USAID
FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Session-3

Theme Presentation

Strategy for Transforming South Asia from Bilateral to Trilateral and Multilateral Power Trade and Development of Competitive Regional Power Market in south Asia Region

Presented by-

Vinod Kumar Agrawal (Technical Director) , SARI/EI/IRADe

&

Rajiv Ratna Panda, (Technical Head) , SARI/EI/IRADe

Conference on "Regional Energy Integration and Cross Border Energy Trade: A New Renaissance for Growth and Development of South Asia Region"

19thFebruary 2020, Hotel The Imperial, New Delhi, India

Contents

- *Prevailing volumes of Electricity Trades amongst SACs*
- *Benefits towards going-in for Trilateral/ Multilateral Trades*
- *Enablers towards Trilateral/ Multilateral Trades*
- *Issues requiring focussed attention*
- *Case study on trilateral and Multilateral Power Trade*
- *key takeaways*
- *Discussion Points-Transition from Bilateral to Trilateral/Multilateral Trades*

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Power Trading Volume amongst SA Countries_ (G to G & Market)

Country	Capacity (MW)	Type	Trader	Tenure (Years)
Bhutan- India	2236	G-G	PTC	35
	126	Market	TPTCL	25
India - Bangladesh	450	G-G	NVVNL	5/25
	790	Market	PTC, NVVNL, Sembcorp	2/3/15
India - Nepal	237	G-G	Bihar/UP state	Long Term Contract
	280	Market	PTC, NVVN	Renewed Every year

USAID FROM THE AMERICAN PEOPLE

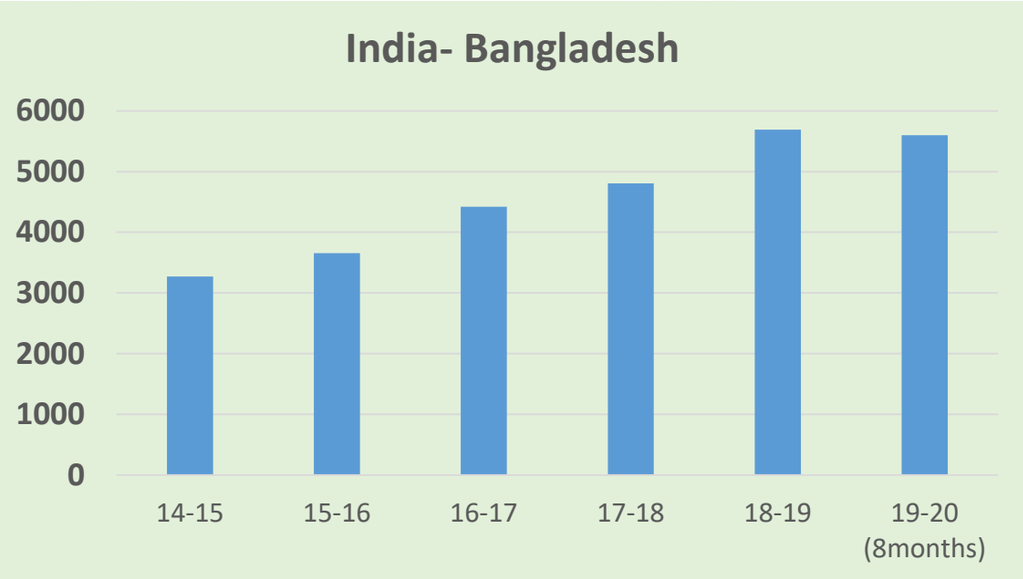
SARI/EI

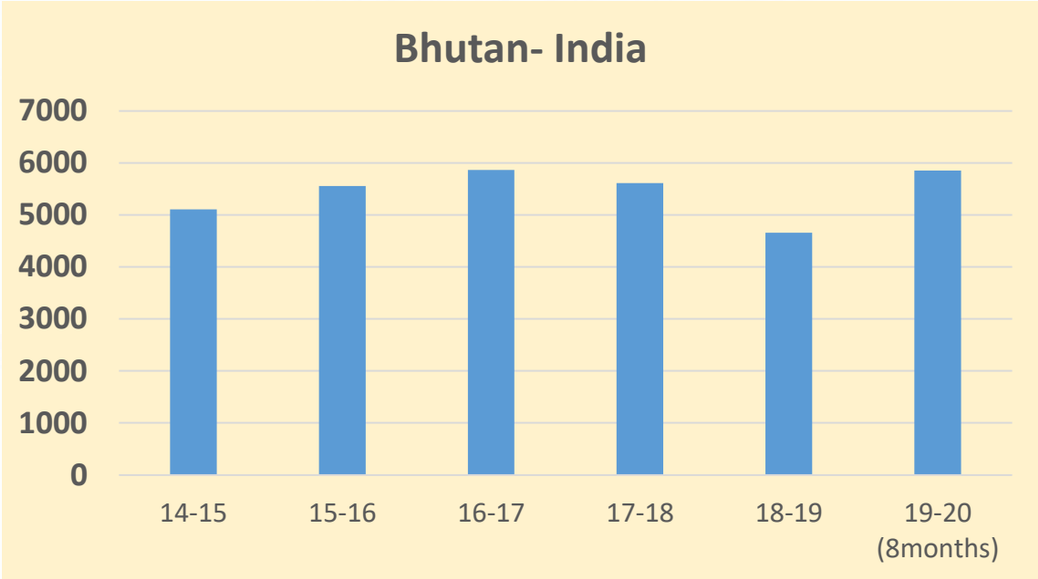
IRADe Integrated Research and Action for Development

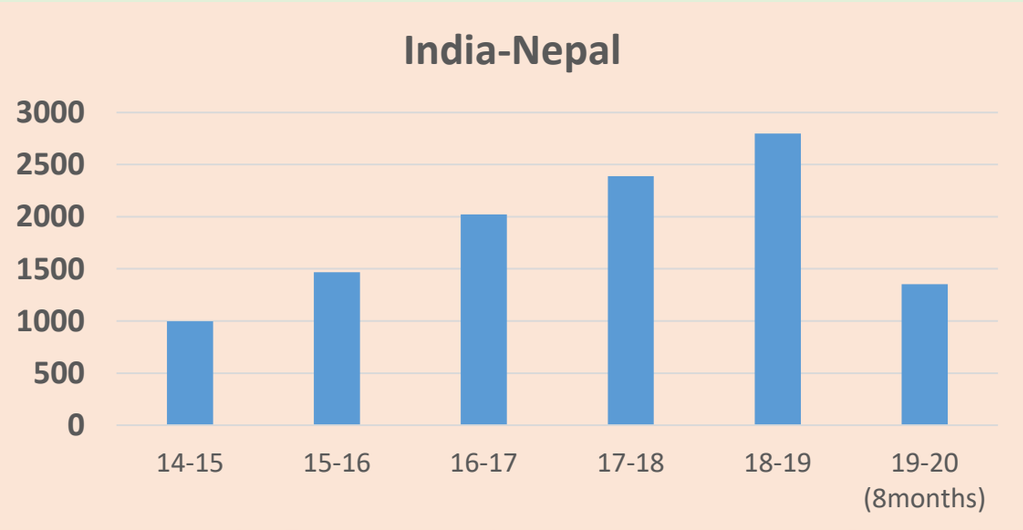
Traded Electrical Energy Volume (MUs) amongst SA Countries_ Last 5 Years

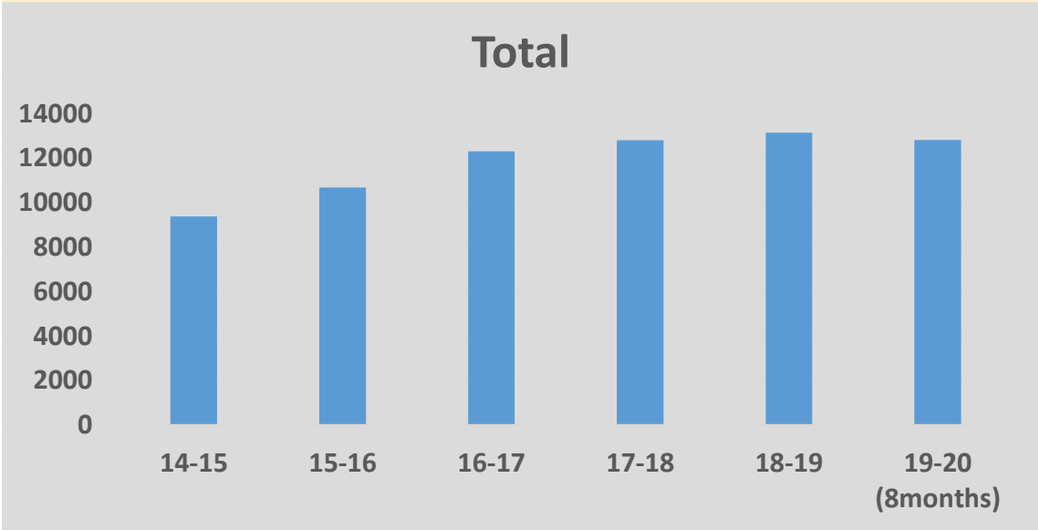
Year	India - Bangladesh	Bhutan - India	India - Nepal	Total
14-15	3271	5109	997	9377
15-16	3654	5557	1469	10680
16-17	4419	5863	2021	12303
17-18	4808	5611	2388	12807
18-19	5690	4657	2798	13145
19-20 (8months)	5600	5856	1354	12810

