South Asia Regional Initiative for Energy Integration (SARI/EI)

Case studies on financing models for cross-border transmission lines

SARI/EI/IRADE Team

Workshop on 'Enhancing Energy Cooperation between India –Nepal'
24th July 2019 at NEA, Kathmandu, Nepal, India

Contents

Cross Border Transmission Lines - Key Drivers towards Inception

- ❑ Sharing of common resources;
- ❑ Meeting the demand in a deficit area;
- ❑ Avenues towards transfer of Zero Cost Energy;
- ❑ Economy Exchange;
- ❑ Consideration of System Security;
- ❑ Sharing of common reserves and surpluses;
- ❑ RE integration and balancing;
- ❑ Geographical and locational advantages;

Cross Border Transmission Lines - Agreement towards Sharing of Costs

Sharing Partners:

- By the partner seeing benefits in the immediate time frame;
- By both the partners looking at the benefits in the long run;
- Sharing of costs by Partner Countries in an equitable manner;
- Socialization of costs through grants and other accrued benefits;

Enablers:

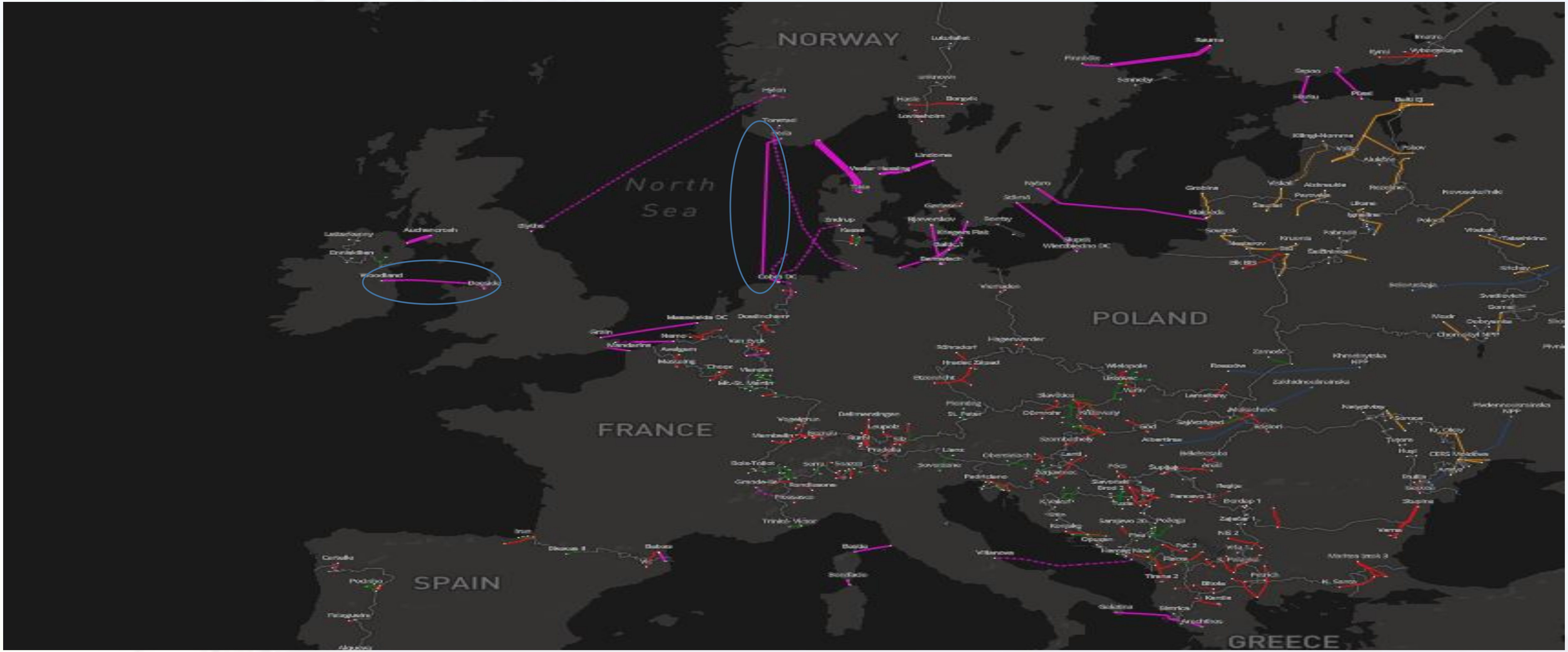
- Avenues available towards computation of benefits to each partner;
- Identification and agreement towards cost sharing principles;
- Harmonization towards Legal and Commercial Frameworks:

Case Study No. -1

EAST WEST INTERCONNECTOR

Connecting UK and Ireland

Interconnected Europe



Composition of Resources in Ireland

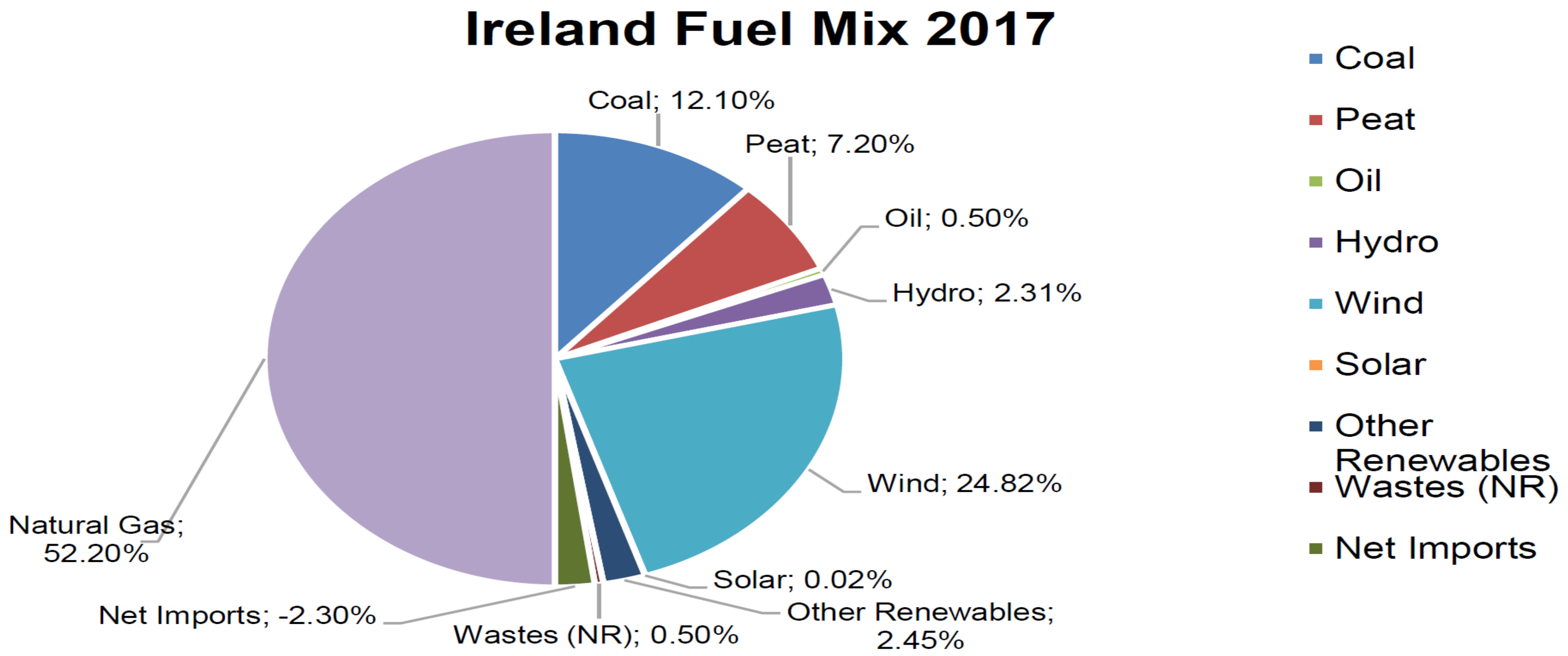
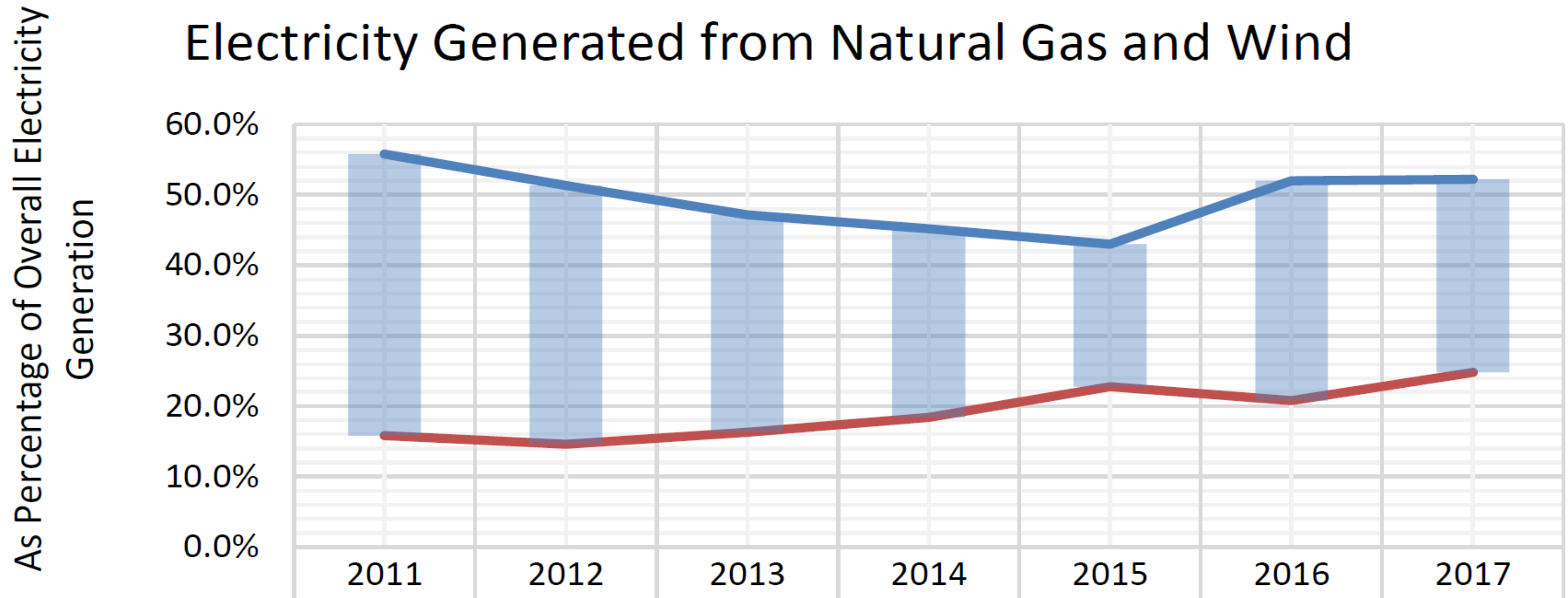


Figure 3-1: Ireland Fuel Mix 2017. Data Source: SEAI Fuel Mix Provisional

Electricity Generated from Wind in Ireland



	2011	2012	2013	2014	2015	2016	2017
Natural Gas	55.8%	51.3%	47.2%	45.2%	43.0%	52.0%	52.2%
Wind	15.8%	14.6%	16.3%	18.4%	22.8%	20.8%	24.8%

Figure 3-2: Electricity Generated from Natural Gas and Wind as a Percentage of Total Electricity Generation. Data Source: SEAI Fuel Mix Provisional

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Assessment of Non-Despatchable plants in Ireland

Year	Capacity 2018 (MW)	Capacity 2027 (MW)
Industrial Generation	9	9
CHP	139	189
Biomass/LFG	24	24
Hydro	22	22
Solar PV	10	300
Wind	3,500	5,510
Total	**3,704**	**6,054**

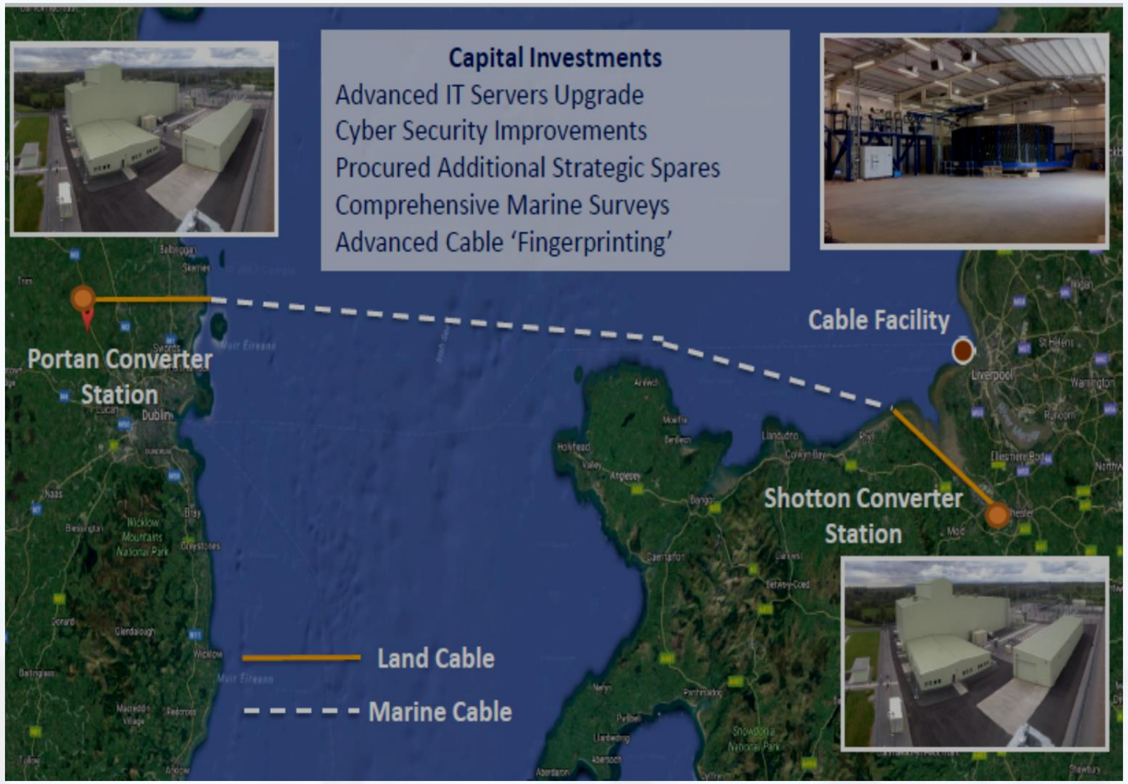
Table 3-2: Assessment of Partially and Non-Dispatchable Plant in Ireland[36]. Data Source: GCS 2018 – 2027

