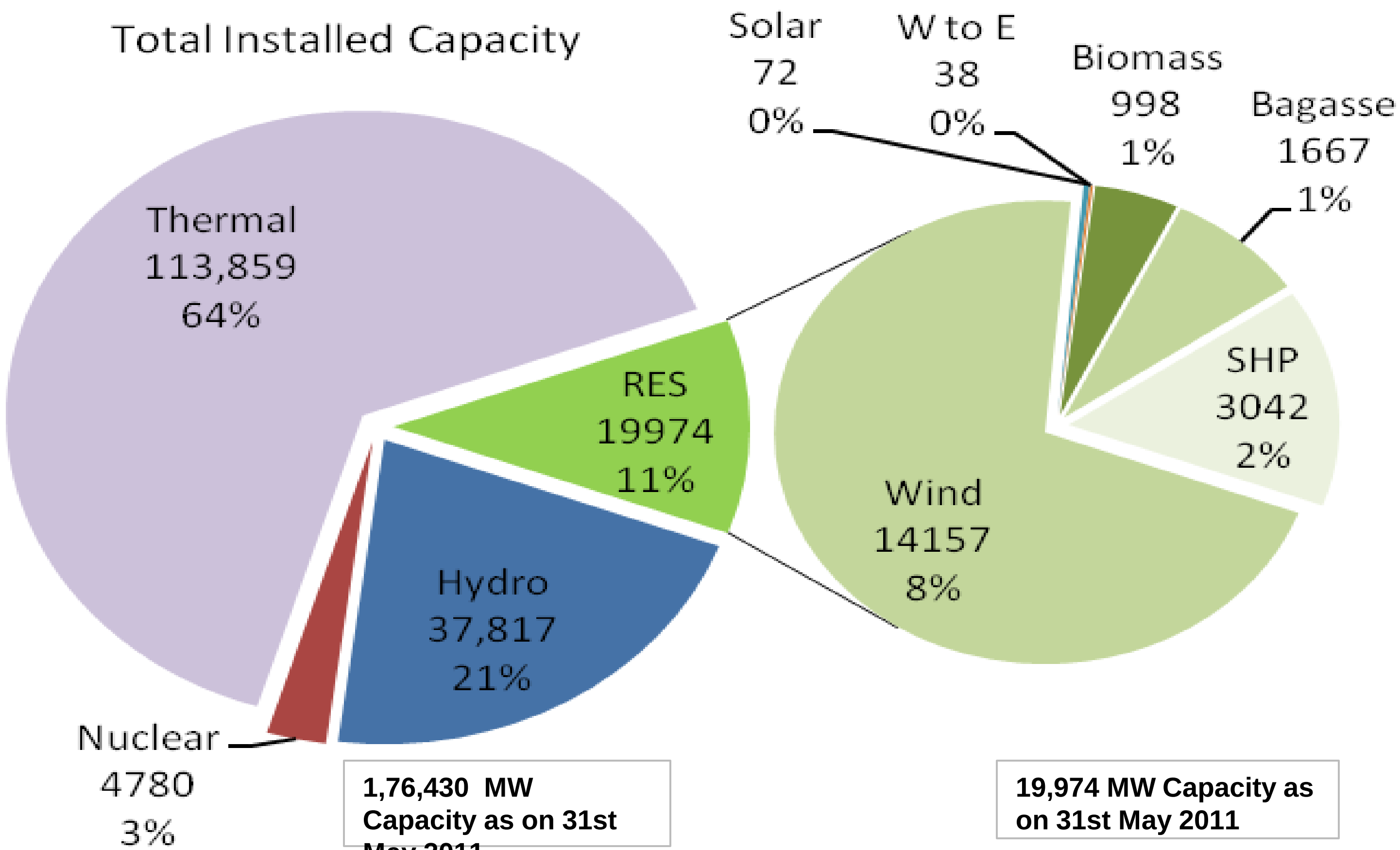
(*e*)*Promote co-generation and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, **a percentage of the total consumption** of electricity in the **area of a distribution licensee;***

RPO Scenario : India….

Region	State	RPO		Total
		Non Solar	Solar	
Northern Region	Himachal Pradesh	11%	0.10%	11.10%
	Haryana	1.25%	0.25%	1.50%
Western Region	Maharashtra	6.75%	0.25%	7.00%
	Goa and Uts	1.70%	0.30%	2.00%
Southern Region	Tamil Nadu			14.00%
	Kerala	2.75%	0.25%	3.00%
Eastern Region	Orissa	4.90%	0.10%	5.00%
	Bihar	2.00%	0.50%	2.50%
North Eastern Region	Mizoram			6%
	Assam	2.70%	0.10%	2.80%

Indian Power Scenario

Present Status Installed Renewable Generation Capacity



1,76,430 MW Capacity as on 31st May 2011

19,974 MW Capacity as on 31st May 2011

Power Supply Position

Power supply position in the country during 2010-2011

Particulars	Energy (MU)	Peak (MW)
Requirement	861591	12287
Availability	788355	110256
Shortage	73236	12031
(%)	8.50%	9.80%

Anticipated power supply position in the country during 2011-2012

Particulars	Energy (MU)	Peak (MW)
Requirement	933741	136193
Availability	837374	118676
Shortage	96367	17517
(%)	10.3%	12.9%

A capacity addition of **17191 MW during the year 2011-12** comprising **14111 MW of thermal, 2080 MW of hydro and 1000 MW of nuclea**r power stations has been considered.

Options available to meet RPOs

Options for Purchasing Renewable to meet RPOs

Feed-in Tariff
[State Regulated Tariff]

Sale of electricity to DISCOMs at State regulated tariff

Purchase of Renewable Power
@ market price

Buy from Third Party

REC Option

Green Attributes

REC
[Solar & Non-Solar]

Sale of RECs at Power Exchange

Electricity

Sale of Electricity at Market Price in open market

Sell to Discoms at Price ≤ Pooled Cost of Power Purchase*

*** - Weighted Average Pooled Price at which distribution licensee has purchased electricity (including cost of self generation, long-term and short term purchase) in the previous year, but excluding the cost of RE power purchase**

1) Purchase Renewable power through FiT

- **Feed in Tariff** :
  - Cost-plus tariff : Generator gets about 14% RoE plus all fixed and recurring costs on normative basis
  - Purchase as-and-when-generated
  - Scheduling not required
  - Local Discom can only purchase through FiT
  - Different tariffs for each source, State, etc.
  - State Commission's jurisdiction

2) Purchase Renewable Power

- ✓ **Buy from RE Generator @Market prices**
  - **Generators will be scheduled.**
  - **Provision For Infirm generation from Wind and Solar Plant :-**
  - **A**ctual generation within +/- 30% of the schedule, no UI would be payable/receivable by Generator. **(effective from 1st Jan,12)**

- ✓ **Buy from third party within State**
  - **Generators not required to be scheduled**
  - **Wheeling on monthly basis**

3) Purchase RECs

- ✓ **Buy Electricity through any source (other than FiT)**
- ✓ **Buy RECs to compensate RPO … mechanism explained**

Why REC a better option than ‘buying renewable power’ ?

Schedulability

- Less predictable
- Less controllable
- Require better prediction tools over one-day
- Scheduling changes till one-hour before

High Overheads

- More System imbalances
- Discoms to spend on more reserves to avoid UI
- More reserves required to balance

Open Access costly

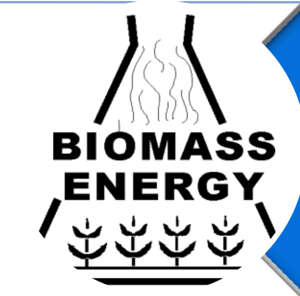
- Payment of Transmission, Wheeling Charges, Losses and Scheduling Charges to LDCs(50-100p/kWh) vis-à-vis 7p/kWh in RECs

RECs are better way to transfer green premium than green energy

REC Trading

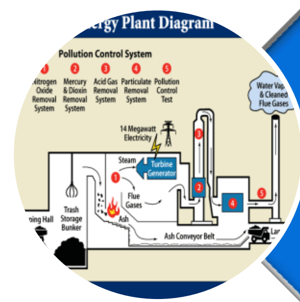
REC Sellers : Approved Sources

Wind



Biomass,
Bio – fuel
co - generation

Solar



Municipal Wastes

Small Hydro

Any type/source approved by MNRE

Process for RE Generators … through RECs

Procedure for ACCREDITION (Through State nodal Agency)

Procedure for REGISTRATION (Through Central Agency NLDC)

Procedure for ISSUANCE (Through Central Agency NLDC)

Procedure for TRADING & REDEMPTION(Through PXs)

Salient Features of REC Mechanism

Participation	Voluntary
REC Denomination	1 MWh
Validity	365 Days after issuance
Categories	1. Solar REC 2. Non-Solar REC
Trading Platform	Power Exchanges only
Banking	Not Allowed
Borrowing	Not Allowed
Transfer Type	Single transfer only , repeated trade of the same certificate is not possible
Penalty for Non-compliance	‘Forbearance’ Price (Maximum Price)
Price Guarantee	Through ‘Floor’ Price (Minimum Price)
Price Discovery Mechanism	Closed Double-sided Auction
Trading Calendar	Last Wednesday of the month (T day)
Trading Period	1300-1500 hrs (T day)
Market Clearing	1700 hrs(T day)

RECs Floor/Forbearance Price

	Floor Price	**Forbearance Price**
Solar RECs	Rs. 12,000/REC	Rs. 17,000/REC
Non-Solar RECs	Rs. 1,500/REC	Rs. 3,900/REC

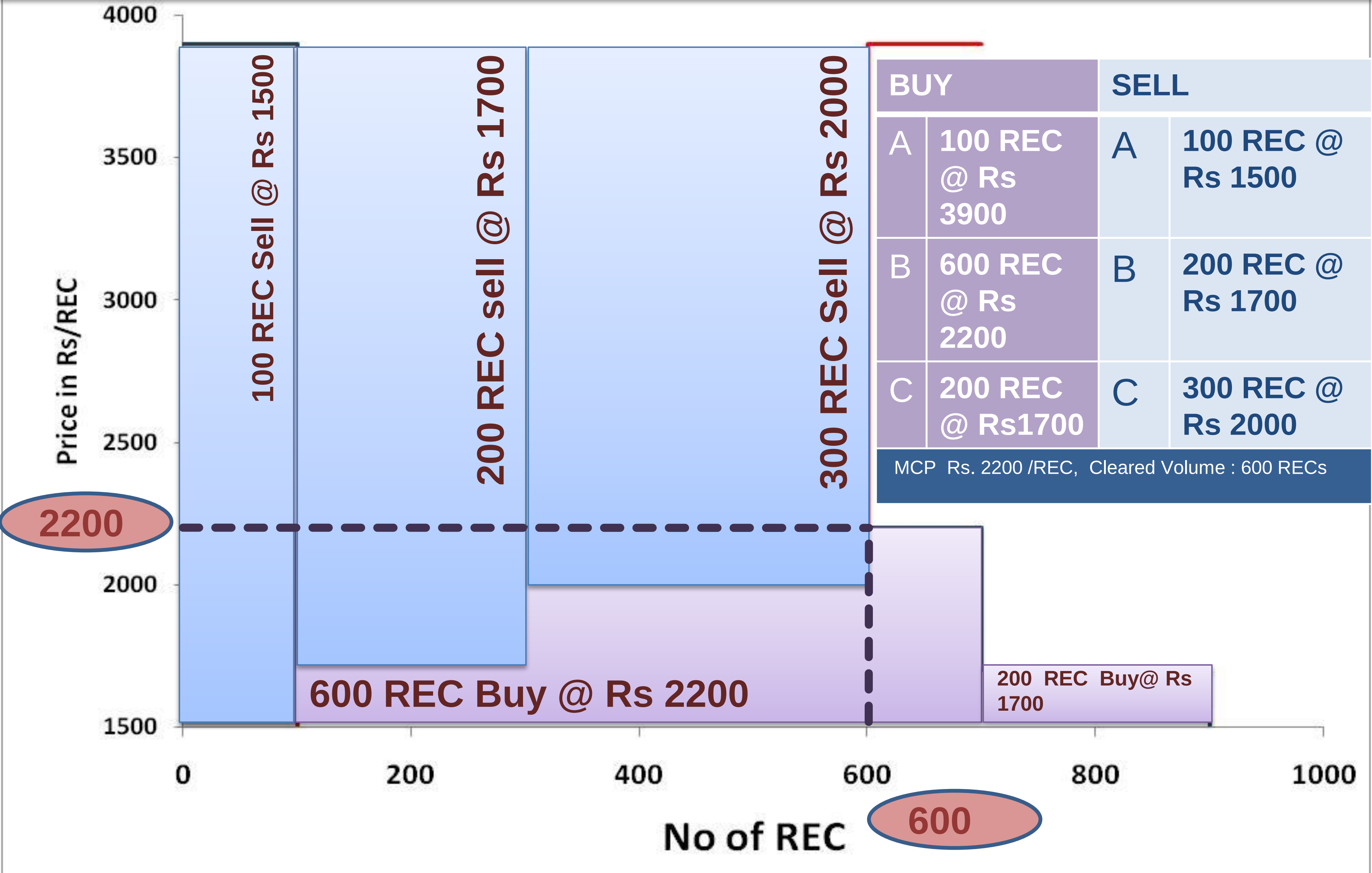
1 REC is equivalent to1 MWh

Reference : CERC Order in matter of Petition no. 99/2010, dated March 23, 2010

Trading at IEX

Trading Day	Last Wednesday of every Month
Market Clearing	Closed Double sided auction
Trading Time	1300-1500 Hrs
By 1530 Hrs	Verification by Central agency for Valid REC by cleared seller at IEX
By 1600 Hrs	Central agency confirms REC
By 1630 Hrs	IEX finalizes trade
By 1700 Hrs	Buyer & Sellers informed to Central Agency
By 1800 Hrs	Invoice raised *(proof of REC trade)*

Cleared volume : 600 RECs **MCP:** Rs 2200/REC



BUY		SELL	
A	100 REC @ Rs 3900	A	100 REC @ Rs 1500
B	600 REC @ Rs 2200	B	200 REC @ Rs 1700
C	200 REC @ Rs1700	C	300 REC @ Rs 2000

MCP Rs. 2200 /REC, Cleared Volume : 600 RECs

Way Forward

Way forward

- Renewable power transfers across the country is difficult
- In-firm nature of renewable power creates reliability issues in power system
- RECs can be exchanged across country
- Common REC Mechanism can be developed

Way ahead

SAARC REC Market

SAARC Electricity Markets

Thank Yu

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CLEAN ENERGY DEVELOPMENT IN NEPAL

Energy to base of economic pyramid (BOP)

July 11 – 13, 2011
Male, Maldives

HIGHLIGHTS

1. Energy consumption
2. Demand vs supply
3. Energy sources
4. Climate Change
5. Clean Energy Initiative
6. Clean Energy Development in Nepal
7. Energy to the base of economic pyramid
8. Expanding Clean Energy

CONSUMPTION

- Average Annual Energy consumption of Nepal= 16 gigajoule
- Average annual world's consumption= 65 gigajoule

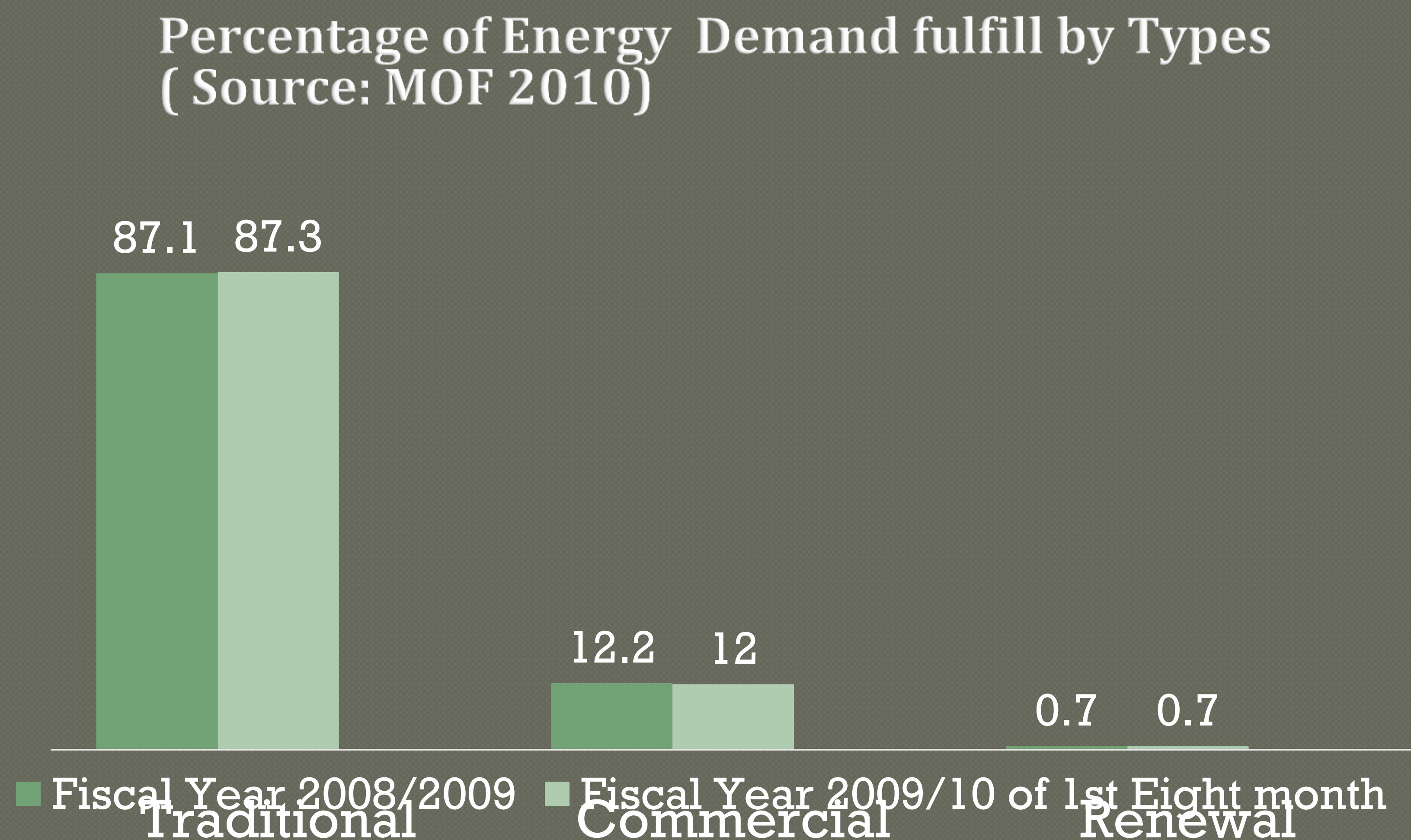
CONSUMPTION

- 9.3 million tones of oil equivalent in 2008/2009

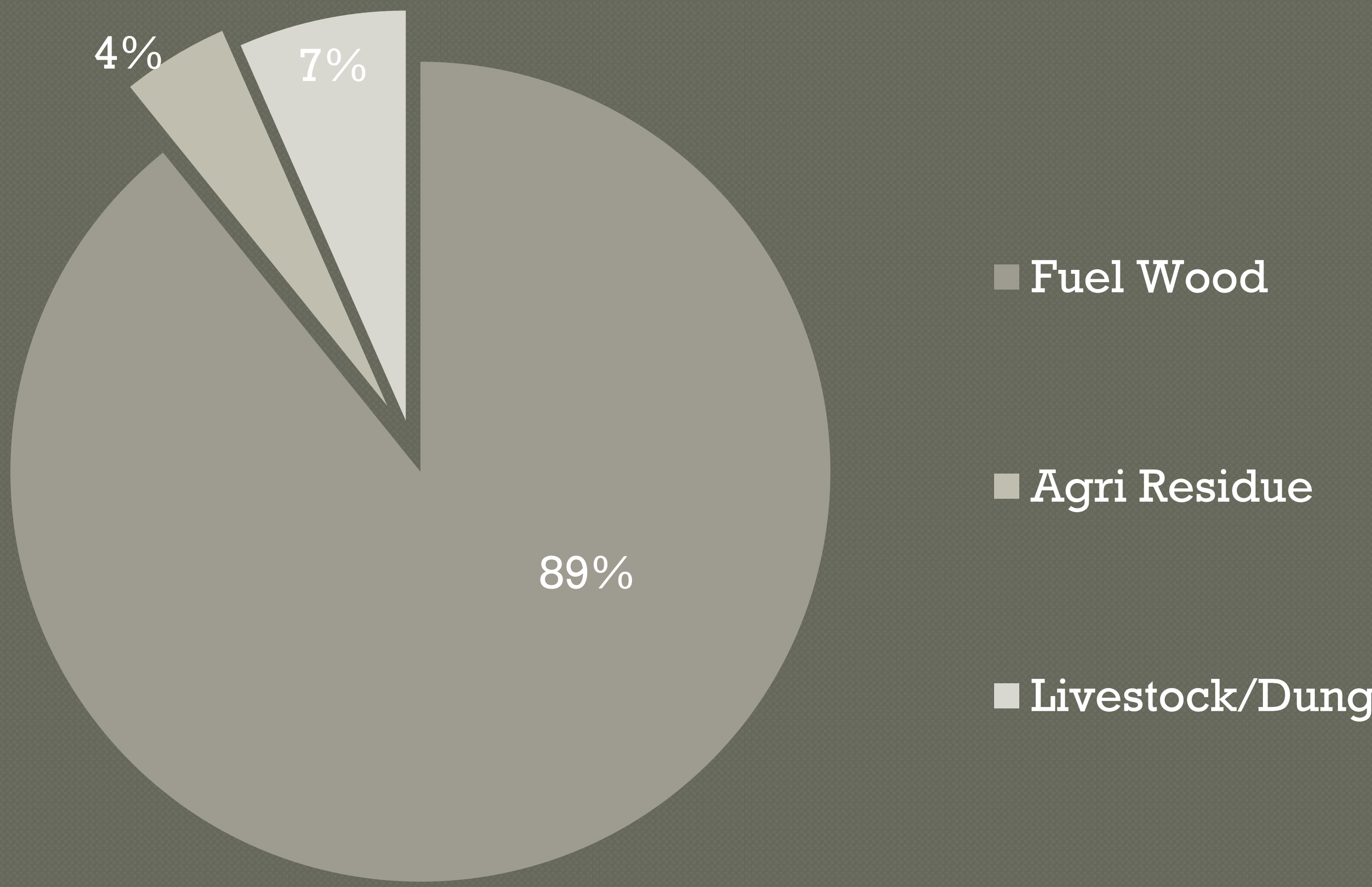
ENERGY SOURCES IN NEPAL

- **Traditional** – Fuel wood, agri residue, dung (cow/buffalo)
- **Commercial**- Petroleum products, coal, electricity
- **Renewal** – micro hydro, wind, solar, biogas

