



Harmonizing the Greater Mekong Subregion (GMS) Power Systems to Facilitate Regional Power Trade (TA8830 ADB) Summary of Results of WGRI Meeting, 18 Jun 2018

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TA8830: Extended scope of work

International Approaches to Network Pricing

Summary of GSM Country Presentations

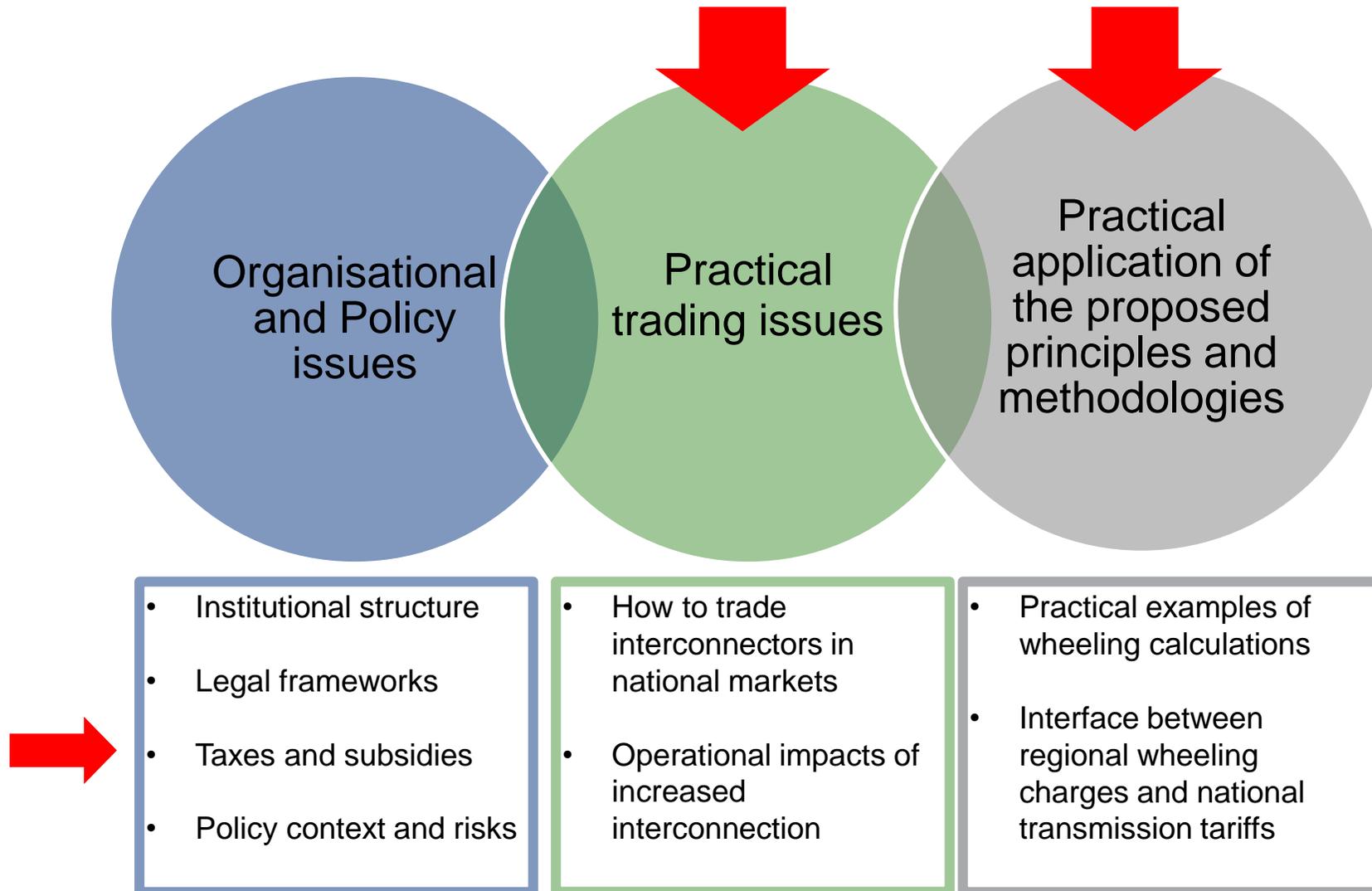


TA8830: Extended scope of work



TA8830: WGRI “Near Term Works”

- Building on conclusions from RPTCC-23





Scope of Work - 1

- **Develop Practical Examples of Wheeling Charge Calculations for the GMS Countries**
 - **Myanmar:** RPTCC-23 agreed with the Myanmar delegation to work with the WGRI Members and the Consultant to estimate transmission charges.
 - **Thailand:** Thailand had expressed interest in exploring the relevance of the MW-km method for its own internal transmission charges.
 - **China:** agreed to review the inter-provincial trading in China and identify lessons for the GMS avoiding clashes between national and regional charging principles and trading rules
 - **Lao PDR:** two areas for cooperation in the WGRI:
 1. Exploring models for BOT transmission development in Laos and the associated wheeling charges, especially the integration of these with national transmission tariffs
 2. Identify the potential learning for the wider GMS community

Practical application of the proposed principles and methodologies



Scope of Work - 2

- Identify 2 or 3 existing international interconnectors which have **surplus capacity** and propose **practical steps** for short-term trading to take place and imbalances to be settled
- Carry out a detailed study of national electricity **subsidies and taxation** regimes that apply to power imports and exports

Practical
trading issues

Organisational
and Policy
issues

Scope of Work - 3



- To inform clearly the starting point for this work, prepare a **survey of national transmission charging methods**, to assess possible issues in applying the regional Methodology for Wheeling Charges
- Identify a first possible **Grid to Grid** interconnection to use as a case study for two-way trading rules and principles

Surveys of Existing Transmission Pricing Methods

Regional all-country survey of existing transmission pricing methods

1

TAB30-REG: Harmonizing the GMS Power Systems to Facilitate Regional Power Trade

National Transmission Pricing Questionnaire
Please provide responses at WGRI Meeting on 10th June 2016

A. Introduction

An extended Terms of Reference has been agreed for the activities of the WGRI, to work towards the practical implementation of the Methodology for Wheeling Charges (MWC) that was agreed in the work completed at RPTCC-23.