East West Interconnector

- HVDC cable link between Ireland and Great Britain.
- Project capacity 450-650 MW
- Length of the cable route - 260 km (185 km under sea)
- Commercially operational with unrestricted power flows since 1st May 2013

Identified Benefits

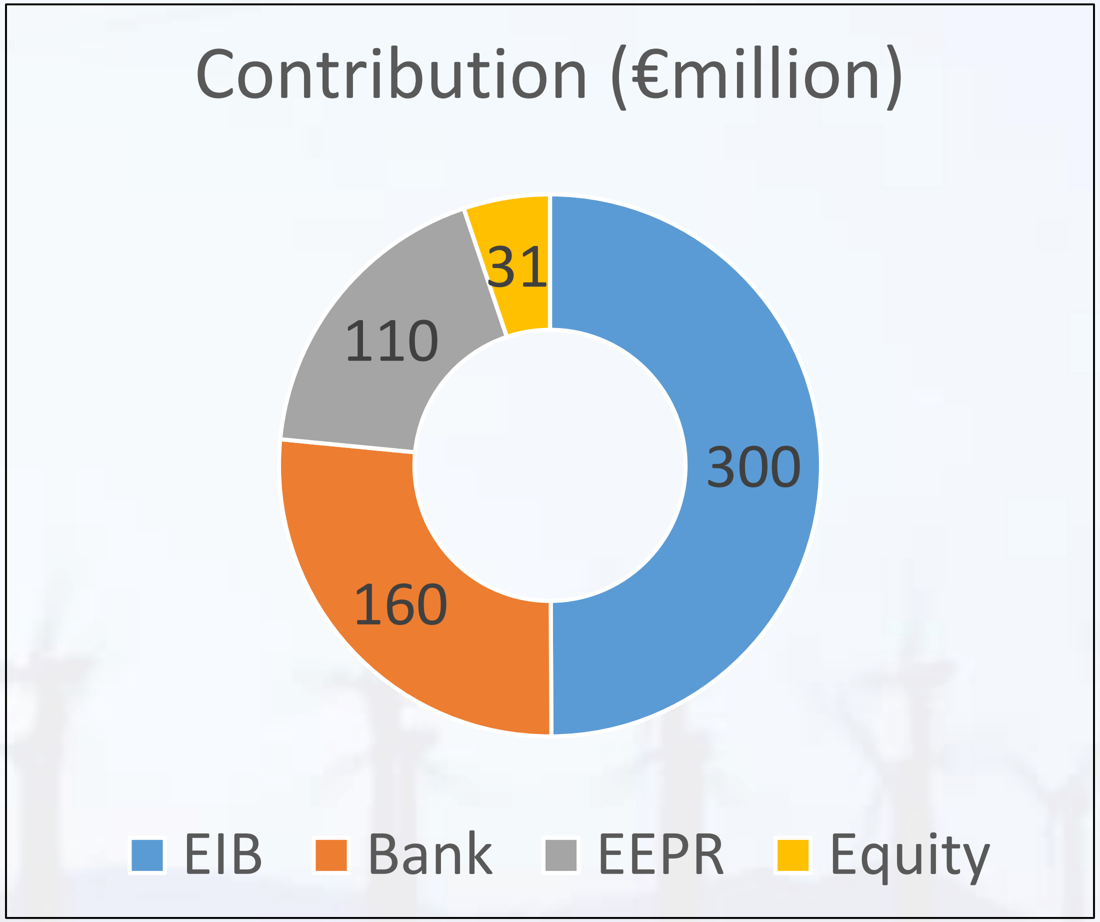
- Energy security for population
- Promote competition in the electricity sector
- Encourage RE in Ireland – transfer wind energy generated in Ireland to UK
- Power Sell from Irish companies to Great Britain and vice-versa
- Technology: HVDC Light ® by ABB
- Transmission capacity – 500MW
- DC Voltage: ±200kV



- AC Voltage: 400 kV (Both ends)
- AC Frequency: 50 Hz (Both ends)

Financing East-West Interconnector

- €600million project cost
  - Commercial lending from financial institution - €160million
  - European Energy Programme for Recovery (EEPR) – €110 million
  - Equity -€31million
  - €300million from European Investment Bank
- Additional €200million for wind farms to Ireland



Exposure Hedging Mechanism Adopted

Risks Identified and Actions

- Uncertain repayment start date, plus mandatory requirements
- Protect against price rises significantly above initial evaluation
- Secure significant cost savings where possible
- Manage exposure risks in line with risk averse policy
- Manage exposures to achieve a good outcome for the project

Financial Instruments Used

- Interest rate hedging
  - Plain vanilla fixed-float swap -low long term SWAP rates
  - Accreting and amortizing
- Commodity exposure
  - Forward swaps
  - Zero cost collar
  - Purchase call option

HEDGING MECHANISMS WERE INCORPORATED FROM PROJECT INCEPTION

Capacity Charges

- Interconnector allocates long-term (or 'forward') transmission rights in the form of Financial Transmission Right Options (FTRs)
- FTRs on EWIC are allocated in auctions facilitated by the Joint Allocation Office (JAO) (JAO auctions capacity on most interconnectors throughout Europe)
- JAO is single point of contact for FTR market—handling registration, systems, auctions, and settlement. Parties wishing to participate in auctions of EWIC FTRs will contract directly with JAO

FTRs on the SEM-GB border will be auctioned on a 'per-interconnector' rather than a 'per-border' basis, i.e. there will be separate auctions for Moyle FTRs and EWIC FTRs. They will also be sold by direction, i.e. there will be SEM-GB FTRs and GB-SEM FTRs - the former entitling the holder to a payment when the GB DAM price is higher and vice versa for the latter.

Commercial Operations

- Right to flow electricity in any particular direction offered on non-discriminatory basis via an explicit auction mechanism on the Auctioned Market Price and implicitly in the Single Electricity Market (SEM).
- Capacity rights offered in units or multiples of 1MW/period.
- Price that users pay in explicit auctions to EIL for each capacity right in a congested auction - (Clearing (Marginal) Price) accepted by EIL (subject to any curtailment in event of unplanned outages).
- If the User doesn't exercise capacity rights, they may subsequently be purchased by another eligible User - use it or sell it ("UIOSI").

Commercial Operations Contd…

- Application with Commission for Energy Regulation – Irish regulator by EirGrid

- It is intended, that the necessary support is recovered via the demand element of TUoS* (from Republic of Ireland customers) net of any other revenue streams which may be available to it.

** Transmission Use of System*

Key Takeaways

Cost of line borne entirely by country gaining maximum benefit (Ireland)

Commercial terms of lending obtained for almost entire project debt

Rules of operation and cost sharing were clear from the very beginning

Part of the cost was socialized onto customers in beneficiary country

Case Study No. -2

NorNed Project

Connecting Norway and Netherlands

Norned Project

- Joint venture between Norwegian transmission system operator Statnett and its Dutch counterpart TenneT
- 580 km long, Capacity of 700 MW
- Dutch mainly import hydropower from Norway through the cable

Goal of NorNed

- Create power grid connection between Norway and Netherlands; contribute to EU strategy of creating single European Electricity Market.
- Positively impact all trilemma policy goals (affordability, sustainability and security of supply)
- Solve limitations of each system, leading to more efficient system with converging prices of both countries
  - Daytime cheap hydropower (about 96% of Norway's production in 2013) could be exported to Netherlands
  - Night time redundant low-cost Dutch electricity could be imported by Norway to fill up water reservoirs
- Reduce CO_2 emissions due to the supply of renewable energy
- Increase reliability of electricity supply through (geographical) diversification of sourcing in both countries

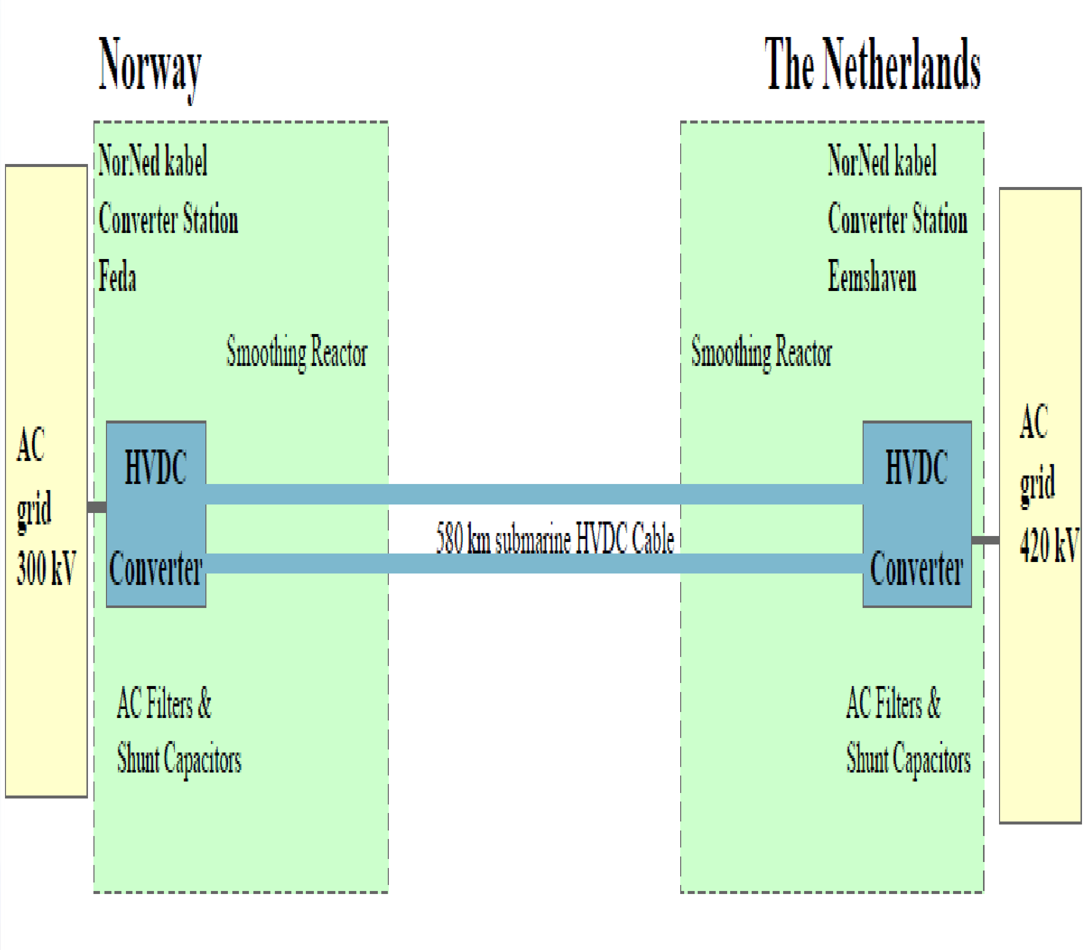
Financing

- Trans European energy networks (TEN-E) strategy 2006-2013 - €3million as a catalyst for investment (studies/preparatory activities)
- TEN-E aimed to increase transmission capacity across Europe

- €600million total construction cost
- €100 million loan of the Nordic Investment Bank to Statnett
- European Investment Bank (EIB) with €280 million to Statnett (~50% of project cost)
- Balance cost financed by Dutch side with congestion revenues from explicit auction of transfer capacities on borders with Belgium and Germany – intention to maximize socio-economic benefit

Technical Details

- Commissioning year: 2008
- Power rating: 700 MW
- No of poles: 1 (midpoint grounded in Eemshaven)
- AC Voltage: 300 kV (Feda), 400 kV (Eemshaven)
- DC Voltage: ± 450 kV
- Length of DC submarine cables: 2 x 580 km
- Main reason for choosing HVDC: Length of sea cable and non-synchronous AC systems

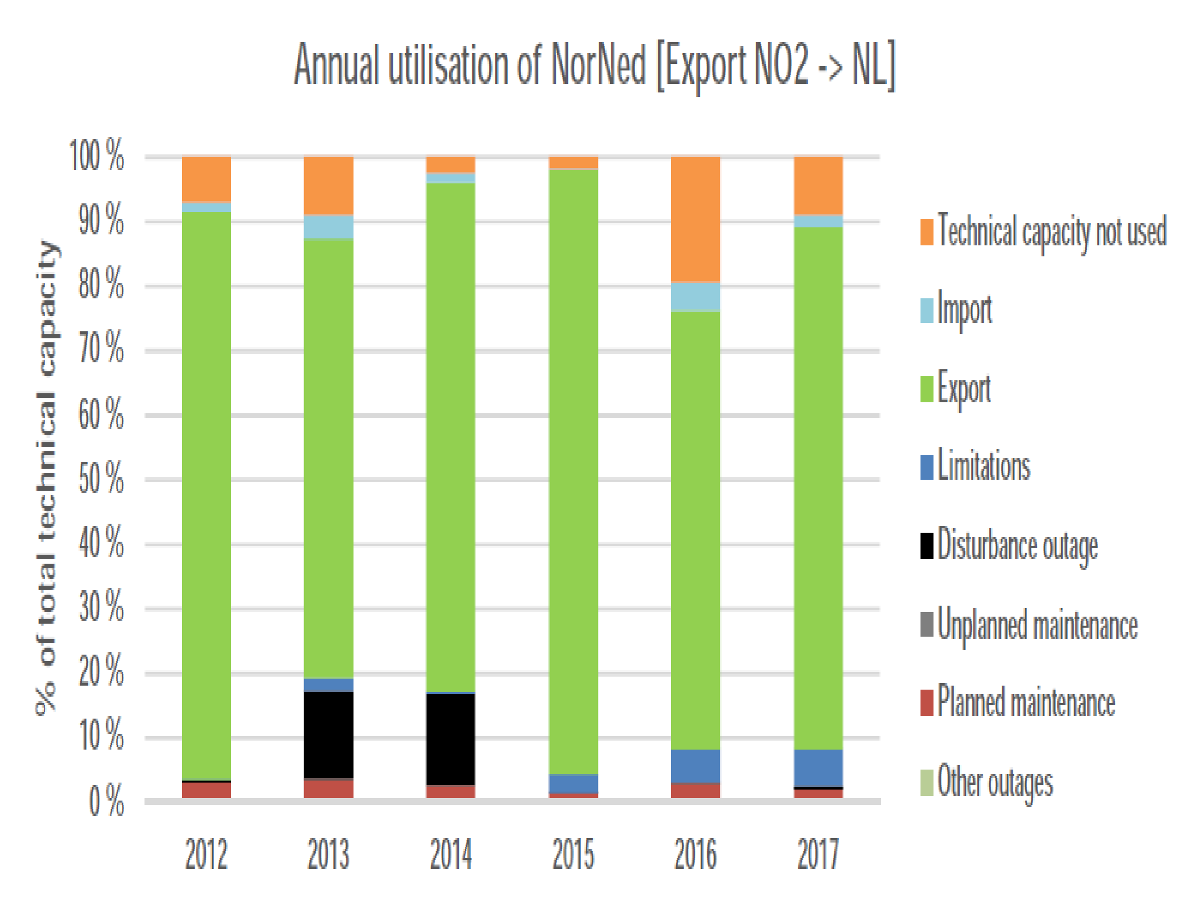


Challenges

- Permission from Dutch Regulator; TenneT needed DTe's permission to finance capital and operational costs from NorNed auction income
  - Key consideration for DTe - high risks involved in developing a large-scale infrastructure project for which Dutch consumers were the ultimate bearer.
  - DTe initially only wanted to consider investment from a merchant perspective
  - DTe finally gave permission in 2004, partly by the inclusion of €2m societal benefit in the business case - key consideration was Europe's TEN-E policy to increase transmission capacity, which made explicit reference to the NorNed initiative.
- Increasing complexity and influence of policymakers - 24 licences in four countries had to be given and 22 agreements with existing cable and pipeline owners needed to be made.