Y to Y Enhancement of the Traded Energy Volume (MUs) amongst SA Countries









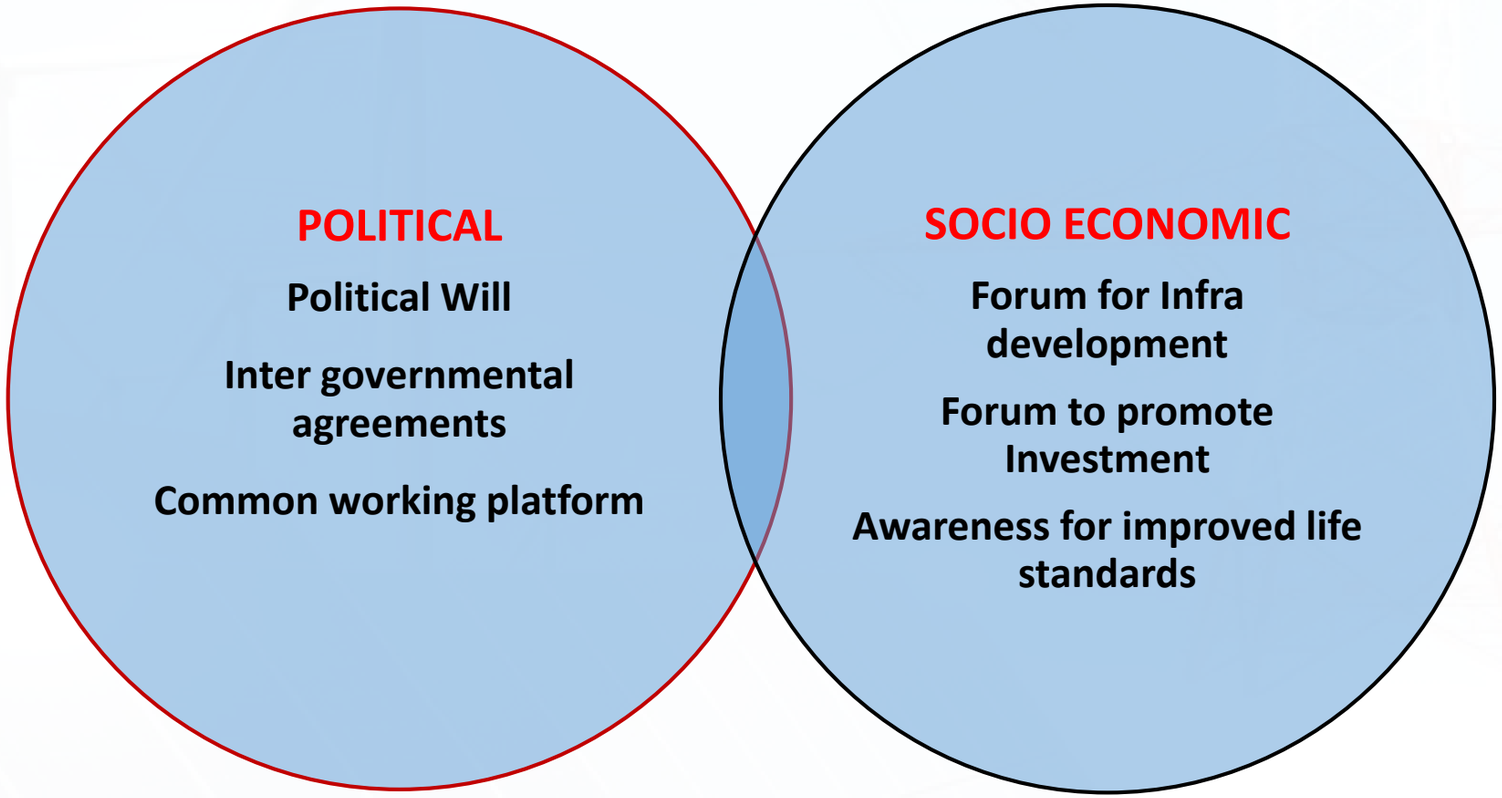
Benefits towards going for Trilateral/ Multilateral Trading

- The shortages in one country's power grid can be readily solved by imports from a country without common borders;
- Costlier power in certain countries can be replaced by cheaper power in the other countries;
- Countries can rely on market to provide reserve generation capacity, lowering their own investment costs;
- Fossil fuel-based generation in some countries can be replaced with cleaner hydropower from other countries;
- Curtailment towards the overall carbon footprint in the region;
- Overall regional costs can be brought down by source optimisation and economy of scales;

Trilateral/ Multilateral Trading _Regulatory Enablers

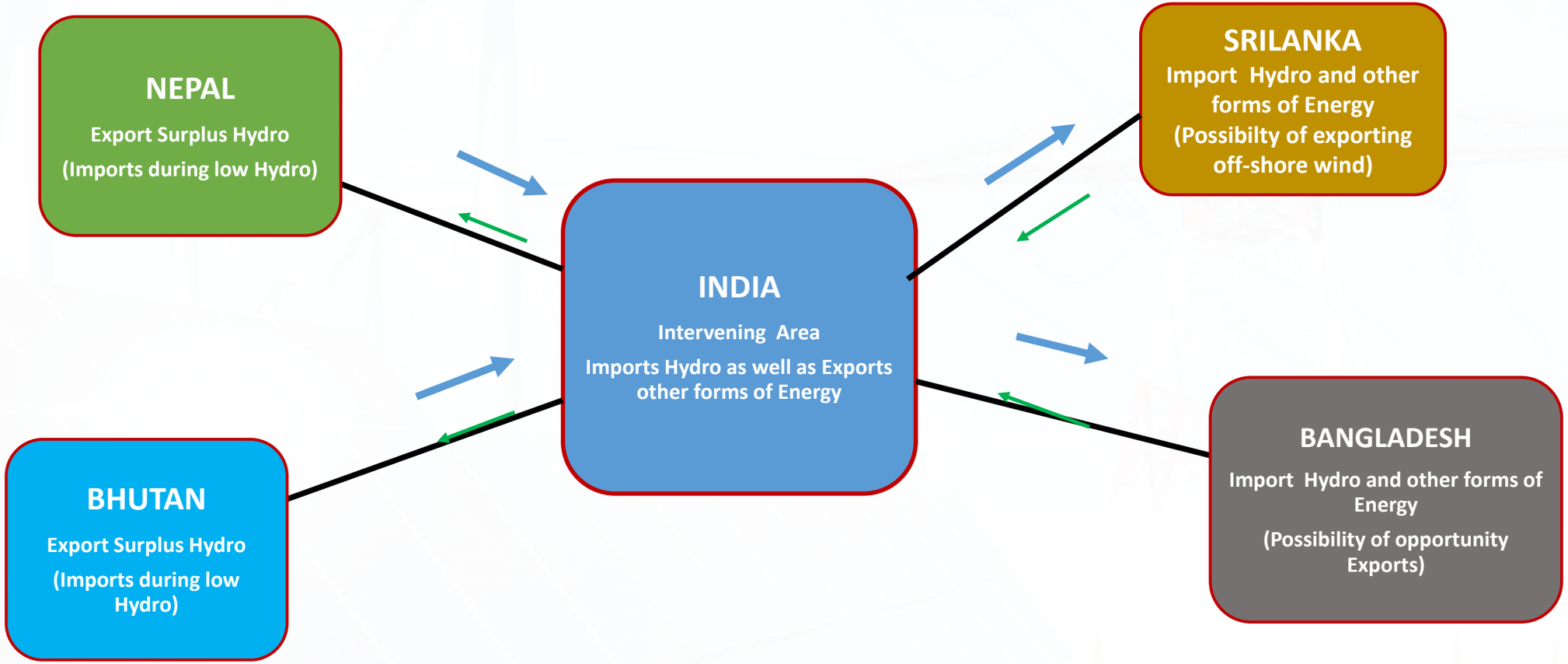
- Permissibility towards use of electricity transmission network under open access;
- Norms towards identification of transmission capabilities and congestion;
- Provision of markets and common open access norms in different countries;
- Participation by more number of power generation and distribution companies;
- Accepted policies and norms towards measurement of deviations and settlements;
- Harmonised policies and norms for accounting and settlement;
- Avenues towards including Renewable power in trades;