B. National Transmission Tariff

To take this new work forward, the first task requires a survey to be completed of the national transmission charge methodology used by each of the GMS member countries. This will enable possible issues in the application of the MWC to regional power trades to be assessed, and assist in the process of integrating wheeling charges with national transmission charges.

To assist this survey, please prepare a brief (15-minute) presentation, with supporting Power Point slides or reference material, to answer the following questions about the way that national transmission tariffs are calculated in your country. Please answer the following questions. If transmission services for networks >110kV are priced separately from energy in the calculation of wholesale and/or retail tariffs.

If transmission tariffs are not calculated separately from energy, please see Section C below.

Network charges

- Which costs are recovered by the transmission charges (e.g. network asset investment costs, equipment operations and maintenance (O&M) costs, overheads, losses, system operation)?
- Who pays the charges, and how are transmission charges split between generation and consumption? Are the charges applied to any cross-border imports or exports?
- What is the structure of transmission charges? (E.g. are there charges for transmission based on energy consumption/generation, or maximum demand/peak generation, or installed generation capacity)?
- Are transmission charges geographically differentiated, and if so, how do they vary across the country? Please explain the reasons for any significant regional differences in charges.
- Please describe the methodology that is used for calculating the charges, and explain whether daily rates or monthly/quarterly charges as described in the TAB30 reports:
 - Postage stamp pricing – each user pays the same charge per kWh or per MW
 - Contract path pricing – users pay for transmission based on an assumed set of assets used in energy transactions
 - Distance-based MW/km pricing, in which the peak flow associated with each national electricity trade is assumed to flow over a defined set of transmission assets
 - Flow-based MW/km pricing, in which the power flows associated with each trade are calculated using a load flow model
 - Long-run marginal cost-based pricing
 - Short-run marginal cost-based pricing

6. How often are charges recalculated? (Annually, or less frequently, or in response to specific changes on the network?)

7. How are the network assets valued in the charge calculation?

- Historical cost basis, using asset values as at the time of installation.
- Modern equivalent asset basis, in which asset costs are based on the nearest equivalent equipment types available today.
- Other (please describe).

Losses charges

- How are losses charged for – are charges based on average losses occurring on the system as a whole, or on the basis of the marginal losses caused by each specific trade?
- What energy price is used for loss charges? Does this vary by hourly/season?

Transmission charging model

10. Please provide any documentation/description of the transmission charging model.

11. Please indicate with reference to the following table of international methods transmission charging methods which one most closely describes the method used in your country.

Country	Postage Stamp	Contract Path	Distance-based MW/km	Flow-based MW/km	LMC-based additional	SRMC-based total
GB						
Ireland	✓					✓
Australia	✓			✓		
Brazil						✓
New Zealand	✓					
Europe (ENTSO-E)	✓					
SAPP (SAPP Proposed)				✓		
Cambodia						
PRC						
Lao PDR						
Myanmar						
Thailand						
Vietnam						

Country-specific detailed surveys for Myanmar, Thailand and Lao PDR

TAB30-REG: Harmonizing the GMS Power Systems to Facilitate Regional Power Trade

Lao PDR: Transmission System Modelling Questionnaire
Please provide responses during Breakout Discussion at WGRI Meeting on 10th June 2016

A. Introduction

An extended Terms of Reference has been agreed for the activities of the WGRI, to work towards the practical implementation of the Methodology for Wheeling Charges (MWC) that was agreed in the work completed at RPTCC-23.

The scope of work agreed included developing practical examples of wheeling charge calculations for the GMS countries. Lao PDR proposed two areas for cooperation in the WGRI, (i) exploring models for BOT transmission development in Laos and the associated wheeling charges, especially the integration of these with national transmission tariffs, and (ii) identifying the potential learning for the wider GMS community for the future development of transmission infrastructure.

To explore to explore this possibility further, details are required of the current transmission models and network data available within EDL, or the Ministry of Energy & Mines that could be used as a starting point for estimating transmission charges.

This questionnaire lists the data that is needed to enable this analysis to proceed. The Lao PDR delegation to the WGRI is asked to provide this information in soft copy as far as possible and to make this available to the consultant during a breakout discussion from the WGRI meeting in Nay Pyi Taw that is scheduled to take place on Monday 10th June 2016. During meeting there will be an opportunity to clarify and discuss the data requirements in detail.

B. Data Requirements

Note: the data requirements listed below describe a comprehensive set of information that would be used to calculate transmission charges for an entire network. Approximations and simplifying assumptions can be made where data is not available, however to help establish the baseline for our work, it will be helpful to know how much of this information is currently available. Priority items are highlighted in red.

B.1 Network Topology

Question 1 relates to the interconnected national transmission network. Questions 2 & 3 relate specifically to interconnectors with neighbouring countries.

It is important in our work to be able to assess the extent of the transmission network and understand how the MW/km methodology might be applied in the existing network. To assist the initial work, we need to gather some basic information about the transmission network.

- Please provide a single line diagram for the transmission network indicating the transmission lines and substations with voltage levels >=110kV. This should indicate the voltage levels of transmission line circuits and provide transformer ratings where possible.



Consultant's Programme/deliverables

- Work programme extends over the next three months
- Includes the finalisation of the ADB Knowledge Product from consultancy work reported at RPTCC-23.

Deliverables	Estimated Submission Date
Report 3: Knowledge Product for publication by ADB	Draft submitted May 2018 Editorial iterations ongoing
Data gathering – wheeling charges (GMS Countries)	Jun 2018 – Aug 2018
Analysis, Framework Plan	Oct 2018
Final report to WGRI	Dec 2018



Applying the MW-km methodology

- Objective is to explore the use of a flow-based MW-km method for **national** transmission charges
- Will be applied to transmission assets – defined as 110kV and above? Or could apply to 220kV and above, depending on national policies and/or modelling practicalities
- Need to recover the costs of assets including transmission lines, cables and substations
- Must apply the method in a way that is compatible with the application of the GMS Methodology for Wheeling Charges developed in our earlier work.