Technical Details

- 2017 - Available technical capacity of 91.9 %.
- Technical capacity not used was 9.2 %.
- 5.0 TWh (80.9 % of the technical capacity) was exported from Norway to the Netherlands
- 0.1 TWh (1.8 %of the technical capacity) was imported to Norway.



Key Takeaways

Regulator considered the concern of the ultimate bearer of cost (Dutch side);

Complexity of the project is not a hurdle if there are advantages;

Patience important – after some time, high levels of utilization justified the cost of the line;

Case Study No. -3

CASA 1000 Project

Table of Content

Background

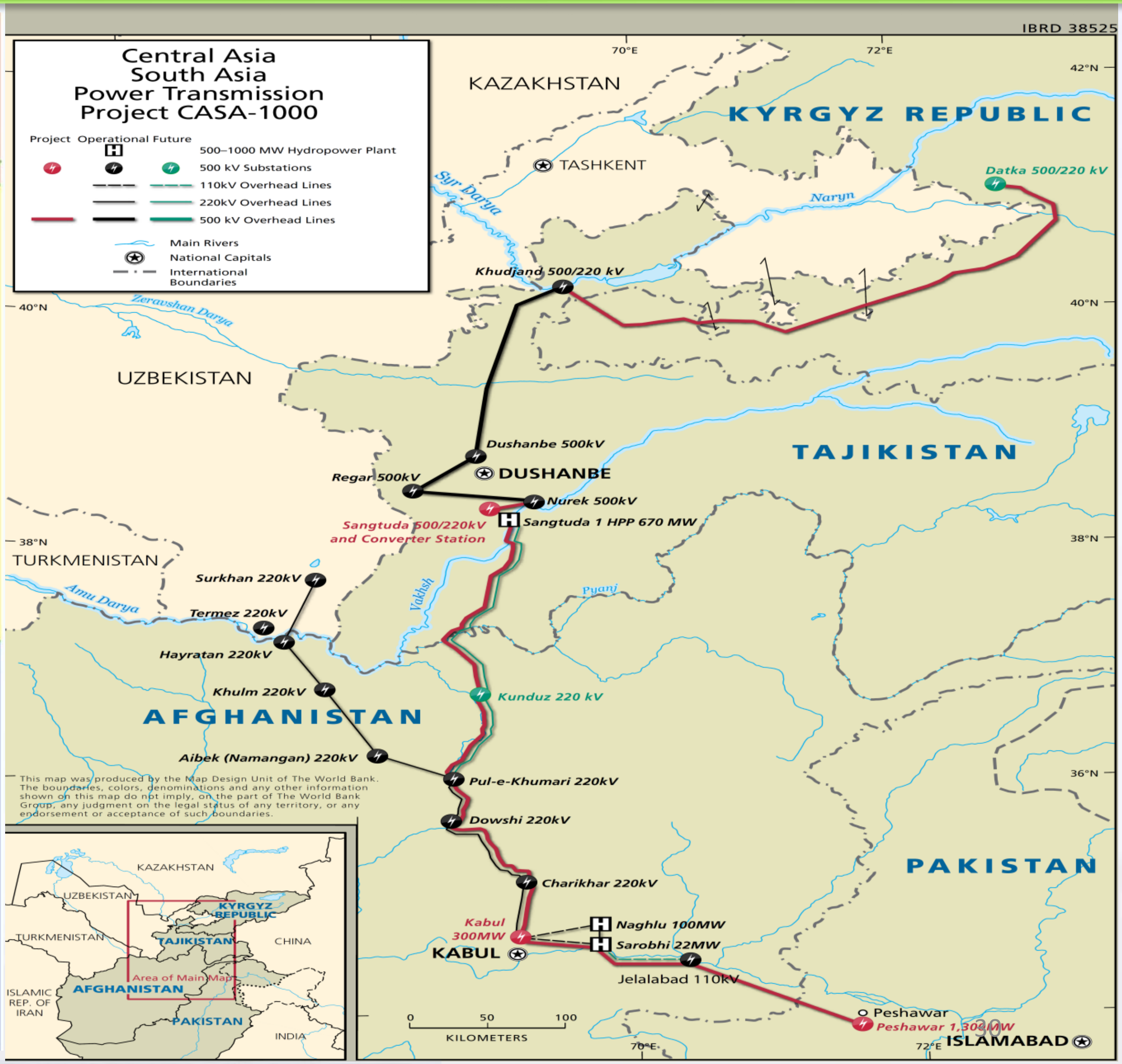
Background -CASA 1000 Project

- **The idea of Central Asia–South Asia Transmission Interconnection Project(CASA 1000) was conceived in 2008.**
- **To transmit 1300MW of surplus electricity (May to Sept) from existing hydel resources in Tajikistan and Kyrgyz Republic through Afghanistan to Pakistan.**
- **Out of 1300MW of expected power, 300MW is for Afghanistan and 1000MW will come to Pakistan**

The CASA-1000 project includes:

- ***500 kV AC line from Datka (in the Kyrgyz Republic) to Sugd-500 (477 km, in Tajikistan)***
- ***1300 megawatt AC-DC Convertor Station at Sangtuda (Tajikistan)***
- ***750 kilometer High Voltage DC line from Sangtuda (Tajikistan) to Nowshera (Pakistan)***
- ***300 MW DC-AC Convertor Station at Kabul, Afghanistan.***
- ***1300 megawatt DC-AC Convertor Station at Nowshera***

Background- CASA 1000 Project



Objective and Potential Benefit of CASA-1000

Objective and Potential Benefit of CASA-1000

Objective of CASA-1000

Ensure a steady source of revenue from power exports for **Tajikistan** and **Kyrgyz Republic**	Alleviate electricity shortages in **Pakistan** during the peak summer season	Establish **Afghanistan's** role as a viable transit country, enhancing growth prospects

Both Tajikistan and the Kyrgyz Republic have substantial (about 80,000 MW) hydropower potential, only a relatively small proportion of which (about 10 %) has been developed to date. A major part of the river flows occur during the summer period; and thus both countries face electricity deficits in the winter when demand is greatest, and have surplus electricity in the summer.

- **The base case economic analysis gives a Benefits to Cost ratio of 1.34 and EIRR[1] of 15.6% {excludes benefits of GHG reduction and Telecom connectivity).**
- **Sensitivity:**
  New generation added enabling a constant yearly exportable surplus of 4 TWh - Benefits to Cost ratio of 2.11 and EIRR of 20.8%
- **Sensitivity:**
  Opportunity cost of US$ 0.20/kWh for Pakistan - Benefits to Cost ratio of 2.89 and EIRR of 31.9%

1- EIRR: Economic internal rate of return.

CASA 1000 Project Cost, Funding Modalities and Tariff

CASA 1000 Project Cost and Funding Modalities

- **Total Project Cost** US$ 997.00 Million*
- **World Bank Funding** US$ 526.50 million (Loan + Grant)
- **Rest are funded by various Grant and soft loan components from various donor agencies.**

Kyrgyz Republic	US$ 200 million
Tajikistan	US$ 250 million
Afghanistan	US$ 300 million
Pakistan	US$ 200 million
Total	US$ 950 million

Source: http://www.casa-1000.org/CASA-1000%20PRESENTATION.ppsx

CASA-1000 has the support of the World Bank Group, Islamic Development Bank, United States Agency for International Development (USAID), US State Department, United Kingdom Department for International Development (DFID), Australian Agency for International Development (AusAID), and other donor communities.

1) World Bank (US$ 526.5 million) (Loan + Grant)
2) Islamic Development Bank (US$ 155 million) (Loan)
3) European Investment Bank (US$180 million) (Loan)
4) European Bank for Reconstruction and Development (US$ 110 million) (Loan)
5) the US (US$ 15 million) (Grant)
6) UK Governments (US$ 46 million) and
7) the Afghanistan Reconstruction TF (US$ 40 million).

Source: As of June 2017, Energy Sector Progress Report and Work Plan (August 2016–May 2017)

* As of 11-4-2019 , http://projects.worldbank.org/p145054/?lang=en&tab=details
* http://www.casa-1000.org/1.%20Project_FAQs_ENG.pdf
http://aeic.af/assets/presentation_files/98dd175ee030895bfd68cfc59e4e517e.pdf
https://www.carecprogram.org/uploads/Energy-Sector-Progress-Report-and-Work-Plan-August-2016%E2%80%93May-2017.pdf

CASA 1000 Tariff : Various Charges

1. **Average Energy Available/Annum 4250GWh**
2. **Energy Charges 5.15 U.S. Cents./kWh***
3. **Transmission Charges 2.98 U.S. Cent/kWh****
4. **Afghan Transit Fee 1.25 U.S. Cent/kWh**
5. **Tajik Wheeling Charges 0.10 U.S. Cents/kWh**
6. **Average Price for Pakistan 9.48 U.S. Cent/kWh**
7. **Implementation period 40 months**

Buyer (Pakistan) to Pay for all the Charges

*The cost of supply of US 1.5 cents/ kWh from Tajikistan had been assumed in the feasibility study while actual agreement is based on US 5.15 cents/ kWh.

** The transmission charge of US Cents 2.91 is ten times higher than that of NTDC and 3 times higher than that in Europe.

The tariff payable by Pakistan is composed of four (4) components and is based on "take & pay" basis for energy delivered and measured at sangtuda, Tajikistan ("delivery point") isUS CENTS 9.41/KWH

Afghanistan is expected to earn revenue of 50 million USD per year. Over the project life of 30 years, Pakistani consumers will pay US$ 1.50 billion

Source : Presentation on CASA-1000 Project Central Asia-South Asia Regional Power Connectivity

CASA 1000 Project : Legal and Commercial Frameworks

1. Master Agreement
2. Foundational Power Purchase Agreement
3. Bilateral Power Purchase Agreements between buyers and sellers
4. Host Government Agreements
5. Coordination Agreements between Sellers-Sellers
6. Finance Agreement between governments and funding agencies
7. Subsidiary Loan Agreement between Government and National Electricity Utilities

All legal, Commercial and country specific implementation arrangements have been signed

CASA 1000 Project : Key Messages

CASA 1000 Project : Key Messages

- Strong Political will.
- Buyer to Pay for all the Charges i.e. Pakistan.
- Mix of Grant and Loan Based Funding of Line.
- Comprehensive Legal and Commercial Frameworks.
- Support and commitment of –international Funding agencies.
- Access to affordable source of Finance.
- Continuous and persistent Effort.

Case Study No. -4

Gulf Cooperation Council (GCC) Electricity Interconnection

Table of Content

Background of GCC Electricity Interconnection

Background and Objective : GCC Electricity Interconnection

- The Gulf Cooperation Council (GCC) electricity interconnection scheme-conceived in **1981**
- **Took off in** earnest in 2001-**GCC Interconnection Authority (GCCIA) established.**
- **2004- Governments (Kuwait, Saudi Arabia, Bahrain, Qatar, UAE & Oman) agreed to finance interconnections & control centre.**
- **Envisaged primarily to share reserve capacity to minimize overall investment in peaking plant.**
- **The feasibility studies justified the scheme on the basis of savings in reserve generating capacity.**
- **The trading arrangements, are based primarily around the interconnectors functioning for sharing of reserve power generation capacity and with secondary function to allow active power trade.**