SOURCES


Percentage of Energy Demand fulfill by Types
(Source: MOF 2010)
87.1
87.3
12.2
12
0.7
0.7
Traditional
Commercial
Renewal
Fiscal Year 2008/2009
Fiscal Year 2009/10 of 1st Eight month

SOURCES OF TRADITIONAL ENERGY IN NEPAL



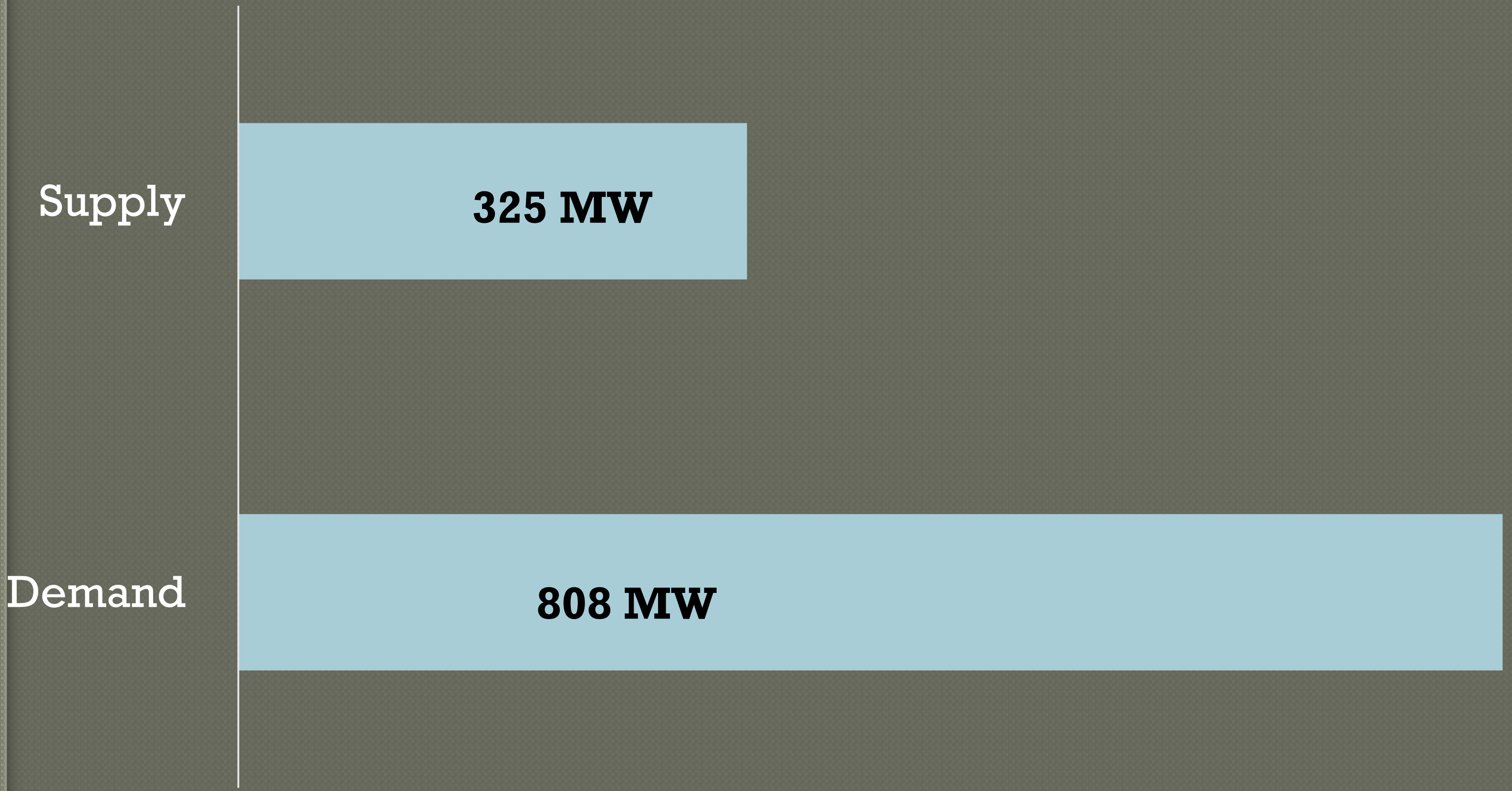
ELECTRICITY

- Total electricity generation 714 MW
- Hydropower 661 MW
  - ✓ 655 MW connected to national grid
  - ✓ 6 MW from micro hydro
- 53.41 MW thermal
- 100 KW from Solar plants

DEMAND vs SUPPLY IN MONSOON

(Source: Ten years hydropower development Report -I, GON, 2009)

DEMAND VS SUPPLY IN WINTER



(Source: Ten years hydropower development Report -I, GON, 2009

CLIMATE CHANGE: CO2 AND NON CO2 GASES

Gases	Sources	Current Increasing %	Contributing %
CO_2	Fossil fuel burning. deforestation	0.5	55
CH_4	Agri residues, Rice, paddies, urban wastages	0.9	15
N_2o (nitro oxide)	Fertilizer use	0.8	6
High GWP related gases *	Various industries	0.4	24

*Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SFCs)

Source: EPA, 2004

CONTRIBUTION TO GREENHOUSE GAS EMISSION BY THE SECTOR AND COUNTRY IN SOUTH ASIA

	Afghanistan	Bangladesh	Bhutan	India	Nepal	Pakistan	Sri Lanka
Sectors							
Energy Transformation and use	-	32	-	1068	5	112	11
Electricity and Heat	-	9	-	558	0	34	3
Manufacturing and Construction	-	10	-	231	1	27	1
Transportation	-	3	-	92	1	25	6
Other fuel combination	-	10	-	147	3	17	1
Industrial process	-	2	0.1	71	0	5	1
Agriculture	-	72	-	639	24	149	-
Waste	-	16	-	88	2	17	-
Forestry	9		-	-	124	33	30

Sources: South Asia Climate Change Strategy, The World Bank, 2009, pg 33

CHALLENGES

- Environmental risk
- Green house gas emission
- Traditional Technology
- Issues of public health

POTENTIAL CLEAN ENERGY IN NEPAL

Today’s Challenge of Nepal: reliable, clean, and efficient energy

POTENTIAL CLEAN ENERGY IN NEPAL

Today's Challenge of Nepal: reliable, clean, and efficient energy

CLEAN ENERGY FOR GROWTH AND DEVELOPMENT

- Accelerate access to affordable and reliable modern energy services to decrease poverty and increase productivity, enhance competitiveness, and thus improve growth and development.
- Without access to clean, and sustainable energy services, the poor are exposed to unhealthy air pollution and create high environmental risk

CLEAN ENERGY POTENTIAL TO GROWTH AND DEVELOPMENT IN NEPAL

1. SOLAR ENERGY

- Nepal has tremendous potential of harnessing solar energy
- Nepal has over 300 days full sunny days in a year
- Nepal receive sun light average 12 hours in a day
- 100 watt household solar systems are highly feasible
- Promote tourism

2. Wind Energy

- Nepal has potential of 3000 mw wind energy
- This has not yet fully explored or realized due to government has not brought clear policy

3. Biogas

Nepal has over 1.9 million biogas plants are feasible

so far about 217,000 plants are installed

4. Bio energy

- Nepal has over 29 % of forest , over 80 percent people's derive their livelihood opportunities from agro forest resources
- By products from these resources have huge potential to harness clean energy (improve cooking stove, briquette, rice husk etc)

4. Methane from Municipal solid waste (MSW)

- Managing MSW to Nepal is huge challenge
- By capturing methane from MSW is huge potential to Nepal
- At present all generated MSW stock in open area not so far from city and residential places

CLEAN ENERGY INTERVENTION IN NEPAL (MOE, 2010)

Clean Energy	Production	Benefited households	End use
Household solar System	2 mw	200,000	lighting
Biogas	540 mw	217,000	Cooking and lighting
Micro hydropower	15 mw	200,000	Lighting, operation of small micro enterprises
Improved Water Mill	5 mw		
Improved cooking Stove		300,000	Cooking

ENERGY TO THE BASE OF ECONOMIC PYRAMID (BOP)

The base of the economic pyramid (also referred to as the Bottom of the Pyramid) refers to the estimated 4 billion people around the world who are poor by any measure and have limited or no access to essential products and services such as energy, clean water, and communications. lobally, people in this socioeconomic group earn US$1 to US$8 in purchasing power parity (PPP) per day (Cited by Bairiganjan et. at, WRI, Washington DC, Institute of Financial Management and Research, Chennai, India, 2010).

THE BASE OF ECONOMIC PYRAMID (BOP)

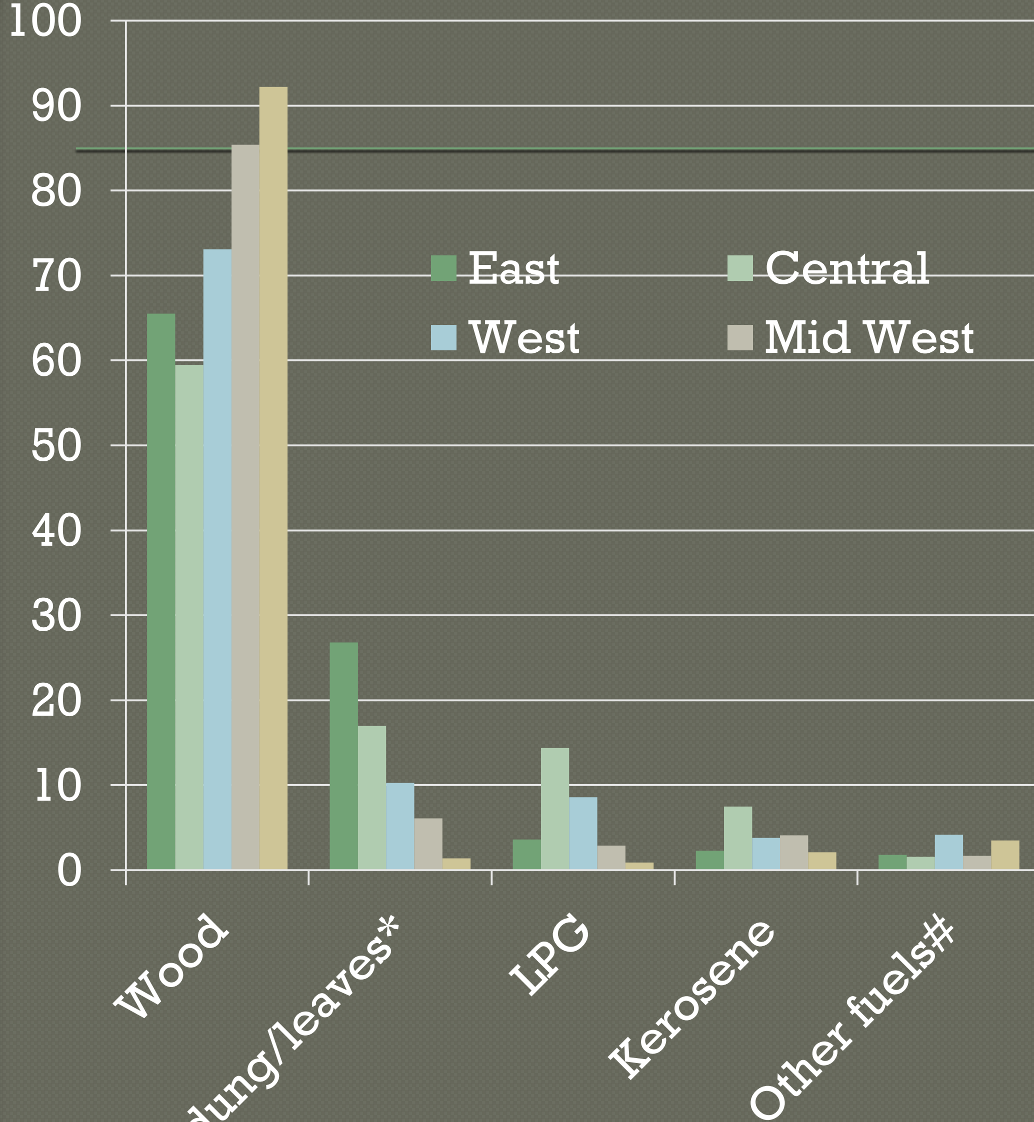
In Nepal: over 80 percent of people are unable to access clean, safe fuels and must rely on burning traditional biomass fuels such as wood, cow dung and crop residue, and are residing rural setting.

Faces of BOP- their livelihood facilitating instruments

Faces of BOP- Nepal

Faces of BOP- Their working pattern

Energy to the base of economic pyramid (BOP)



*: straw, thatch

#: electricity, biogas, coal,/charcoal and other category (Source: NLSS, 2003/04, pg 40

Scaling up clean energy services to the BOP is great challenge to developing nations.

DREE-Decentralized Clean Energy Enterprise

Energy enterprises supplying energy services for community or households in specific geographic region. This model supply energy (small hydro, biomass, solar technology and ICS) to the BOP where grid connections are not available or costly for connecting.

Potentiality of DCEE

1. Numbers of household
2. Lower product price/annual cost - affordable
3. Life span
4. Adoption rate
5. Comparative Advantage:

higher level of operational reliability, low upfornt cost, size to meet demand, customized power solution based on individual requirements, long term cost saving, health benefit from emission of pollutants, climate friendly and conserve biodiversity and ecosystem

DCEE- Business Model

Providing through company owned minigrid, power price to existing energy price expenditure level, supplied village, using existing under utilized grid infrastructure, sold on credit, in partnership with local microfinance institution, installment payment modality, large scale sales, sold directly consumer.

Opportunities

Subsidies, carbon credit can generate new revenue, leasing options (Brazil and USA), partnership with MFIs and can reduce financing and marketing cost, industry groups can lobby to policy makers, provide service to resources, less product misuse, and implement pay per use enterprise model that support purchasing pattern and income streaming

Elements of Promoting DCEE

- State of activity in Nepal's BOP clean energy market
- Energy related consumption and expenditure pattern
- Market value of DCEE
- Government policy and initiatives affecting BOP power sector
- The role of non profit and international development partners

NAMASTE !

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CLEAN ENERGY DEVELOPMENT IN PAKISTAN

CURRENT ENERGY CONSUMPTION, ENERGY EFFICIENCY MEASURES, & AVAILABLE RE RESOURCES

SEQUENCE

- An Introduction to Pakistan & its Energy Scenario
  - Sources & sectors organization
  - Supply, consumption, demand, Shortfalls
- Energy Efficiency Measures in Pakistan
  - Areas & Range of Activities
  - Government Organs Responsible for EE / EC
  - Initiatives & Achievements
- RE & Pakistan
  - RE targets & Policy
  - RE Resources & Potential
  - Initiatives & Achievements

PAKISTAN – AN INTRODUCTION








PAKISTAN – FACTS & FIGURES

- Total area: approx 810,000 km^2

- Population: 180 Million, growing at 2.2% per annum
  - Rural population: 65%

- Climate – mostly dry
  - Monsoon rains July-Sep
  - The Western Disturbance Dec-Mar
  - Average annual rainfall: 255 mm
    - Increases to 600-750mm after rainfall increases
    - More than 750mm in the foothills & northern mountains
    - About 60% of rainfall occurs during monsoon

SOURCE: PAKISTAN STATISTICAL YEARBOOK 2010

PAKISTAN – FACTS & FIGURES

- Economy
  - Agriculture-based
    - 25% of Pakistan's total land is under cultivation – watered by one of the world's largest irrigation systems
    - Agriculture accounts for 21% of GDP & employs 41% of the labor force
    - Agriculture land: 34.82 million hectares
      - Forest area: 3.78 million hectares
      - Arable land: 31.04 million hectares
        - **Culturable waste: 9.09 million hectares**
        - **Cultivated area: 21.95 million hectares**

SOURCE: PAKISTAN STATISTICAL YEARBOOK 2010

PAKISTAN – FACTS & FIGURES

- Economy
  - Agricultural hub is Punjab
    - Average annual rainfall < 250mm
    - Extensive irrigation makes Punjab a rich agricultural region
    - Agriculture land: 14.55 million hectares (Arable land: 14.01 million hectares)
    - The land of "five waters" - five tributaries of the Indus River flow through most of Punjab
    - 56% of country's population
  - Main agricultural exports: cotton & rice
  - Main imports: petroleum products, industrial machinery, food items

SOURCE: PAKISTAN STATISTICAL YEARBOOK 2010

ENERGY SCENARIO

- Increasing population & developing economy - increasing national energy needs
  - Power demand to reach **130,000 MW** by 2030