Priority activities – the key requirements for calculating charges

1. A **database** of:
 - Transmission system technical characteristics
 - Circuit Costs
 - System Demand in peak loading conditions
 - Generation dispatch in peak load conditions
2. A **power flow model** that can easily be used to model increments and decrements in demand and generation
 - The MW-km method is a transaction-based method
 - System needs to be modelled “with and without” each transaction
3. A clear understanding of **the way that power is traded** in the current environment
 - How are contracts defined?
 - Where is the buying and selling point for the energy?
 - How will the charges relate to these contracts?

Engagement with the WGRI members – key steps



Data collection

- Review data collection questionnaires
- Discuss existing transmission tariffs (where these exist)
- Discuss transmission system models

System modelling

- Develop and agree method for calculating charges
- Agree network studies for wheeling cases to be investigated
- Discuss results – bilateral meetings and WGRI as a group

Knowledge sharing

- Present the results of the national charge calculations
- Discuss the implications for other countries and for MWC application
- Develop next steps for wider MWC application



WGRI Discussion

- Review of international experience in transmission charge application
- Starting points: Current status of transmission charging in GMS member Countries
- Priorities for GMS member countries and areas where assistance can be provided
- Learning from GMS countries' experience or trial to date and areas where specific contributions will be helpful
 - Particularly relevant experience from PRC and Thailand
- Priorities and next steps



International Approaches to Network Pricing

International Charging Methods



- Broadly fall into two types: **postage stamp** and **flow-based**
- Can be used in combination, to recover a proportion of **fixed** and **locational** costs

Country	Postage Stamp	Contract Path	Distance-based MW-km	Flow-based MW-km	LRMC based nodal/zonal	SRMC-based nodal
GB					✓	
Ireland	✓				✓	
Australia	✓			✓		
Brazil					✓	
New Zealand	✓					
Europe (ENTSO-E)	✓					
SAPP				✓		
WAPP (Proposed)				✓		



International transmission charging methods - 1

- **Great Britain**

- Transmission Use of System tariffs consist of two parts:
 - **Locational** tariffs
 - **Residual** tariffs, which adjust the locational element to recover the correct revenue
- Paid by **generation and demand**
- Locational tariffs are calculated using a **transport model**
 - A DC Load-flow based model
 - Calculates incremental costs to the Transmission Owner of supplying generation and demand in different locations
- Differentiates charges into **27 Generation zones** and **14 Demand zones**
- Charges take account of different system expansion costs for overhead lines and cables and different voltages
- Allowance is built into the pricing for transmission system security
- Charges applied to generation and demand – 17%/83% split in 2018/19



International transmission charging methods - 2

- **Ireland**

- Generation pays a **locational** and **postage-stamp** charge
 - Locational element accounts for 30% of charge, postage-stamp 70%
- Demand charges are **postage-stamp** only
- Locational charges are based on a “reverse MW-mile” method
 - Generators are credited in situations where flows are reduced on particular lines
 - Based on a DC load flow model
- Each generator’s contribution is analysed in turn, based on “with and without” scenarios
 - Loads decreased proportionately across the system when each generator is removed
- 4 dispatch scenarios are modelled (winter and summer peak, with different levels of wind penetration)
- Costs based on modern equivalent asset values of all new and recently built assets



International transmission charging methods - 3

- **Australia – TransGrid (New South Wales)**

- Splits revenue requirements into four categories:
 - Annual Service Revenue Requirement (ASRR) for Entry Services
 - ASRR for Exit Services
 - **ASRR for Transmission Use of System Services**
 - **50% Locational**
 - **50% Postage Stamp**
 - ASRR for Common Services – **100% postage stamp**
- } “Connection Charge”
- **Cost Reflective Network Pricing**
 - Allocation of generation to load using a “fault level” approach
 - Generators closest to the load are assumed to have the greatest contribution
 - Determine proportional use of different network assets using load flow modelling
 - Identifying operating scenarios of maximum “stress” on the network



International transmission charging methods - 4

- **Southern African Power Pool**
 - **MW-km flow based method**
 - Methods based on the analysis of individual transactions
 - Point to point **physical bilateral contracts**
 - Defined generation injection, defined load point
 - Identifying the **proportional use of transmission assets** by each trade
 - **Modern equivalent asset valuations**, with depreciation
 - Depreciation limited to **50%** of the asset value
 - Important to ensure recovery of costs for long-term assets
 - Seeking to provide incentives for regional power trading
 - Wheeling regarded as a marginal activity, no defined method for combining wheeling tariffs with national transmission charges
 - No scaling of charges to achieve a defined revenue for each national system operator



International transmission charging methods - 5

- **European TSOs (ENTSO-E) Inter-TSO Compensation Mechanism**

- “Fair compensation to transmission system operators for the costs of hosting cross-border flows of electricity”
- Compensation for:
 - **Energy losses** relating from cross-border flows based on “with and without” estimates
 - **Costs of making infrastructure available** to host cross-border flows: a Union-wide assessment of long run average incremental costs of making infrastructure available
- Charges based on calculations of net flows into and out of each national network
- Pending the LRAIC calculation, a flat sum of €100m per annum is defined as the compensation sum available
- Individual TSO shares calculated based on:
 - **Transit factor:** total transit flow on each TSO’s system as a proportion of total transits (75%)
 - **Load factor:** $(\text{Transits})^2 / (\text{Load} + \text{Transits}) / [\text{Total System Load} + \text{Transits}]$
- This is a regional postage charging scheme, not applicable for national



Summary of GMS Country Presentations



Scope of presentations

- Countries were asked to give a summary of the current status of national transmission charges, and to describe ongoing work;
- Key objectives:
 - To understand the priority areas for next steps in the work, and where assistance may most effectively be provided by the WGRI and the Consultant;
 - To identify the contributions and learning that the countries themselves can bring to assist the development of transmission charging;
 - To discuss data and modelling requirements if calculations of possible transmission charges are to be performed;
 - Network models
 - Appropriate system demand scenarios
 - Cost data

Key findings from the country presentations



- **Cambodia**

- EDC performs charge calculations and these are approved by government;
- EDC enters into contracts in which the investment costs of transmission infrastructure are reflected, however more information is required about how these are derived.