Trilateral/ Multilateral Trading _Non Regulatory Enablers

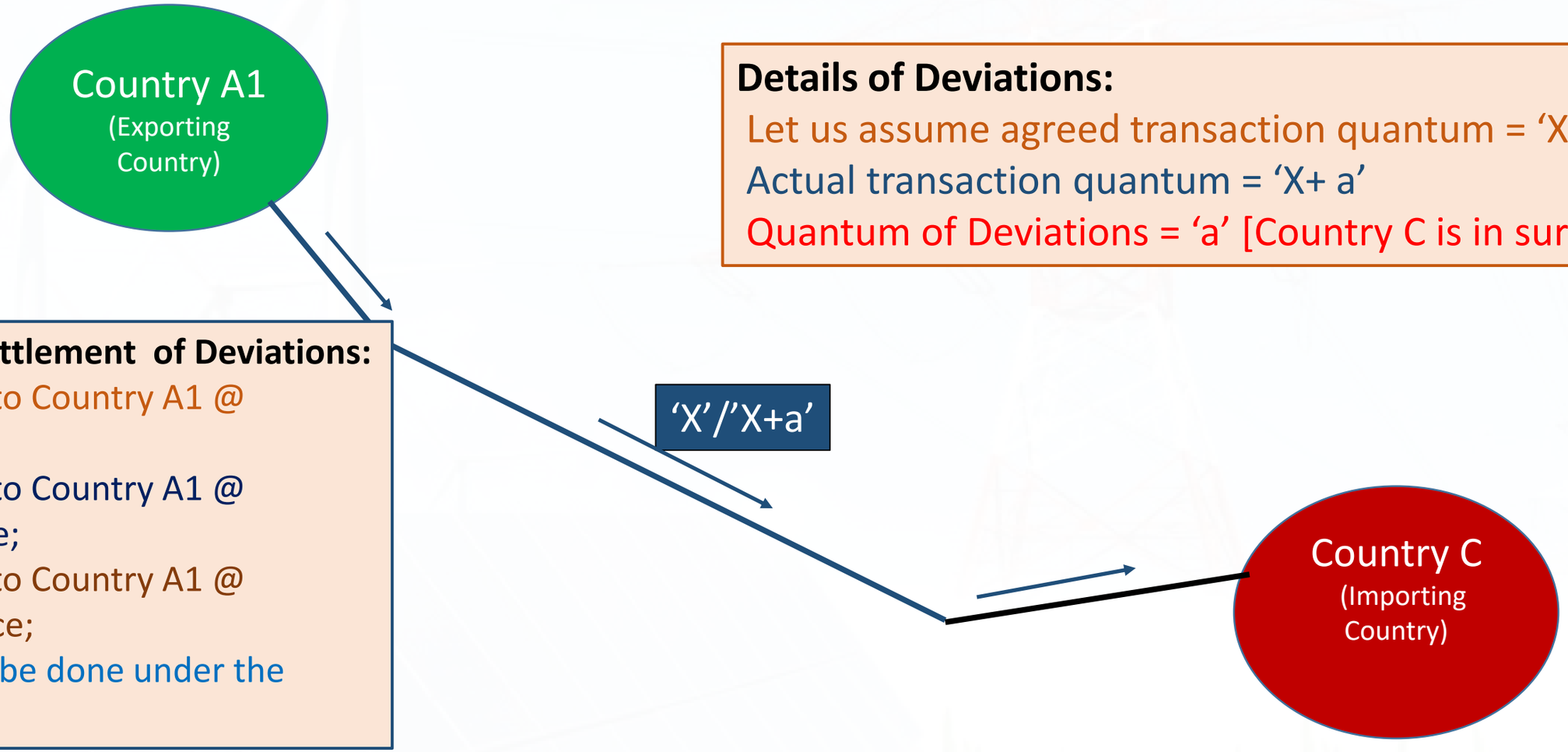


Issues requiring focussed attention while going for Trilateral/Multilateral Power Trade

Typical Multilateral Trading Scenario_ BBINS Region



1A. Deviations in actual flow _ Treatment under Typical Bilateral Transaction



Details of Deviations:

Let us assume agreed transaction quantum = 'X'

Actual transaction quantum = 'X+ a'

Quantum of Deviations = 'a' [Country C is in surplus]

Avenues towards settlement of Deviations:

Country C may pay to Country A1 @ Contract price;

Country C may pay to Country A1 @ Prevailing Mkt. price;

Country C may pay to Country A1 @ Mutually agreed price;

The settlement can be done under the running contract;

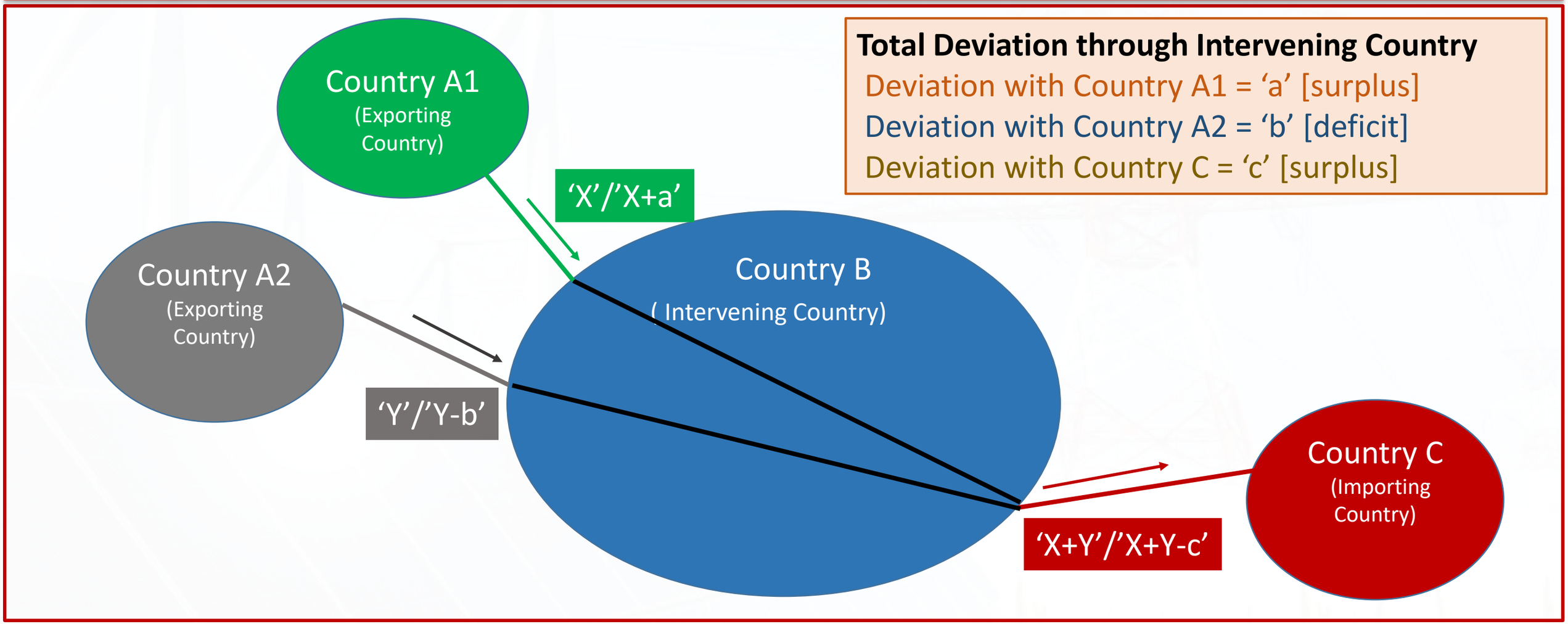
Settlement of deviations in case of bilateral transaction is relatively simple and straight