- Supply-demand gap widening – energy infrastructure inadequate to meet demand

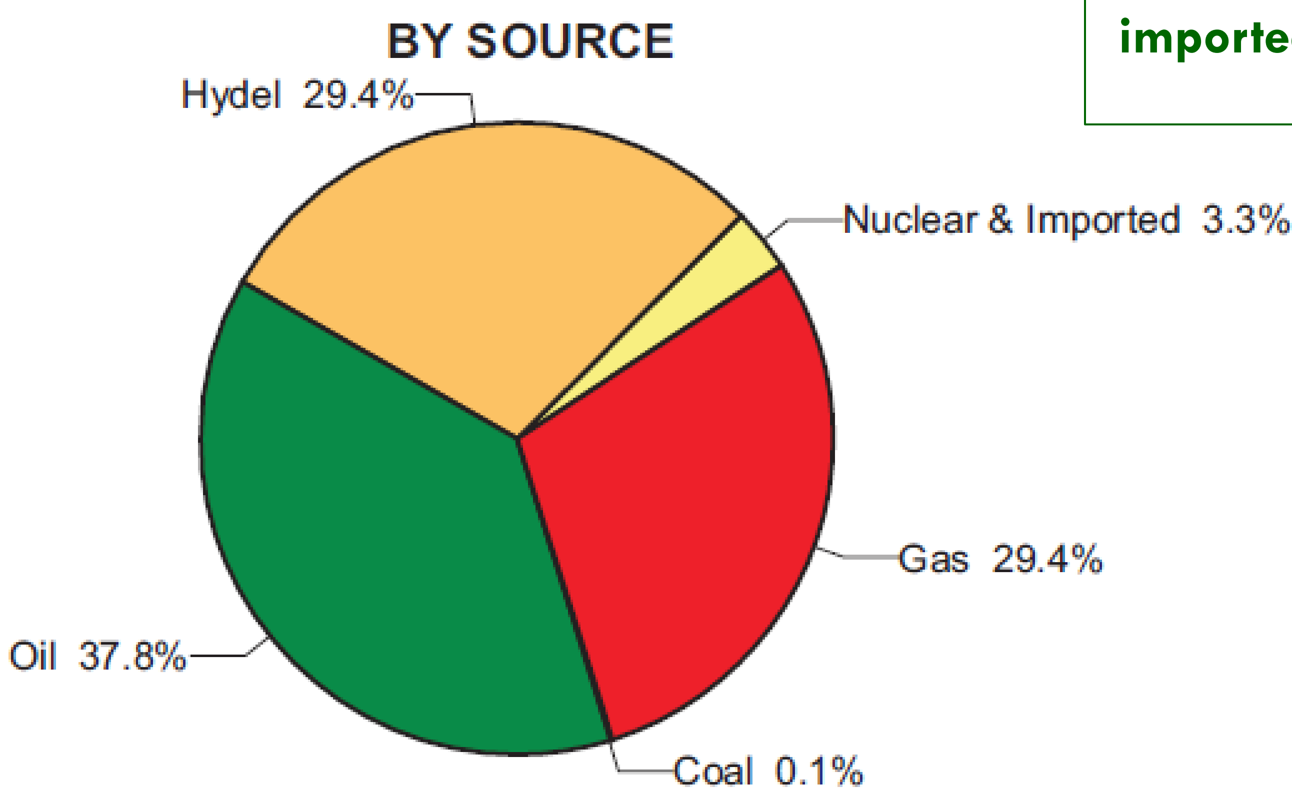
- Energy imports & import bill increasing

ENERGY SCENARIO

- Energy cost becoming prohibitive for consumer
- Limited energy access – rural areas mostly deprived of energy infrastructure
- Hurts national economy

ENERGY SCENARIO
Sources of Electricity

ELECTRICITY GENERATION 2009-10
Total: 95,608 GWh



Thermal –67.3%

0.3% of electricity imported in 2009-10

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Sources of Electricity

- Most of our energy comes from fossil fuels

- Fossil fuel consumption in thermal power generation
  - Oil: 56.2%
  - Gas: 43.6%
  - Coal: 0.2%

- FO imported & expensive

Source: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Power Producers

- 03 major power producers
  1. *WATER & POWER DEVELOPMENT AUTHORITY (WAPDA) – 1958*

  2. *KARACHI ELECTRIC SUPPLY COMPANY (KESC) – 1913 (nationalized in 1952, reprivatized in 2005)*
     - Electricity generation, transmission & distribution to Karachi & parts of Sindh & Balochistan

  3. *PAKISTAN ATOMIC ENERGY COMMISSION (PAEC) – 1956*
     - Nuclear power generation

ENERGY SCENARIO
Power Producers

- Shift in GoP's policy – restructure Pakistan's power sector
  - Inefficiencies in *WAPDA* – no growth in power generation
  - In 1992, the GoP approved *WAPDA*'s Strategic Plan for privatization of Pakistan's power sector
  - Aims:-
    - Deregulate power sector
    - Promote private power producers
    - Privatize selected entities

ENERGY SCENARIO
Power Producers

- Formal disintegration of *WAPDA* & bifurcation in responsibilities
  - *WAPDA*: Hydel generation & operations

  - The *PAKISTAN ELECTRIC POWER COMPANY (PEPCO)* was established
    - Manages transition of WAPDA from bureaucratic to a corporate, productive & commercially viable entity
    - Controls the thermal power generation & distribution companies that were earlier with *WAPDA*

ENERGY SCENARIO
Power Producers

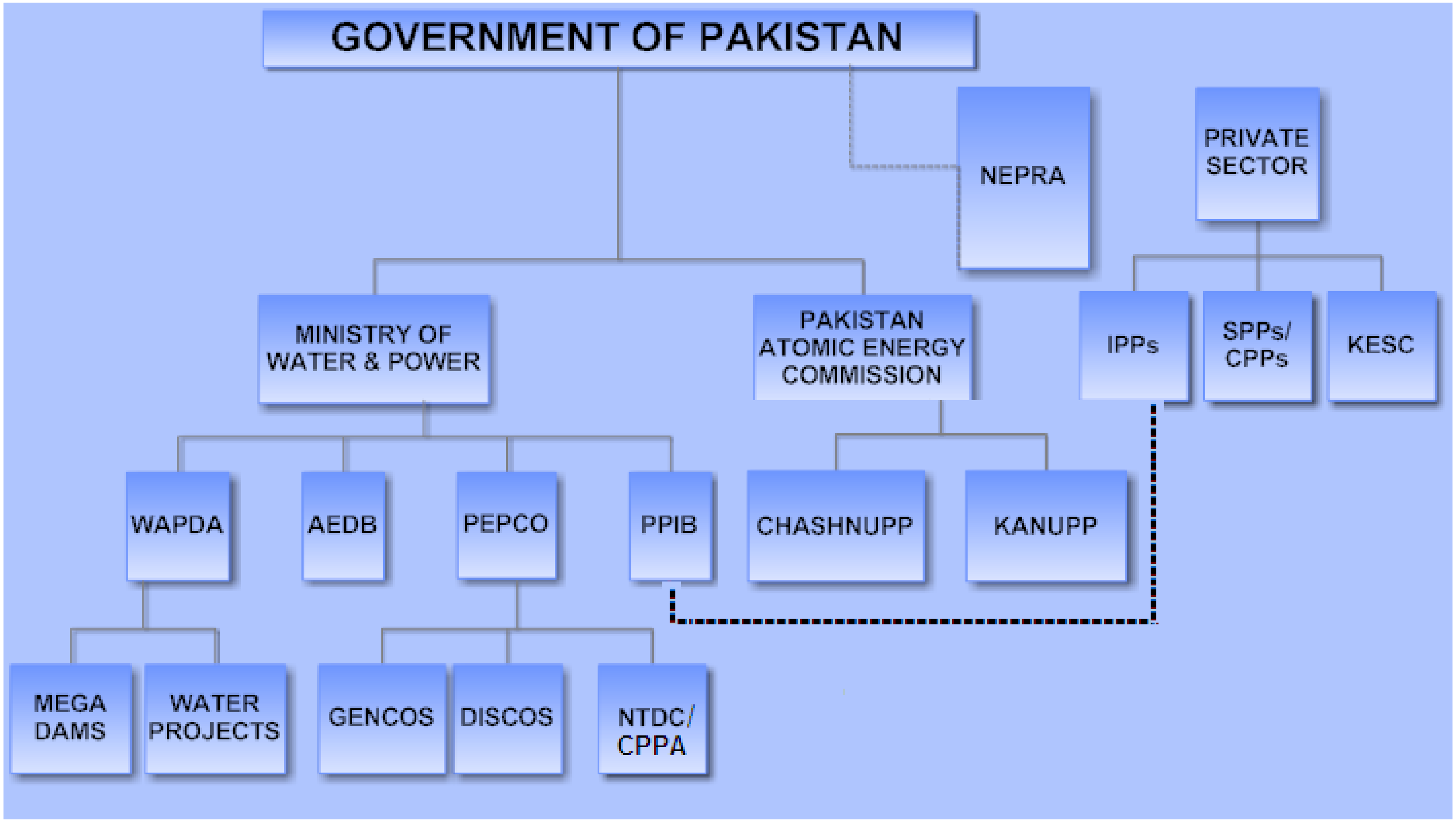
- *PRIVATE POWER & INFRASTRUCTURE BOARD (PPIB) – 1994*
  - To promote private sector participation in the power sector – levelized tariff structure (tariff reduces with time)
  - Facilitates investors in establishing private power projects & executes Implementation Agreement (IA)
  - 27 IPPs are operational in Pakistan
    - 5 new added in 2009-10, increasing thermal installed capacity by1,089 MW

ENERGY SCENARIO
Power Producers

- The changed landscape of power production:
  1. *WAPDA*
  2. *PEPCO*
  3. *KESC*
  4. *PAEC*
  5. IPPs
  6. *Rental Power Plants (RPPs)*

ENERGY SCENARIO

Power Sector Players



ENERGY SCENARIO
Power Sector Players

- *NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)* – 1997
  - Issues licenses for power production, transmission & distribution
  - Specifies electricity tariffs

- *NATIONAL TRANSMISSION & DISPATCH COMPANY (NTDC)* – Aug 1998
  - Operates under *PEPCO*
  - Central power purchasing agency
  - Operates & maintains grid stations & transmission lines

ENERGY SCENARIO

Power Sector Players

- *KESC* – 2 M customers
  - Operates in the private sector
  - Generates thermal power
- 08 Distribution Companies (DISCOs) – 19.6 M customers
  - Under *PEPCO*
- *ALTERNATIVE ENERGY DEVELOPMENT BOARD (AEDB)* – May 2003
  - Central national body on RE

ENERGY SCENARIO
Installed capacities as on 30th June 2010

- Hydel
  - Estimated potential according to *PEPCO*: 60,000 MW
  - Major hydel power projects in Pakistan:
    - Tarbela: **3,478 MW**
    - Ghazi-Barotha: **1,450 MW**
    - Mangla: **1,000 MW**

Total Hydel capacity: *6,481 MW*

Hydel electricity generated varies between 2,414 MW & 6,761 MW depending upon river flow

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Installed capacities as on 30th June 2010

- Thermal
  - *PEPCO* thermal (12 plants): **4,900 MW**
  - *KESC* thermal (5 plants): **1,955 MW**
  - IPPs thermal (27 plants): **7,123 MW**
    - 5 new IPPs were added in 2009-10, increasing thermal installed capacity by1,089 MW

Total Thermal capacity *13,978 MW*

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Installed capacities as on 30th June 2010

- Nuclear
  - 02 nuclear reactors (Sindh, Punjab)

Total Nuclear capacity *462 MW*

  - 3rd nuclear power plant in Punjab became operational in May 2011: 330 MW

TOTAL INSTALLED CAPACITY: ***20,922 MW***

PAKISTAN'S ELECTRICITY DEMAND: ***14,500 MW***

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Installed capacities as on 30th June 2010

- Rental Power Projects (RPPs)
  - 19 RPPs committed to by GoP
    - Planned electricity production: 2,700 MW
  - 02 have come online
    - Added 272 MW of electricity to the national grid
    - 03 plants are in installation process
  - Much national debate over RPPs
    - Extremely expensive electricity

SOURCE: THE EXPRESS TRIBUNE, 6TH JUNE 2011

ENERGY SCENARIO
Electricity Shortfall

- Demand for electricity growing @ 9% annually
- Electricity supply growing @ 7% annually
- 15-20 hours of unannounced load shedding across the country

ENERGY SCENARIO
Electricity Shortfall

- Shortfall of electricity: 5,000-7,000MW estimated for summer 2011*
  - For May 2011:
    - Average peak supply = 12,818MW
    - Average peak demand = 16,446 MW
  - Generation-related factors
    - Water flow
    - Gas availability
    - Furnace oil import & circular debt issues
  - Demand-related factors – varied use

**** SOURCE: PEPCO***

ENERGY SCENARIO

Cost per Unit of Electricity

Electricity produced from….	Cost per unit (Pak Rs.)	(Cents)
Hydel	**1.18 - 4 ***	**1.39 – 4.7**
Thermal		**6-30**
- WAPDA		**8.17**
- IPPs	**11.18**	**13**
- RPPs		**≥ 30 cents**
Coal	**6-7**	**7-8**
Nuclear		**12.2**

*** *WAPDA* claims the cost per unit is Rs. 1.05**

ENERGY SCENARIO
Cost per Unit of Electricity

- Consumers pay a much higher price per unit of electricity consumed
  - Due to pilferages, surcharges, & high %age of thermal-based electricity on grid

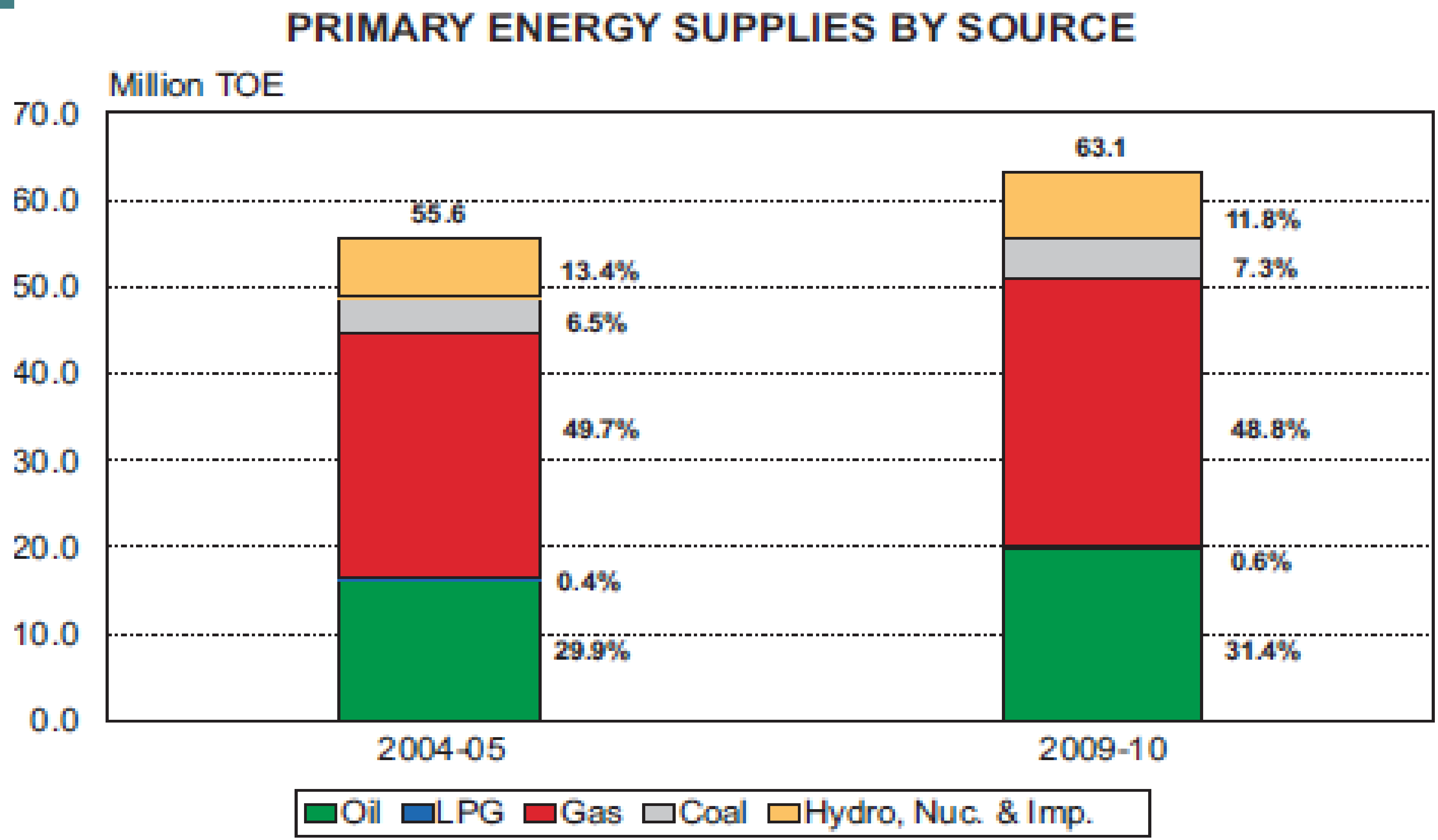
- Price per unit: Rs. 6.5-9 (7.55-10.5 cents)
  - Varies with *WAPDA* & *KESC*
  - With usage bracket
  - & with type of user
  - Due to pilferages, surcharges, & high %age of thermal-based electricity on grid

ENERGY SCENARIO
Electricity Consumption by Sector

Sector	%age Share
Domestic	46.1
Commercial	7.5
Industrial	26.7
Agriculture	13.03
Street lighting	0.6
Bulk supplies, traction, & other Government	6.05

*** Public Utilities Only**
SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Energy Supplies by Source

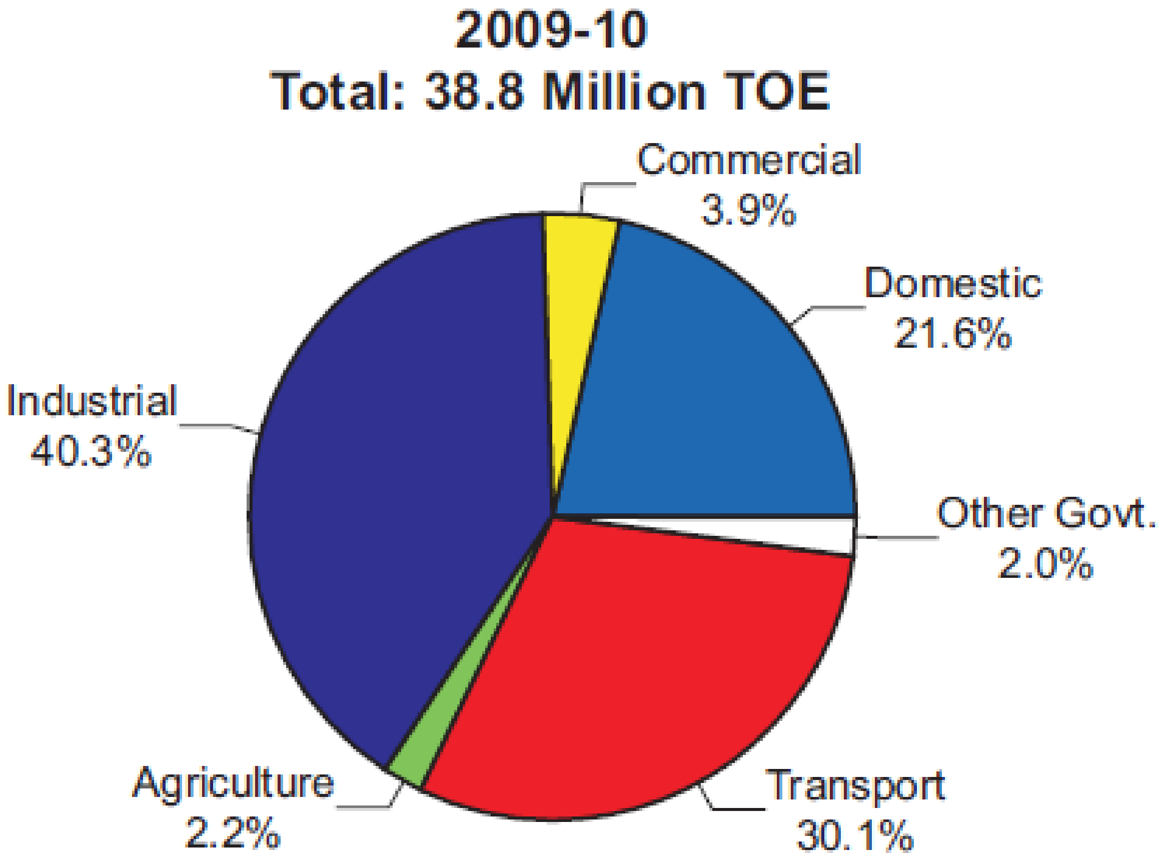


SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO

Energy Consumption by Sector 2009-10

(Excluding fuels consumed in thermal power generation)



SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO

Production, Consumption, Demand

- Gas
- Oil
- Coal

ENERGY SCENARIO
Production, Consumption, Demand

- Gas
  - Highest percentage as source in energy mix (49%)
  - Pakistan's gas reserves as on 30th June 2010: **27.59 trillion cubic feet** *
    - Will last for 20 more years if used at the current rate of 4 billion cubic feet production per day
    - Balochistan has the major gas reserves: **19 trillion cu ft** **