Objectives of the GCCIA Interconnector

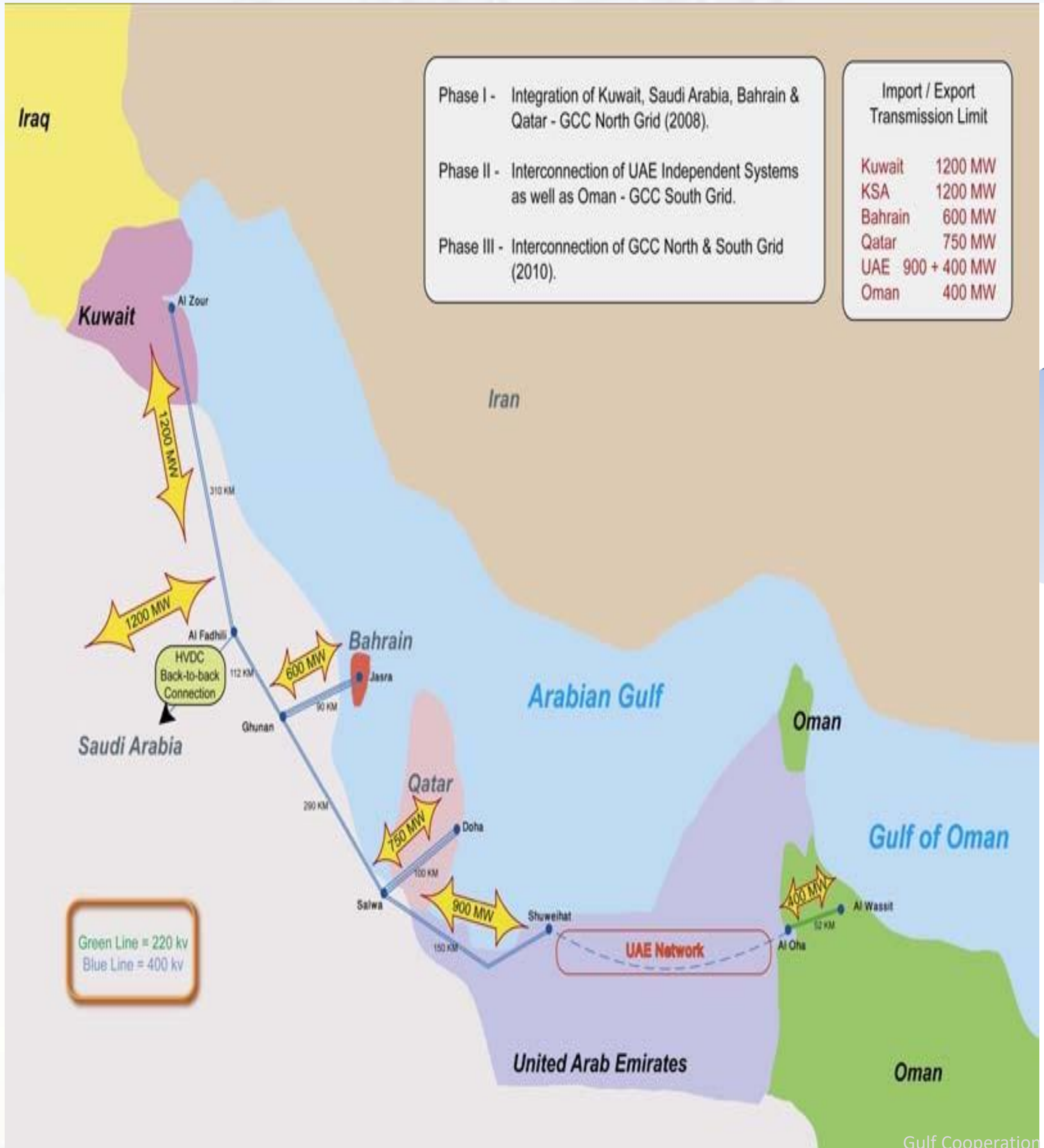
1 Sharing Of Installed Capacity Resources

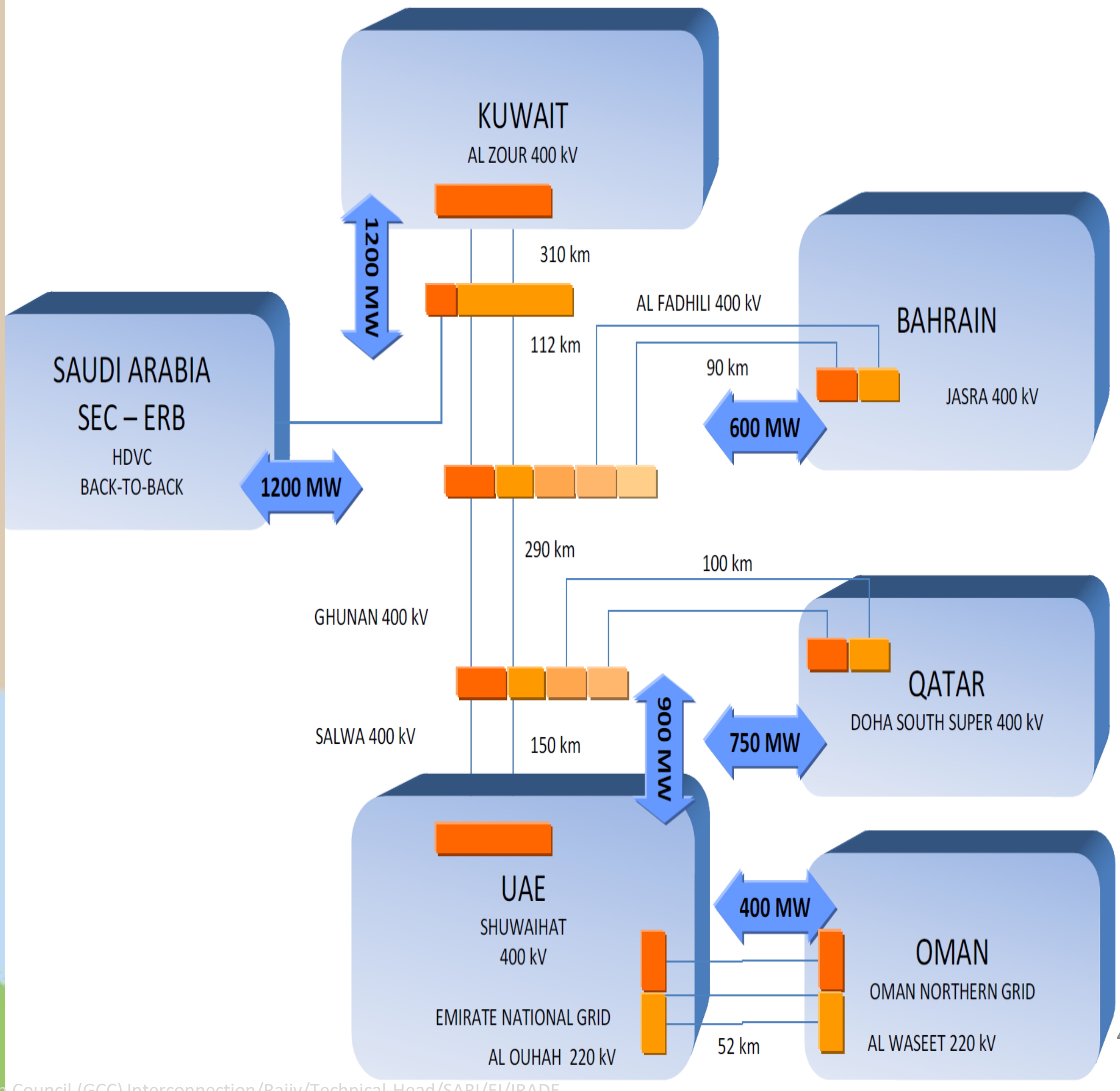
2 Supporting Each Other In Case Of Emergencies

3 Entering Into Contracts For Operating Reserves

4 Trading Electrical Energy By Scheduled Energy Transfers

GCC Electricity Interconnection and Electricity Interconnection Projects, Phases I, II & III, Size of Interconnectors to Each Country





System	Size(MW)
Kuwait	1200
Saudi Arabia	1200
Bahrain	600
Qatar	750
UAE	900
Oman	400

GCC Transmission Interconnection Cost , Principle of Cost Sharing and Funding Modalities

GCC Transmission Interconnection Cost , Principle of Cost Sharing and Funding Modalities

- The capital cost of the three phases of the project was estimated at
  - **US$1.1 billion,**
  - **US$300 million and**
  - **US$137 million**, respectively

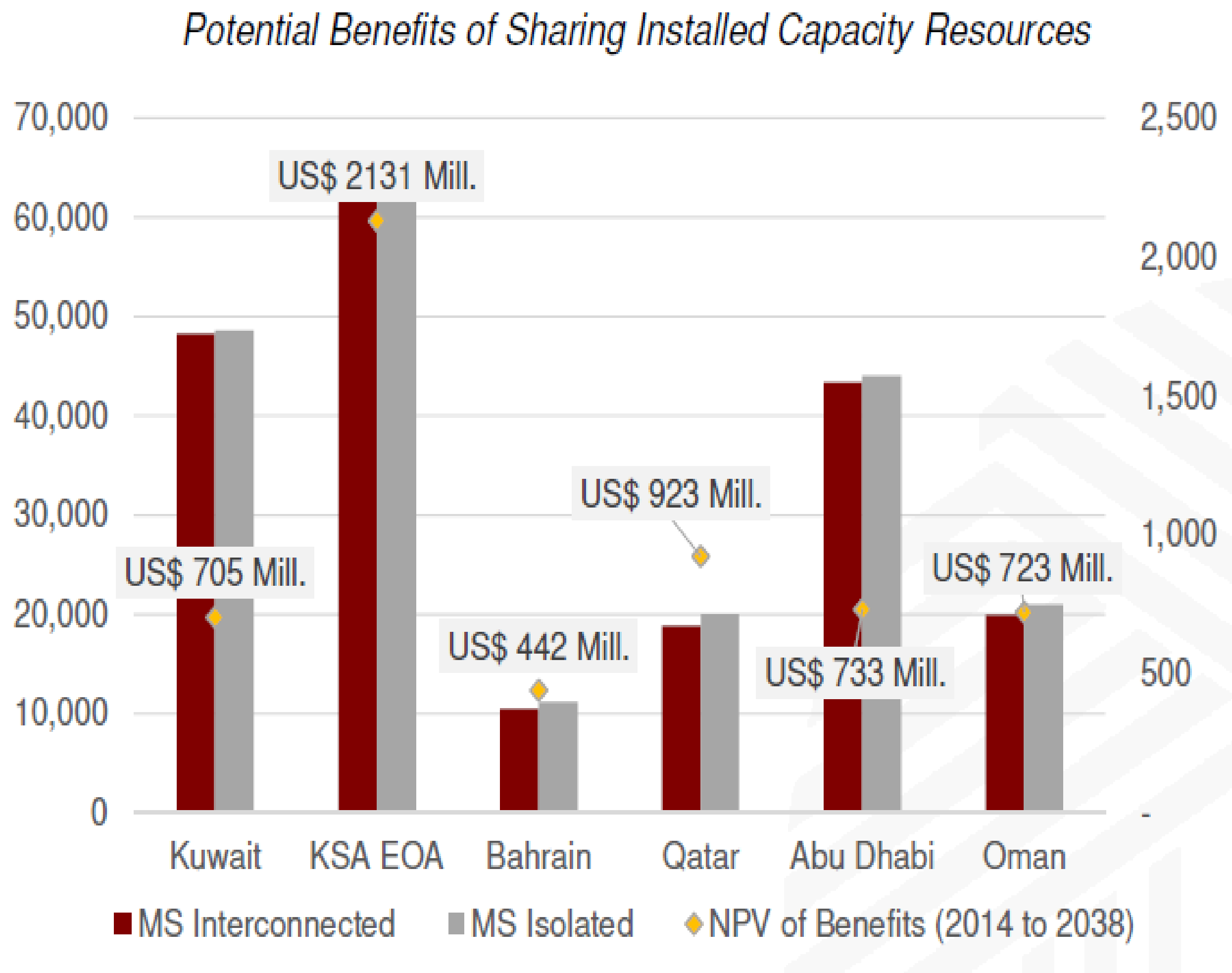
- It was agreed among the GCC countries that costs would be shared **in proportion to the net present value of estimated reserve capacity savings**.

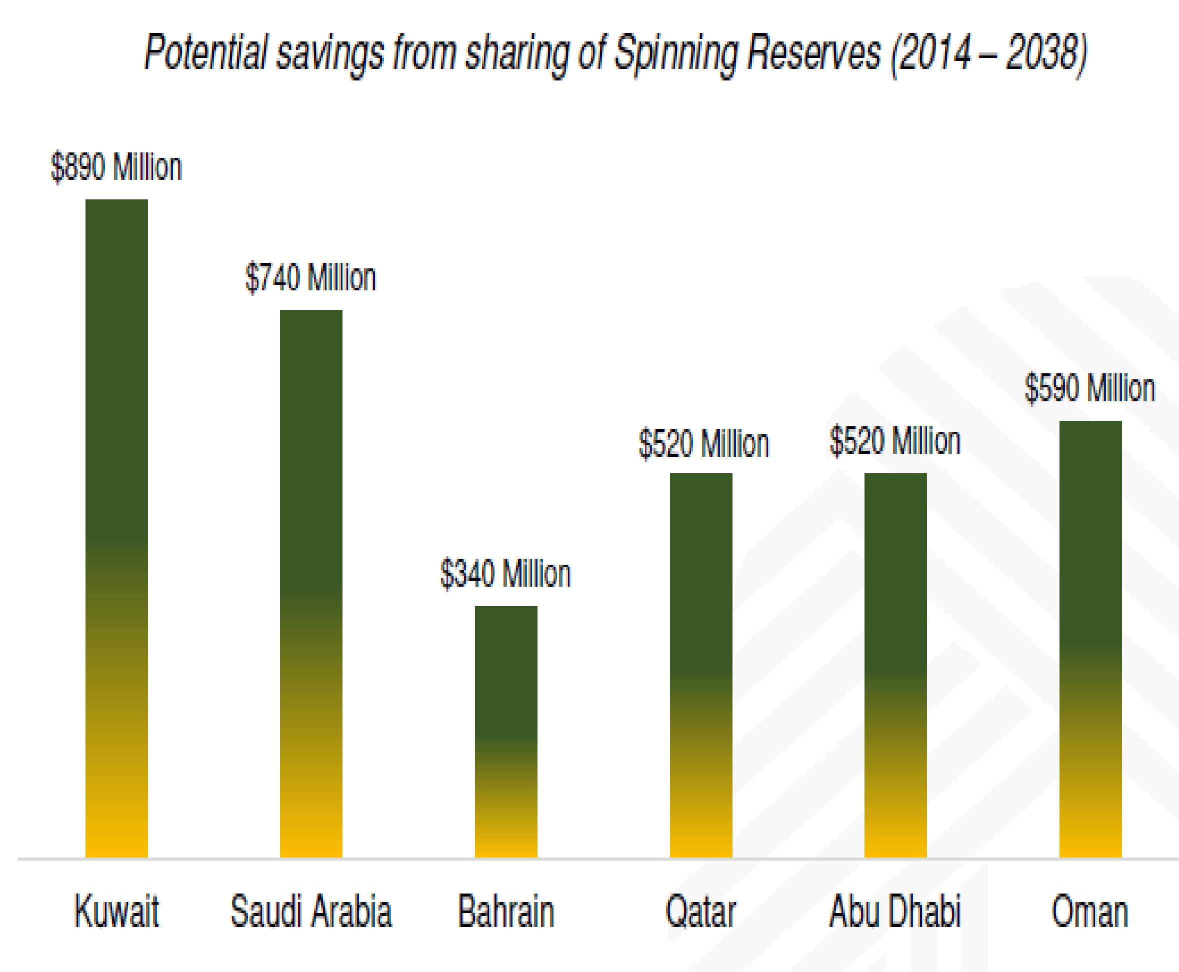
- Each country was responsible for **sourcing their share of the capital required, which could be from combinations of debt or equity as decided by each member state**