- **PRC**

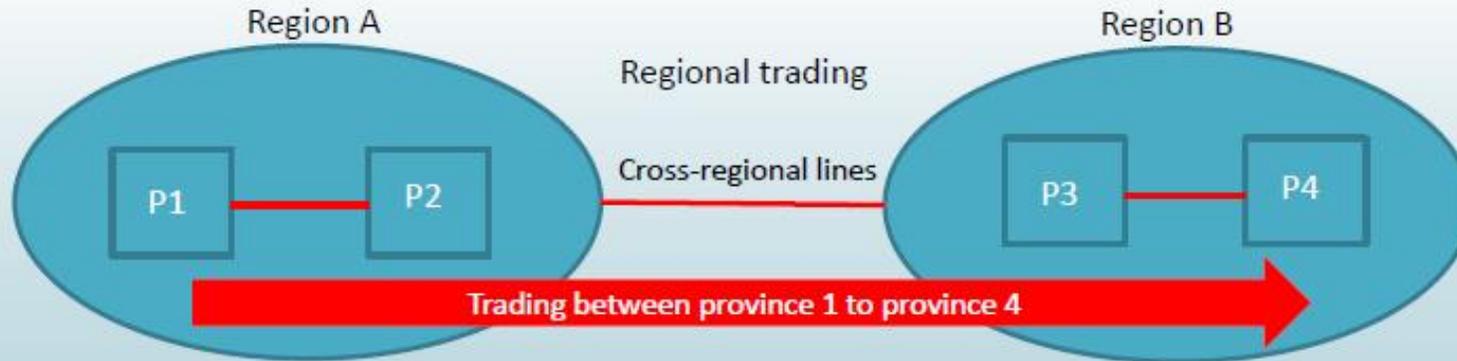
- presented information on the current status of inter-Provincial transmission charges;
- Interface between intra-Provincial and inter-Provincial charges;
- Relevant for considering how national and cross-border transmission charges might work in the GMS.



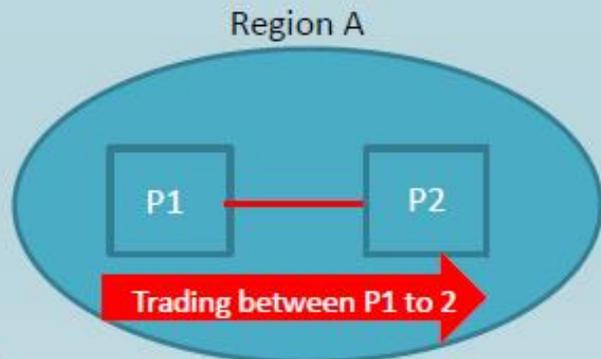
3. Outline of the Inter-Provincial Power Trading Rules



1. The Inter-provincial power trading rule for medium and long term



The P1-2-3-4, region1 and 2's WC, and interconnection cost to TSOs in the trading



Trading within the region

The P1-2 and the region's WC, and interconnection cost to TSOs in the trading

WC: $r/nTPA(RABr \text{ and } RABp)$, Stamps, Cost-plus
Interconnections: Contract path, Cost-plus