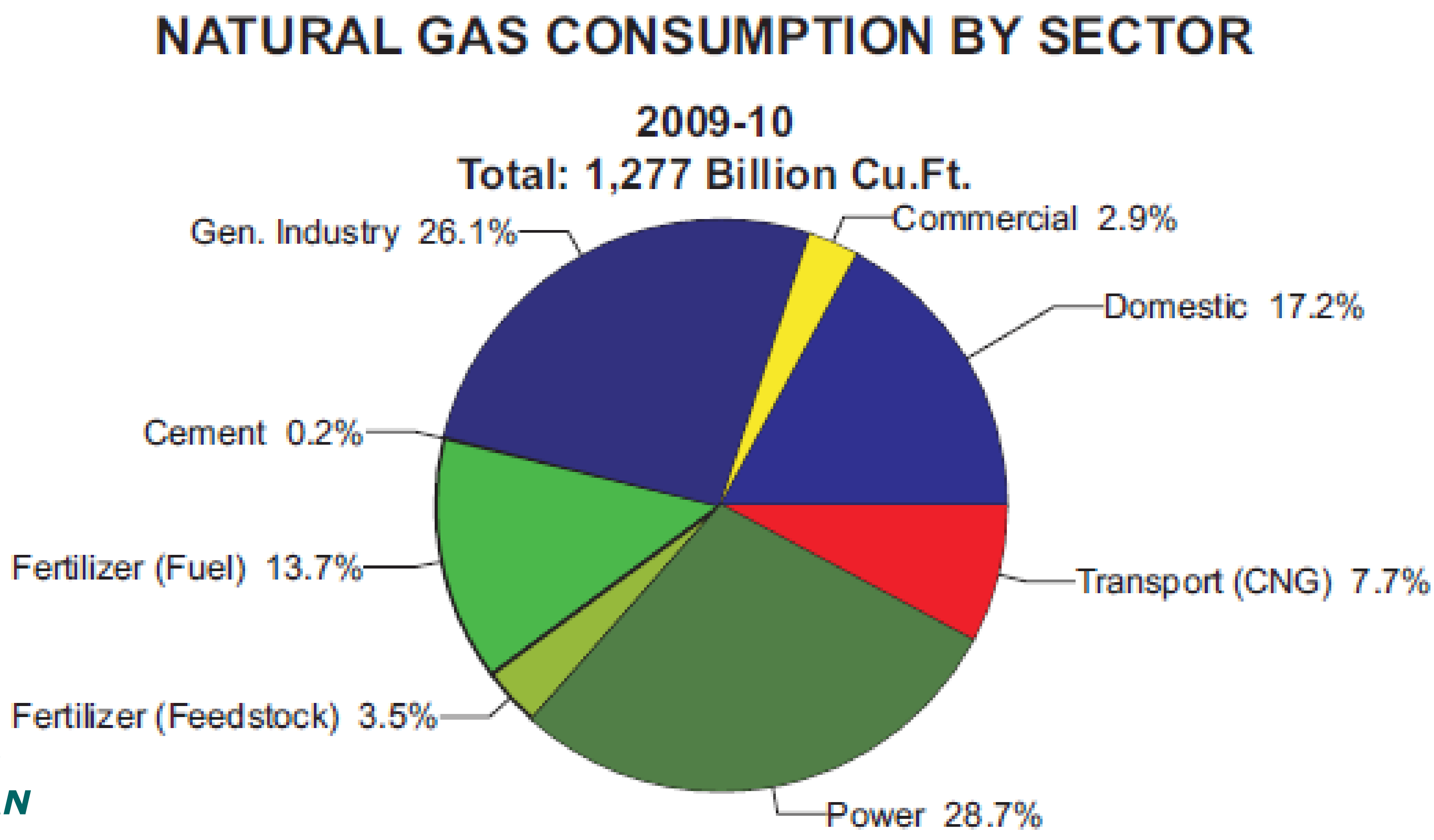
*** SOURCE: PAKISTAN ENERGY YEARBOOK 2010**
*** * MINISTRY OF PETROLEUM & NATURAL RESOURCES (JAN 2010)**

ENERGY SCENARIO
Production, Consumption, Demand

- Gas
  - Gas production per year: **<u>1.48 Trillion Cu Ft</u>** *
  - Consumption of natural gas in 2009-10: **<u>1.278 Trillion Cu Ft</u>**
  - Demand for gas: **<u>1.934 Trillion Cu Ft per year</u>** **
    - Number of consumers in 2010: **<u>5.95 M</u>** **
    - Steadily increasing every year
    - Up 6% from 2009
  - Gas shortages are causing heavy loss to industries

** SOURCE: PAKISTAN ENERGY YEARBOOK 2010*
*** SOURCE: MINISTRY OF PETROLEUM & NATURAL RESOURCES (JAN2010)*

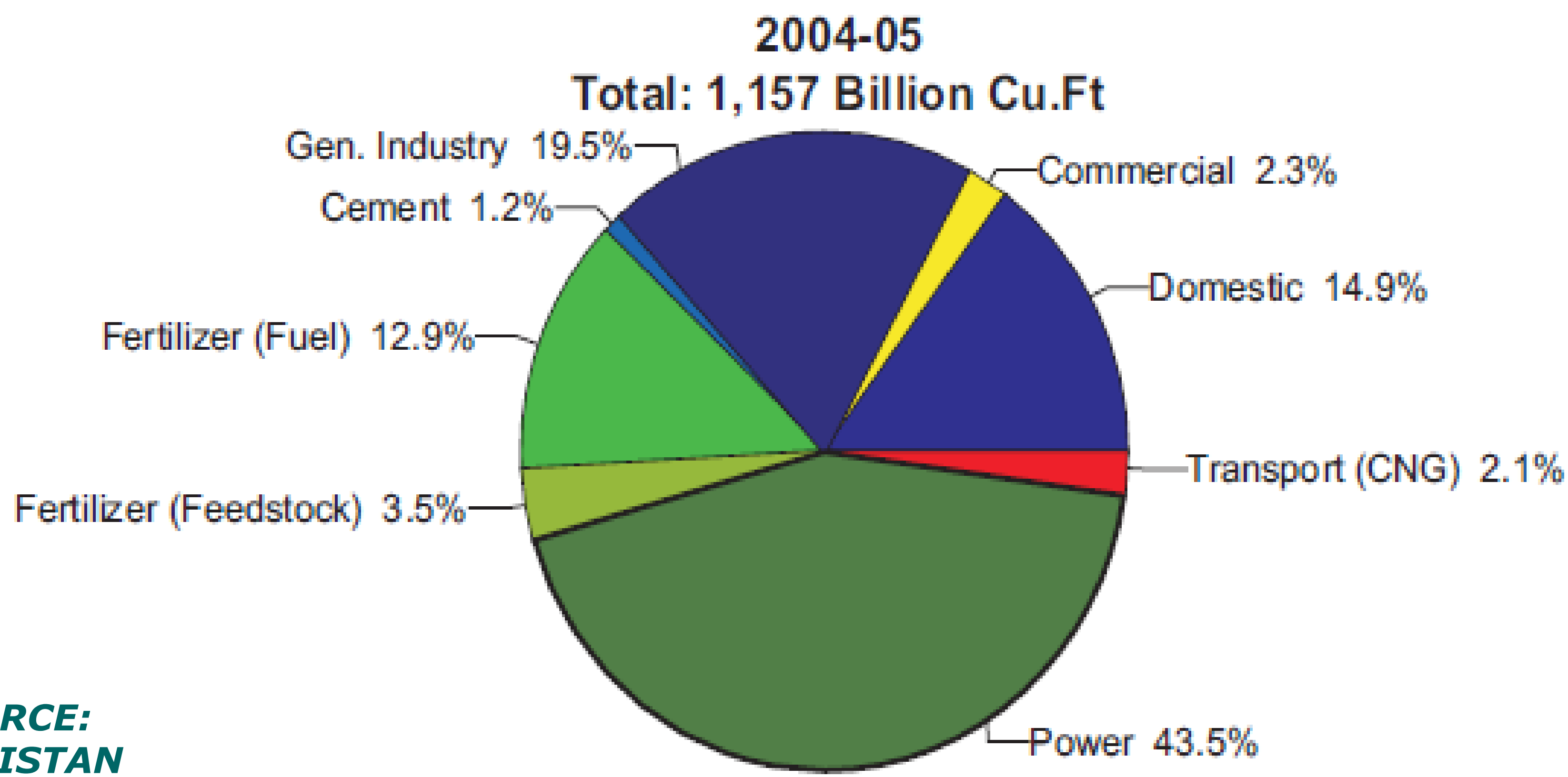
ENERGY SCENARIO
Production, Consumption, Demand



SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Production, Consumption, Demand

NATURAL GAS CONSUMPTION BY SECTOR



SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO

Production, Consumption, Demand

- Oil
  - Biggest source after natural gas – mostly imported
  - During 2009-10 oil consumption increased by 7% over the preceding year
    - 27% increase in use of gasoline consumption in transport sector
      - Consumption of E10 was added in transport sector during 2009-10 (**<u>4,926 tonnes</u>**)
    - 16% increase in furnace oil consumption in power sector

ENERGY SCENARIO
Production, Consumption, Demand

- Oil
  - Reserves
    - Proven oil reserves in Pakistan: **306.552 M US barrels** as on 30th June 2010 (**41.82 M tonnes**) *

    - Some sources estimate Balochistan oil reserves at **6 trillion US barrels** (on-shore & off-shore)

6.8 – 8 US barrels in 1 metric ton (tonne). Used here: 7.33 US barrels in 1 tonne

**** SOURCE: PAKISTAN ENERGY YEARBOOK 2010***

ENERGY SCENARIO
Production, Consumption, Demand

- Oil
  - Production:
    - Indigenous crude oil production for 2009-10: **23.7 M US barrels (3.23 M tonnes)** *
    - **64,948 US barrels per day** (most of it comes from Sindh)
  - Demand:
    - Demand for oil: **19.2 M tonnes per year** **
    - Indigenous oil production meets less than 20% of country's demands
    - Reliance on imported oil

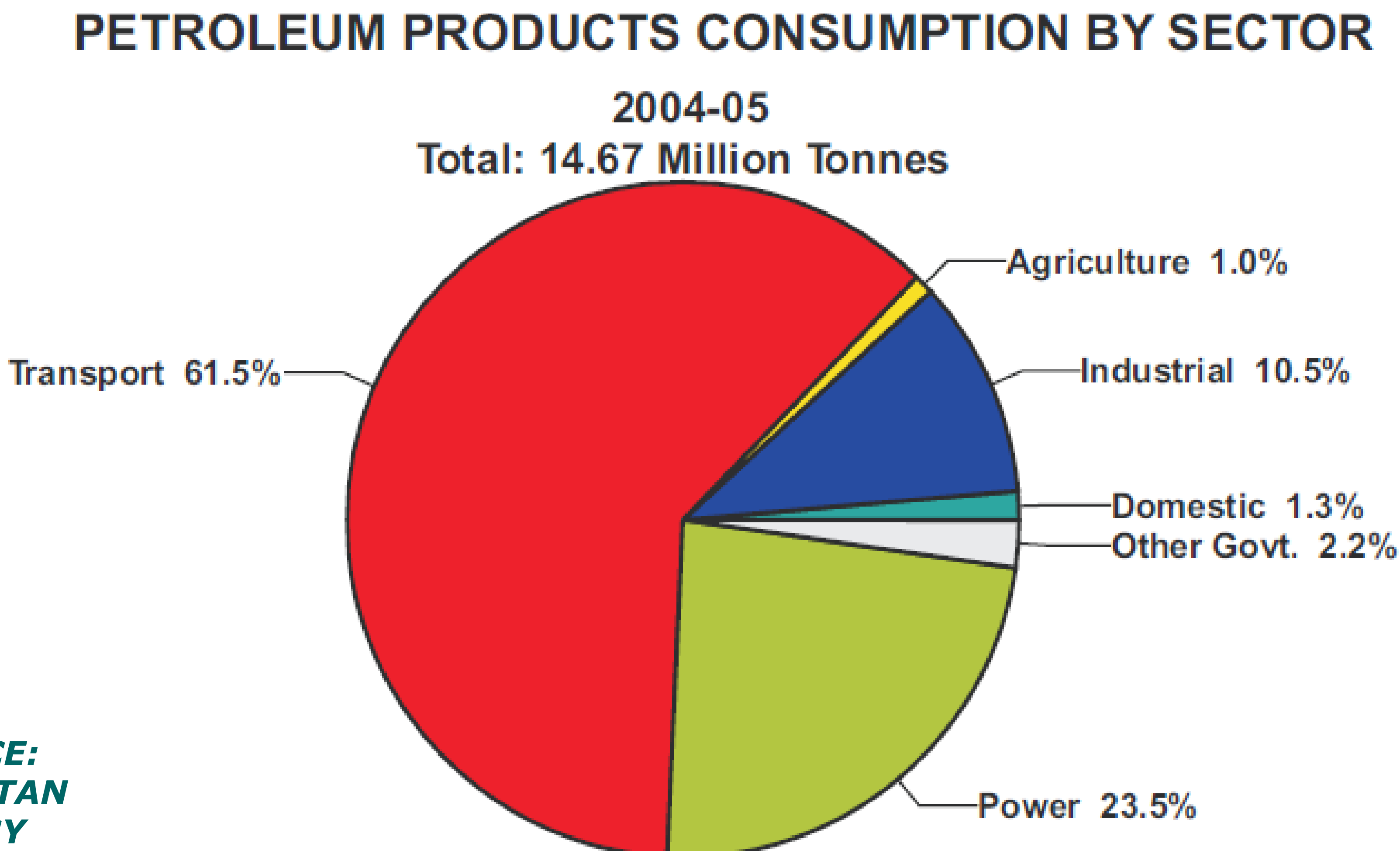
*** SOURCE: PAKISTAN ENERGY YEARBOOK 2010**

**** SOURCE: MINISTRY OF PETROLEUM & NATURAL RESOURCES (JAN 2010)**

ENERGY SCENARIO
Production, Consumption, Demand

- Oil
  - Oil imports are estimated to rise to **32.5 M tonnes** by 2015
    - Imported from Saudi Arabia (lead importer), Kuwait, UAE, Singapore, Malaysia, India, Bahrain, Oman & Holland
    - Contributor to trade deficit – increasing oil prices not helping
    - Energy security vulnerability

ENERGY SCENARIO
Production, Consumption, Demand

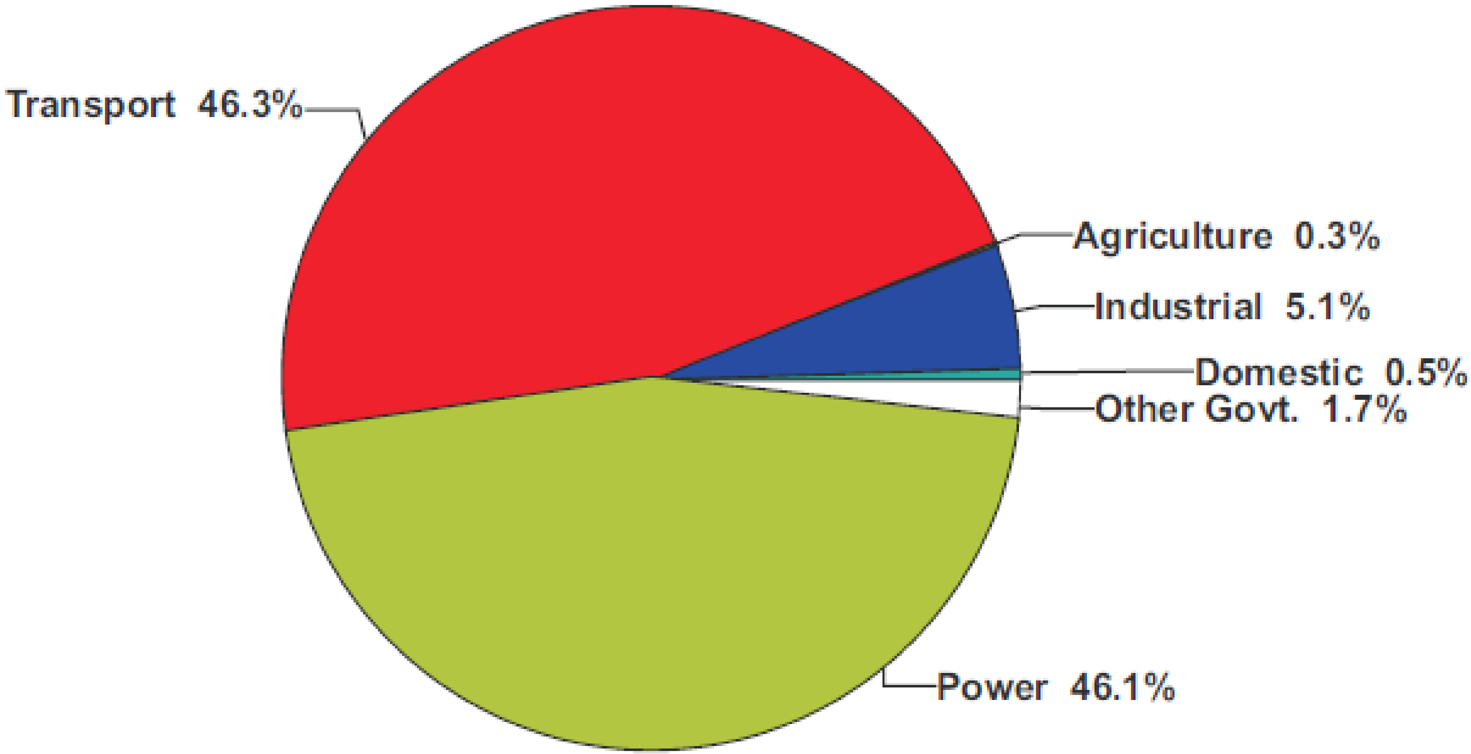


SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Production, Consumption, Demand

PETROLEUM PRODUCTS CONSUMPTION BY SECTOR

2009-10
Total: 19.13 Million Tonnes



SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Production, Consumption, Demand

- Huge consumption for power generation
  - Has steadily been rising since 2004-05
  - Our economy can be richer by billions of dollars if power generation is supplemented with alternate / renewable means

ENERGY SCENARIO
Production, Consumption, Demand

- Coal
  - Plays a minor role in Pakistan's energy mix
  - Numerous studies have concluded that all coal reserves in Pakistan are suitable for electricity generation
  - Coal reserves in Pakistan

Punjab (Salt Range, Makerwal)	**235 MT**
Balochistan	**217 MT**
KPK	**99 MT**

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Production, Consumption, Demand

- Coal
  - Coal reserves in Pakistan:
    - Sindh
      - Thar desert (discovered in 1992) **<u>175,506 MT</u>**
      - Other locations **<u>9,951 MT</u>**

<u>185,457 MT</u>

Total coal reserves *186,007 MT*
(186 Bn T)

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Production, Consumption, Demand

- Coal
  - Production of coal in Pakistan in 2009-10: **3.48 MT**
  - Import of coal in 2009-10: **4.657 MT**
  - Consumption of coal in 2009-10: **8.138 MT**

SOURCE: PAKISTAN ENERGY YEARBOOK 2010

ENERGY SCENARIO
Production, Consumption, Demand

- Coal
  - Thar reserves
    - Has attracted foreign & domestic development interest - preliminary studies suggest that Thar is capable of generating 100,000MW for 2 centuries
  - Underground Coal Gasification (UCG) project in Thar desert in development stages

SOURCE: PPIB

ENERGY EFFICIENCY MEASURES

ENERGY EFFICIENCY (EE)

- The huge energy shortfall in Pakistan has led to:
  - Extended blackouts
  - Energy becoming a very expensive commodity
  - Non-provision of energy to critical areas

- Imperative to design better systems that minimize energy consumption & improve efficiency

- Areas in which EC / EE measures are being taken:-
  - Industry
  - Agriculture
  - Transport
  - Building
  - Domestic

ENERGY EFFICIENCY (EE)

- Range of activities
  - Identification of EE/EC opportunities
  - Technology demonstration & pilot projects
  - Information & outreach, training & education
  - Plans & policies