	Sharing of Capital Costs	
Country	Phase I	Phase I & III
Kuwait	33.8%	26.7%
Saudi Arabia	40.0%	31.6%
Bahrain	11.4%	9.0%
Qatar	14.8%	11.7%
UAE	-	15.4%
Oman	-	5.6%
Total	100.0%	100.0%

Potential Saving from Sharing of Installed capacity and Spinning Reserves

Potential Saving from Sharing of Installed capacity and Spinning Reserves





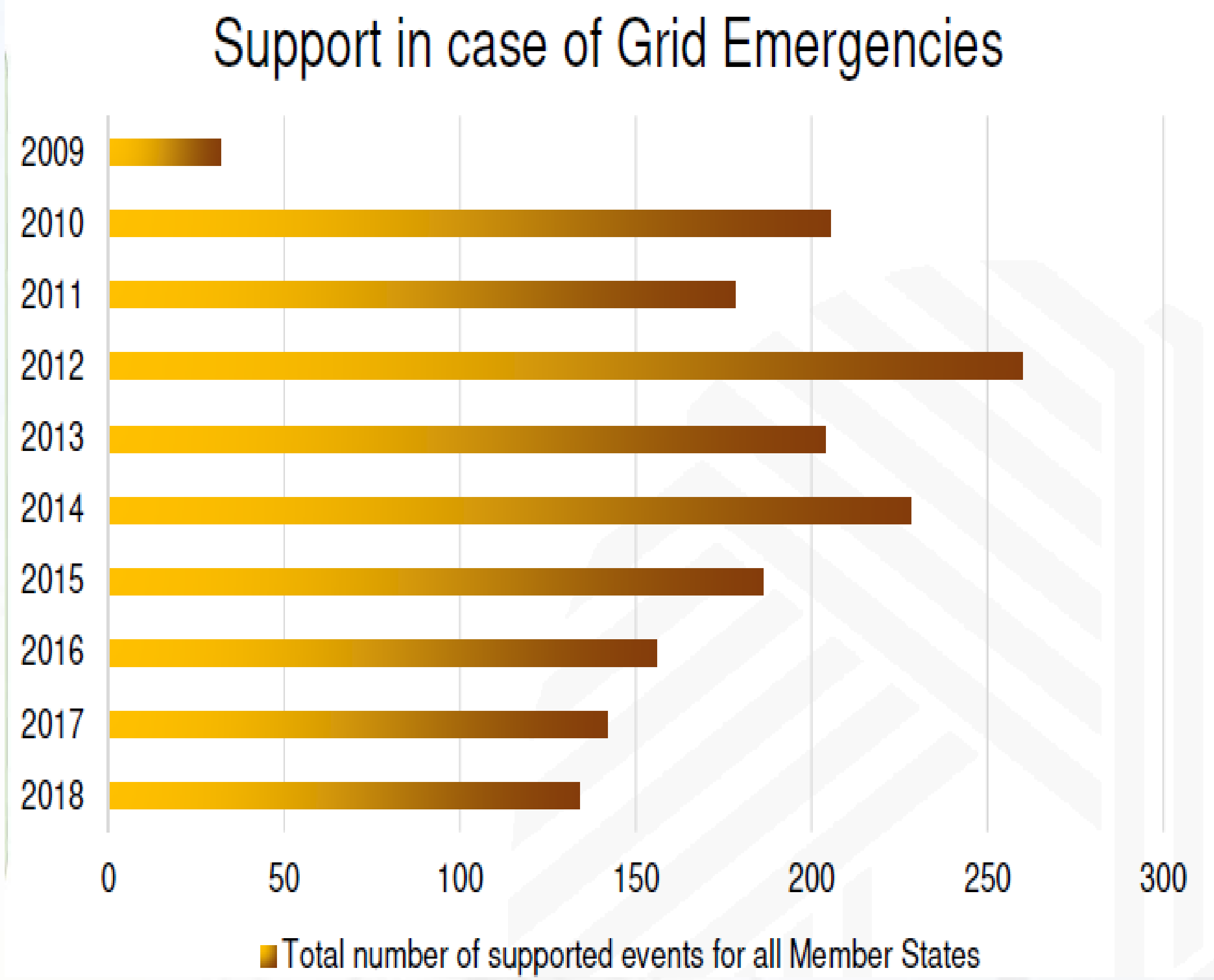
The estimated savings for the period 2014 to 2038 (25 years) from sharing installed capacity resources is around US$ 5.66 billion (NPV)

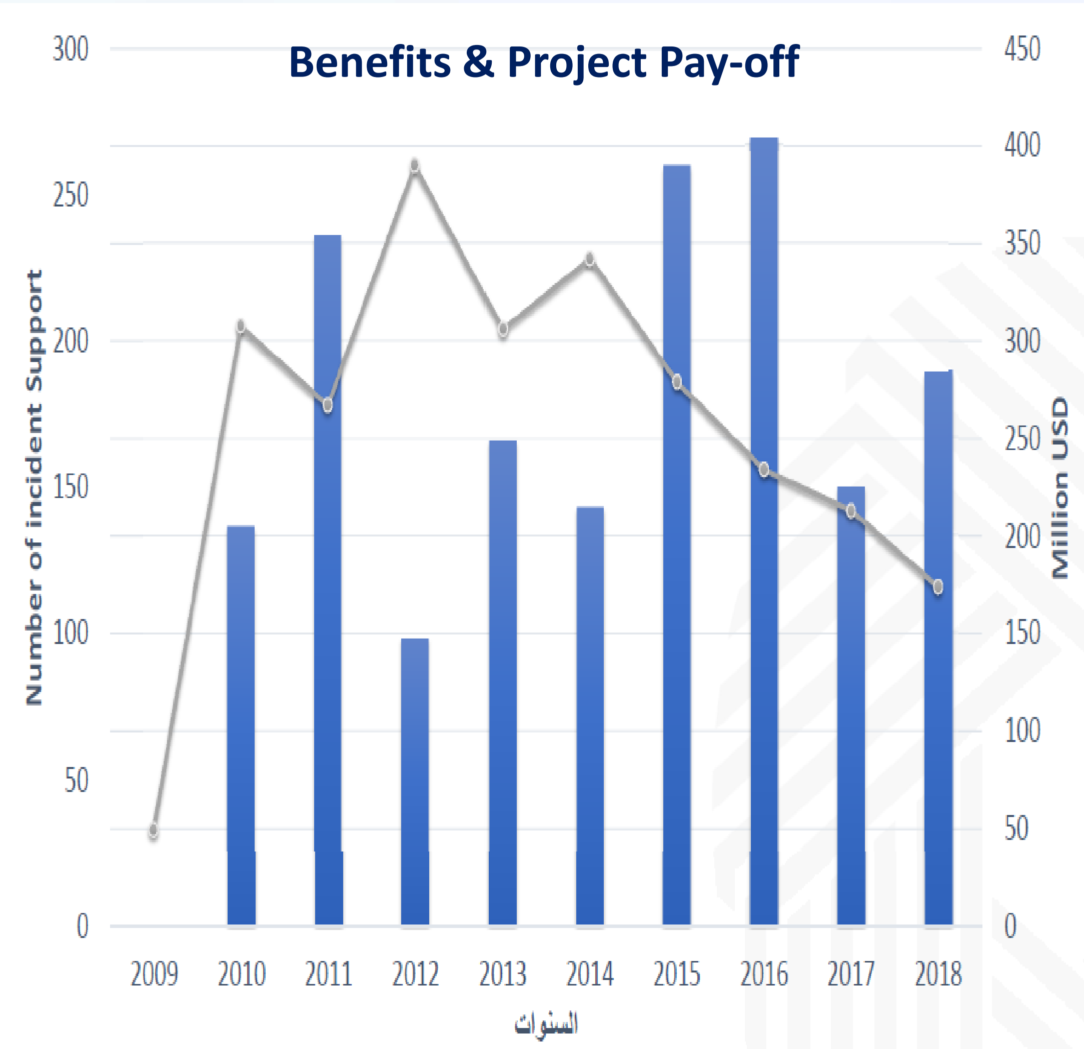
As per GCCIA studies, total savings due to power trading among Member States for 2014 to 2038 are:

- **a reduction of \$23.57bn in fuel and non-fuel variable O&M costs, and**
- **a reduction of 192.84 million tonnes in CO_2 emissions**

Benefits Accrued- Support in case of Emergencies & Project Pay-off

Benefits Accrued- Support in case of Emergencies & Project Pay-off





GCC interconnector helped Member States in avoiding power supply interruptions in as many as 1,725 frequency events occurred during 2009 to 2018 due to sudden loss of generation in Member States.

Allocation of Transmission Capacity on GCCIA Interconnector and Cost Recovery

Allocation of Transmission Capacity on GCCIA Interconnector and Cost Recovery

The transmission rights on interconnector are issued for

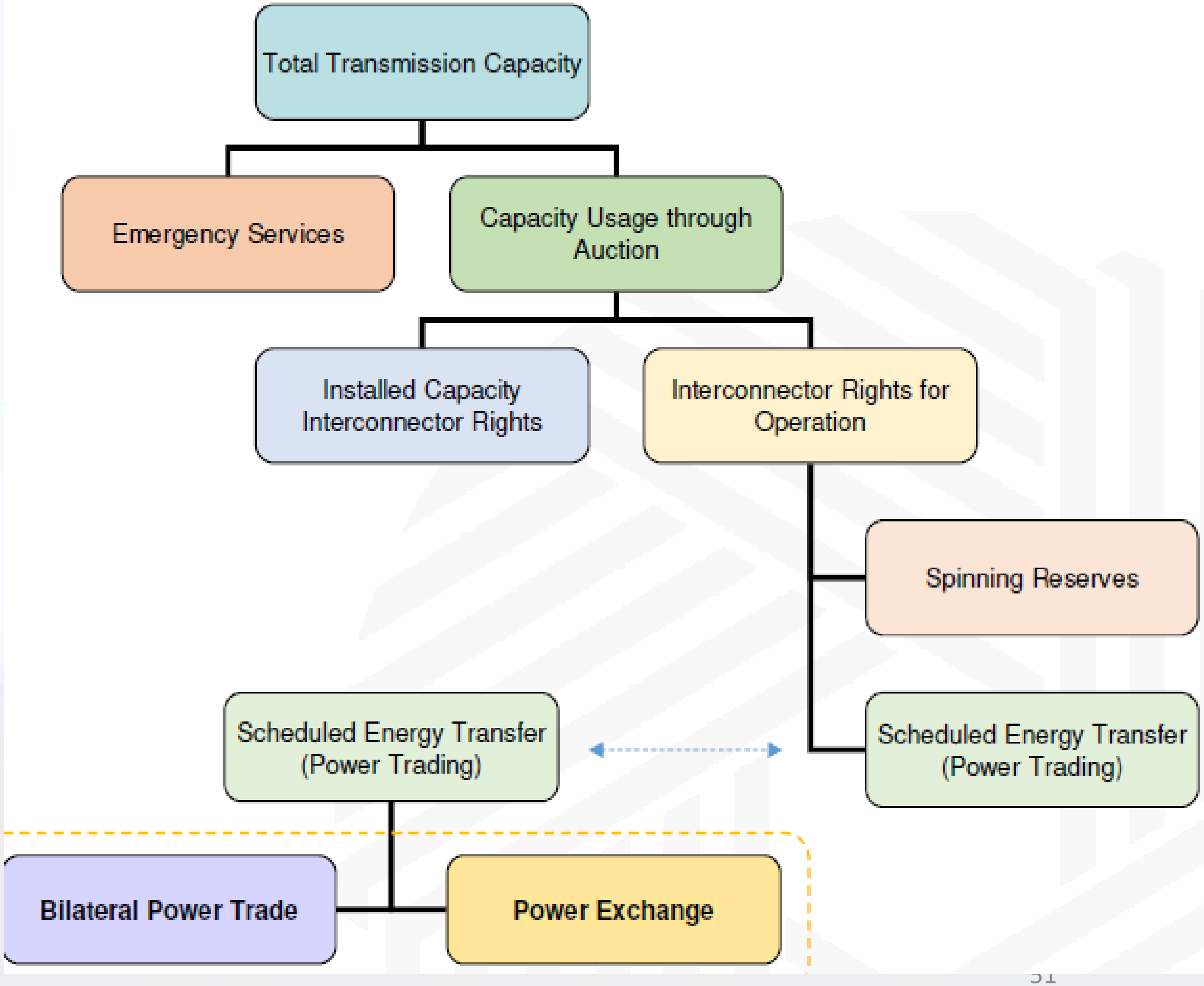
- ❑ Meeting Installed Capacity Obligations
- ❑ Operational Rights for meeting spinning reserves requirements
- ❑ Executing power trade transactions

➢ **Socialization of Cost by GCCIA**

➢ The transmission charges for using the GCCIA interconnector **was fixed at US$ 5/MWh since 2010**.

➢ Realizing the need to incentivize power trade, the GCCIA BoD **waived off the transmission charges** for the years 2016 to 2018.

➢ The transmission charges are now **fixed at US$ 0.5/MWh (90% discount to the earlier charges)**



Key Messages

Key Messages

- **Strong Political will.**
- **Cost Sharing: Costs shared in proportion to the net present value of estimated reserve capacity savings.**
- **Each member country is responsible making financing arrangement for building Interconnection.**
- **Comprehensive Legal and Commercial Frameworks.**
- **Robust Regional Institution GCC Interconnection Authority (GCCIA).**
- **Socialization of Cost by GCCIA.**
- **Internalization of associated benefits such as C02 emission, fuel saving etc.**
- **Continuous and persistent efforts.**

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Case Study No. -5

South Asian Experience

India Bangladesh Trade

Importing power from India to partially meet the power deficit.

Baharampur (India) - Bheramara (Bangladesh) 400kV D/C line along with 2x500MW HVDC Back-to-Back terminal at Bheramara.