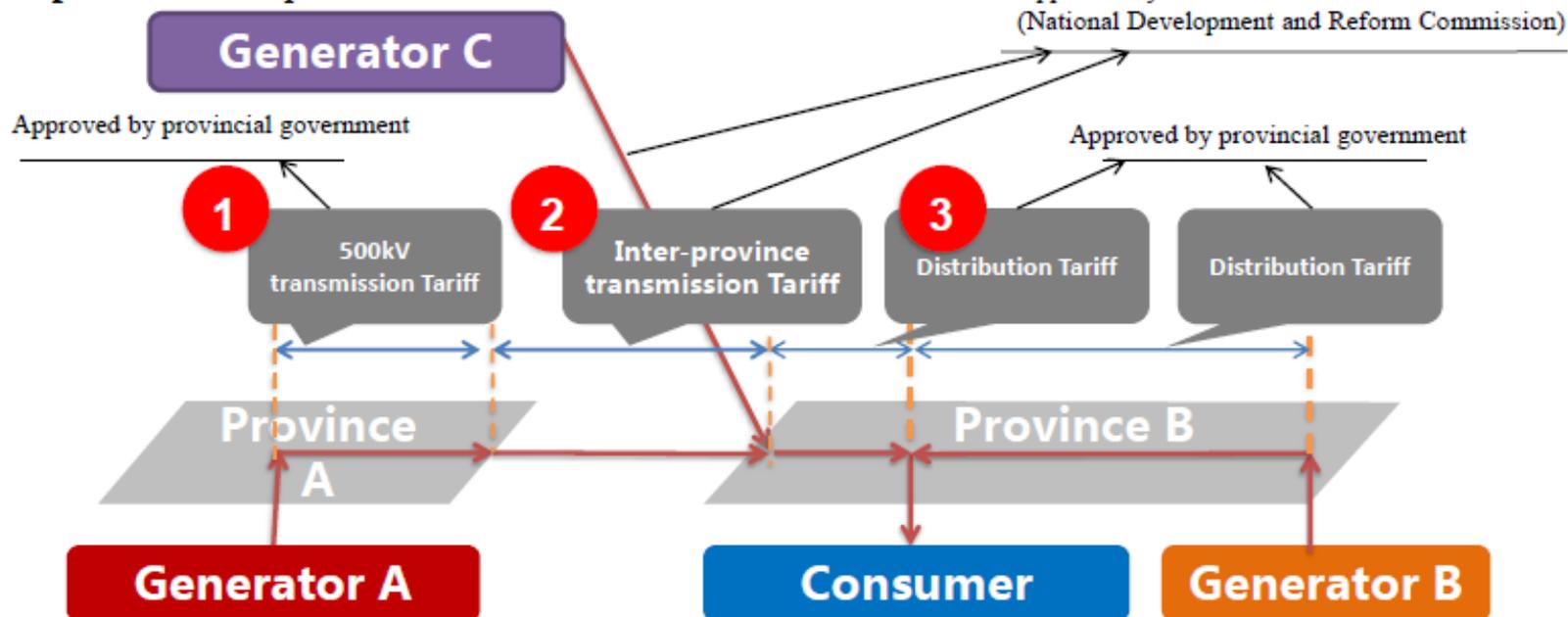
Transmission and Distribution Tariff

广州电力交易中心
GUANGZHOU POWER EXCHANGE CENTER



Contract path method for inter-province transmission

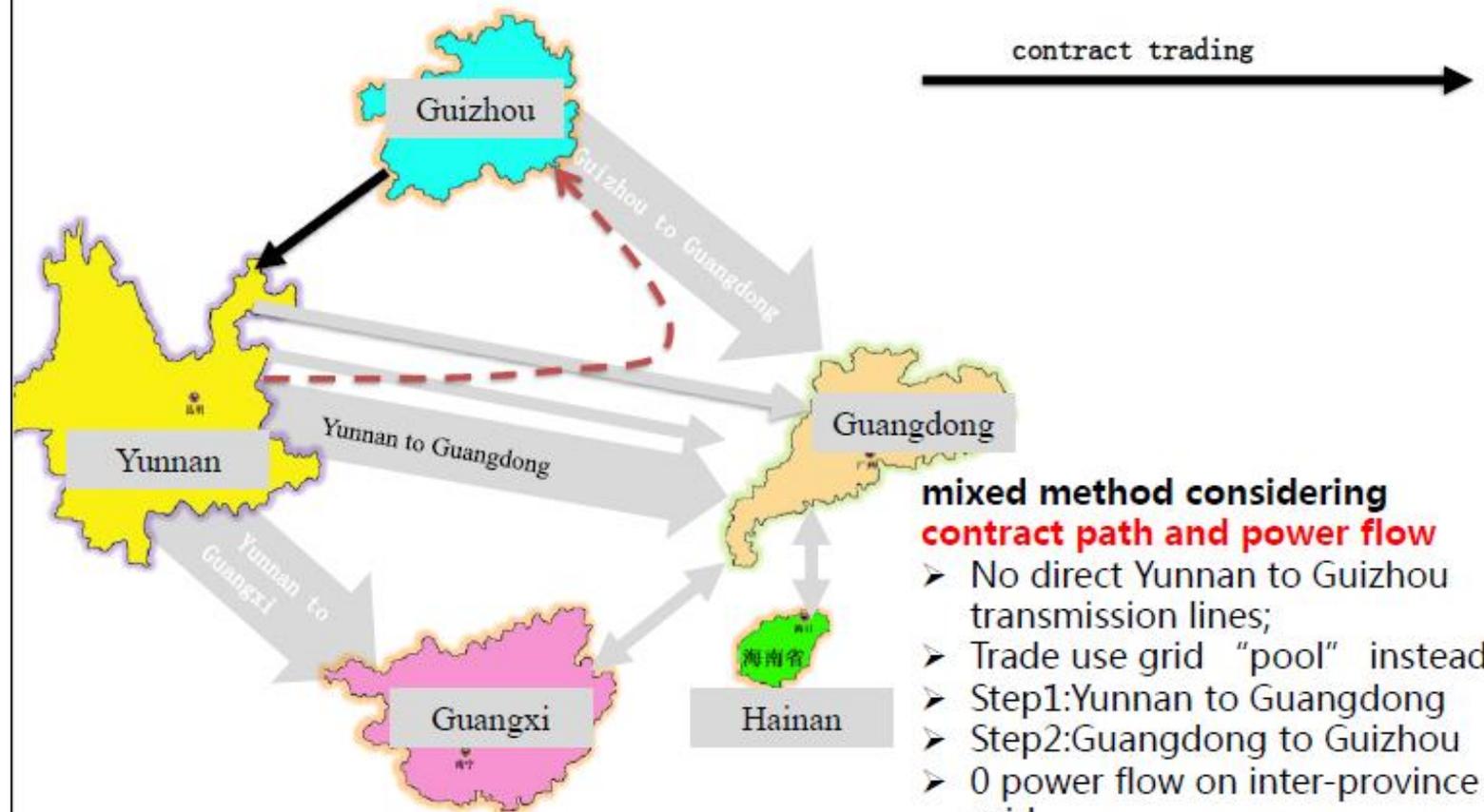
Stamp method for provincial distribution and transmission



Purchase price for Consumer = Energy price
+ T&D tariff
+ Tax
+ additional charges for Government funds

Application cases-mixed method

广州电力交易中心
GUANGZHOU POWER EXCHANGE CENTER



mixed method considering contract path and power flow

- No direct Yunnan to Guizhou transmission lines;
- Trade use grid "pool" instead
- Step1:Yunnan to Guangdong
- Step2:Guangdong to Guizhou
- 0 power flow on inter-province grid
- Total volume west-to-east remains the same



- A set of clearly defined priorities for next steps in transmission charging, being addressed by existing projects

Update for RPTCC-24

- TL charge for Domestic IPP
- Existing project: Nabong 500KV transmission facilities, LTM project
- Lao-Viet Interconnection
- GOL is considering to sign MOU with Developer to study BOT of transmission including establishment the Transmission Company