- Governmental organs responsible for EE/EC
  - *NATIONAL ENERGY CONSERVATION CENTRE (ENERCON)*
  - *PAKISTAN ENGINEERING COUNCIL (PEC)*
  - *NATIONAL PRODUCTIVITY ORGANIZATION (NPO)*

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- *ENERCON* – 1987
  - The national focal point for EE & EE activities

  - Projects:-
    - Barrier Removal to Energy Efficiency Standards & Labeling – BRESL
      - Accelerate adoption & implementation of energy standards & labels (ES&L) in Asia
      - Bring energy savings from use of energy efficient appliances/equipment

    - Establishing Model MVE certification centers in collaboration with private sector

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- *ENERCON* – projects
  - National Awareness Campaign on Energy & Environment Conservation (Project ACE) in 2003
    - Achievements
      - Boiler furnace tune-ups
      - Industry & building energy audits
      - Building Energy Code
      - Training & education workshops
  - Energy Conservation Through Training & Mass Awareness Campaign – Project TMAC
    - Imparting EC Training on:
      - Agriculture
      - Buildings
      - Transport
      - Industry & Power
      - CDM

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- *ENERCON & PEC*
  - Jointly developing the Building Code of Pakistan
    - Energy provisions to be made an integral part
    - Purpose: provide minimum requirements for energy-efficient design & construction of buildings
    - Energy provisions shall apply to:
      - Building envelopes
      - Heating, ventilation & air conditioning (HVAC)
      - Water heating
      - Lighting
      - Electrical power & motors

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- *PEC*
  - Converting *PEC* buildings to "Green Buildings"
    - *PEC* building employs LEDs instead of conventional light bulbs – a model for other organizations
  - Awareness programs on EE & RE

ENERGY EFFICIENCY (EE)

Initiatives & Achievements

- *NATIONAL PRODUCTIVITY ORGANIZATION (NPO)*
  - Operates under *MINISTRIES OF INDUSTRIES & PRODUCTION*
  - Objective: enhance productivity & competitiveness of Pakistan's industry by reducing cost of energy
  - Energy audits in 6 units of textile sector under Renewable Energy & Energy Efficiency framework to enhance productivity & quality

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- Initiative by GoP (2010) to replace incandescent bulbs with Compact Fluorescent Lights (CFL) or energy savers
  - Import & free distribution of energy savers
  - Effort to use 75-80% less electricity

- Commercialization of CNG as a transport fuel
  - Project implemented by the *HYDROCARBON DEVELOPMENT INSTITUTE OF PAKISTAN (HDIP)*
  - Cleaner than petrol & diesel
  - Cost savings for consumers
  - CNG kits easily available across Pakistan

ENERGY EFFICIENCY (EE)

Initiatives & Achievements

- Development of environmentally friendly rickshaw oil
  - *HDIP* & state-owned OMC *PAKISTAN STATE OIL COMPANY LIMITED (PSO)* developed a blend of two-stroke lube oil to be used in the recommended dosage with super-petrol
  - Would reduce:
    - Smoke & noise level
    - Fuel consumption by more than 30%

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- CNG rickshaws
  - Rickshaws converted to CNG in different cities
  - Up to 1,200 converted

- PM program for 8,000 CNG buses
  - July 2008: The Federal Cabinet announced launch of 8000 CNG buses for major urban cities of Pakistan for efficient, environment friendly & affordable public transport

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- Replacement of lighting with LEDs across federal & provincial capitals, & other cities
  - Street & part lighting
  - Traffic lights
  - Indoor lights (private / public sector)
  - LEDs are being assembled in Pakistan
  - High demand because of rising electricity costs

- Energy-efficient stoves
  - *PCRET* has developed stoves that save 30-40% energy
  - Used extensively in rural areas

ENERGY EFFICIENCY (EE)
Initiatives & Achievements

- Awareness & outreach program for EE / EC
  - Print & electronic media campaigns encouraging consumers to save energy & switch to energy-efficient appliances
  - Conferences, workshops, leaflet distribution, etc.

- To clip demand peaks & encourage efficiency, GoP:
  - Announced closure of commercial markets at 8pm during summers
  - Introduced daylight savings; heavy media campaign
  - Highest consumption slab pays three times more than first slab

ENERGY EFFICIENCY (EE)

Private Sector EE / EC Initiatives

- Energy-efficient / instant gas geysers
  - Initially were imported
  - Now SKD kits are being imported & assembled in Pakistan
  - Demand increasing due to rising gas prices

- Energy savers in domestic use
  - Demand on the rise
  - Significant short & long-term cost savings for consumers

- Import of LEDs & assembly / integration in Pakistan
  - Replacing conventional lighting running on-grid with LED lighting
  - Using LED lighting in solar solutions

RENEWABLE ENERGY & PAKISTAN

RE TARGETS SET BY GoP

	2005	2010	2015	2020	2025	2030
RE (Electrical) Installed Capacity (MW)	**180**	**880**	**1680**	**3150**	**5850**	**9700**
Renewable Energy Supplies (MTOE)	**0.17**	**0.84**	**1.60**	**3.00**	**5.58**	**9.20**
RE Mix in National Energy Supplies	***0.3 %***	***1.1 %***	***1.3 %***	***1.7 %***	***2.2 %***	***2.5 %***

SOURCE: MEDIUM TERM DEVELOPMENT FRAMEWORK

RE POLICY OF PAKISTAN

- Wind Risk - responsibility of GoP
- Guaranteed Electricity Purchase
- Grid provision at doorstep
- Attractive Tariff (17%-18% ROE)
- Counter Guarantee by the ADB for first few projects
- Special Incentives by the State bank for up to 10 MW plants
- No Import Duties on Equipment
- Zero Sales Tax
- Net Metering
- Carbon Credits

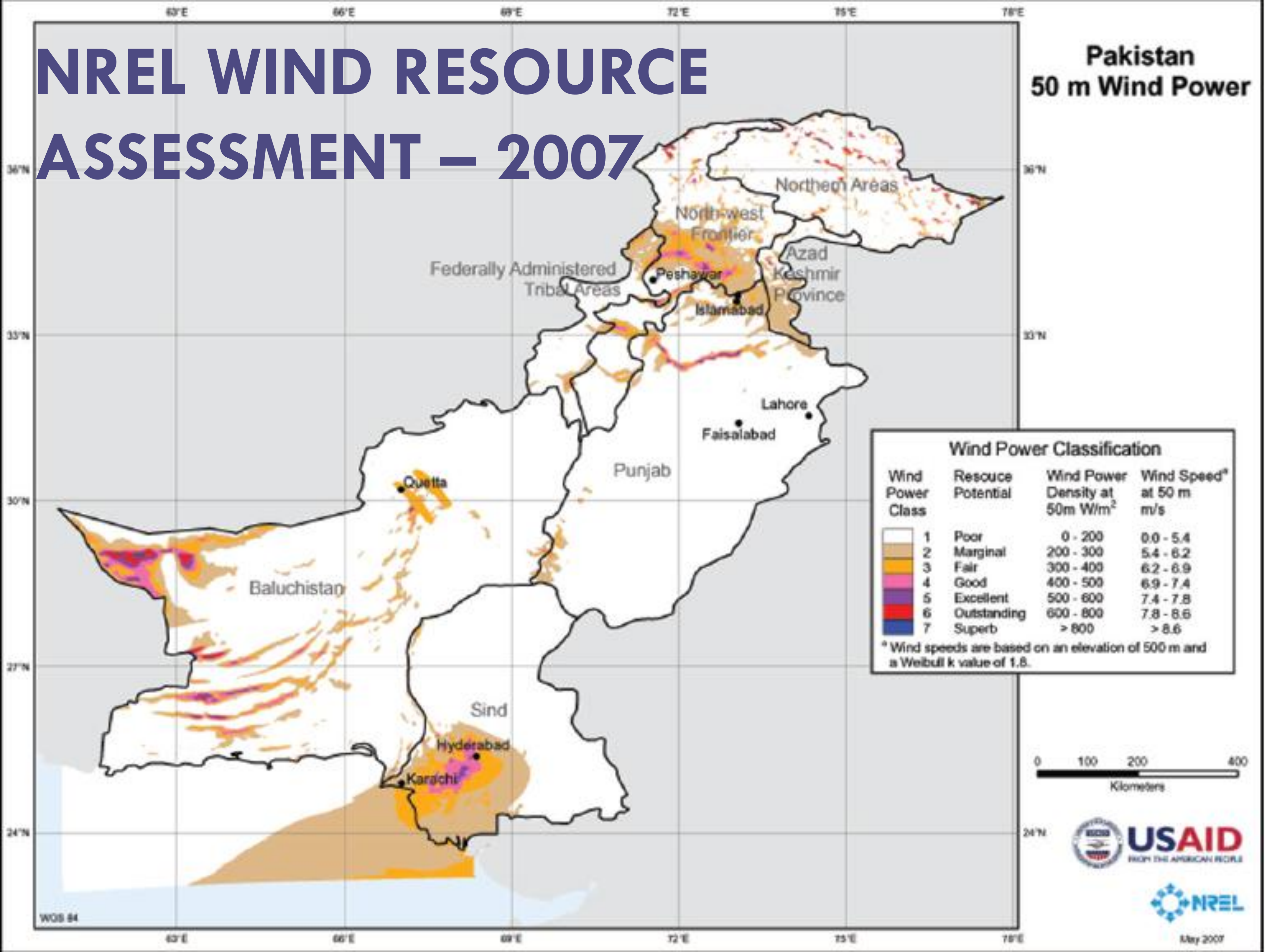
RE RESOURCES IN PAKISTAN

- High potential exists for use of renewable resources for indigenous energy production
- Abundant resources in Pakistan for energy generation through:
  - Small hydel
  - Wind
  - Solar
  - Cogeneration / Biomass / Waste-to-Energy
  - Biofuels

RE RESOURCES
Small Hydel

- Natural waterfalls & canal heads available in Pakistan with a potential of 4,500 MW
  - 171 microhydel units in Hindukush mountain range by the *AGA KHAN RURAL SUPPORT PROGRAM (AKRSP)* - a donor-funded integrated rural support program
    - Providing electricity to around 17,000 houses
  - 03 small hydro projects completed using low head small flow rate mini hydro turbines
  - *WORLD BANK* project to install 103 micro-scale hydro power stations in isolated northern Himalayan villages

NREL WIND RESOURCE ASSESSMENT – 2007



RE RESOURCES
Wind

- Wind grading as per *NREL*
  - Pakistan's total land area: 877,525 km^2

Wind Resource Utility Scale	Wind Class	Wind Power (W/m^2)	Wind Speed (m/s)	Land Area (km^2)	Percent Windy Land
Good	4	400 – 500	6.9 – 7.4	18,106	2.1
Excellent	5	500 – 600	7.4 – 7.8	5,218	0.6
Excellent	6	600 – 800	7.8 – 8.6	2,495	0.3
Excellent	7	> 800	> 8.6	543	0.1
TOTAL					3%

SOURCE: NREL WIND MAPPING DATA

RE RESOURCES
Wind

- Class 4+ = good-to-excellent for utility-scale applications
  - 26,400 sq km (3% of Pakistan's total land area)
  - Potential for 132,000 MW of power generated from wind energy (based on assumption of 5 MW/km^2)

- Almost 9% of Pakistan's land area has Class 3 or better wind resource
  - Good potential for small-scale off-grid hybrid applications (wind/diesel or wind/solar)

SOURCE: NREL WIND MAPPING DATA

RE RESOURCES
Wind

- Gharo~Keti-Bandar corridor (1,046 km coastal belt from Sind to Balochistan) alone has a potential of about 50,000 MW
  - Average wind speed: 7 m/s at 50 meters height

- Sites in Baluchistan, Punjab & Northern Areas being identified

SOURCE: NREL WIND MAPPING DATA

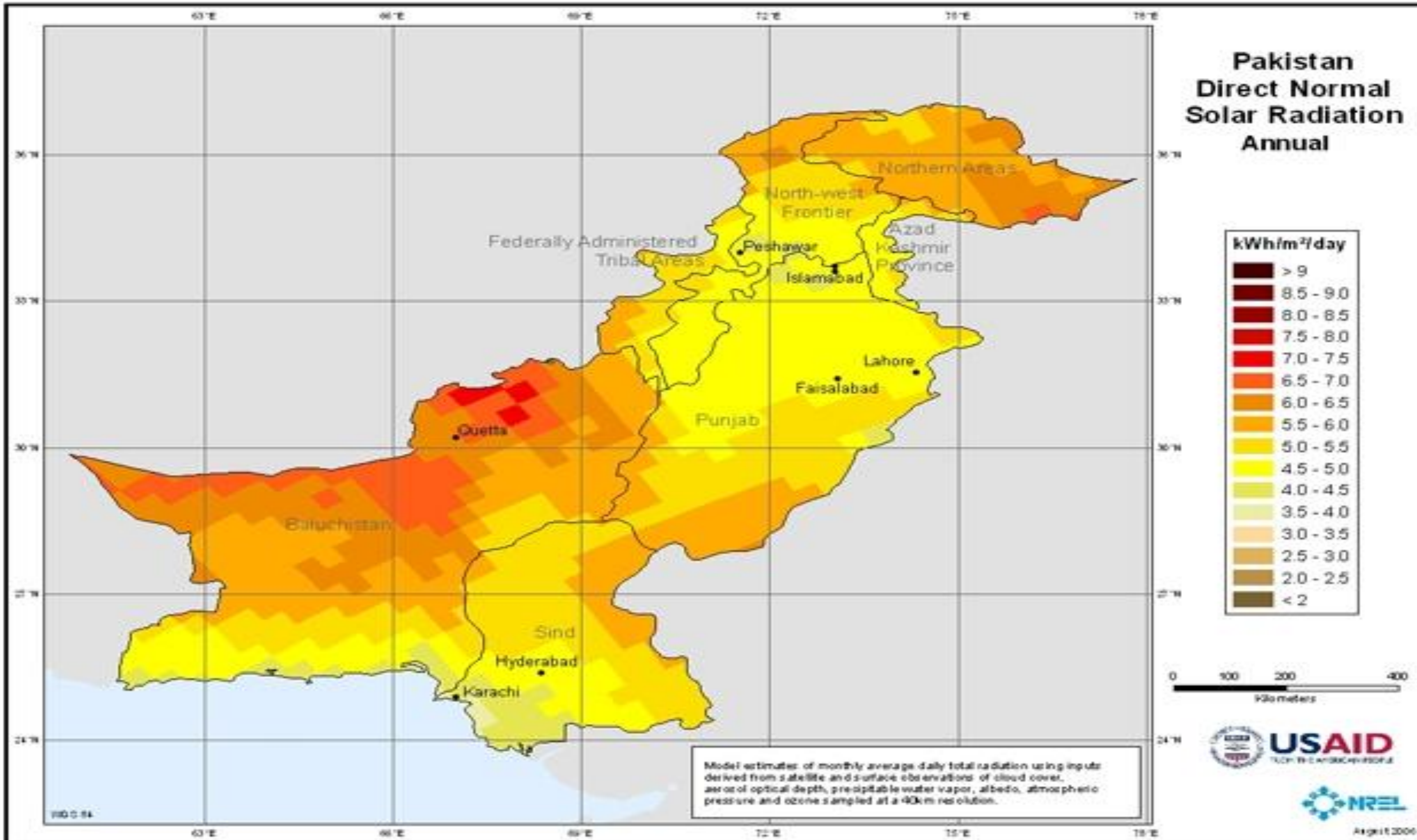
RE RESOURCES
Wind

- Projects
  - 1 project of 6MW installed by *ZORLU ENERJI* (existing tariff: 14.9 cents per unit which will come down to 4 cents after 10 years)
  - Recently *FFC ENERGY* has achieved Financial Close for 49.5 MW
  - In process – Energy Purchase Agreement
    - *ZORLU ENERGI* for 56.5 MW
  - Land & LOI issued to 18 companies
    - 7 at advanced stages
    - Rest at feasibility stages

RE RESOURCES
Wind

- GoP is encouraging IPPs to enter the sector
  - Incentives
    - Wind risk taken by GoP
    - 100% power purchase guaranteed
    - Grid access on doorstep
    - Land facilitation by GoP
    - Fiscal incentives: tax rebates, asset depreciation, etc.
    - 18% ROE in dollar terms
    - Upfront tariff of 16 cents per unit has been proposed for wind power plants which will be set up with rupee loans from Pakistani banks & 13 cents per unit for plants which will be set up with dollar loans from foreign banks
    - Levelized tariff

NREL SOLAR POTENTIAL ASSESSMENT



RE RESOURCES
Solar

- Excellent conditions for deployment of solar energy solutions
- Potential for solar (PV & thermal) – 5 to 5.5 $kWh/m^2/day$
- 5-7 years payback for commercial applications (where no grid electricity is available)

RE RESOURCES
Solar

- Solar PV
  - Telecom BTS sites converted to solar
  - Solar lighting projects done
  - Solar irrigation & lighting projects in tribal area to encourage economic activity
  - *AKHTER SOLAR PLC* – the first solar PV modules manufacturing facility in Pakistan – 2005
    - A source of high-quality solar panels for solar-based solutions across Pakistan

RE RESOURCES
Solar

- Solar PV
  - Pakistan's First On-Grid Solar Power System (Smart Grid system) by *PEC – 2008*
    - Collaboration with *NUST, PCRET,* & *AEDB*, grant from Japan
    - *PEC* Islamabad will be converted to Green Building using an on-grid solar unit of 180 kw
    - Excess electricity to flow to the national grid
    - Project has entered implementation phase
    - In the next step, the *PLANNING COMMISSION* building will be converted similarly

RE RESOURCES
Solar

- Solar Thermal
  - Scarce availability of gas to industry – huge gap between supply & demand

  - Industrial scale solar water heater developed for industries in need of hot water
    - Capacity: 5,000 – 30,000 liters per day of water
    - Temperature range: 55°C - 85°C
    - Indigenous design
    - Cost-effective
    - Viable solution to industry fuel shortages

RE RESOURCES
Solar

- Solar Thermal
  - Use of domestic solar water heaters on the rise
    - Production / assembly in Pakistan
  - Solar food driers
    - Pilot projects started by GoP
    - Helps the agricultural sector & boosts export

RE RESOURCES
Cogeneration/Biomass/Waste-to-Energy

- Vast agricultural base providing biomass

- Biomass is abundantly used as an energy source in rural Pakistan
  - Wood
  - Grass, leaves, & bushes
  - Crop residue
  - Cow-dung & poultry-waste
  - Organic waste

- No formally recorded data available of the amount of biomass used / energy produced at rural level

RE RESOURCES
Cogeneration/Biomass/Waste-to-Energy

- Bagasse-based power generation
  - An important element of GoP's AE strategic plan
  - Advantages:
    - Power generation cost is very low as the fuel (bagasse) is available virtually at no cost
    - The fuel is available on site & fuel transportation infrastructure is not required
    - Transmission losses are reduced; bagasse co-generation power plants are decentralized
    - Net zero emission of CO_2
    - Sugar mills have decades of experience of related technology

RE RESOURCES
Cogeneration/Biomass/Waste-to-Energy

- Bagasse-based power generation
  - Pakistan's sugar industry crushes **30-40 M tons** of sugarcane per year
  - Yields about **12 M tons** of sugarcane waste – bagasse – captive biomass
  - Potential of bagasse-based co-generation power estimated at over 2,000 MW
  - Surplus electric power generated by sugar mills can be provided to national or local grid
  - A sugar mill crushing 2,000 tons cane daily can generate 11 MW, of which 2 MW will be its own consumption & the rest can be sold

RE RESOURCES
Cogeneration/Biomass/Waste-to-Energy

- *AL-MOIZ BAGASSE CO-GENERATION PROJECT*, D.I. KHAN – 2008
  - Established by *AL-MOIZ INDUSTRIES*, producers of sugar & sugarcane by products
  - A 27MW grid connected co-generation biomass power plant project
  - Estimated average emission reduction of 23,319 tons of CO_2 equivalent per year
  - Plant has been validated on the basis of *UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCC)* criteria for CDM

Contd..