Surajmaninagar (Tripura) – Comilla (Bangladesh) 400kV D/C radial interconnection (Currently operated at 132kV)

Break-up of the Import is as follows:

250 MW is allocated by GoI from NTPC (ISGS) stations through long-term PPA

300 MW is supplied by DVC under LTA

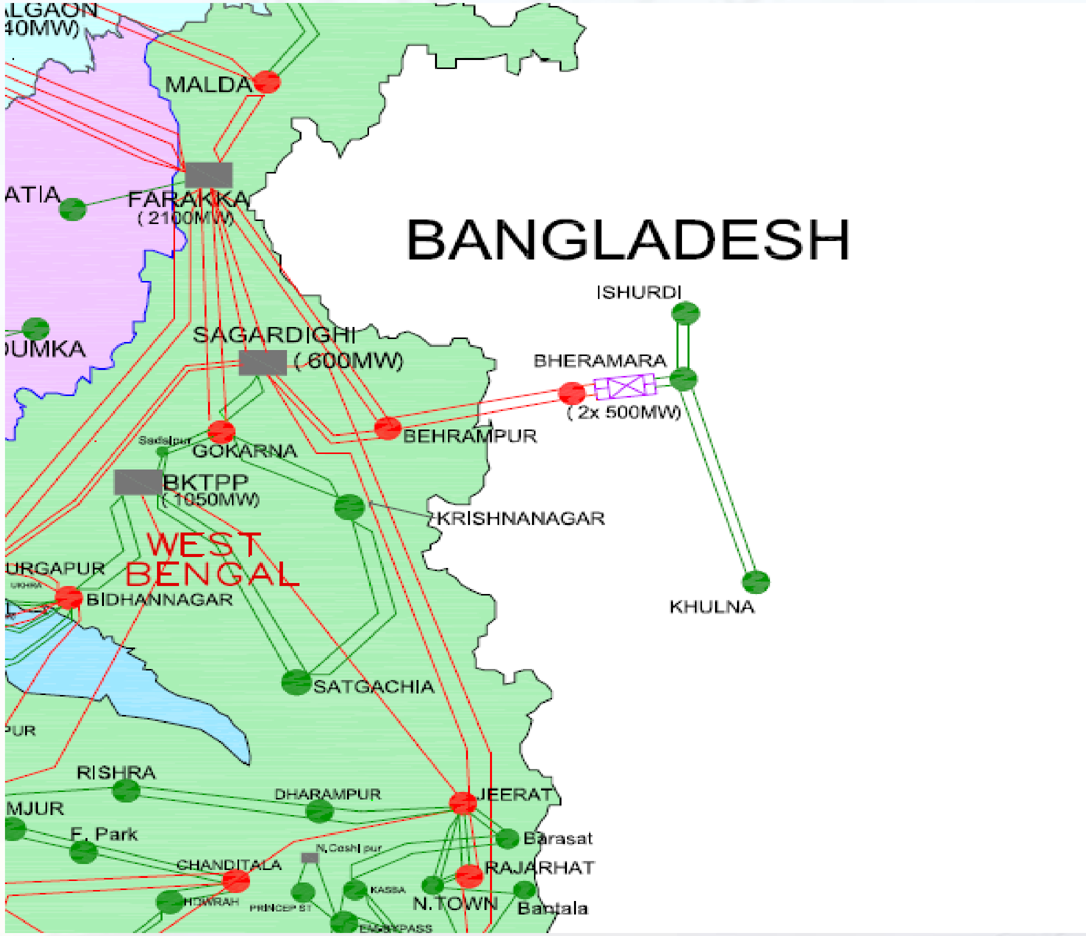
198 MW is supplied by WBSEDCL through short-term contract (Trader PTC)

245 MW is supplied by Sembcorp through short-term contract (Direct)

160 MW is supplied by Tripura State Electricity Corporation Ltd.

Existing Interconnections

400 KV BEHRAMPUR - BHERAMARA D/C LINE



400 KV SURAJMANINAGAR - COMILLA D/C LINE

Financing

Baharampur – Bheramara

Transmission Infrastructure- Details

- Baharampur (India) – Bheramara (Bangladesh) 400 KV D/C line along with 2* 500 MW HVDC Back-to Back terminal
- Line Indian portion: 85 KM 400kV Double Circuit line (Twin ACSR Moose Conductor) and switching-station
- Line Bangladesh portion: 27 KM 400kV Double Circuit line and HVDC back-to-back station

Funding

- Indian portion: Financed by PGCIL India at a total cost of Rs 198.48 crore.
- Bangladesh portion: Funding support from Asian Development Bank (ADB)

Surajmaninagar - Comilla

Transmission Infrastructure- Details

- Line Indian portion: 18 KM 400kV Double Circuit line (Twin ACSR Moose Conductor).
- Line Bangladesh portion: 47 KM 400kV Double Circuit line and HVDC back-to-back station
- Line is currently operating at 132 KV.

Funding :

- Indian portion: Financed by PGCIL India at a total cost of Rs 100.38 crore.

Transmission Charges for both above lines (Indian Portion): BPDB to pay POWERGRID tariff determined as per prevailing CERC regulations

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Case Study No. -5

South Asian Experience

India Nepal Trade

The import of power by Nepal from India is under various bilateral treaties and power purchase contracts.

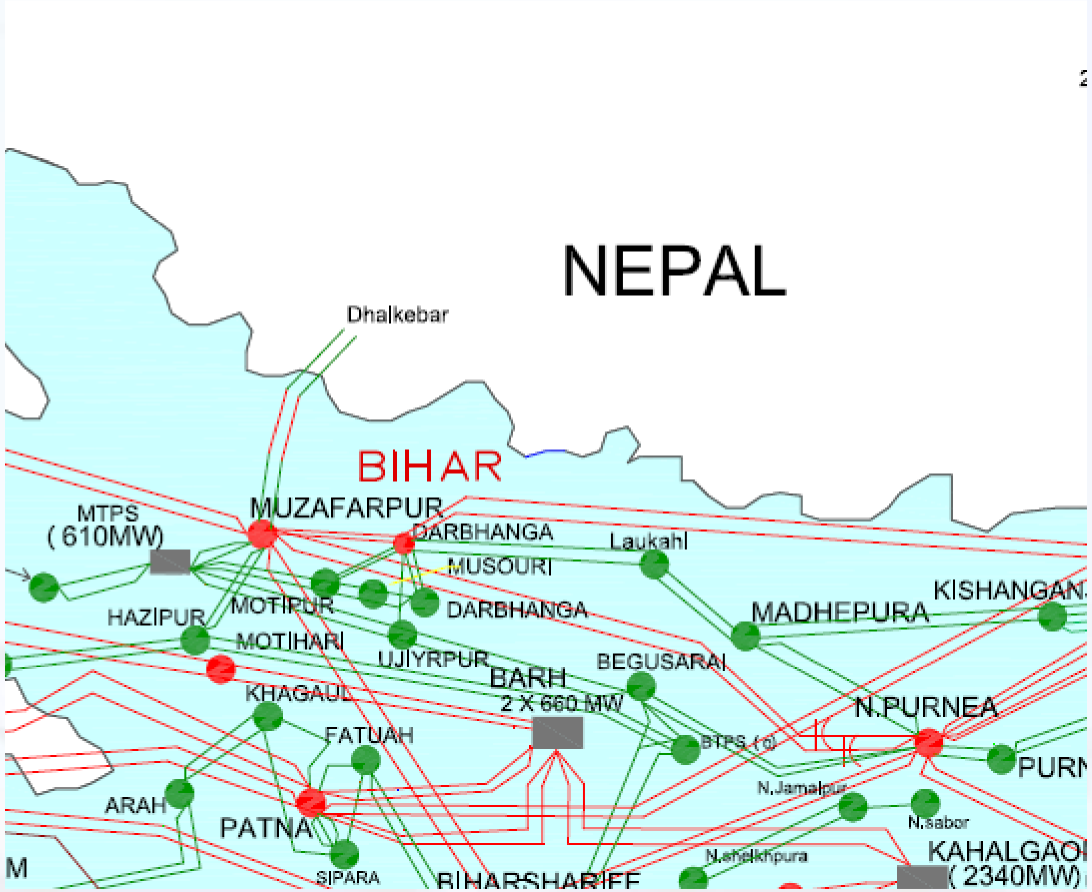
Majority of these arrangements are long-term in nature and certain short-term contracts for import of power during dry months with details as below:

- About 300MW: 132kV & below radial lines
- About 225MW: Dhalkebar (Nepal) - Muzaffarpur (India) 400kV D/c line (operated at 220kV)
- About 25MW: Tanakpur (India) - Mahendargarh (Nepal) 132 KV line

Sembcorp Energy India Limited	Tripura State Electricity Corporation Limited	DB power limited	GMR Kamalanga Energy Limited	PTC
SR-ER	NER-ER	WR-ER	ER-ER	NR-NR
120 MW	30 MW	50 MW	25 MW	25 MW

MUZAFARPUR – DHALKEBAR 400 KV D/C LINE

Company Name	Ownership
Nepal Portion : Power Transmission Company Nepal Limited (PTCN)	NEA (50%), POWERGRID (26%), Financial Institutes of Nepal (14%) and IL&FS Energy Development Company (10%)
Indian Portion : Cross-border Power Transmission Company Limited (CPTC)	IL&FS Energy Development Company (38%), POWERGRID (26%), Satluj Jal Vidyut Nigam Ltd (26%) and NEA (10%)



Financing

Transmission Infra:

- Transmission Infra:
- Indian Portion: Constructed and commissioned by CPTC (Muzaffarpur to Sursand) for 90 KM
- Nepal portion: From Bittamod (near Sursand in India) to Dhalkebar of 42.10 Kms length (Nepal portion of Indo-Nepal inter-connection.
- The line was declared under commercial operation on 19.02.2016 and initially operated at 132 KV.
- Currently the line is operating at 220 KV and likely to be made operational at 400 kV by the end of year 2019.

Funding and Transmission Charges

- Indian portion: CPTC has funded the transmission infra
- Total Project Cost (Indian portion) is Rs 242.51 Crore
- Nepal portion: PTCN has funded the transmission infra

Transmission Charges:

- NEA has reserved full transmission capacity and has signed Implementation and Transmission Service Agreement (ITSA) with both PTCN and CPTC.

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Case Study No. -5

South Asian Experience

India Bhutan Trade

- About 1350 MW (Bhutan to India) (from Tala-1020MW; Chukha-336MW; kurichu-60; and Dagachu-126MW)
  - Tala HEP- Siliguri 400kV 2xD/C (one circuit via Malbase in Bhutan)
  - Chukha HEP - Birpara 220kV (3 circuits)
  - Kurichu HEP - Geylephu - Salakati 132kV S/C
- Major share of generated power exported to India after meeting the internal demand of Bhutan.
- Dagachhu HEP (126 MW) -1st hydropower on Public Private Partnership (PPP) basis by creating a JV with Tata Power Company Limited, India.

Tala Transmission

Transmission Line- Details

- From Indo—Bhutan border to Siliguri (West Bengal)
- Ownership - Powerlinks Transmission Ltd. – JV between Power Grid Corporation of India Limited (PGCIL) and Tata Power Limited

Transmission Infra:

- Total length of Indian portion: Construction of 231 Km 400 kV from Tala to siliguri and further Bongaigaon – Malda 400 KC D/C line.
- Transmission Infrastructure: Entire transmission capacity was assigned to PGCIL under a TSA for a regulated transmission fee.

Funding

- Indian portion: Powerlinks Transmission Ltd.
- Bhutan portion: As a part of Geneartion Project

Transmission Charges:

- Paid by the Indian consumers/beneficiary
- Annual Transmission Charge (Bhutan Border to Siliguri) - 1638 Lakh INR
- LILO of second ckt of Bongaigaon- Malda 400 KV D/C transmission line- 1758.60 Lakh INR

Tala transmission

Transmission Line- Details

- From Indo—Bhutan border to Siliguri (West Bengal)
- Ownership is with - Powerlinks Transmission Ltd. A Joint Venture between Power Grid Corporation of India Limited (PGCIL) and Tata Power Limited

Transmission Infra:

- Total length of Indian portion: Construction of 231 Km 400 kV from Tala to siliguri and further Bongaigaon – Malda 400 KC D/C line.
- Transmission Infrastructure: Entire transmission capacity was assigned to PGCIL under a TSA for a regulated transmission fee.

Funding

Indian portion: Powerlinks Transmission Ltd.

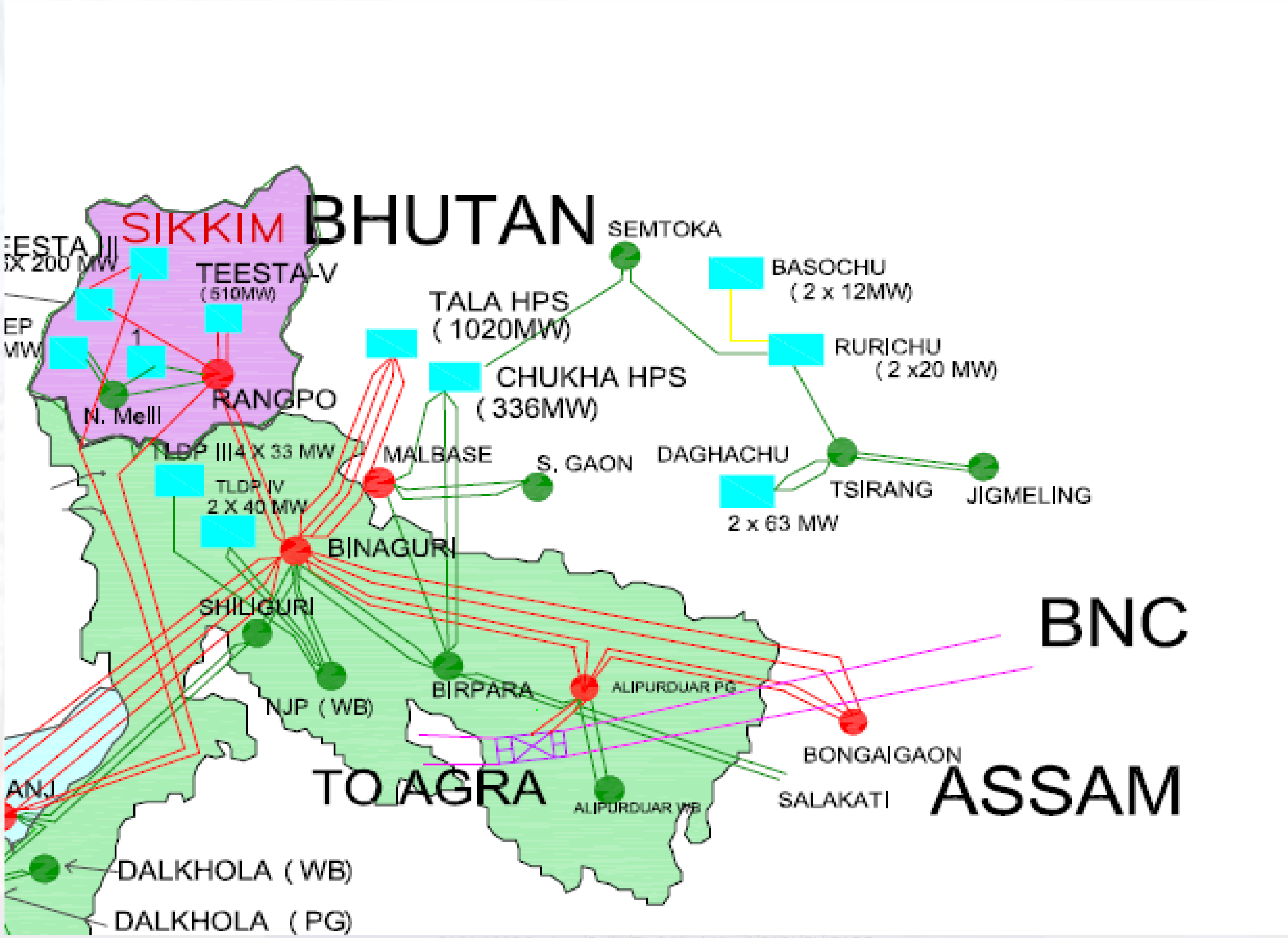
Bhutan portion: As a part of Geneartion Project

