

**Greater Mekong Subregion Economic Program**  
**20<sup>th</sup> Meeting of the Regional Power Trade Coordination Committee (RPTCC-20)**  
Phu Quoc, Viet Nam, 27– 28 June 2016

## **I. INTRODUCTION**

1. The Greater Mekong Sub-region (GMS) countries convened the 20<sup>th</sup> meeting of the Regional Power Trade Coordination Committee (RPTCC-20) on 27–28 June 2016 in Phu Quoc Island, Viet Nam. This time the RPTCC-20 is organized in combination with the meetings of the working group on performance standards and grid code (WGPG) and working group on regulatory issues (WGRI). The meetings of working groups discussed findings of the two reports prepared by consultants under the RETA 8830, deliberated on the recommendations and proposed work plans. The RPTCC meeting on the next day, (i) approved the recommendations and work plans for the two working groups; (ii) updated the progress of the RETA 9003; and updated the GMS Regional Investment Framework and its Implementation Plan; (iii) held a discussion about the new WB supported technical assistance to the GMS; and (iv) discussed revision of criteria for hosting the Regional Power Coordination Center (RPCC). Refer to **Annex 1** for the agenda and program.

2. The RPTCC-20 and working group meetings were organized by Electric Regulatory Authority, Ministry of Industry and Trade, Viet Nam, in cooperation with the Asian Development Bank (ADB). Members of Regional Power Trade Coordination Committee (RPTCC) and representatives of ADB, Agence Française de Développement (AFD), and the World Bank attended the meeting. **Annex 2** provides list of participants.

### **A. Working Group Meetings**

3. Mr. Bruce Hamilton, the consultant working under the RETA 8830 made a presentation, highlighting the review of GMS country performance standards and proposed standards for GMS countries for cross-border interconnection projects. His presentation also proposed for GMS countries consideration integrated planning process (**Annex 3**).

4. Mr. Prasert Sinsukprasert from Thailand, the chair of the WGPG, chaired the discussion that followed the presentation. The meeting reviewed the proposed changes to five standards: voltage control, frequency control, harmonic distortion standards in use, maximum fault clearance time and power system planning studies requirement. The discussions and WGPG comments are in **Annex 4**.

5. Questions were raised as to why the proposed standards have some parameters that are looser than the national standards. For example, for frequency control, PRC and Viet Nam already adopted 49.8 – 50.2 (Hz) for frequency control during normal operation, while the other countries use 49.5 – 50.5 (Hz) range. Similarly the maximum fault clearance time<sup>1</sup> for 500 kV system was questioned, because all countries perform better than the proposed revised standards. Consultant was requested to provide basis of his recommendations with technical information on the impacts of each parameter in GMS interconnected system.

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<sup>1</sup> The stronger the power system is, the longer the maximum fault clearance time is. This is also an index indicating the stability level of the system i.e. the ability of anti-disturbance, though the faster for protection relay to clear the fault, the better for the system to keep stability.

6. The meeting deliberated that the consultant will incorporate the comments provided at this meeting, provide more rationale and justification for the proposed standards. The meeting intended to submit the standards with discussed modifications for adoption by RPTCC.

7. The meeting also discussed the consultant proposed 5-step process for regional planning. The meeting recognizes the importance of regional planning process. It was emphasized that national planning provide inputs to regional planning and the two processes should be consistent. The meeting highlights the necessity of having a set of agreeable data for sharing while conducting the regional planning and sharing among the countries for national planning as well. It was agreed that the national load flow analysis can be carried out by national team, using the available models.

8. Mr. Jonathan Hedgecock, the consultant supporting the WGRI made a presentation, summarizing the obstacles to GMS regional power trade, drawing the lessons from the existing GMS power trade, international experiences related to the roles of an independent regulator. He finally proposed for adoption a set of recommendations and steps to be taken for the WGRI (**Annex 5**).

9. Ms. Wu Ye from PRC, the chair of the WGRI, chaired the discussion that followed the presentation. The discussion focuses on the linkages between the obstacles identified and the clarity of the recommendations that the consultant proposed. It was argued that the obstacles identified do not clearly represent obstacles. The obscurity of obstacles inhibited the consultant making clear and relevant recommendations. Meeting participants pointed out the recommendations that study to be carried out to demonstrate the benefit of interconnection is not relevant and not clear, what kind of study, region-wide or project specific. The meeting participants asked the consultant to back up his identified obstacles with detailed assessment of the current situation in the GMS countries, provide more background assessment before naming the obstacles. The consultant also presented examples of regional independent regulators, but did not clearly describe how its functions and roles would work in the GMS. This confused the participants, because it looks as if the consultant proposed super regulator, which regulates everybody, this seemed unrealistic.