RE RESOURCES
Cogeneration/Biomass/Waste-to-Energy

- *SHAKARGANJ* bagasse-biogas-natural gas cogeneration project – 7MW
  - *SHAKARGANJ SUGAR MILLS (SML)*, Jhang, has 5 boilers that consume bagasse, biogas & natural gas to generate steam for the process & power generation
  - The energy produced is consumed by the sugar mill & ethanol distilleries
  - Soon *SML* will be giving electricity to the grid

- Landhi Cattle Colony Biogas Project
  - Pilot Phase completed
  - Full scale project (48 MW plus 1.25 Million CERs) being prepared with assistance from *ADB*

RE IN PAKISTAN
Biofuels

- Pakistan rich in resources for Biofuels – Ethanol & Bio-Diesel
- Ample land available – cultivatable & marginal – for plantation of energy crops

Contd..

RE IN PAKISTAN
Biofuels – Ethanol Resources

- Feedstock used for ethanol production in Pakistan
  - Sugarcane & molasses
  - Pakistan is the world's 7th largest sugarcane producer – **49.37 M tonnes** in 2009-10
  - Area with sugarcane plantation: **942,870 hectares**
  - Molasses production in 2009-2010: **1.557 M tons**

SOURCE: PAKISTAN SUGAR MILLS ASSOCIATION (PSMA) ANNUAL REPORT

RE IN PAKISTAN
Biofuels – Bio-Diesel Resources

- Pakistan has several indigenous plant species that are fit for Bio-diesel production

- Criteria for selection of Bio-diesel resources
  - Must be native
  - Non-competing with food crops & agricultural land
  - Chemical profile – oil, fatty acids
  - Quality & quantity of crude oil & Bio-diesel
  - By-products utilization
  - Non-allergic & non-toxic to other life forms
  - Yield of NTFPs for rural / industrial development

RE IN PAKISTAN
Biofuels – Bio-Diesel Resources

Pongamia Pinnata – the native Bio-diesel resource

RE IN PAKISTAN
Biofuels – Bio-Diesel Resources

- The Pongame tree
  - Height when fully grown: 40-50 feet
  - Span: 10-15 feet
  - Exists in large numbers in Pakistan, though scattered
  - Grows in:
    - Federal capital area
    - Central & Upper Punjab
    - Sindh

RE IN PAKISTAN
Biofuels – Bio-Diesel Resources

- The Pongame tree
  - Native to Pakistan ; tried & tested as a hardy plant
    - Requires little water
    - Goats do not like it
    - Leaf litter is good organic fertilizer
    - Biodiversity home for living biota
    - Protects soil from erosion
    - Protects soil from water logging & salinity – twin problems for most Pakistani land
  - Yield from 5^{th} year onwards

Yields of different sources-REVISED.xlsx

RE IN PAKISTAN

Biofuels – Bio-Diesel Resources

- Other non-edible resources native to Pakistan
  - Cotton seed
  - Castor bean
  - Mesquite (wild arabic gum tree) – a local shrub
  - Jojoba – a shrubby plant
  - Wild Carthame (Wild Safflower)

RE IN PAKISTAN
Biofuels – Bio-Diesel Resources

- Jatropha
  - Not native to our part of the world
  - Cannot grow in very hot or very cold climates
  - Needs 1000mm annual rainfall
  - Jatropha plantation pilot projects being undertaken by private / public sector companies in Pakistan

- Supplemental resources:
  - Waste Vegetable Oil (WVO) & Animal Fat (AF)
    - Yield of Bio-diesel > 90%
    - Large quantities available in urban areas
    - Collection mechanism somewhat established
    - Production process simple

RE IN PAKISTAN

Cost Per Unit – Various RE Source

Energy Source	Cost Per Unit (cents)
Wind	**13-14 cents**
Solar	**21 cents**
Small Hydro	**6-7 cents**
Waste-to-Energy	**5-7 cents**

SOURCE: AEDB, PAKISTAN

RE IN PAKISTAN
Initiatives & Achievements

- Major players
  - Government sector
  - Semi-Government
  - Non-Government
  - Private sector

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- Ministries
  - Environment
- *AEDB*
- *PCRET*
- *PEC*
- Universities – industry-academia collaboration

RE IN PAKISTAN

Govt. Sector Initiatives & Achievements

- *MINISTRY OF ENVIRONMENT*
  - Established a *CDM CELL*
    - Awareness program on CC potential in various sectors
    - Granted host country approval to 36 CDM projects
    - 11 registered from Pakistan with *CDM EXECUTIVE BOARD (EB)*
    - The largest CDM project: *PAK ARAB FERTILIZER*, Multan, generates more than 1 million CERs / year
    - Anywhere from $8–$20 per CER can be earned

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- *MINISTRY OF ENVIRONMENT*
  - Set up the *PAKISTAN ENVIRONMENTAL PROTECTION AGENCY (PEPA)*
    - Responsible to implement the Pakistan Environmental Protection Act, 1997 – the act provides for:
      - Protection, conservation, rehabilitation & improvement of environment
      - Prevention & control of pollution
      - Promotion of sustainable development
    - Conducts environmental assessment studies of various installations & projects

RE IN PAKISTAN

Govt. Sector Initiatives & Achievements

- *MINISTRY OF ENVIRONMENT*
  - *PEPA*
    - Initiative to avail carbon credit facility for all Brick Kilns owners in Pakistan
      - Pakistan has hundreds of brick kilns operating in clusters in rural & sem-urban areas of the country producing fired clay bricks
      - A valuable industry - indigenous & providing employment in rural areas where agriculture may not be enough to sustain all the people
      - Environmental & health hazards of brick kilns
      - Potential to reduce GHG emissions & claim Carbon Credits

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- *AEDB*
  - Mandate:-
    - Implement policies & projects through private sector in Alternative Energy (AE)
    - Assist & facilitate development & generation of AE to achieve sustainable economic growth
    - Encourage TOTs & develop indigenous manufacturing base
    - Undertake RE projects on commercial scale (AEDB Act 2010)
  - Played a pioneering role in RE in Pakistan
    - Awareness building
    - RE Policy
    - Developing & mobilizing the private sector
    - Research in academia & other institutions

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- *PAKISTAN COUNCIL OF RE TECHNOLOGIES (PCRET)* – May 2001
  - Mandate:
    - Conduct research in RE
    - Establish facilities & expertise
    - Awareness building
  - Projects:
    - Biogas for rural development
    - Pilot-scale production of solar cells & modules
    - Testing lab for solar PV & solar thermal appliances
    - Electrification of remote villages in FATA & northern areas through installation of 70 microhydel plants
    - Rural / urban electrification using solar energy

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- *PAKISTAN ENGINEERING COUNCIL (PEC)*
  - Launched the Alternative Energy Resource Portal
    - Database of Pakistan's public & private sector organizations & individuals in alternative energy development
    - Caters information needs of individuals & organizations interested to switch to alternative energy, especially solar

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- *NATIONAL UNIVERSITY OF SCIENCES & TECHNOLOGY (NUST)*
  - Pakistan's leading R&D university – S&T prowess
  - High level of commitment to scientific research
  - Activities seen as key change factors in the national scenario

  - *CORPORATE ADVISORY COUNCIL (CAC), NUST* – a think tank in the making

Think.Collaborate.Build

RE IN PAKISTAN

Govt. Sector Initiatives & Achievements

- *NUST*
  - CAC
    - Mandate
      - Bridge gap between academic research & business requirements
      - Create effective linkages & collaboration
      - Assist in commercialization of *NUST* projects
      - Be advocates for policy & industry direction through the role of a premium think tank
      - Build knowledge repository & database for industry to use
    - Power & Energy sector

RE IN PAKISTAN
Govt. Sector Initiatives & Achievements

- *NUST*
  - Carries out valuable industry-specific research in RE
    - Solar
    - Bio-Diesel
    - Energy Efficiency (improving industrial motor efficiency)
    - Efficiency improvement of micro-wind turbines
    - Curriculum development & HRD

RE IN PAKISTAN
Initiatives & Achievements

- Semi-Government sector
  - FATA Development Authority
    - Solar PV pumping for irrigation & drinking water – collaborative project with *NUST*
    - Solar PV lighting purposes
  - Thar Development Authority
    - Solar PV lighting
    - Use of solar energy for water pumping & filtering for drinking purposes

RE IN PAKISTAN
Initiatives & Achievements

- Semi-Government sector
  - Gwadar Development Authority
    - Solar PV street lighting
    - Solar Thermal for converting sea-water to drinking water
  - Housing authorities in government & semi-government sectors
    - Outdoor lighting
    - Solar geysers for domestic use

RE IN PAKISTAN
Initiatives & Achievements

- Private sector companies offering RE solutions in Pakistan
  - Due to early incentive by GoP, private sector giants & small entrepreneurs have ventured into RE
  - Covering various areas in the value chain
    - Raw material supply (import, distribution)
    - Equipment Assembly / Manufacturing
    - Consultancy
    - Audits

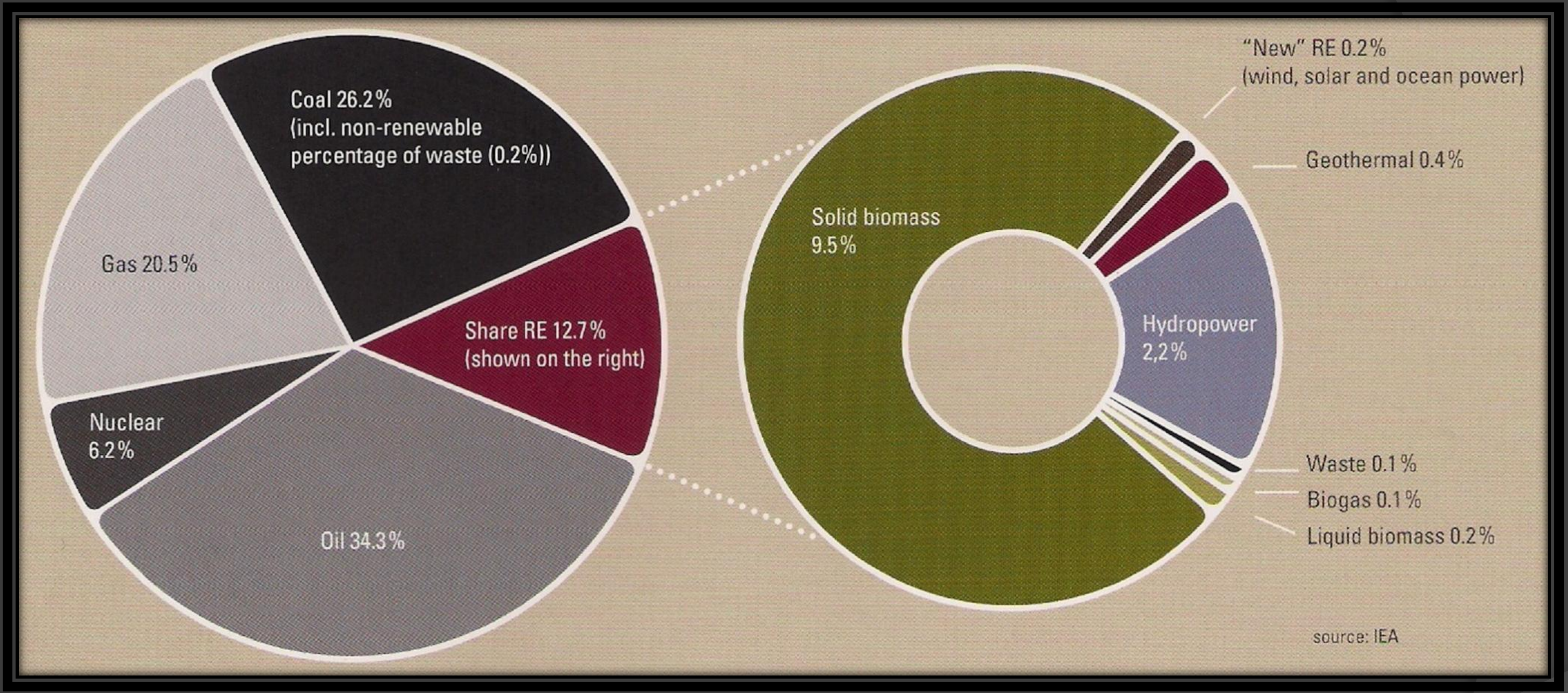
WE NEED TO COLLABORATE!!!!

- Data / information sharing
  - SARI/E Resource Portal
- Industry linkages
- University linkages
- Help ourselves & each other develop RE
- Become the “model region” in RE

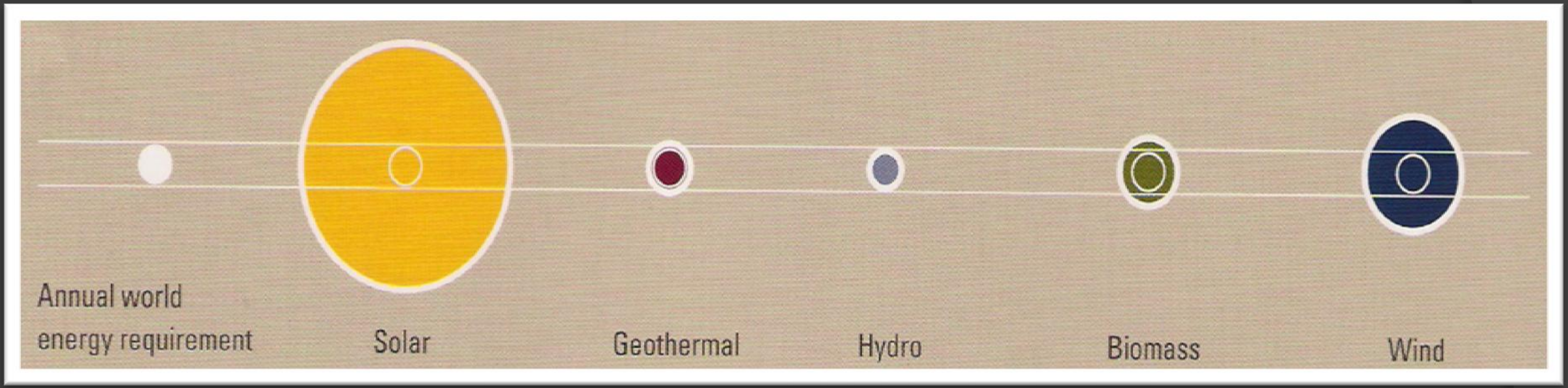
OVERVIEW OF RENEWABLE ENERGY PROGRAMME IN INDIA

S. P. GON CHAUDHURI
ADVISOR (RENEWABLE ENERGY)
GOVERNMENT OF WEST BENGAL

Energy is one of the most important basic human needs and key input for all round economic growth of the country. With our focus on planned energy sector growth, the installed capacity of power generation in India has crossed 1,60,000 MW and is likely to cross 2,00,000 MW by the end of the present five year plan (11^{th}) in 2012.

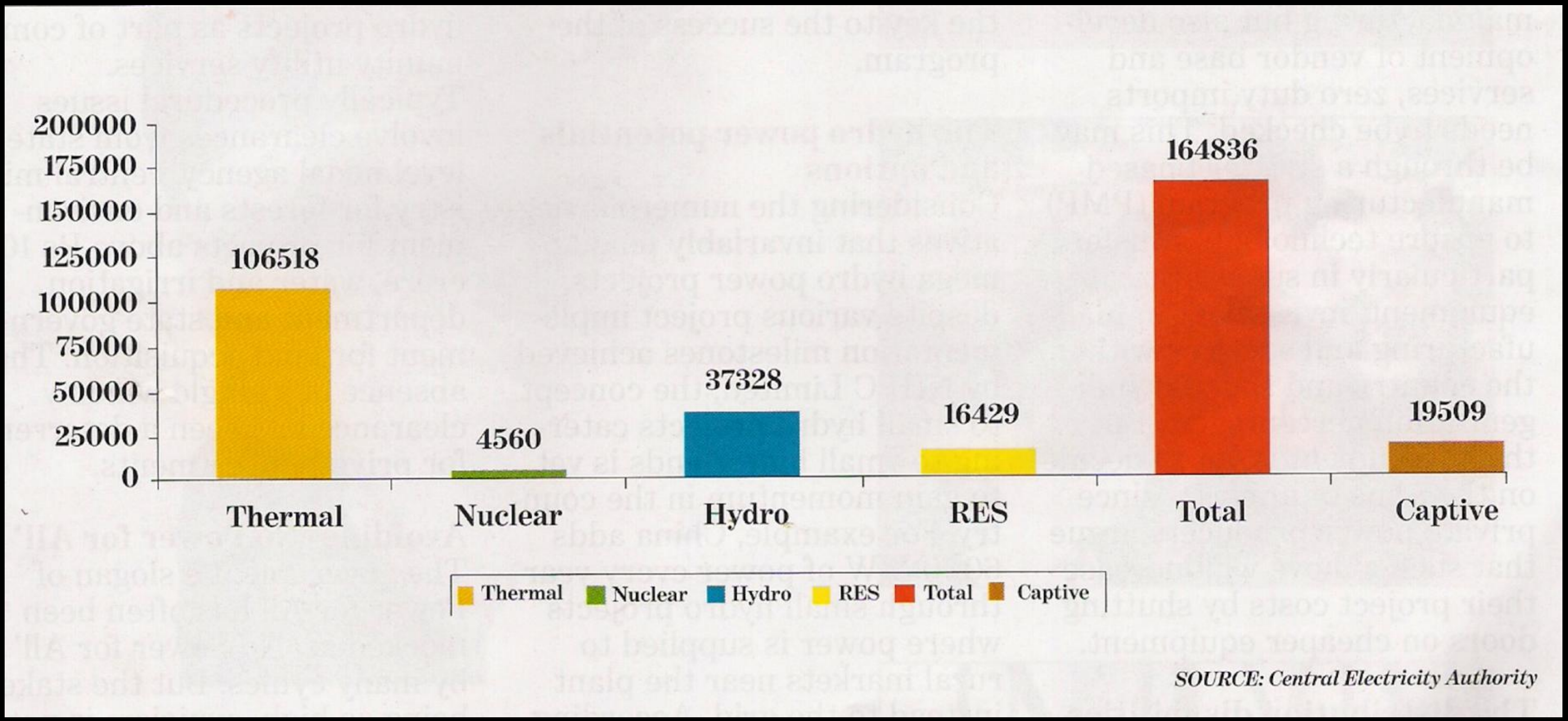


Structure of Global Energy Consumption



World wide potential of different Renewable Energy Sources

Electricity Scenario in India ::



Source: Central Electricity Authority

Future energy demand ::

Population in Millions	Year	Billion Kwh				Projected Peak Demand(GW) @ GDP Growth Rate		Installed capacity Required (GW) @ GDP Growth Rate	
		Total Energy Requirement @GDP Growth Rate		Energy Required at Bus Bar @ GDP Growth Rate					
		8%	9%	8%	9%	8%	9%	8%	9%
1197	2011-12	1097	1167	1026	1091	158	168	220	233
1275	2016-17	1524	1687	1425	1577	226	250	306	337
1347	2021-22	2118	2438	1980	2280	323	372	425	488
1411	2026-27	2866	3423	2680	3201	437	522	575	685
1468	2031-32	3880	4806	3628	4493	592	733	778	960

It is clear India will need an installed capacity of 960 GW of power in the year 2031-32 if the Country maintain 9% of GDP this will however, go down in case of lower GDP growth rate.

The question is how India is going to cater such high demand.