Transmission Charges: Paid by the Indian consumers/beneficiary

Annual Transmission Charge (Bhutan Border to Siliguri) - 1638 Lakh INR

LILO of second ckt of bongaigaon- Malda 400 KV D/C transmission line- 1758.60 Lakh INR

Interconnection of Network between Bhutan and India



SUMMARY OF SOUTH ASIAN EXPERIENCE

	Bhutan→ India	India→ Bangladesh	India→ Nepal
Parties	POWERGRID - POWERLINKS	POWERGRID - BPDB	• NEA - PTCN • NEA - CPTC
Term	25 years	35 years	25 years
Transmission charges (Tariff)	• POWERGRID to pay POWERLINKS tariff determined as per prevailing CERC regulations • POWERLINKS filed tariff petition for 2014-19 period	• BPDB to pay POWERGRID tariff determined as per prevailing CERC regulations • POWERGRID filed tariff petition for its part to CERC • Provisional tariff allowed = 240.9 million INR (FY14)	• Basis for Tariff (Nepal part): ✓ RoE, Interest on loan, Depreciation, Interest on Working Capital, O&M expenses • Basis for Tariff (India part): Tariff to be determined by CERC as per prevailing regulations
Tariff recovery	Tariff to be paid on System Availability (normative availability of 98%)	Tariff to be paid on System Availability	Tariff to be paid on System Availability
Payment security mechanism	• Letter of Credit ✓ Irrevocable revolving LC in Scheduled Bank in India ✓ Value = estimated one month charges	Letter of Credit	• Letter of Credit ✓ Irrevocable revolving LC in favour of PTCN / CPTC in a Scheduled Bank in Nepal / India ✓ Value = 105% of estimated one month charges ✓ 12 months term • NEA to also furnish Bank Guarantee valid for 12 months for an equivalent value of one year charges

Key Messages

- Strong political will
- Reduce the power deficit and accrue the economic gain by power trade in the region.
- Beneficiary/consumer -pay the transmission charges
- Estimation of power flow across the transmission line is necessary for reducing the risk
- National interest - socialization of transmission cost

Case Study No. -6

Sharing of HVDC links amongst different Regional Players in India

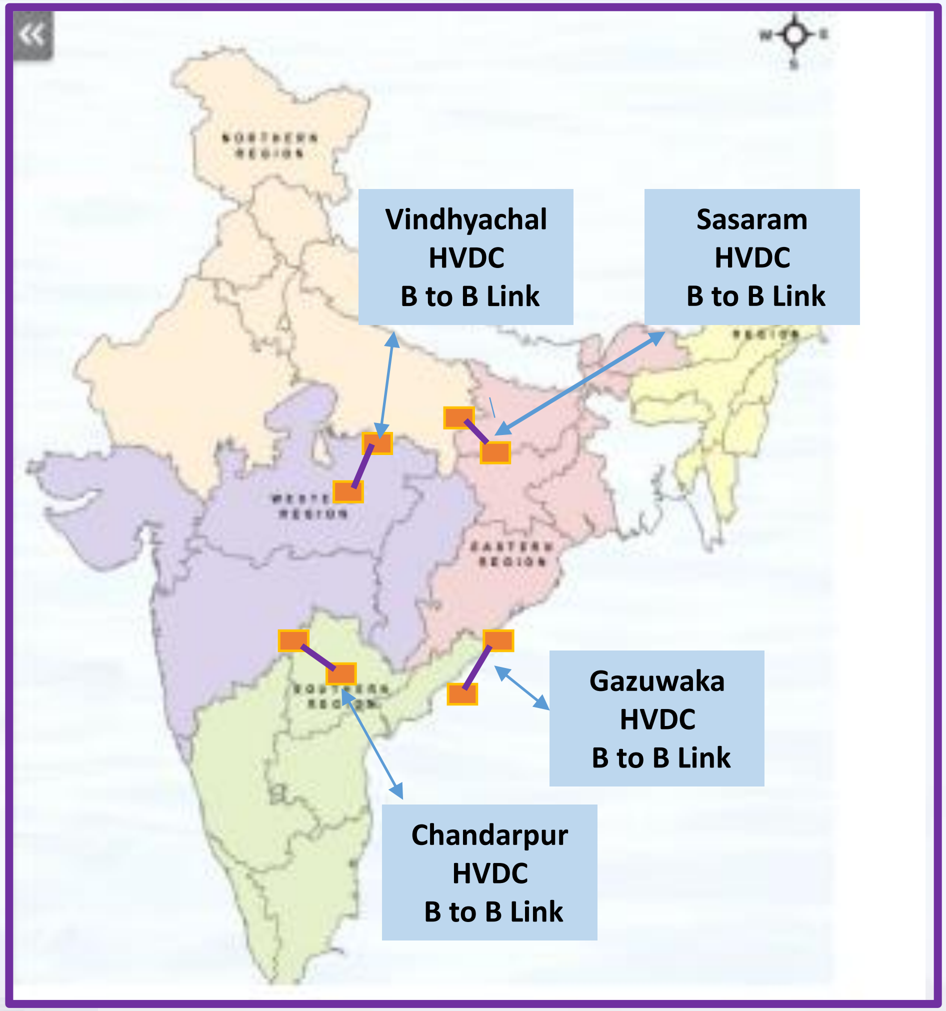
USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Details of HVDC Links in Indian Grid

Sl No	Project Name	Connecting Regions	Power Rating (MW)	Mode of Operation	Length (KMs)
1	Rihand - Dadri	Within NR	1500	Bipole	816
2	Balia - Bhiwadi	Within NR	2500	Bipole	780
3	Talcher- Kolar	ER-SR	2500	Bipole	1369
4	Biswantah Chariali- Agra	NER-ER-NR	6000	Multi Term.	1728
5	Mundra - Mahendergarh	WR-NR	2500	Bipole	986
6	Champa- Kurushetra 1	WR-NR	3000	Bipole	1288
7	Champa- Kurushetra 2	WR-NR	3000	Bipole	1287
8	Vindhyachal HVDC B-B	NR-WR	500	Back to Back	-
9	Sasaram HVDC B-B	NR-ER	500	Back to Back	-
10	Gazuwaka HVDC B-B	ER-SR	1000	Back to Back	-
11	Chanderpur HVDC B-B	WR-SR	1000	Back to Back	-



USAID FROM THE AMERICAN PEOPLE

SARI/EI

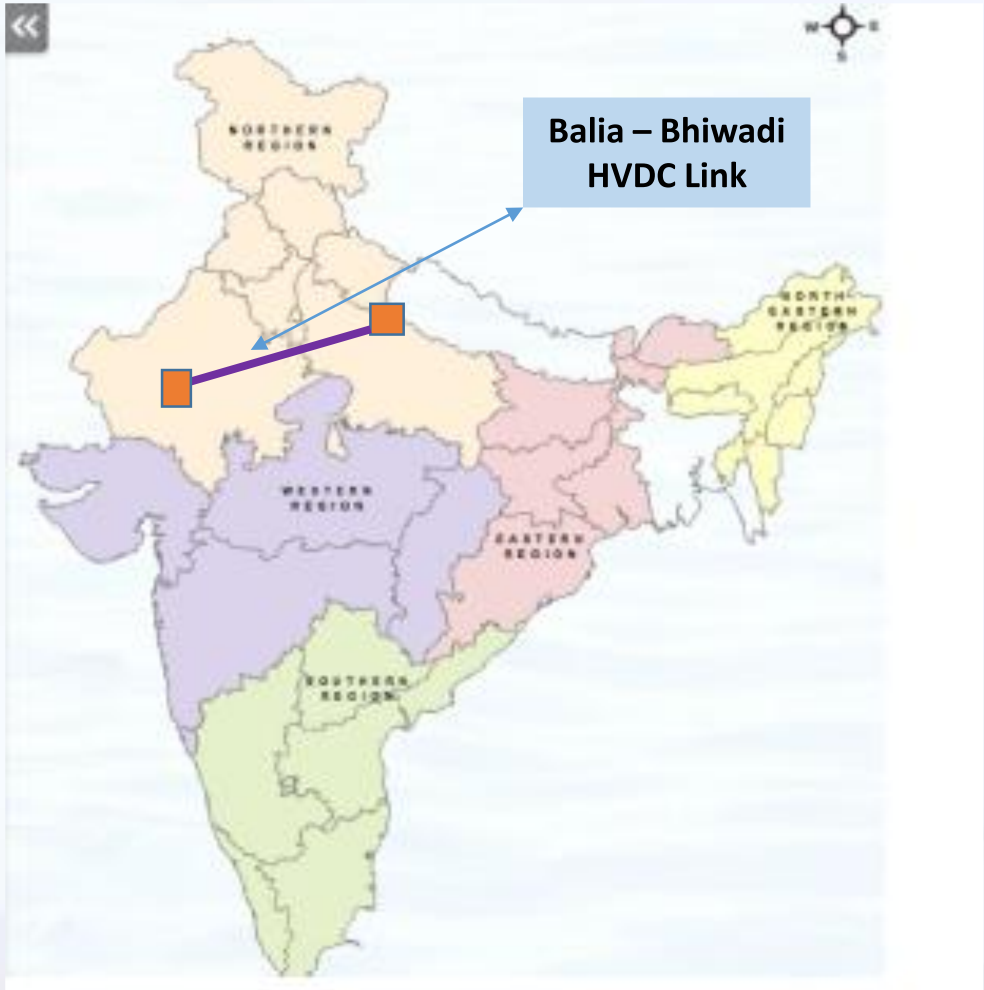
IRADe Integrated Research and Action for Development

SHARING OF HVDC RIHAND-DADRI HVDC LINK

Computation of Trans. Charges of 1500 MW Rihand – Dadri HVDC Link		
Yearly Transmission Charges (YTC)	Say for year 2019-20	Rs.120 Crore
Reliability Component	10%	Rs. 12 Crore
Region Responsible for payment towards transmission Charges	HVDC link primarily used within Region	NR Region
YTC to be paid by NR DICs* (*Designated ISTS Customers)	90%	Rs.108 Crore
Total Approx. LTA* Granted to NR DICs (*Long Term Access)	Both Drawee States and Injection Utilities without Target Customers	34000 MW
HVDC Charges to be paid by NR DICs towards Rihand – Dadri HVDC	Rs./MW/Month	Rs 2647/-

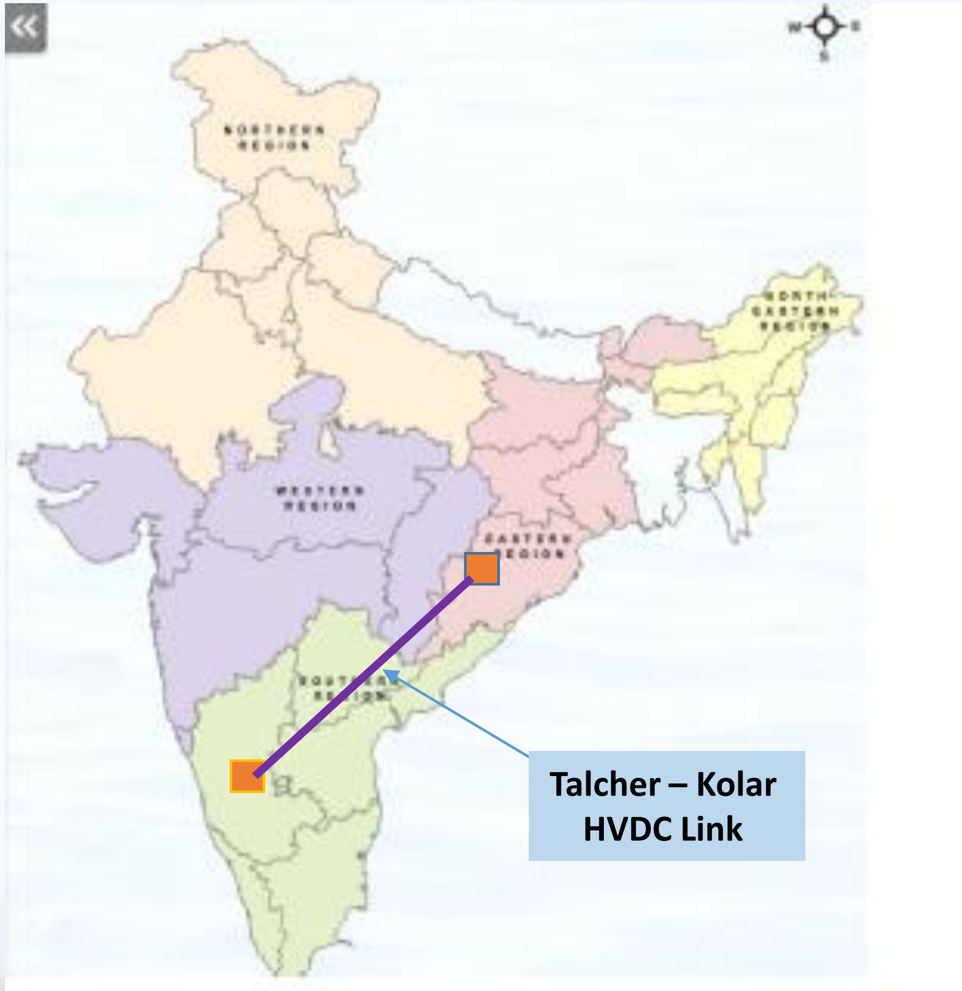
SHARING OF HVDC BALIA-HVDC BHIWADI LINK

Computation of Trans. Charges of 2500 MW Balia – Bhiwadi HVDC Link		
Yearly Transmission Charges (YTC)	Say for year 2019-20	Rs.347 Crore
Reliability Component	10%	Rs. 35 Crore
Region Responsible for payment towards transmission Charges	HVDC link primarily used within Region	NR Region
YTC to be paid by NR DICs* (*Designated ISTS Customers)	90%	Rs.312 Crore
Total Approx. LTA* Granted to NR DICs (*Long Term Access)	Both Drawee States and Injection Utilities without Target Customers	34000 MW
HVDC Charges to be paid by NR DICs towards Balia – Bhiwadi HVDC	Rs./MW/Month	Rs 7647/-