10. The market design, third party access and wheeling charge methodology lacked the background assessment, methodological details and require more work. The meeting participants asked the consultant to develop further these concepts and describe clearly what and how they can be proposed for GMS countries. The meeting participants also asked that the consultant make clear the linkages between obstacles, recommendations and next steps to be carried out by WGRI.

## **B. Opening Session of RPTCC-20**

11. Director General Mi Mi Khaing, Department of Electric Power Planning, Ministry of Electricity and Energy, Myanmar, chaired the RPTCC-20. Mr. Nguyen Anh Tuan, Director General, Electricity Regulatory Authority, Ministry of Industry and Trade, Viet Nam and Mr. Duy-Thanh Bui, Senior Energy Specialist, Energy Division, Southeast Asia Department, ADB both acted as Vice Chair of RPTCC-20.

12. DG Mi Mi Khaing opened the meeting. She extended her warmest welcome to all delegations of GMS countries and thanked the government of Viet Nam and ERAV for hosting the RPTCC-20. The Chair also thanked ADB and development partners for continuously supporting the GMS. She thanked the two working groups for an active and engaged working

day for harmonizing performance standards for interconnection projects and overcome regulatory barriers. The Chair lady mentioned that the MOU for establishing the RPCC has been signed by all countries and put in effect in December 2013. But the selection of the host city for RPCC is still going on. According to the resolutions of RPTCC-19 the ADB has prepared a revised evaluation criteria, the Chair called on all countries to engage in the discussion of the revised evaluation criteria and hopefully will find solution to this.

13. DG Nguyen Anh Tuan welcomed all participants, the ADB, AFD and WB to this RPTCC-20. Referring to national power development plans, DG Nguyen Anh Tuan pointed out the power sector in the GMS countries develop rapidly with electricity demand increase with high rate and total regional capacity doubles by 2025. Mutually beneficial power trade has been a priority of Viet Nam since long time Viet Nam purchases power from PRC, Lao PDR and sells electricity to Cambodia. However due to various technical and regulatory barriers the power trade between Viet Nam and neighboring countries is still limited in quantity and scale. DG Nguyen Anh Tuan informed that Viet Nam has started operating the generation competitive market since 1 July 2012, and through this experience competition is the efficient way of mobilizing the supply to meet the demand. He indicated this experience can be a good reference for developing cross border power trade among the GMS countries. He finally wished the meeting full success.

### **C. Adoption of working group recommendations and work plans**

14. RPTCC-20 adopted the following recommendations for WGPG: (i) report for the proposed performance standards be improved incorporating comments and suggestions provided at the meeting of WGPG; then the report be circulated to GMS countries for final approval, the proposed performance standards will then be adopted by GMS countries; (ii) recognize the importance of integrated planning process; the first step is to review existing national network models and system studies being conducted by GMS countries; followed by preparation for integrated planning study, for criteria will be prepared (see **Annex 6**).

15. RPTCC-20 adopted the following recommendations for WGRI: (i) the report on the obstacles to power trade be revised, incorporating comments and suggestions provided at the meeting of WGRI, making clear the linkages between obstacles and recommendations, then the report be circulated to GMS countries for final approval; (ii) develop critical elements of the intermediate market for GMS according to the MOU, namely (a) procedure for short term contracts; (b) procedures for third party access; (c) methodology for calculating wheeling charges; and (d) mechanism for settling of unbalance trade and metering mechanism. The work plan indicates that the development of third party access and wheeling charge methodology will be implemented toward the end of 2016, and balancing and metering mechanism to be developed in first half of 2017 (see **Annex 7**).

16. RPTCC-20 emphasized the importance of full engagement by GMS countries in the technical and regulatory studies. Only the full participation of GMS countries brings meaningful results of the work of consultants. The countries are requested to review timely the report prepared by the consultants and provide feedback in timely manner.

### **D. Update of the progress of RETA 9003**

17. ADB staff and consultant made a presentation describing the inception of the RETA9003, process of applying the integrated resource planning with SEA (**Annex 8**).