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development IRADe

1B. Deviations at different Seams _ Treatment under Multilateral Trade



Total Deviation through Intervening Country

Deviation with Country A1 = 'a' [surplus]

Deviation with Country A2 = 'b' [deficit]

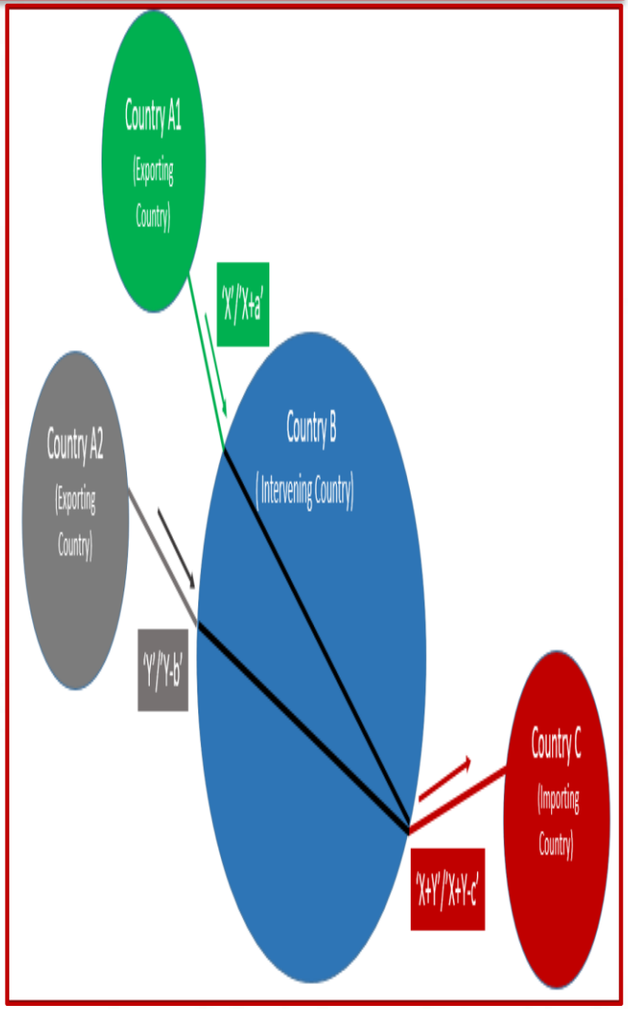
Deviation with Country C = 'c' [surplus]

Deviations at all the seams with the intervening country will have to be identified

1C. Deviations at different Seams _ Treatment under Multilateral Trade

Critical points related to settlement of deviations in case of Multilateral Transactions :

- ✓ The nature of contract and rates for the two transactions may be different;
- ✓ There may be no co-relation between the contract rates vis a vis the rates prevailing in the intervening country;
- ✓ The rates in the intervening country may vary from time to time and at times may even become negative;
- ✓ At no stage the intervening country may like to get exposed to any financial loss;
- ✓ There also has to be an agreed financial instrument to ensure dispute free and timely settlement;



Pre-conceived philosophy is important to compute the deviations at different seams

2A. Computation of Transfer Capability_ Treatment under Bilateral Transaction

National Load Despatch Centre, New Delhi
Transfer Capability between India and Bangladesh for July 2019

Issue Date: 28th March 2019 Issue Time: 1800 hrs Revision No. 0

Date	Time Period in IST (hrs)	TTC from India to Bangladesh from Indian Side*	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Limiting constraint	Comments
1st July 19 to 31st July 19	0000-0630	1000	0	1000	510	490		Under N-1 of 400 kV Berhampore Bheramara, voltage at Berhampore tends to dip.	
	0630-2330	1000		1000	510	490			
	2330-2400	1000		1000	510	490			

Country A1
(Exporting Country)

Country C
(Importing Country)

TTC - 'X'
ATC – 'X-a'

Transfer Capability can be found out based on the minimum of :

- ✓ Thermal limit of the intervening circuit;
- ✓ Stability limit of the connecting network;
- ✓ Export capability at the Exit Point;
- ✓ Import Capability at the Entry Point;

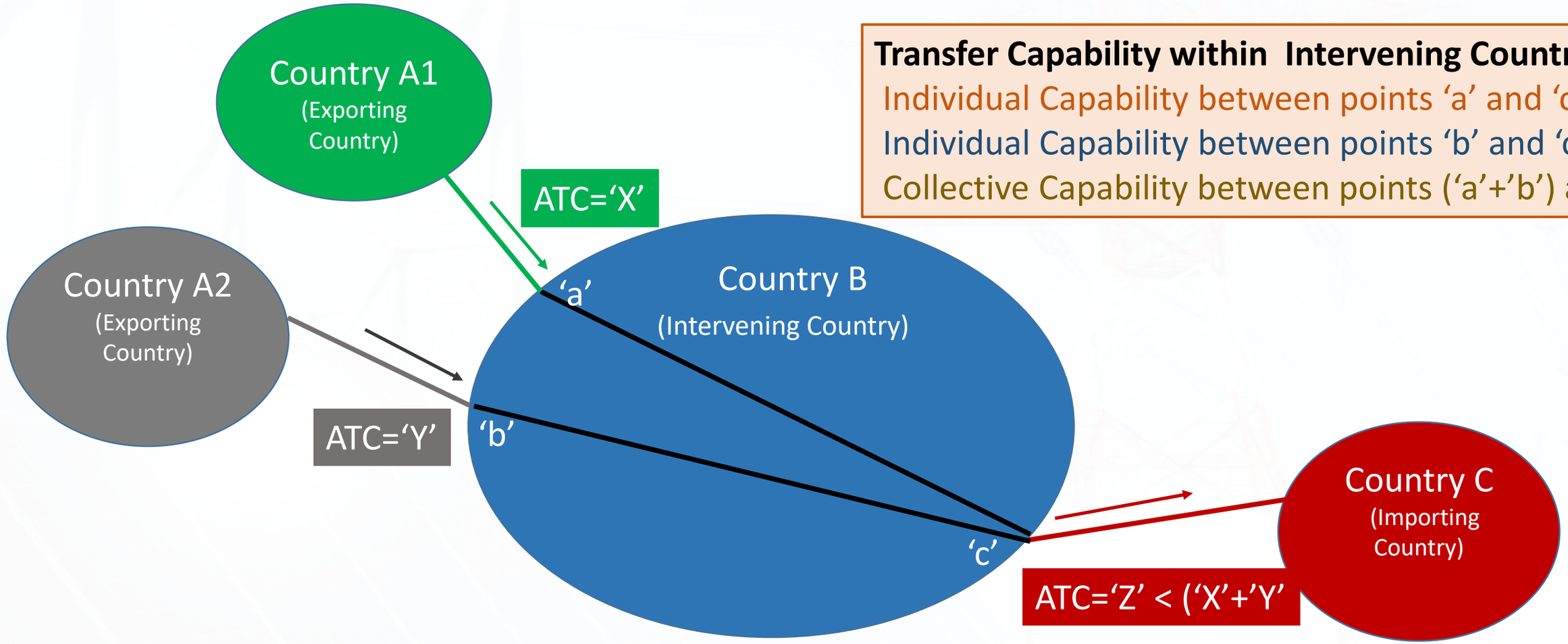
Practice of declaration of Transfer Capability between two countries is already in vogue;

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

2B. Computation of Transfer Capability_ Treatment under Multilateral Transaction



Transfer Capability within Intervening Country :

Individual Capability between points 'a' and 'c';

Individual Capability between points 'b' and 'c';

Collective Capability between points ('a'+'b') and '