Update for RPTCC-24

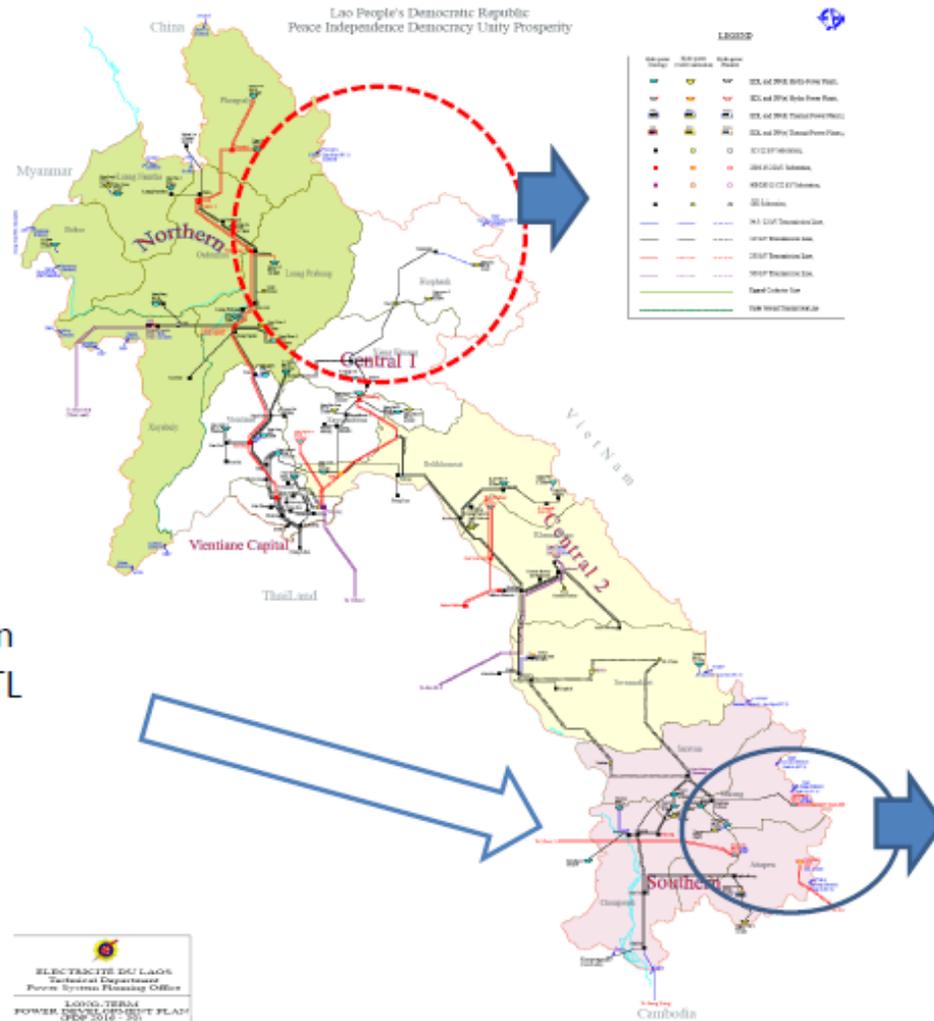
Targets power exports from Laos to Vietnam:

- 1000 MW by 2020
- 3000 MW by 2025
- 5000 MW by 2030

Maximize Using of common TL

Lao-Viet Interconnection:

- exporting power via Xekaman 1HPP and Xekaman 3 HPP's TL
- investment for new line and upgrade in Laos
- TL charge based on new investment





Update for RPTCC-24

GOL is considering to sign MOU with Developer to study BOT of transmission including establishment the Transmission Company

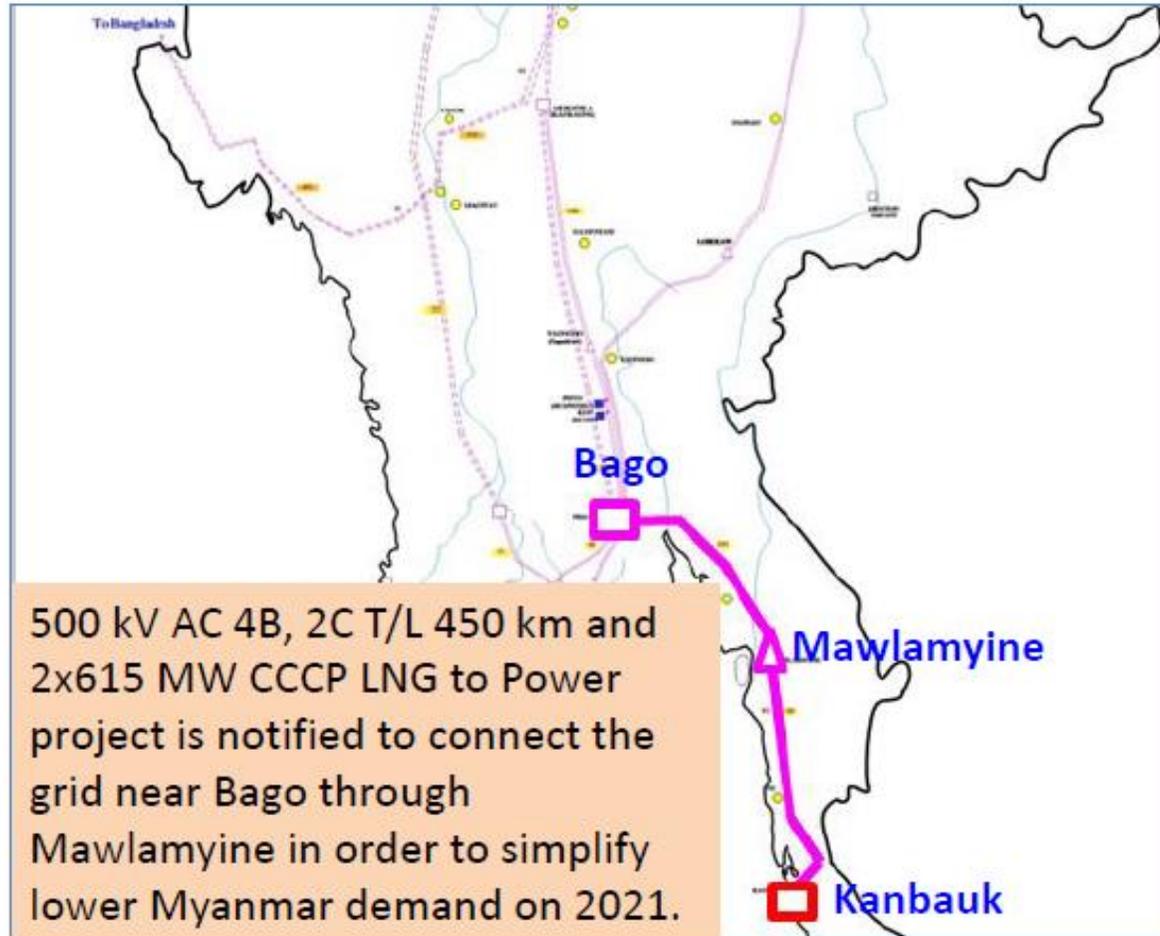
- Technical feasibilities
- Business model
- Financing scheme
- etc



- Presentation entitled “Towards the Practical Implementation of the Methodology for Wheeling Charges”
- Priorities for investigation are related to possible transfer of 500kV transmission lines that would be built as part of IPP development, to Department of Power Transmission and System Control (DPTSC)
- How would the charges for subsequent use of the transmission assets be addressed?
 - Requires an understanding of both the transmission project itself and the likely use of the line in a variety of operating scenarios
 - Objective is to carry out a pilot study first, and then to apply learning to a second case.