## **E. Update Implementation of the GMS Regional Investment Framework**

18. ADB staff presented the implementation of the GMS Regional Investment Framework (RIF) and informed the meeting about the progress report under preparation for submitting to the next SOM (**Annex 9**). Based on the latest information, GMS countries updated the status of the Xekaman 1 – Pleiku 2 transmission line. The transmission line is under construction aiming to meeting the COD for the Xekaman 1 in 2017. The line is being financed by the private developer both in Laos and Viet Nam sides. The PRC – Laos – Thailand interconnection has not any progress, but it is still under considerations depending on the import opportunities by Thailand and depending on the exporting price by PRC.

19. It was noted that while there are many energy/power projects under implementation and/or under development, the GMS RIF-IP is less updated, thus under-reporting the very active area in the region. The meeting agreed that ADB send the template for update to GMS focal points and request update of the RIF-IP through email so that the most recent picture of the power sector in the GMS countries to be updated to the RIF.

## **F. Technical Assistance by the World Bank**

20. The World Bank presented a brief description of the new technical assistance to support GMS countries in power trade development, particularly supporting the two working groups. The WB TA has three pillars: (i) assessment of power trade alternatives; (ii) power market regulatory issues; and (iii) performance standard and grid codes (**Annex 10**).

21. The meeting emphasizes that it is important to avoid duplicating works under the WB TA and RETA8330. The pillars (ii) and (iii) of the WB TA seems to overlap significantly with the on-going activities of the RETA8330. The WB explained that by recruiting Ricardo as the TA consultant, the WB wishes to avoid duplicating efforts of the two TA. Meeting participants have voiced that there is an overlapping of scope of work and requested that the WB resources be used for other un-investigated areas. For example, the RETA 8330 requires the development of third party access principles; development of wheeling charge methodology and development of cross-border trade compensation rules. At the same time, the WB TA proposes to review industry structure; review third party access regulations. These reviews must precede the above mentioned tasks of RETA 8330 anyway so these are unnecessarily overlapped.

22. Meeting participants requested the WB to send to GMS countries all relevant documents for them to be able to review and provide their views and comments for best utilization of the WB resources.

## **G. Discussion of Revised Criteria for Bidding on RPCC Headquarters**

23. Mr. Bui, ADB informed that according to the resolution of the RPTCC-19 the Evaluation Committee (comprising ADB staff, representatives of AFD, DFAT, and the WB) has prepared and submitted to GMS countries the revised evaluation criteria on 18 February 2016 and requested country comments by 31 March 2016. ADB has received comments from PRC on 31 March 2016 and from Viet Nam on 21 June 2016 (after the deadline). The comments received from PRC and Viet Nam have been circulated via email to all countries for information.

24. The chair persons called on the meeting to discuss the revised criteria in the constructive ways, with consensus so that to be able to finalize and adopt the criteria. The chair



persons pointed out that RPTCC has spent too much time on this issue and hope to resolve the issue at this meeting.

25. RPTCC members engaged in a long discussion on this issue without reaching consensus. After trying all possible means, the chair persons declared that the RPTCC-20 has exhausted all possibilities and yet the RPCC-20 could not adopt the final set of criteria for hosting RPCC. Therefore this matter will be referred to the senior official meeting for guidance. The Chairpersons also advised that future RPTCC meetings will not discuss the issue of hosting RPCC headquarters anymore.

## **II. Agreements and Next Steps**

26. The following agreements were reached:

- (i) RPTCC-20 adopted the work plans for the two working groups as presented in the morning session.
- (ii) Despite no agreement on the criteria for hosting the RPCC, RPTCC-20 agreed to continue to foster GMS power trade and interconnections.
- (iii) RPTCC-20 requested the WB to provide details of its new TA for GMS countries to review.

## **III. Other Matters**

27. **Venue of Next RPTCC Meeting.** Cambodia has agreed to host the next meeting tentatively scheduled end-2016. ADB will correspond with Cambodia and other countries to fix the date and exact venue.