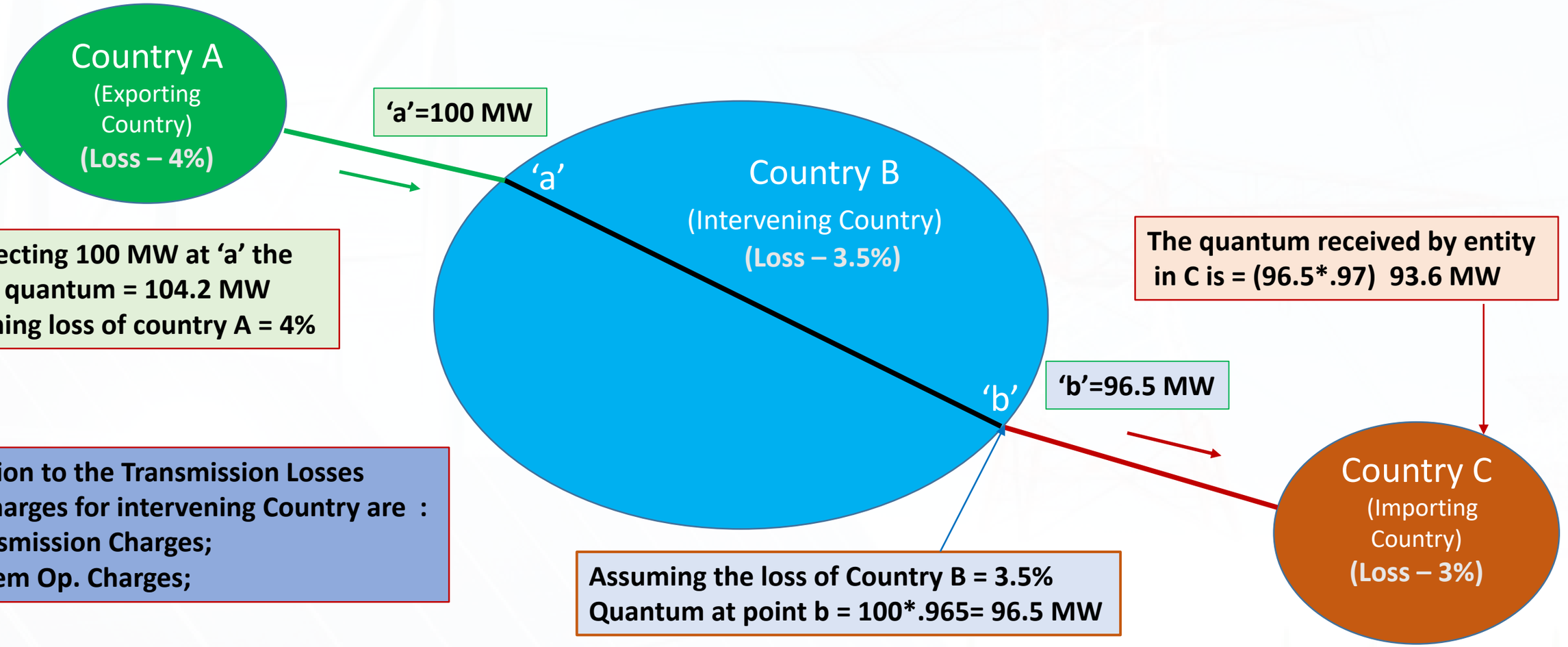
Integrated study of the Regional Grid would be important to compute the ATC

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Accounting for Loss, Transmission and Operating Charges_ Multilateral Trade



For injecting 100 MW at 'a' the export quantum = 104.2 MW (assuming loss of country A = 4%

The quantum received by entity in C is = (96.5*.97) 93.6 MW

In addition to the Transmission Losses other charges for intervening Country are :

- ✓ Transmission Charges;
- ✓ System Op. Charges;

Assuming the loss of Country B = 3.5%
Quantum at point b = 100*.965= 96.5 MW

Strategy for losses, trans. charges & op. charges for intervening country ?

Case Study on trilateral and Multilateral Power Trade

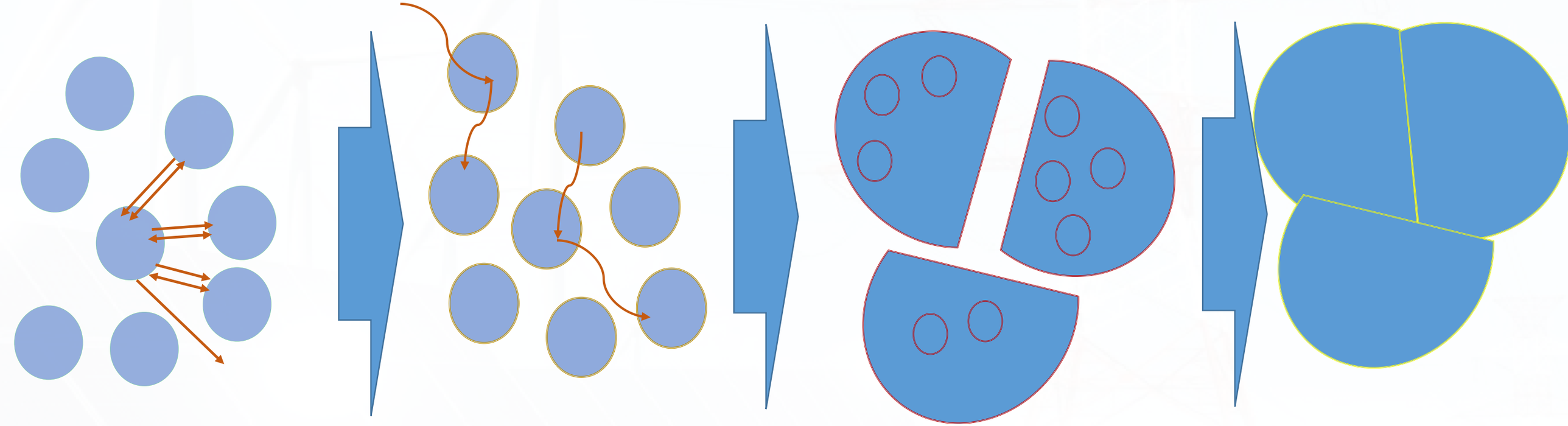
USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

IRADe

Power system and Market Integration evolution across the Globe



Establishing Bilateral Connections , bilateral Market

Moving towards Trilateral/Quadrilateral Connection, Trilateral Market

Developing Sub regional Grids, Sub-Regional Power Market

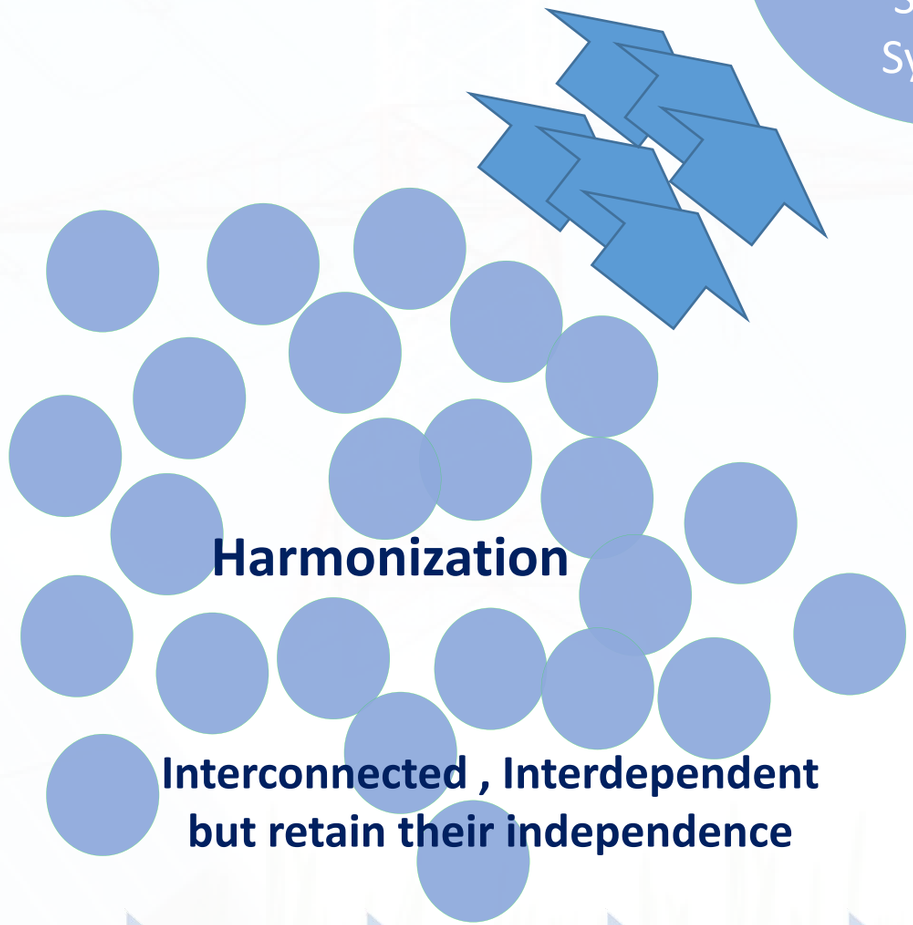
Fully Interconnecting sub regional Grids and Creating Common Grid and Unified Market

SA CBET Future Outlook-:-Moving from Bilateral to Tri/Multilateral and Market Integration

Power System and Market Integration-International Experiences

Bilateral, unidirectional power trade	• Thailand imports from Lao PDR, Bangladesh –India Power Trade • China imports from Myanmar
Bilateral, bidirectional power trade	• Malaysia–Singapore (non-financial), USA ↔ Baja California, Mexico • Nepal-India , India-Bhutan
Multilateral, multidirectional trade among differentiated markets	• Southern African Power Pool (SAPP) • SIEPAC (Central America)
Multilateral, multidirectional trade among harmonised markets	• European Union Internal Energy Market
Unified (pooled) market structure, differentiated operations	• Nord Pool
Unified market and operations	• PJM

Complete Integration, Uniform and Single System



Reference - IEA (2019), "Integrating Power Systems across Borders ", IEA, Paris, www.iea.org/publications/reports/integratingpowersystemsacrossborders/
IEA (2019), "Establishing multilateral power trade in ASEAN", IEA, Paris, www.iea.org/publications/reports/EstablishingmultilateralpowertradeinASEAN/.