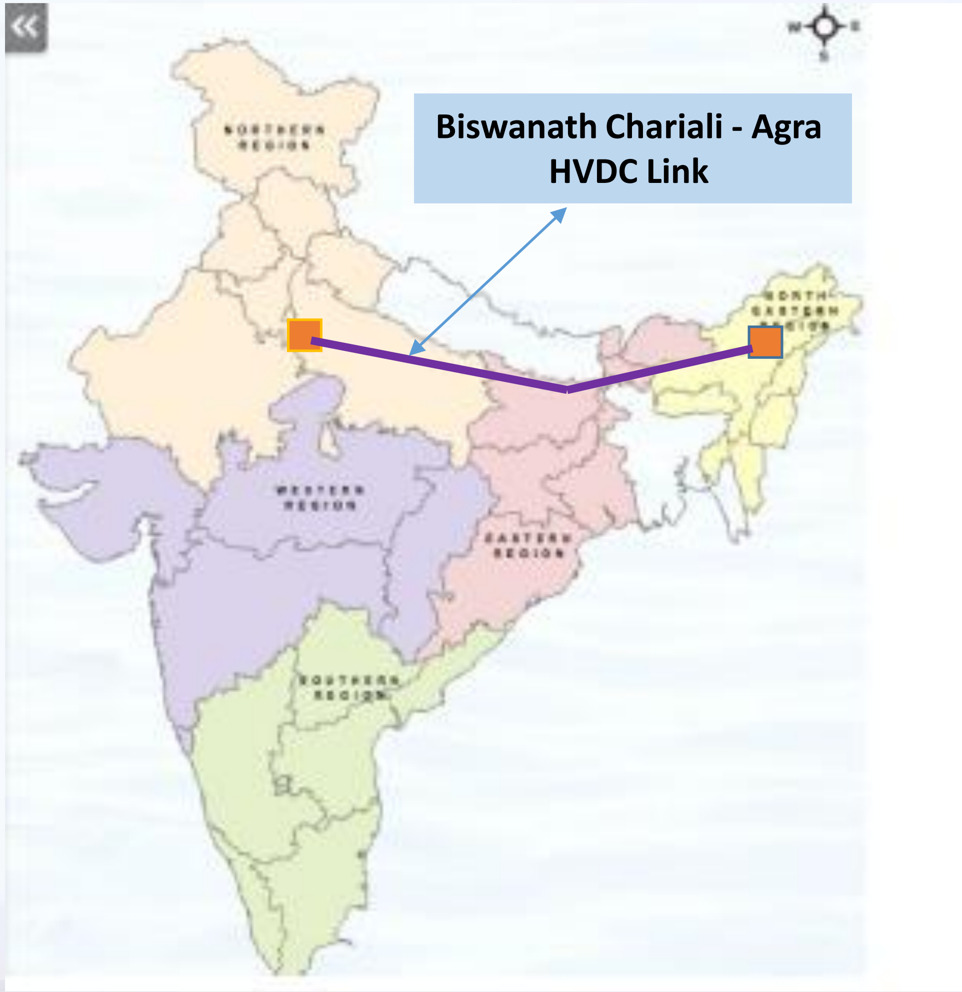
SHARING OF HVDC TALCHER- KOLAR HVDC LINK

Computation of Trans. Charges of 2500 MW Talcher - Kolar HVDC Link		
Yearly Transmission Charges (YTC)	Say for year 2019-20	Rs.216 Crore
Reliability Component	10%	Rs. 22 Crore
Region Responsible for payment towards transmission Charges	HVDC link primarily used within Region	SR Region
YTC to be paid by SR DICs* (*Designated ISTS Customers)	90%	Rs.194 Crore
Total Approx. LTA* Granted to SR DICs (*Long Term Access)	Both Drawee States and Injection Utilities without Target Customers	24800 MW
HVDC Charges to be paid by SR DICs towards Talcher- Kolar HVDC	Rs./MW/Month	Rs 6518/-



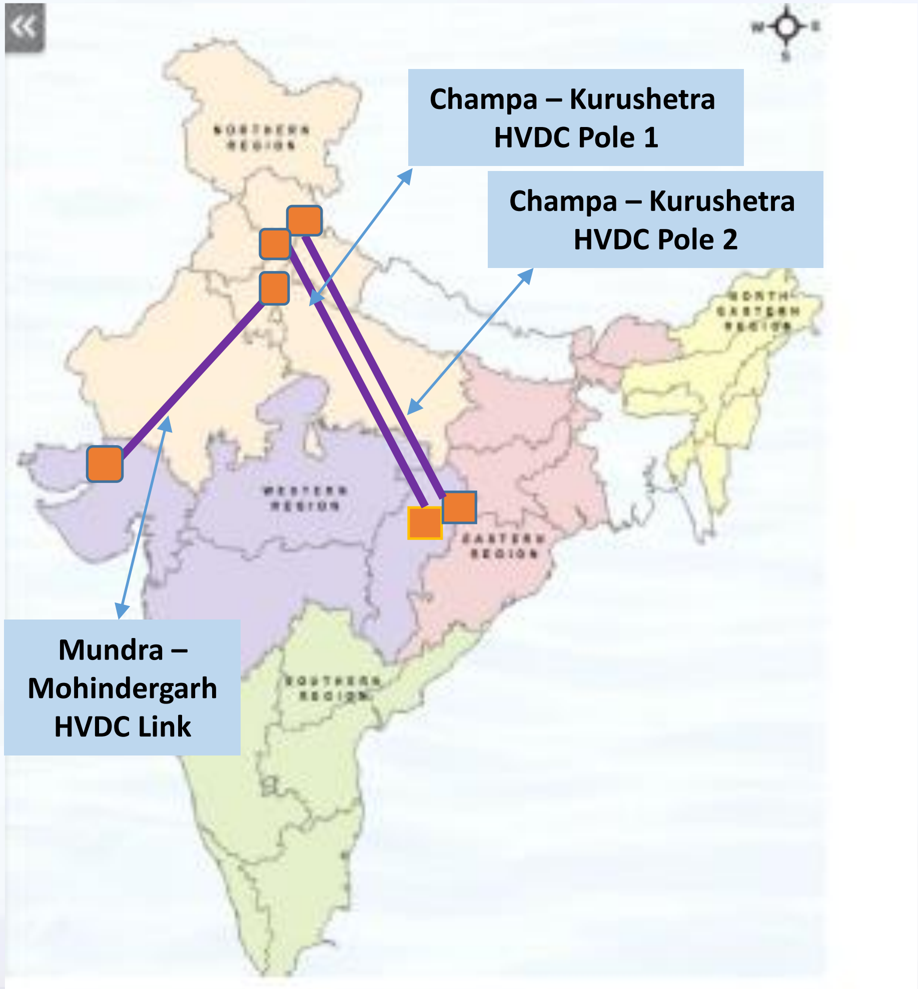
SHARING OF HVDC BISWANATH CHARIALI – AGRA HVDC LINK

Computation of Trans. Charges of 6000 MW BNC - Agra HVDC Link		
Yearly Transmission Charges (YTC)	Say for year 2019-20	Rs.1440 Crore
Reliability Component	10%	Rs. 144 Crore
Region Responsible for payment towards transmission Charges	HVDC link renders support to all Regions	All 5 Regions
YTC to be paid by NR, WR, SR, ER & NER DICs	90%	Rs.1296 Crore
Total Approx. LTA Granted to DICs NR- 34000 MW, SR - 24800 MW WR- 24500 MW, ER – 8950 MW NER – 2730 MW	Both Drawee States and Injection Utilities without Target Customers	94980 MW
HVDC Charges to be paid by NR, SR, WR, ER & NER DICs towards BNC – Agra HVDC	Rs./MW/Month	Rs 11370/-



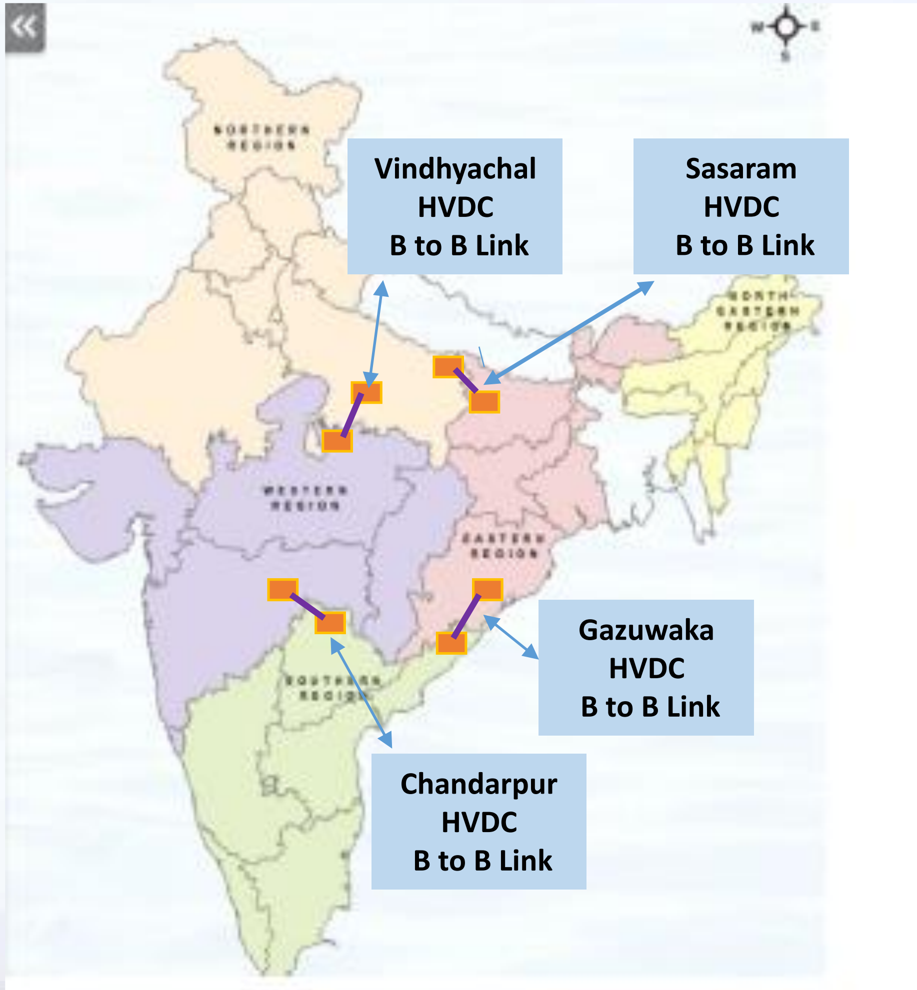
SHARING OF HVDC LINKS BETWEEN NORTHERN & WESTERN REGIONS (3 NOs.)

Computation of Trans. Charges of HVDC Links between NR & WR		
Yearly Transmission Charges (YTC) Champa – Kurushetra HVDC Pole 1 Champa – Kurushetra HVDC Pole 2 Mundra – Mohindergarh HVDC Pole	Say for year 2019-20 1500 MW (3000 MW) 1500 MW (3000 MW) 2500 MW	Rs. Crore. : 964 /- : 140/- : 704/-
Reliability Component	10% of Champa –Kurukshetra HVDC Pole 1 10% of Mundra -Mohindergarh HVDC Bipole	
In Champa – Kurukshetra Pole 1, 1500 MW capacity is allocated to different Generator DICs	90 % YTC of Pole 1 is booked directly to concerned Generator DICs	
In Champa – Kurukshetra Pole 2, 398 MW capacity is allocated to different Generator DICs & balance 1102 MW to PoC Pool.	YTC equivalent to 398 MW capacity is booked directly to concerned Generator DICs ; YTC equivalent to 1102 MW Capacity is added to Common Pool for recovery through PoC.	
In Mundra – Mohindergarh HVDC Pole 1495 MW is booked to Adani Power for transfer of power to Haryana and balance 1005 MW to PoC Pool.	YTC equivalent to 1495 MW Capacity is booked directly to Adani Power and YTC equivalent to 1005 MW Capacity is added to Common Pool for recovery through PoC.	



SHARING OF HVDC BACK TO BACK LINKS (4 NOS.)

Computation of Transmission Charges of HVDC Back to Back Links		
Details of Back to back link Vindhyachal HVDC Back to Back Sasaram HVDC Back to Back Gazuwaka HVDC Back to Back Chandrapur HVDC Back to Back	**Capacity** 2*250 MW 1*500 MW 2*500 MW 2*500 MW	**YTC** : 28.6 Cr. : 18.4 Cr. : 62.2 Cr. : 41.3 Cr.
Regions Responsible for payment towards transmission Charges	HVDC Back to Back links render support to all 5 Regions	All 5 Regions
Reliability Component	10% of YTC of all above HVDC Back to Back Links towards Reliability Component	
Recovery of Transmission Charges	Cost equivalent to 90% of YTC is added to Common Pool for recovery through PoC.	



USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Concluding Remarks and Way Forward

- Transmission is infrastructure of infrastructures;
- Invariably the links are lightly loaded during the initial runs;
- The pay-off from the transmission link is to be seen in long horizon;
- While evaluating the cost benefit analysis of the link, the cost of lost opportunities are also to be considered;
- Getting the link loaded to full capacity from Day 1 may not be the best scenario – shows the case of lost opportunities in the past;
- Substantiating the link as a profitable venture can expedite the process;

THANK YOU

SARI/EI PROJECT SECRETARIAT

B-44, Shivalik, Malviya Nagar, New Delhi 17