**RPTCC-20**

**ANNEXES**

# ANNEX 1

Greater Mekong Subregion (GMS)  
20<sup>th</sup> Meeting of the Regional Power  
Trade Coordination Committee  
(RPTCC-20)  
27 – 28 June 2016

Novotel Hotel, Phu Quoc, Viet Nam



**Agenda and Program**

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***Day 1, 27 June***

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08:15AM – 08:30AM Registration

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***WGPG Meeting***

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08:30AM – 08:45AM Opening address by WGPG Chair (Thailand)  
Purpose of the meeting and expected outcome (ADB)

08:45AM – 09:30AM Presentation of WGPG consultant's report on the findings and  
recommendation to the WGPG (B. Hamilton, WGPG consultant)

09:30AM – 09:45AM Coffee break

09:45AM – 11:15AM GMS countries response to consultant's report  
(15 minutes allotted for each country)

11:15AM – 12:00NN Discussion and adoption of :  
(i) report findings and recommendations; and  
(ii) work plan for WGPG in 2016-2017 including  
responsibility of consultant, GMS countries, and  
WGPG members

12:00NN – 01:30PM Lunch break (Food Exchange Restaurant)

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***WGRI Meeting***

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01:30PM – 01:45PM Opening address by WGRI Chair (PRC)  
Purpose of the meeting and expected outcome (ADB)

01:45PM – 02:30PM Presentation of WGRI consultant's report on the findings and  
recommendation to the WGRI (J. Hedgecock, WGRI consultant)

02:30PM – 04:00PM GMS countries response to consultant's report  
(15 minutes allotted for each country)

04:00PM – 04:15PM Coffee break

04:15PM – 04:45PM Discussion and adoption of :  
(i) report findings and recommendations; and  
(ii) work plan for WGRI in 2016-2017 including  
responsibility of consultant, GMS countries, and  
WGPG members

Greater Mekong Subregion (GMS)  
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04:45PM – 05:30PM	Presentations by WB consultants
05:30PM – 06:00PM	Q&A on WB presentation
07:00PM – 09:00PM	Dinner (Host Country)

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**Day 2, 28 June**

**RPTCC Meeting**

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08:30AM – 09:00AM	Opening Session <ul style="list-style-type: none"><li>• Opening address by RPTCC Chair (2016-2017), --- Myanmar</li><li>• Welcome address by host country, Director General Nguyen Anh Tuan, Electricity Regulatory Authority of Vietnam (ERAV), Viet Nam</li><li>• Welcome address by Duy-Thanh Bui, Senior Energy Economist, Energy Division, Southeast Asia Department, Asian Development Bank</li></ul>
09:00AM – 09:15AM	Group Photo
09:15AM – 09:45AM	Summary of recommendations to WGPG and its work plan for 2016-2017. Adoption by RPTCC (ADB/Aruna)
09:45AM – 10:15AM	Summary of recommendations to WGRI and its work plan for 2016-2017. Adoption by RPTCC (ADB/Bui)
10:15AM – 10:45AM	Coffee break
10:45AM – 11:15AM	Update on progress of RETA9003-REG (Hyunjung Lee, Energy Economist, ADB)
11:15AM – 11:45PM	Update on the Regional Investment Framework (Jyotsana Varma, Senior Regional Specialist, ADB)
11:45AM – 12:15PM	Discussion about WB TA, its work plan (WB)
12:15PM – 01:30PM	Lunch break (Food Exchange Restaurant)
01:30PM – 03:30PM	Discussion on revised criteria on bidding of RPCG headquarters Adoption of criteria or alternative resolution
03:30PM – 04:00PM	Coffee Break





# ANNEX 2

**Greater Mekong Subregion (GMS)  
20<sup>th</sup> Meeting of the Regional Power Trade Coordination Committee  
and Working Groups Meeting  
27–28 June 2016, Novotel Hotel, Phu Quoc, Viet Nam**

**LIST OF PARTICIPANTS**

**Cambodia**

1. Karodine Cheng, Planning Officer, Planning Management Information System and Tariff
2. Choumnit Gnhoung, Deputy Director, Energy Development Department, Ministry of Mines and Energy
3. Sothea Kin, Chief, Planning Office, Ministry of Mines and Energy
4. Selaroth Thy, Generation and Transmission Officer, Electricity Authority of Cambodia

**People's Republic of China**

5. Licong Chen, Program Officer, National Energy Administration
6. Yunpeng Suo, Program Officer, National Energy Administration
7. Hongjiang Tan, Program Officer, National Energy Administration
8. Wu Ye, Division II of Regulation, Department of Market Regulation, National Energy Administration
9. Xinhao Lin, Deputy Director, International Cooperation Department, China Southern Power Grid
10. Peng Li, Senior Engineer, System Operation Department, China Southern Power Grid
11. Zhifei Liang, Senior Engineer, Marketing Department, China Southern Power Grid
12. Qing Long, Section Chief, ICD, China Southern Power Grid
13. Min Tang, Deputy Director, Yunnan Power Grid Co. Ltd., China Southern Power Grid
14. Lei Xiaomeng, Chief Expert, Regional Power Interconnection, China Electricity Council