Most of the power plants in India are Coal Based

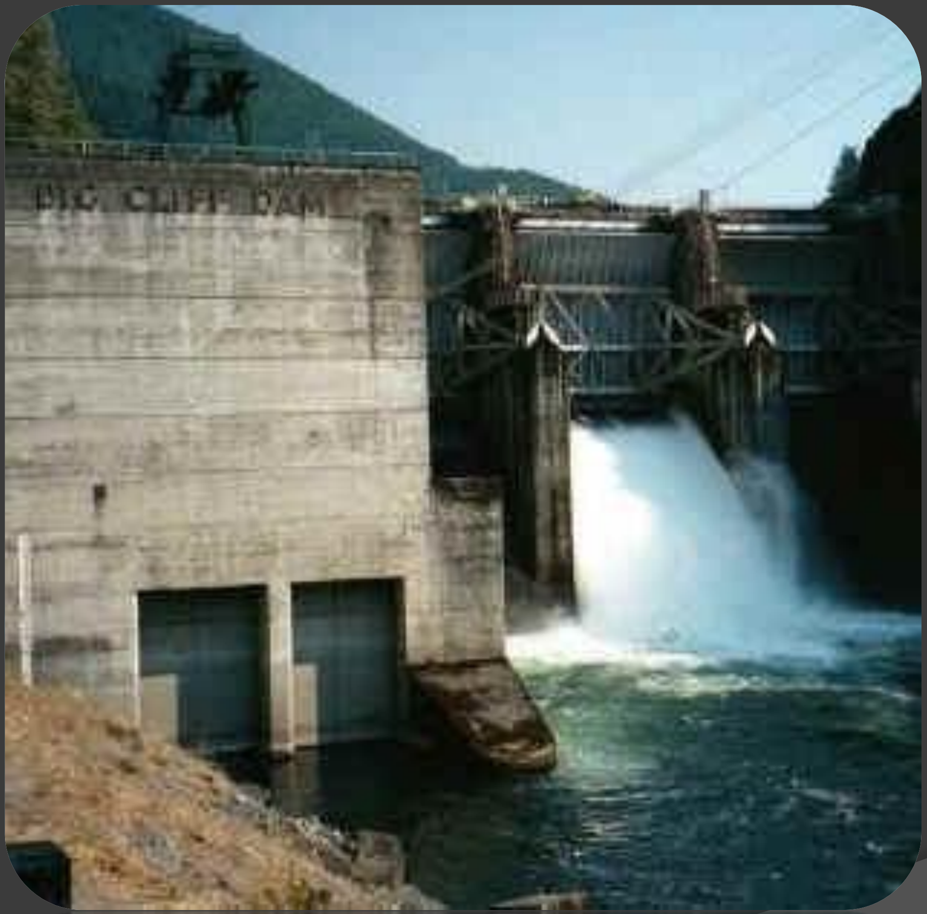
Barriers ::

Coal ::

As on April 2005, the ratio of proved coal resources and annual coal production in our country indicating balance life of resources shows 144 years for coal as against 22 years for oil and 52 years in case of gas. This fits fairly with the world scenario in which also the balance life for coal is about 164 years as against 40 years for oil and 67 years in case of gas. However, the quality of Indian coal is very poor and demand and supply does not tally resulting import of coal by Indian power industry significantly. This has a tremendous impact on price of electricity from coal.

Moreover, coal based electricity generation is a major source of pollution. There is public pressure against coal based power generation. In this backdrop it would be difficult to harness the entire coal reserve of India.

India is also endowed with abundant Hydro Power Plant potential of about 149 GW (Giga Watt)

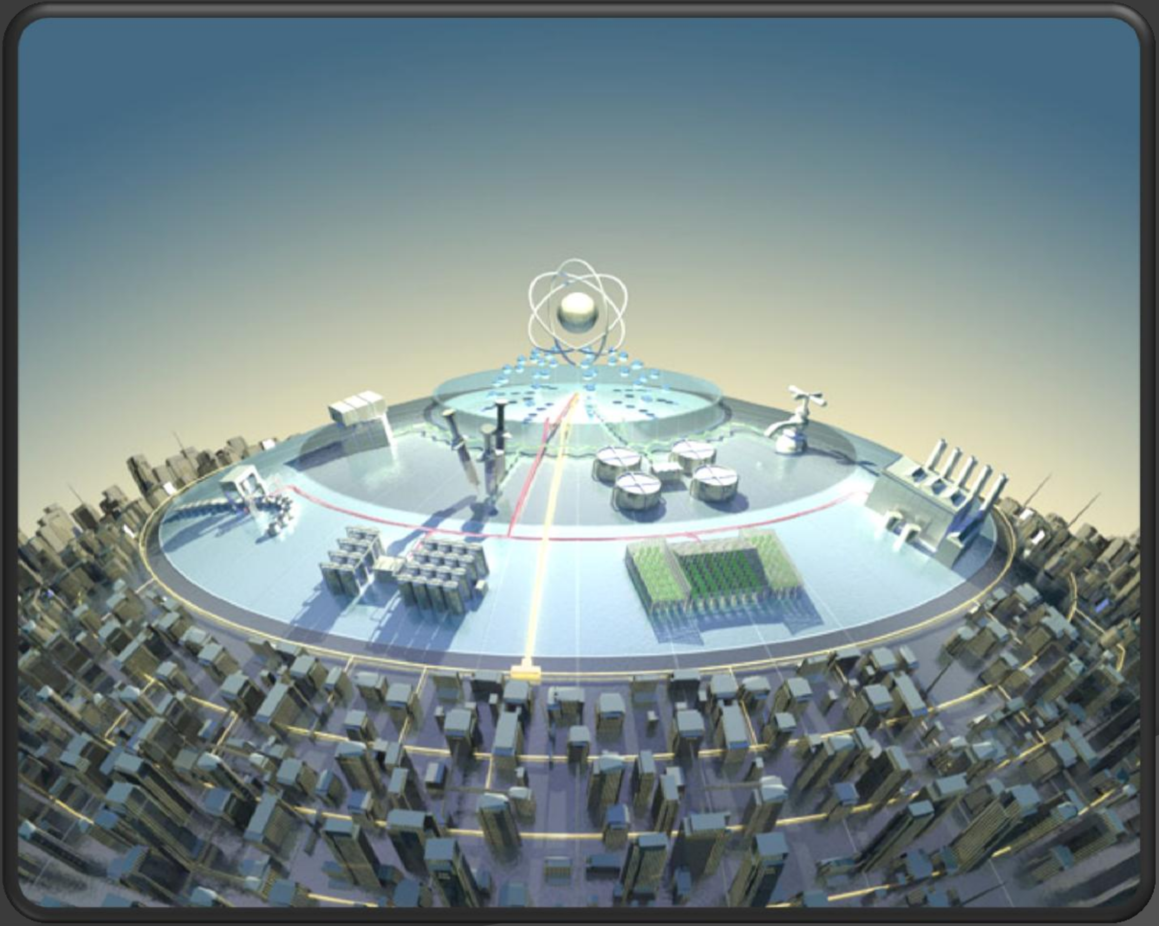


Barriers ::

Hydro Power ::

The construction of Hydro Electric Projects is a challenging task that not only involves meticulous planning and huge investment, but also faces numerous unforeseen hurdles that can stall work at any point of time. Law and orders, protest from Environmentalists, Poor infrastructure in Himalayan and Sub Himalayan Region, Inter State Dispute, International Dispute over sharing of water are the major challenges which restricts Hydro Power Development in India.

India do have a Mega Plan to harness Nuclear Power. However, there are many techno political issues in this Sector which need to be addressed.



Renewable Energies are sustainable and profitable and they provide independence from imported raw materials. Renewable Energies are safe and reliable. The technology exists, the process are tried and tested and there are countless success stories. Dependable, renewable energies have become reality. Renewable energies are win-win all round companies, countries as well as for the environment.

Renewable Energy Potential in India ::

The Renewable Energy Potential of India is very high. India is a tropical country and blessed with plenty of sunshine almost all over its surface and throughout the year. More over, India is an Agricultural Country and produces huge quantum of Agricultural waste.

India has a long coastal line with a wind power potential of 45,000 MW. The solar power potential of India is more than 9,00,000 MW. The top five countries in terms of renewable power capacity in 2009 were China, US, Germany, Spain and India. Together these countries accommodate for around two thirds of the global renewable power capacity.

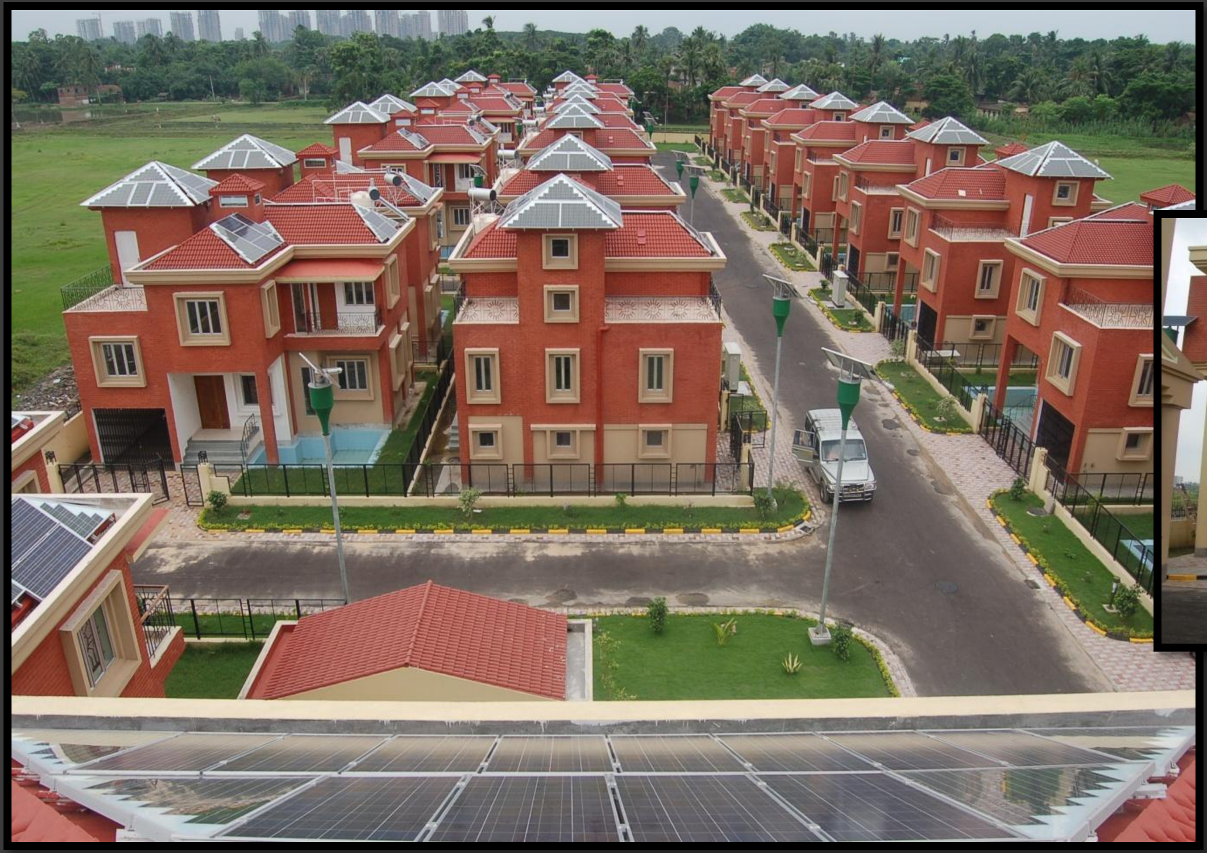
National Solar Mission aims for Global Leadership ::

The Jawaharlal Nehru National Solar Mission (JNNSM) has set very aggressive targets for Solar Power capacity addition in the country. It aims at achieving 20,000 MW by the year 2022. The programme will be implemented in three phases involving the achievement of 1100 MW of grid connected capacity in the first phase (till 2013), 4000 MW in the second phase (2013-2017) and the remaining in the third phase (2017-2022) .


1st MW level grid connected solar PV power Plant, Asansol, West Bengal

The small roof-top grid connected solar power plants are also becoming popular day by day.

50 Watt LED based Street Lighting System
New Business Opportunity in Urban Areas




The guidelines for JNNSM has already been announced. All the State Regulatory Commission has declared Solar Power Tariff. It is expected the programme will pick up from 2011-2012. JNNSM has opened up investment opportunity both in manufacturing sector and power generation sector.

Wind Power Programme in India ::

The wind power potential of India is 45,000 MW excluding off shore. India is one of the leading countries in the World in regard to harnessing of wind power. India has an installed wind power capacity of more than 14,000 MW. Large size wind machines of capacity 3 MW are now available in the country. Indian west coast has much higher wind power potential than east coast.

Most of the Regulators have declared wind power Tariff. GBI is also available for wind power generation.

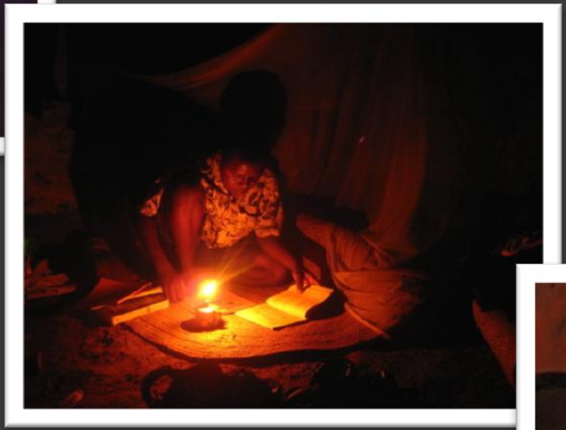
Potential of Biomass Power in India ::

By Convention the term “Biomass” is used in India mainly for crop residue, waste by products of crop processing, woody produce of forests, biomass acquired from growths in waste lands, and the woody produce of forests, potential of biomass based energy in India is to the tune of 20,000 MW with a plant load factor of 75-80%. India is World’s Second biggest producer of sugarcane. About 7,000 MW of power could be generated in India from dry Bagasse.

10 MW Biomass based Power Plant, Bankura, West Bengal

Already generated 10 Million Units of Green Energy.
More than 200 people are working in the Project.

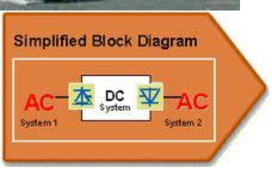
Half a billion people of India do not have access to electricity.

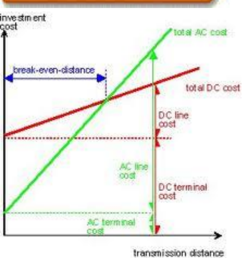


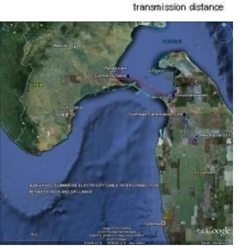
Renewable Energy particularly off grid solar photovoltaic can play a major role in this regards.

About 5 million people in Indian villages now use solar power.


THANK YOU

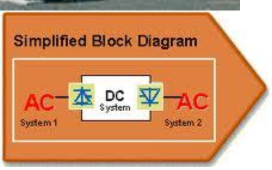


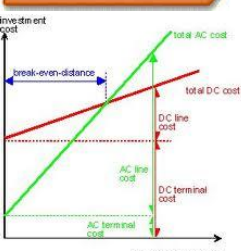


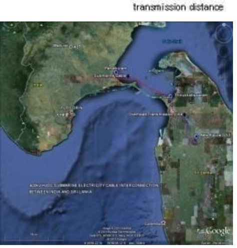


Feasibility Study for Interconnection of India-Sri Lanka Electricity Grids

Kamani Jayasekera
Chief Engineer (Transmission Planning)
Ceylon Electricity Board
11th July 2011

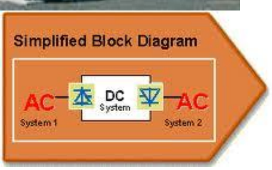


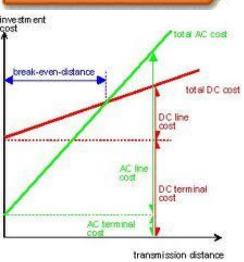


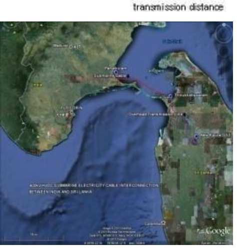


Sri Lanka needs new generation to meet increasing demand

Power exchange with India be a candidate for meeting future power demand



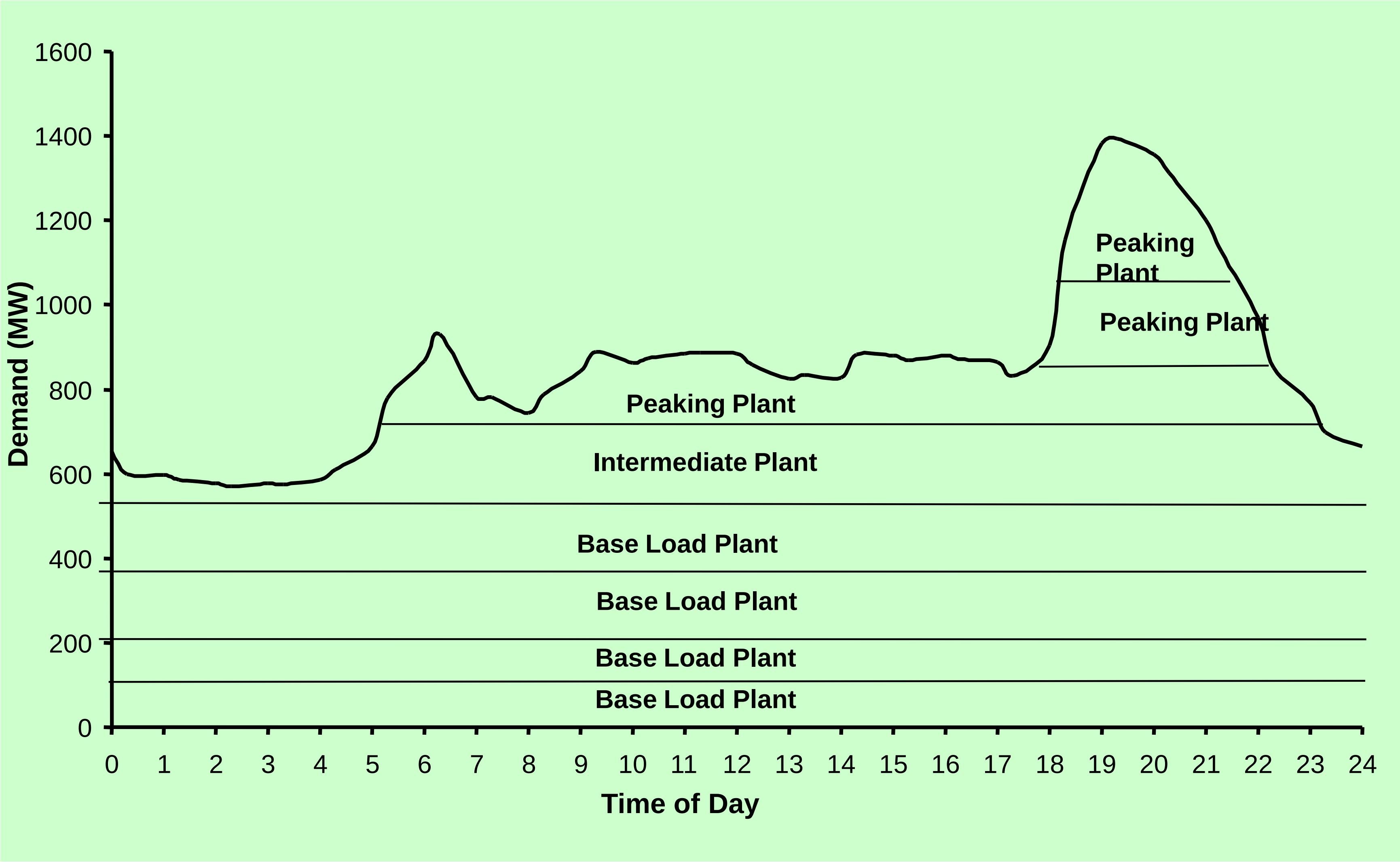




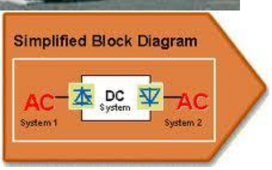
Benefits and Opportunities

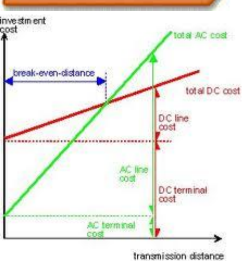
- Meeting growing power demand with imported power
- Improved load profile - valley filling
- Improved system reliability and security
- Access to electricity from cheaper sources of power generation in the South Asia Region
- Opportunity to enter into India Power Exchange for energy trading
- Reduction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