Why Lao PDR, Thailand, Malaysia, Singapore (LTMS) Trade Project

Why Lao PDR, Thailand, Malaysia, Singapore (LTMS) Trade Project ?

Both South Asian and ASEAN Region have many similarities

- Eight Countries, 1.76 billion, 23 % of world's population;
- Similar Socio-Economic Conditions, Developing Country Context
- SAARC Existing Cross Border Trade – ~ 3536 MW (All Bilateral)
- SAARC-Steps are being taken to move from Bilateral to Multilateral (Trilateral Trade:- Bhutan-India-Bangladesh , Nepal -India-Bangladesh)
- SAARC-Power Market Structure: Except India all other SA countries have Single Buyer Model. In India-Competitive power market & power exchange exist (Wholesale Competition)

- Ten Countries, 634 Million People, 9% of world's population;
- Similar Socio-Economic Conditions, Developing Country Context
- ASEAN –Existing Cross Border Trade - ~5502 MW (Mainly Bilateral)
- ASEAN- After Long years of Bilateral Trade , Recently Steps have been taken to move from Bilateral to Multilateral (Lao PDR-Thailand-Malaysia-Singapore - A path breaking Project).
- ASEAN Power Market Structure: Except Singapore, Philippines, Vietnam all other ASEAN countries have Single Buyer Model. In Singapore (Wholesale), Philippines (Wholesale and Retail) Vietnam –Cost Pool.

Why Lao PDR, Thailand, Malaysia, Singapore (LTMS) Trade Project ?

- Bhutan & LAO PDR-Hydro Power Surplus/Export*
- Large Hydro Potential
- Looking to Diversify Market

- India & Thailand large Power Sector
- Transit and Wheeling Country
- Have Bilateral Connection -Neighbours

- Bangladesh & Malaysia– rapidly growing power demand
- Dominance of Fossil Fuel (Bangladesh –Gas & Malaysia- Gas & Coal

Very Similar Motivation

* 1878 MW of coal Capacity –Export to Thailand
* 399.35MW in November 27, 2018 at 18:18 hrs.

Lao PDR, Thailand, Malaysia, Singapore (LTMS) Trade Project

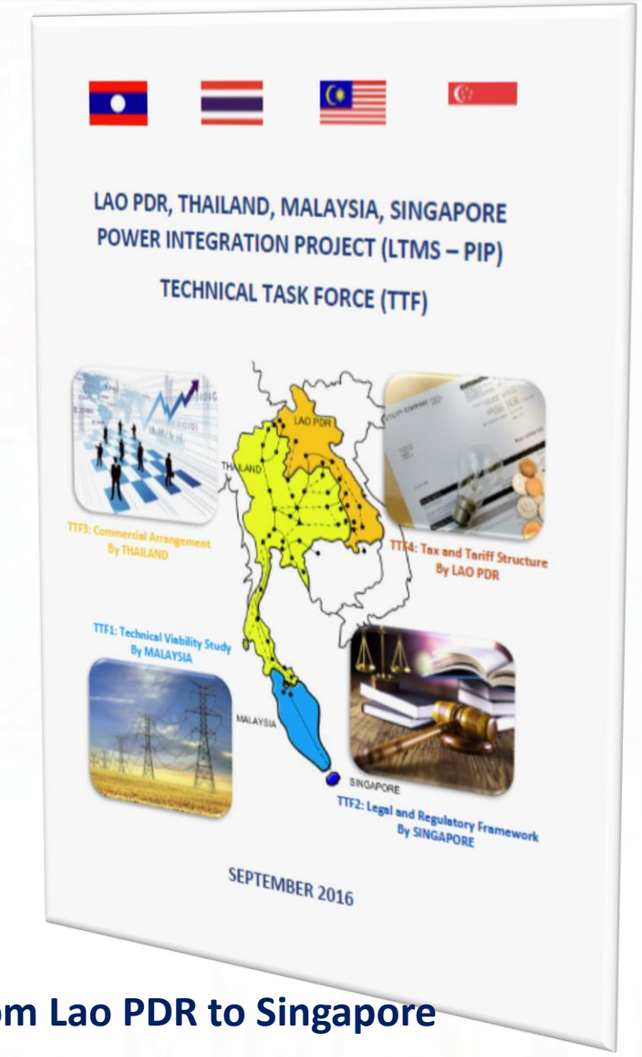
- 1st multilateral power trade: LAO PDR (cheap hydro power) to Singapore/Malaysia via Thailand & Malaysia to support ASEAN Power Grid. Idea came up in 2014.

- The project is being be implemented in 2 phases
  - Phase 1- 2018-2019 (LTM-PIP)
    - Power Trade of up to 100MW btw. Lao PDR & Malaysia via Thailand only utilizing existing network & interconnections. Later up to 300 MW
  - Phase 2- 2020 or beyond (LTMS-PIP)
    - Possible expansion to include Singapore when second interconnection cable btw. Singapore & Malaysia is back in service.
    - Singapore-fully liberalised power market. Exporting country will need to establish a local subsidiary to sell electricity directly in Singapore's market.

LTMS–PIP Working Group, Deep Commitment and Formal Mechanisms

LTMS–PIP WG

- **Task Force 1- Technical viability Study led by Malaysia**
- **Task Force 2 Legal and regulatory Framework led by Singapore**
- **Task Force 3 Commercial Arrangement led by Thailand**
- **Task force 4 Tax and tariff Structure led by Lao PDR**



- To implement this project, a LTMS–PIP Working Group (WG) was formed with four technical task forces looking into
  - Technical
  - Legal and Regulatory
  - commercial
  - Tax and tariff aspects of the project
- As a first step, each country developed a grid study- to confirm technically possible -100 MW trade from Lao PDR to Singapore
- Ownership and Fairness - Each country led a Particular Task Force

1 Source: Presentation on The ASEAN Power Grid Strategic Plan under the APAEC 2016-2025 Blueprint: Update and Prospects by Dr. TwarathSutabutr, Chairman of ASEAN Power Grid Consultative Committee in the ASEAN Power Grid Summit 2018 22ndMay 2018, Vientiane, Lao PDR

LTMS Project: Deep Political Commitment and Strict Timeline

Dec 2013
Idea
mooted during a special ASEAN Senior Officials Meeting on Energy (SOME) in Manado, Indonesia. (11 number of Interconnection with 3500 MW of Capacity)

Nov 2015
Intergovernmental (IG) Mechanism formed
LTMS-PIP Working Group (WG) and 4 Technical Task Forces (TTFs) were formed on technical, commercial, legal and tariff aspects

Sept 2016
Report Finalised and IG MoU signed
at the 34th ASEAN MINISTERS ON ENERGY MEETING (AMEM) held in Nay PyiTaw, Myanmar for implementation of Phase 1
MoU is valid for five years