**Lao PDR**

15. Chansaveng Bounngong, Deputy Director General, Department of Energy Policy and Planning, Ministry of Energy and Mines
16. Bounngong Bouttavong, Deputy Director, Technical Department, Electricite Du Laos
17. Santisouk Phimpachanh, Director, Power System Planning Division, Department of Energy Policy and Planning, Ministry of Energy and Mines
18. Khamphanh Sihavong, Director, Department of Energy Business, Ministry of Energy and Mines
19. Somsanith Sadettan, Deputy Manager, Transmission and Substation Development Department, Electricite Du Laos

**Myanmar**

20. Mi Mi Khaing, Director General, Department of Electric Power Planning, Ministry of Electricity and Energy



21. Saw Si Thu Hlaing, Director, Department of Electric Power Planning, Ministry of Electricity and Energy
22. Win Myint, Deputy Chief Engineer, Electric Power Generation Enterprise, Ministry of Electricity and Energy
23. Moe Thet, Director, Department of Power Transmission and System Control, Ministry of Electricity and Energy

### **Thailand**

24. Vudthidech Chamnikij, Senior Policy and Plan Analyst, Office the Prime Minister/Office the National Economic and Social Development Board
25. Punnee Rojrungsithum, Director, Power Supply Planning Group, Ministry of Energy
26. Panunong Sathorn, Plan and Policy Analyst, Energy Policy and Planning Office
27. Prasert Sinsukprasert, Deputy Director General, Energy Policy and Planning Office
28. Rongrit Chattaworn, Energy Regulatory Commission
29. Ongart Rukkhawattanakul, Plan and Policy Analyst, Office the Prime Minister/Office the National Economic and Social Development Board
30. Arthit Sode-Yome, Engineer, Electricity Generating Authority of Thailand
31. Tawachai Sumranwanich, Assistant Director, System Planning Division-Transmission, Electricity Generating Authority of Thailand
32. Sawapop Takapong, Head, Smart Grid Planning Section, Electricity Generating Authority of Thailand
33. Somruedee Tipmabutr, Administrative Officer, Electricity Generating Authority of Thailand

### **Viet Nam**

34. Pham Quang Huy, Deputy Director General, Electricity Regulatory Authority of Vietnam
35. Do Hung Manh, Deputy Director, Power Market Development, Electricity Regulatory Authority of Vietnam
36. Nguyen Quang Minh, Deputy Director, Planning and Demand – Supply Balance Monitoring, Electricity Regulatory Authority of Vietnam
37. Nguyen Anh Tuan, Director General, Electricity Regulatory Authority of Vietnam
38. Pham Tuam Ngoc, Senior Expert, Power System Analysis and Planning Department, NLDC
39. Le Huu Phuc, Director General, International Relation Department, MOIT
40. Hoang Thanh Phuong, Deputy Director, Synthetic and Subregional Cooperation, MOIT
41. Pham Minh Tuan, Deputy Director, Power Market Department, Electricity Regulatory Authority of Vietnam

### **Development Partners**

42. Dejan Ostojic, Lead Energy Specialist, The World Bank
43. Ky Hong Tran, Senior Energy Specialist, The World Bank
44. Stephane Tromilin, Project Manager, Sustainable Energy Division, AFD-French Development Agency

**ADB Consultants and Others**

45. Graeme Chown, World Bank Consultant, RICARDO-AEA
46. Bruce Hamilton, President, ADICA
47. Jonathan Hedgecock, ADB Consultant, RICARDO-AEA
48. Rafaelita Jamon, ADB Consultant
49. Patrick Miller, ADICA Representative
50. Stuart Thorncraft, IES
51. Don Webster, Managing Consultant, RICARDO-AEA

**ADB**

52. Duy-Thanh Bui, Senior Energy Economist, SEEN
53. Aruna Wanniachchi, Senior Energy Specialist, SEEN
54. Hyunjung Lee, Energy Economist, SEEN
55. Minnie Zarah Ramas, Project Analyst, SEEN
56. Christine Samaniego, Senior Operations Assistant, SEEN
57. Au Minh Tuan, Senior Project Officer (Energy), VRM
58. Jyotsana Varma, Senior Regional Cooperation Specialist, SERC