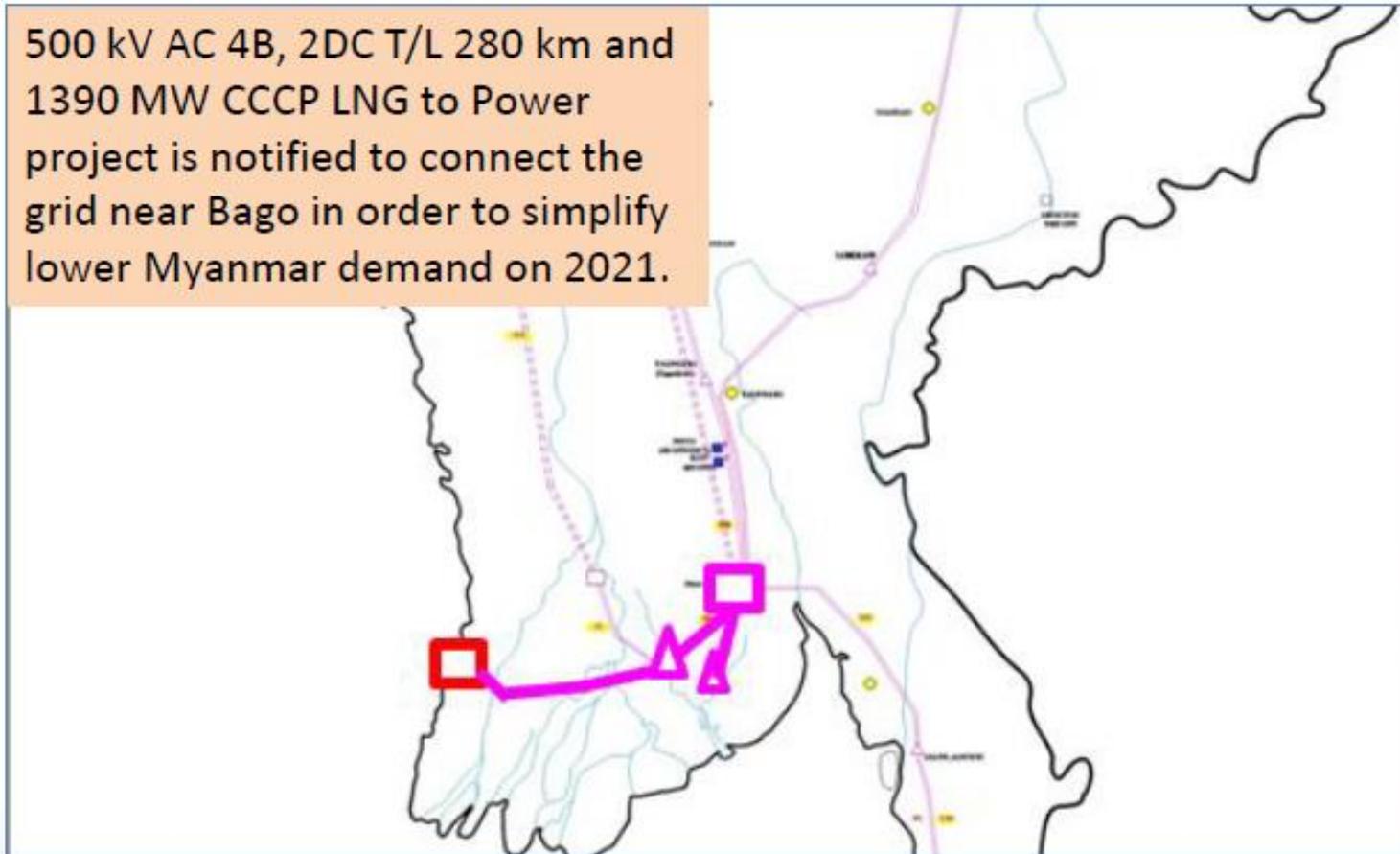
Priorities for transmission charges in new projects – 1230 MW





Priorities for transmission charges in new projects – 1000 MW

500 kV AC 4B, 2DC T/L 280 km and 1390 MW CCCP LNG to Power project is notified to connect the grid near Bago in order to simplify lower Myanmar demand on 2021.





- Discussion focused on three points:
 1. The current experience in Thailand with the Postage Stamp methodology for transmission charges and its usefulness under the Enhanced Single Buyer model;
 2. Possible areas for improving cost-reflective pricing with the Postage Stamp approach;
 3. three different elements of the Lao-Thailand-Malaysia interconnection project, which is a trial of multi-wheeling transmission practice.



The Structure of Transmission Charge

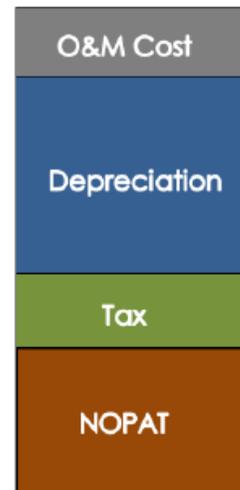
Transmission Charge will be calculated based on energy consumption

EGAT Transmission
Tariff calculation

=

$$\frac{\text{Net Present Value of Allowed Revenue}}{\text{Net Present Value of Energy Transmitted by EGAT}}$$