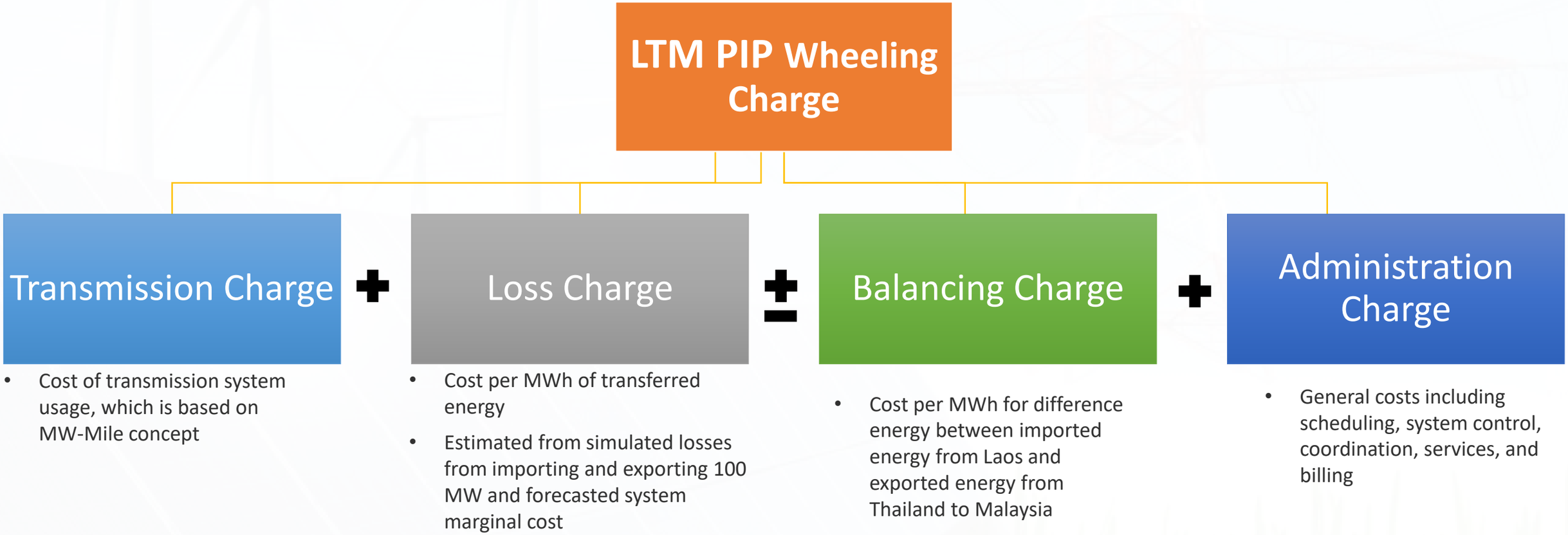
Sept 2017
Energy Purchase & Wheeling Agreement (EPWA) signed
between ElectriciteDu Laos (EDL), Electricity Generating Authority of Thailand (EGAT) and Tenaga Nasional Berhad(TNB) was signed at the 35th AMEM held in Manila, Philippines for implementation of Phase 1

Jan 2018
Trade Commenced
As of March 2019, 24.97 GWh has been traded

4th Sept 2019
Agreed to Increase to 300 MW & Renewal of EPWA
37th AMEM
4 September 2019, Bangkok, Thailand

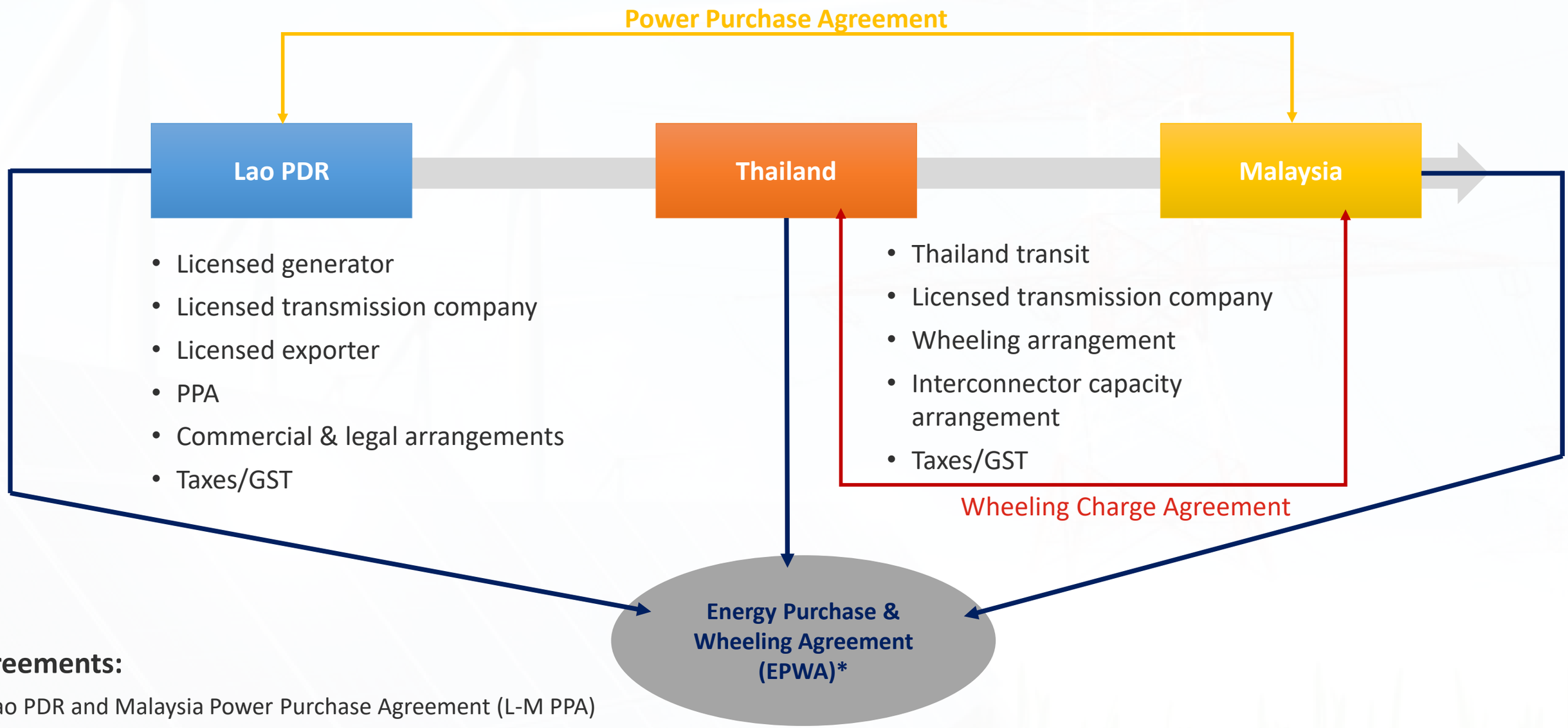
LTMS Project: Wheeling Charge Methodology

Wheeling charge comprised of a) transmission- the distance of the trade (megawatts mile); b) loss charge-a loss charge (charged per megawatt hour); c) balancing charge (also per megawatt hour); and d) administrative charges- a fixed administrative charge.



[1] *Source:* Establishing Multilateral Power Trade in ASEAN, IEA, August 2019 (page 48)
Reference - IEA (2019), "Integrating Power Systems across Borders ", IEA, Paris, www.iea.org/publications/reports/integratingpowersystemsacrossborders/
Source: Lao PDR – Thailand – Malaysia – Singapore on Power Integration Project (LTMS-PIP) related various sources , web link weblink web link web link

Current Commercial Arrangement (Phase-1)



Agreements:

- Lao PDR and Malaysia Power Purchase Agreement (L-M PPA)
- Thailand and Malaysia Wheeling Charge Agreement (T-M WCA)

Wheeling charges are being paid by Lao PDR to Thailand (the transmission system owner). Lao PDR recovers this wheeling charge from Malaysia under the terms of the bilateral PPA1.