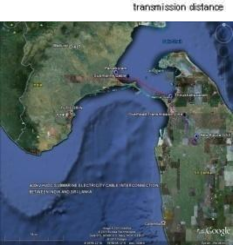
Typical Daily Load Curve



Background

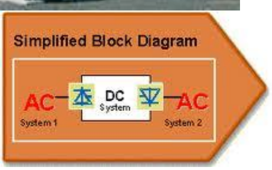


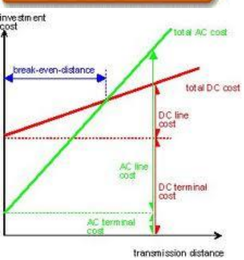


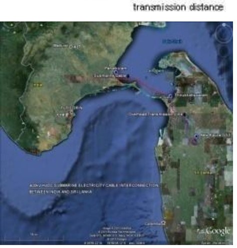


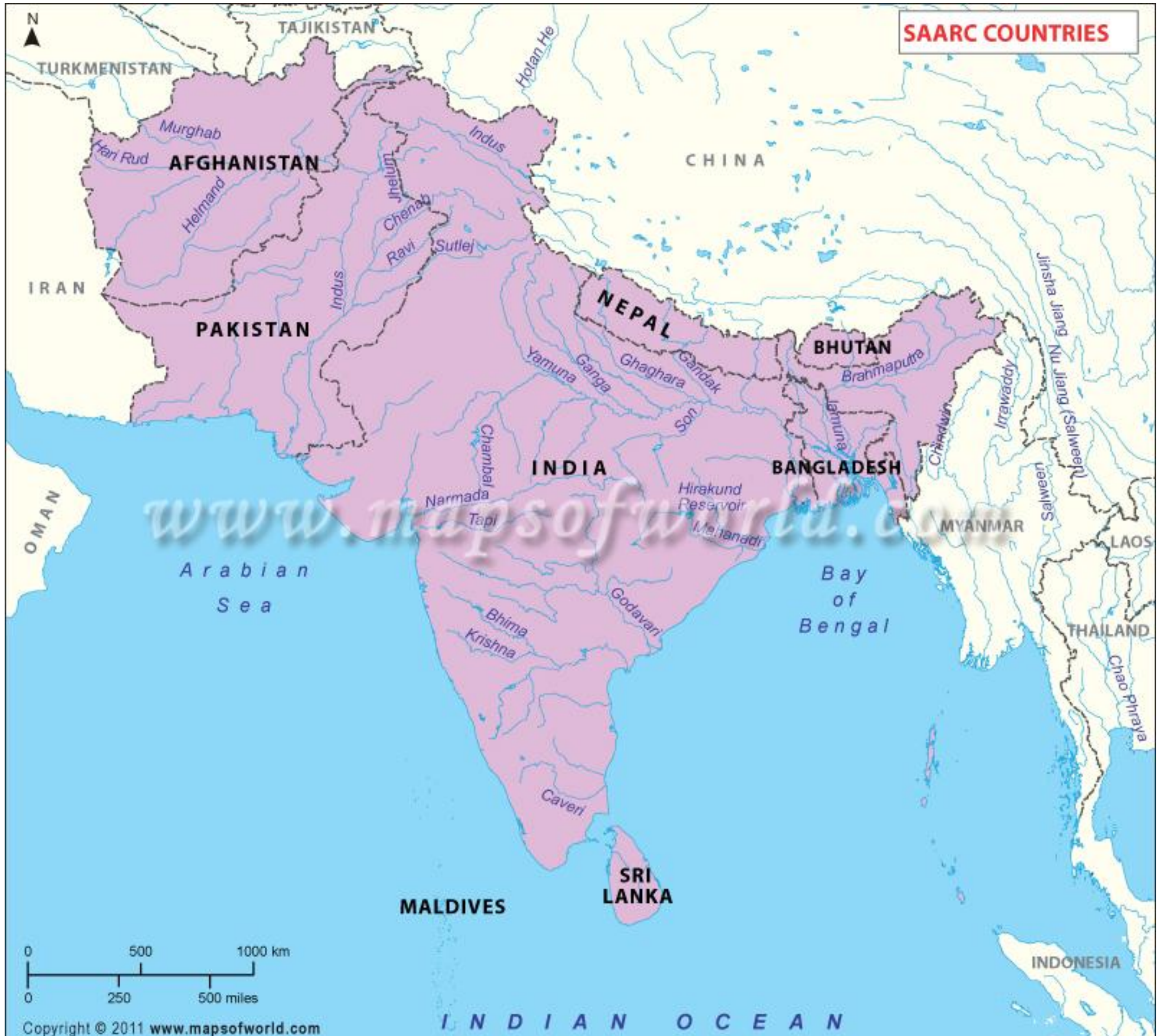
- Under consideration since mid 1970's
- Pre-feasibility study conducted with the assistance of USAID in 2002 by Nexant Inc.
- Review of the Pre-feasibility study with assistance of USAID in 2006 by Nexant/ Power Grid Corporation of India
- Considered under SAARC and BIMSTEC Regional Grid

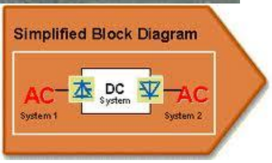
SAARC Region

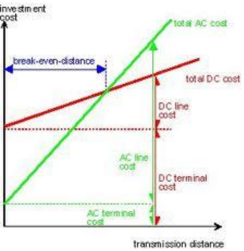










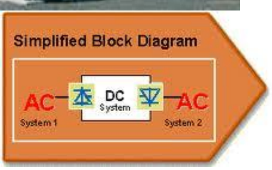


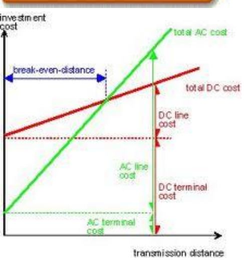
Background

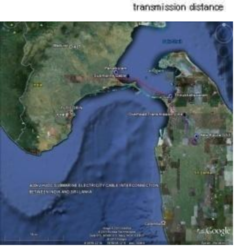
- Bilateral discussions by Secretary , Ministry of Power and Energy Sri Lanka and Secretary Ministry of Power, India in Dec 2006.

- Cabinet of Ministers, Sri Lanka 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.

Power Transmission Interconnection options





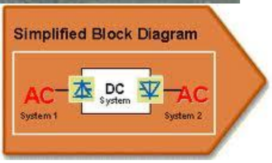


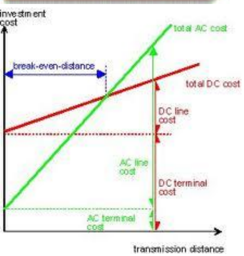
Background

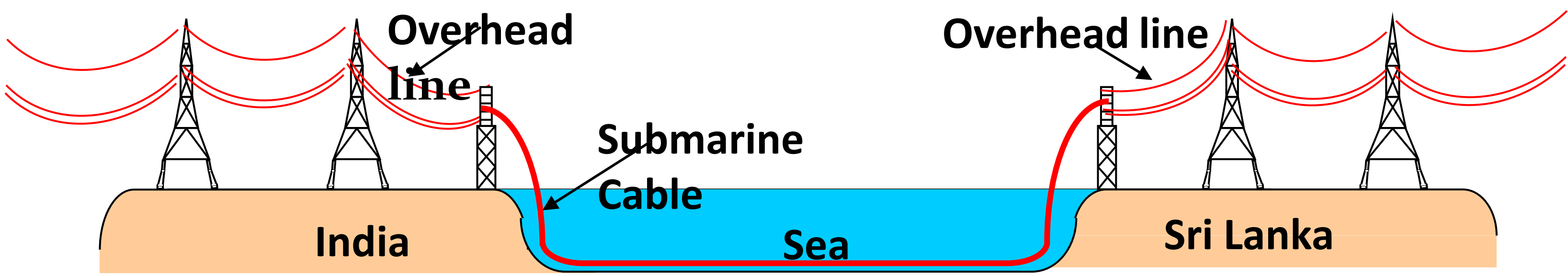
- Executing Agencies; CEB and PGCIL are jointly carrying out the feasibility study

- Estimated cost : US$ 3.0 Million
  - ✓ shared by GOI and GOSL in equal proportion

Proposed Interconnection Option







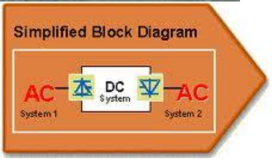
Transmission System in Submarine Cable

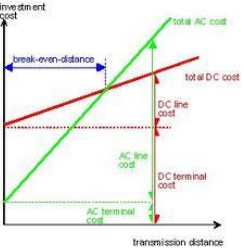
Two cables will be laid in two trenches 10m apart at a depth of 2m below seabed.

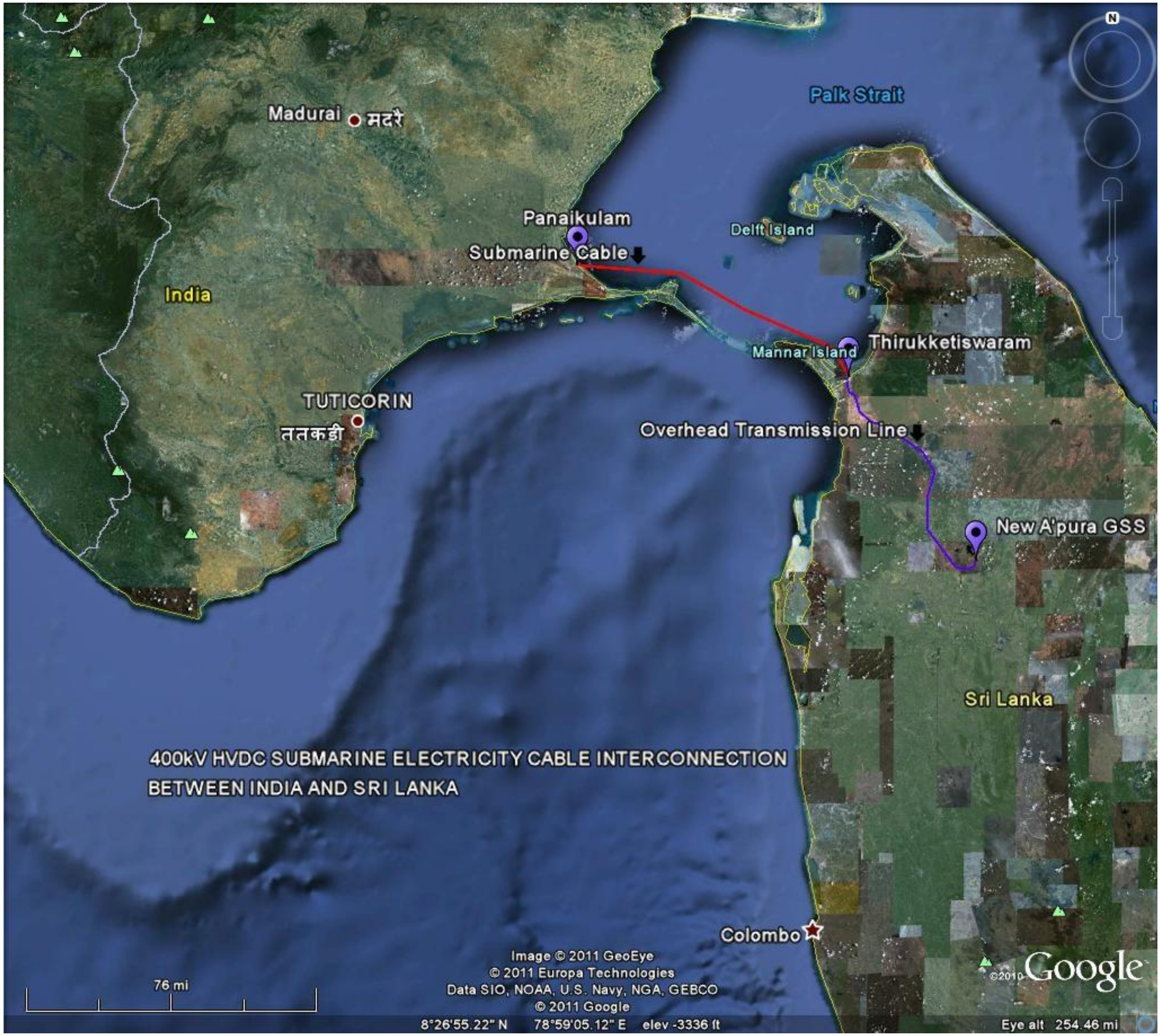
Quantum of Power Exchange

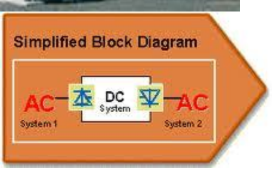
2015 onwards - 500 MW
2020 onwards - 1000 MW

Interconnection option

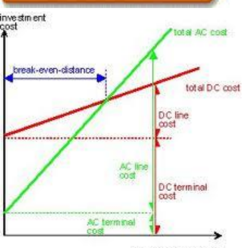




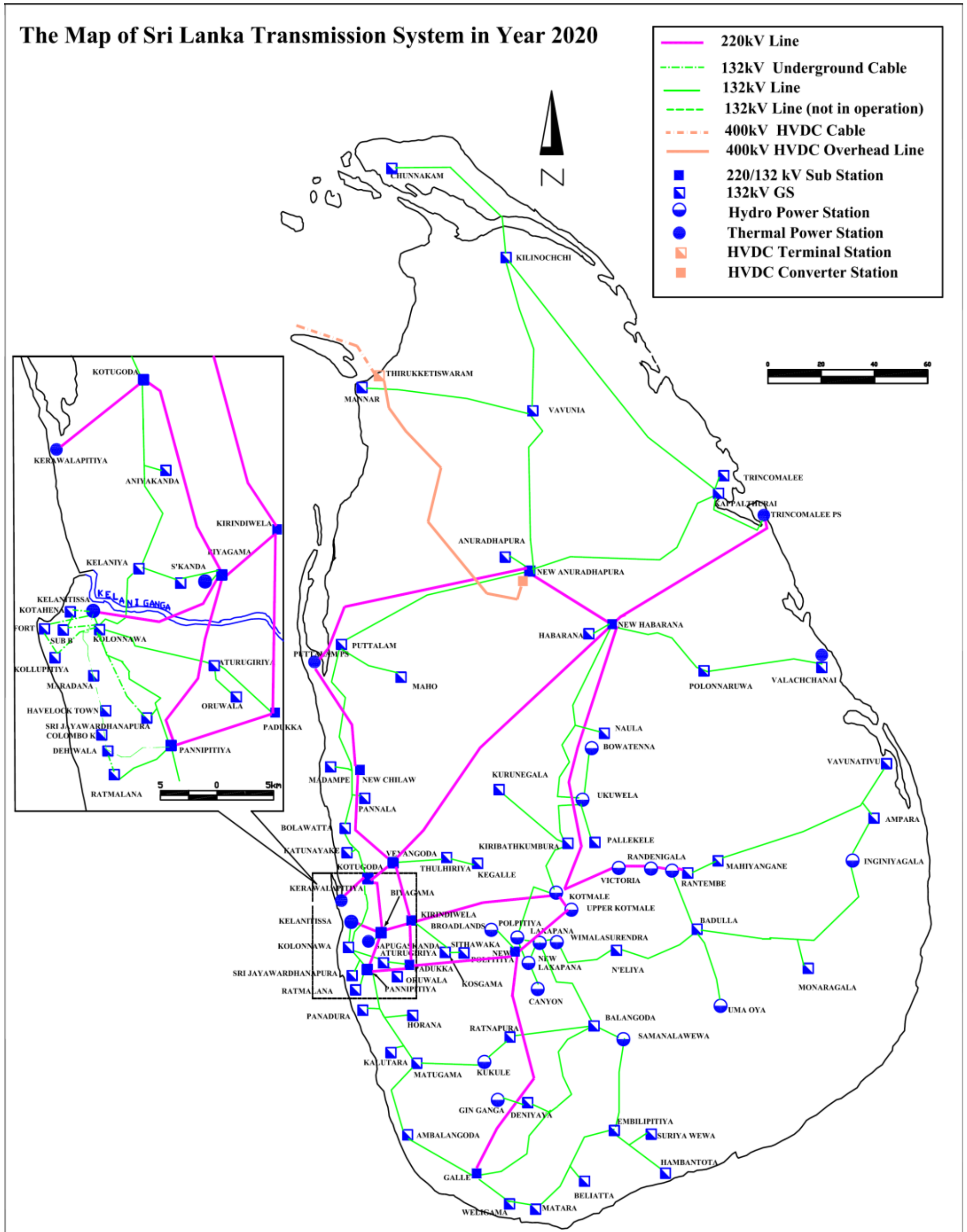




Simplified Block Diagram
AC
System 1
DC
System
AC
System 2

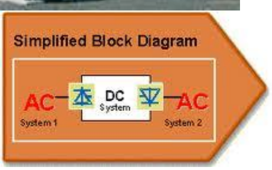


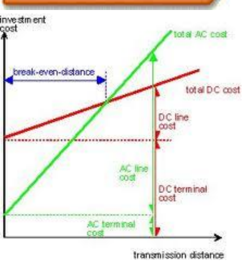
investment cost
total AC cost
break-even-distance
total DC cost
DC line cost
AC line cost
DC terminal cost
AC terminal cost
transmission distance

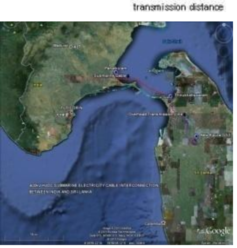


The Map of Sri Lanka Transmission System in Year 2020
220kV Line
132kV Underground Cable
132kV Line
132kV Line (not in operation)
400kV HVDC Cable
400kV HVDC Overhead Line
220/132 kV Sub Station
132kV GS
Hydro Power Station
Thermal Power Station
HVDC Terminal Station
HVDC Converter Station
N
0
20
40
60
CHUNNAKAM
KILINOCHCHI
THIRUKKETISWARAM
MANNAR
VAVUNIA
TRINCOMALEE
KAPPALTHURAI
TRINCOMALEE PS
ANURADHAPURA
NEW ANURADHAPURA
NEW HABARANA
HABARANA
PUTTALAM
PUTTALAM PS
MAHO
POLONNARUWA
VALACHCHANAI
NAULA
BOWATENNA
KURUNEGALA
UKUWELA
VAVUNATIVU
AMPARA
MADAMPE
NEW CHILAW
PANNALA
BOLAWATTA
KATUNAYAKE
VEYANGODA
THULHIRIYA
KEGALLE
KIRIBATHKUMBURA
PALLEKELE
RANDENIGALA
VICTORIA
RANTEMBE
MAHIYANGANE
INGINIYAGALA
KOTUGODA
KERAWALAPITIYA
BIYAGAMA
KOTMALE
UPPER KOTMALE
KIRINDIWELA
BROADLANDS
POLPITIYA
LAXAPANA
WIMALASURENDRA
BADULLA
KELANITISSA
KOLONNAWA
SAPUGASKANDA
ATURUGIRIYA
SITHAWAKA
NEW POLPITIYA
NEW LAXAPANA
N'ELIYA
PADUKKA
SRI JAYAWARDHANAPURA
ORUWALA
RATMALANA
PANNIPITIYA
KOSGAMA
CANYON
MONARAGALA
UMA OYA
PANADURA
HORANA
BALANGODA
RATNAPURA
SAMANALAWEWA
KALUTARA
MATUGAMA
KUKULE
GIN GANGA
DENIYAYA
EMBILIPITIYA
AMBALANGODA
SURIYA WEWA
HAMBANTOTA
GALLE
BELIATTA
WELIGAMA
MATARA
KOTUGODA
KERAWALAPITIYA
ANIYAKANDA
KIRINDIWELA
KELANIYA
S'KANDA
BIYAGAMA
KELANITISSA
KOTAHENA
FORT
SUB B
KOLONNAWA
KELANI GANGA
KOLLUPITIYA
MARADANA
ATURUGIRIYA
HAVELOCK TOWN
SRI JAYAWARDHANAPURA
COLOMBO K
ORUWALA
PADUKKA
DEHIWALA
PANNIPITIYA
RATMALANA
5
0
5km

Present Status

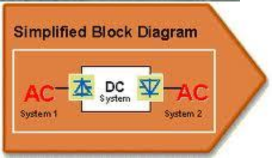






- Feasibility study is presently being carried out by PGCIL and CEB including the Environmental Impact Assessment.

  Technical, economical, financial, environmental, legal and institutional issues will be addressed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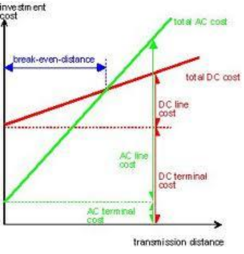
investment cost
total AC cost
break-even-distance
total DC cost
DC line cost
AC line cost
DC terminal cost
AC terminal cost
transmission distance

The End