Concept for Transmission Charge Calculation



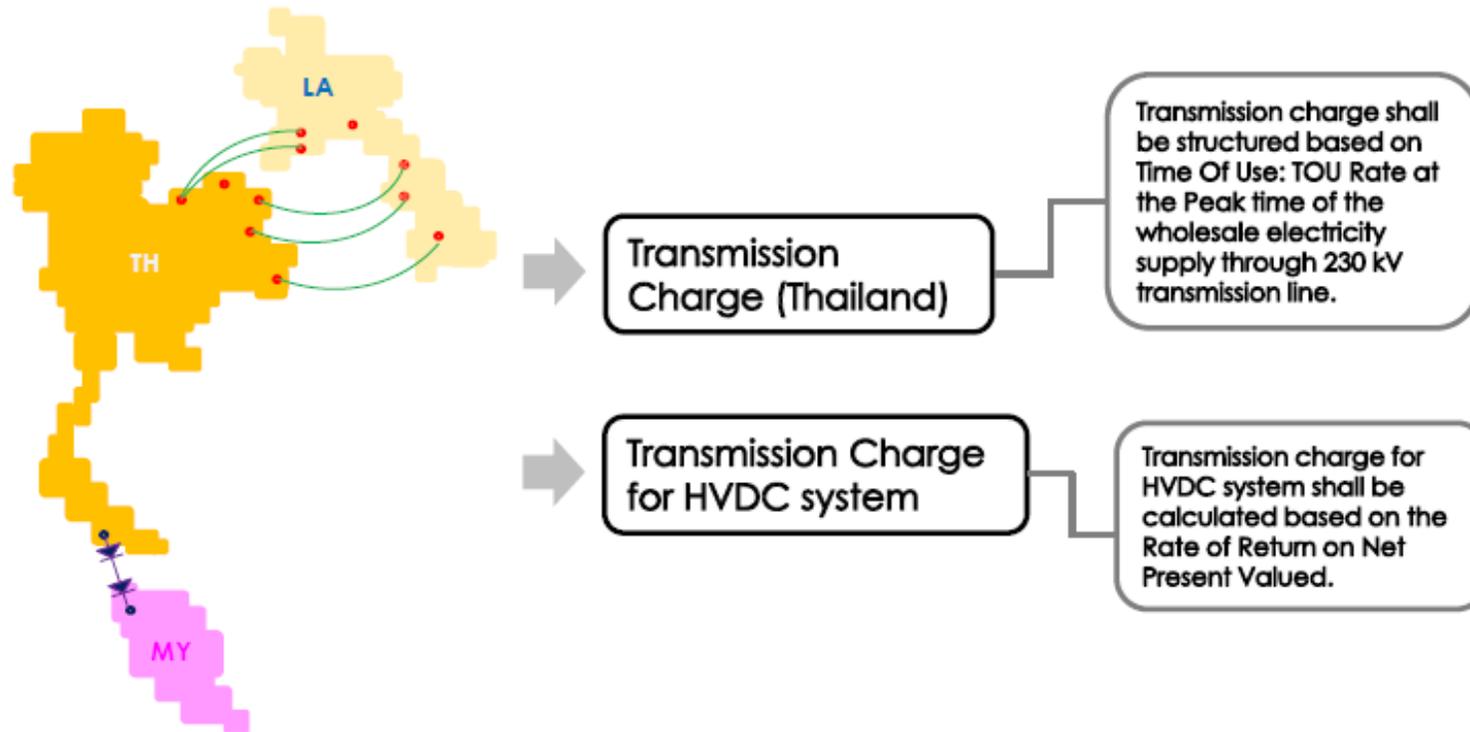
Allowed Revenue (Mbaht)

Allowed Revenue (Mbaht)
= NOPAT + Tax + Depreciation + O&M Cost
stipulated by ERC



The Structure of Wheeling Charge Calculation

The charges related to LTM-PIP project could be categorized into 2 schemes



Both will reflect Cost of Capital, Return on Invested Capital, Operation Cost and O&M Cost. The tariff rate is supposed to be transparent and be consented by all relevant parties.



- Discussion focused on Vietnam's experience with the application of the Postage Stamp approach to transmission pricing, including the key stages in its application.



Transmission Charges (3/5)

- **Features of transmission charge mechanism**
 - Uniform price that does not depend on transmission distance and off-take point (VND/kWh)
 - Developed and approved annually
 - Payment: EVN/EPTC, PCs and customers purchasing power directly from the transmission grid have to pay transmission charge to the NPT
- **Procedure of developing and approving the annual transmission charge**
 - Calculated by NPT and checked by EVN
 - Appraisal by ERAV (Regulator)
 - Approved by MOIT leader



6



Transmission Charges (4/5)

- **Calculation Method:**

- Transmission charge (g_{TT}) is defined based on the following formula:

$$g_{TT_N} = \frac{G_{TT_N}}{A_{SL_N}}$$

- G_{TT} - Annually allowed power transmission revenue for NPT, based on total allowed capital costs, total operation and maintenance costs for NPT and adjusting factor of NPT revenue for year N (VNĐ).
- A_{SL} - Total forecasted amount of power to be transmitted (kWh).





Transmission Charges (5/5)

- **The current transmission charge in Vietnam:** 110,88 VND/kWh (around 0,49 US cent/kWh)
- **Issues under consideration**
 - Transmission charge period: can be applied from 3 to 5 years
 - Study for applying the capacity pricing transmission mechanism
 - Payment mechanism from the power utilities using the transmission grid



Possible priorities for the next phase of work



- **Lao PDR**

- Review the key requirements for creating of a national Transco
- What are the regulatory requirements, licensing needs and commercial agreements required?
- How would the Transco be funded?
- Which assets would be transferred, and how would their costs be recovered?
- (Not addressing the areas of work that are already covered by other projects)

- **Myanmar:**

- Develop an approach for the treatment of 500kV transmission lines that would be developed as part of an IPP project and transferred to DPTSC subsequently
 - How would charges for using the line be calculated and applied?
 - What sort of modelling would be needed?
 - What level of costs need to be recovered?
 - Would a flow-based methodology that allocates costs to users be appropriate?

Possible priorities for the next phase of work



- **Thailand**

- A review of other international single buyer markets, looking at the scope for introducing flow-based charging for national transmission prices
- Working with the postage stamp method, investigating the possibility of making this more cost reflective:
 - Considering the development of peak and off-peak charges (including the “critical peak” period, recognising that Thailand currently has three peaks during the day) What about seasonal variations in the charges?
 - Also considering the differentiation of capacity vs. energy costs
 - Investigating the possible application of charges to generation as well as demand.
- Drawing on Thailand’s wheeling charge work under the LTM project to inform other discussions in the WGRI (but noting confidentiality constraints)

Key stages in the immediate future work



Review scope of work definitions and share with Lao, Myanmar and Thailand delegations

Assess data requirements for carrying out specific investigations, send to delegations and conduct meetings

Develop analytical work, share with country delegations, WGRI and report at RPTCC-25



Thank you!