*** Signed between ElectriciteDu Laos (EDL), Electricity Generating Authority of Thailand (EGAT) and Tenaga Nasional Berhad(TNB)**

USAID
FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Key takeaways form LTMS PIP Project

LTMS Project: Key takeaways form LTMS PIP Project for SA

- ***Can start with existing infrastructure with small level of trilateral trade as a pilot case. Builds Confidence***
- ***Political support is essential.***
- ***Marrying of Overall Economics and Political interests – Objective of achieving Better Regional Integration across ASEAN across sectors.***
- ***Critical Roll Played by Intergovernmental Mechanisms- ASEAN Ministers on Energy Meeting (AMEM) , Senior Officials Meeting on Energy (SOME).***
- ***Dividing work across the participating countries - giving everyone has a stake in, and a sense of ownership.***
- ***A country to be actively involved in development process even if it does not take part in trading arrangement initially (Singapore).***
- ***A small country like LAO –PDR can succeed in accessing far distance markets.***
- ***Time bound (with 3 years from LMTS PIP WG ,trade started) and Negotiations and agreement on Wheeling charge Methodology.***
- ***TNB is under no obligation to purchase any minimum amount of energy from EDL*.***
- ***Initial Success of trilateral trade accelerate trade – Decided to increase the power trade (100 mw to 300 mw) .***

* https://www.thestar.com.my/business/business-news/2017/09/27/tnb-enters-into-aseans-first-multilateral-energy-pact

Minimum Requirement for Trilateral/Multilateral

- Strong Political will
- Intergovernmental agreement(s)
- Regional Outlook/Vision.
- Structured Intergovernmental Political Forum

Political

- No legal and Regulatory Obstacle- Minimum to have Access to Third Party Network.
- Some Forum for Regulators for Discussion.
- Common Understanding on dealing with Regulatory Aspects

Regulatory

- Harmonised technical standards (grid codes) or agreed norms
- Harmonised wheeling charge methodology or agreed methodology .
- Co-ordinated Grid Planning
- Data & information sharing
- Interconnector capacity availability calculation, deviation settlement, loss accounting

Technical and Commercial

- Institutional arrangements
- Imbalance Settlement and payment mechanism
- Dispute resolution mechanism
- Regional Forums

Institutional

* https://www.thestar.com.my/business/business-news/2017/09/27/tnb-enters-into-aseans-first-multilateral-energy-pact

Discussion Points _ Transition from Bilateral to Trilateral/Multilateral Trades

Learning from examples of Regional Integration having multilateral trades ?

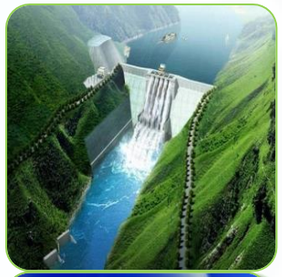
How the different countries in SA are going to be benefited with multilateral trades ?

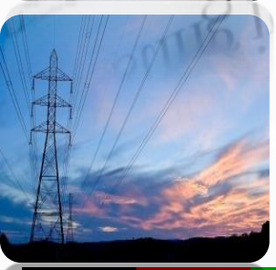
Specific advantages trilateral/multilateral trades bring over bilateral trades, particularly towards accelerating regional power market ?

How the transmission capacity in the intervening country can be channelized under multilateral trades ?

What kind of socio economic impact this transition can bring ?

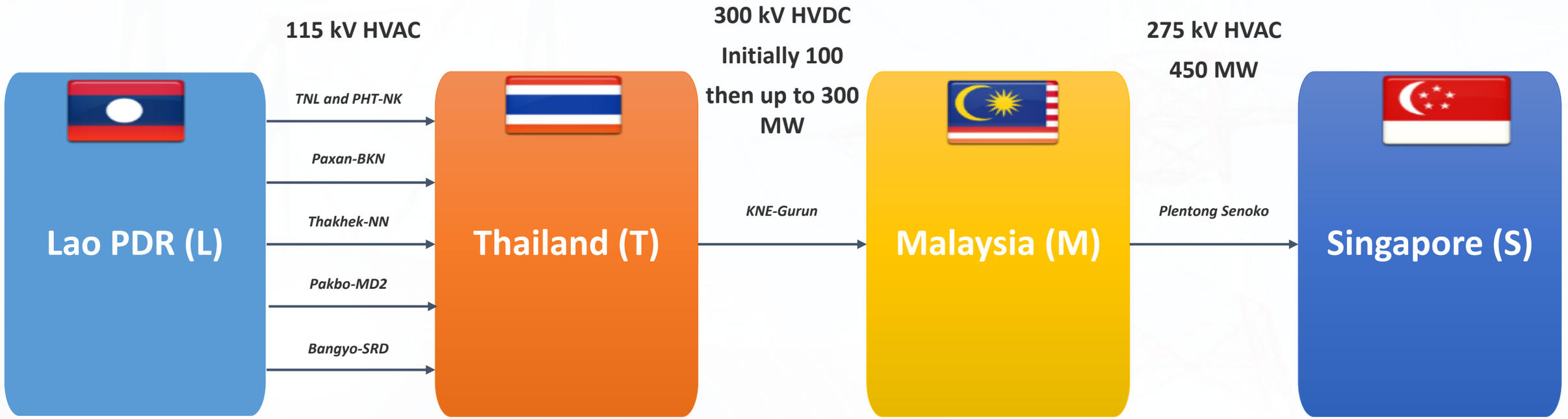
With multilateral trades what are the specific challenges in respect of accounting and settlement ?





Thank You

LTMS - Existing Interconnection & Physical Flow-2018*



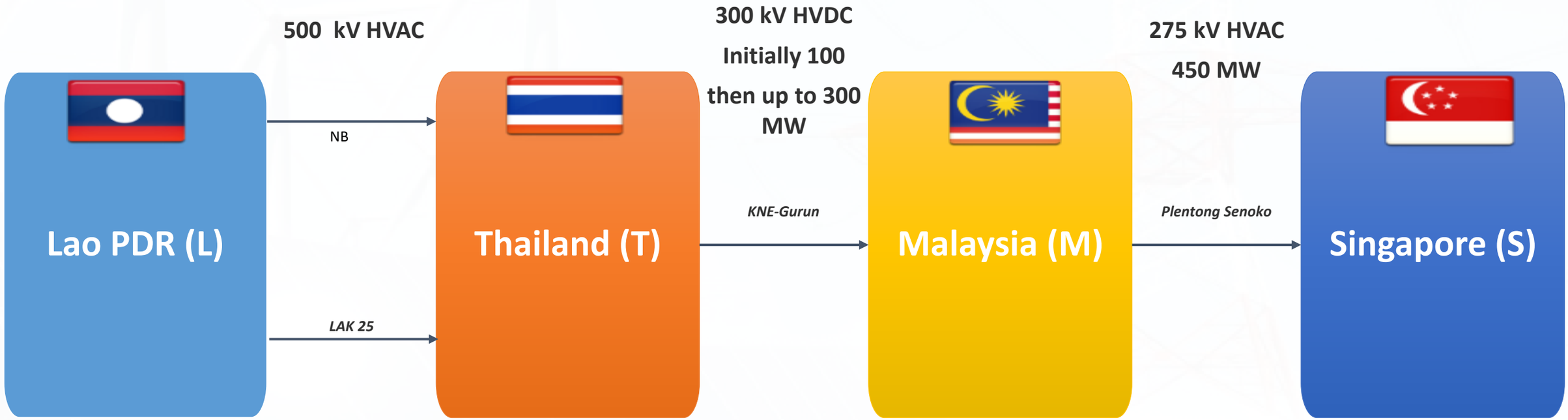
Power flow control through interconnections:

- Between Lao PDR and Thailand: without power flow control (without ACE)
- Between Thailand and Malaysia: controlled by pole control of HVDC
- Between Malaysia and Singapore: AGC setting of Area Control Error (ACE)

1. *Lao-Thailand: TNL and PHT to NK, Paxan-BKN, Thakhek-NN, Pakbo-MD2, Bangyo-SRD all are 115 kV Thailand – Malaysia: KNE-Gurun 300 kV 300 MW HVDC Between Malaysia – Singapore: Plentong-Senoko 275 kV HVAC*
2. *Thailand–Malaysia is a monopolar 300 kV overhead line with a maximum transmission rate of 300 MW*
3. ** Malaysia-Singapore only after 2020, This slide indicates the whole LTMS project as Planned including M-S connection. There is no flow between M-S in 2018*

Source: Lao PDR – Thailand – Malaysia – Singapore on Power Integration Project (LTMS-PIP) related various sources , web link weblink web link web link

LTMS - Existing Interconnection & Physical Flow-2019*



Power flow control through interconnections:

- Between Lao PDR and Thailand: without power flow control (without ACE)
- Between Thailand and Malaysia: controlled by pole control of HVDC
- Between Malaysia and Singapore: AGC setting of Area Control Error (ACE)

1. *Lao-Thailand: TNL and PHT to NK, Paxan-BKN, Thakhek-NN, Pakbo-MD2, Bangyo-SRD all are 115 kV Thailand – Malaysia: KNE-Gurun 300 kV 300 MW HVDC Between Malaysia – Singapore: Plentong-Senoko 275 kV HVAC*
2. *Thailand–Malaysia is a monopolar 300 kV overhead line with a maximum transmission rate of 300 MW*
3. ** Malaysia-Singapore only after 2020, This slide indicates the whole LTMS project as Planned including M-S connection. There is no flow between M-S in 2019*

Source: Lao PDR – Thailand – Malaysia – Singapore on Power Integration Project (LTMS-PIP) related various sources , web link weblink web link web link