# ANNEX 3



# ***WGPG Consultant's Report***



Presented by: Bruce Hamilton  
and Patrick Miller

# Topics of Discussion

1. Introduction
  - a) Past RPTCC and WGPG Efforts
  - b) Current WGPG Consultant Services
2. ADICA Proposed Performance Standards
3. Gap Analysis Summary
4. Proposed GMS Regional Planning Process
5. Recommendations
6. Proposed Work Plan for 2016-2017

# Topics of Discussion

- 1. Introduction**
  - a) Past RPTCC and WGPG Efforts**
  - b) Current WGPG Consultant Services
2. ADICA Proposed Performance Standards
3. Gap Analysis Summary
4. Proposed GSM Regional Planning Process
5. Recommendations
6. Proposed Work Plan for 2016-2017

# Milestones in Power Trade Cooperation [1/2]

- 2002**
  - Regional indicative master plan on power interconnections is completed.
  - Intergovernmental agreement (**IGA**) on GMS regional power trade signed.
  - Regional Power Trade Coordination Committee (**RPTCC**) is established to coordinate implementation of power trade pursuant to the IGA.
- 2004**
  - IGA on regional power trade is ratified by all six GMS countries.
  - Guidelines for the RPTCC is adopted at 1<sup>st</sup> RPTCC meeting.
- 2005**
  - Memorandum of Understanding on Guidelines for Implementation of Stage 1 of Regional Power Trade Operating Agreement (**MOU-1**) signed.
- 2008**
  - MOU on Road Map for Implementing the GMS Cross-Boarder Power Trading (**MOU-2**) is signed.
  - Updated regional master plan on power interconnection is completed.
- 2009**
  - GMS Energy Sector Strategy study is completed (RETA 6301).
- 2010**
  - Generation planning criteria defined and OptGen database prepared.
  - Second update of GMS regional master plan: identification of priority interconnections & potential power trade, and gap analysis on frequency control and operating reserves, is completed by RTE Intl. (RETA 6440). 4

# Milestones in Power Trade Cooperation [2/2]

- 2011**
  - GMS Strategic Framework 2012-2022 is adopted.
  - Discussions are initiated on establishment of the Regional Power Coordination Center (**RPCC**) as dedicated coordination center for regional power trade.
- 2012**
  - Two working groups are formed: (i) performance standard and grid code (**WGPG**); and (ii) regulatory issues (**WGRI**).
- 2013**
  - GMS Ministers approve Regional Investment Framework (**RIF**) energy sector pipeline.
  - Strategic Environment Assessment (SEA) of national Power Development Plans (PDPs) by ICEM (RETA 7764).
- 2014**
  - GMS Energy Sector Assessment, Strategy and Road Map completed.
  - Assessment matrix established for prioritizing energy sector projects.
  - RPTCC endorses GMS RIF Implementation Plan (2014-2018)
- 2015**
  - Four investment projects and four technical assistance projects ranked with high priority and included in the RIF-Energy Implementation Plan.
  - Harmonizing GMS Power System to Facilitate Regional Power Trade (TA 8830-REG) is initiated to provide support to WGPG and WGRI.



# WGPG Overview

**Chair – Thailand    Co-chair – PRC**

Set up in 2012 to oversee:

- 1. Gap analyses** on technical performance standards and grid code across 6 GMS countries
- 2. Implementation plan** for harmonization of countries' performance standards and grid code
- 3. Transmission studies:**
  - (i) policy on scheduling & accounting
  - (ii) coordinated operational planning
  - (iii) communication infrastructure
  - (iv) data exchange
- 4. Metering arrangements**

# WGPG Milestones

- 2012** • Assessment of potential synchronous power market operation with recommendation for hierarchical levels of GMS coordination completed by Mr. Michel Caubet.
- 2013** • Recommendation on regional metering arrangements and reference performance standards, and performance of Gap Analysis between GMS and UTCE Performance Standards by Mr. M. Caubet.
- 2014** • Updating of country performance standards and presentation of proposed remedies of various barriers arising from gap analysis.
  - Continued discussion of key criteria affecting potential for synchronous operations.
- 2015** • Harmonizing the GMS Power System to Facilitate Regional Power Trade (TA 8830-REG) is initiated to provide support to WGPG and WGRI

# Topics of Discussion

1. Introduction
  - a) Past RPTCC and WGPG Efforts
  - b) Current WGPG Consultant Services**
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4. Proposed GSM Regional Planning Process
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# Summary of WGPG Efforts & Consultant Support

WGPG Priorities	Past WGPG Efforts	WGPG Consultant Support under TA 8830-REG
<b>1. Gap Analysis on Performance Standards (PS) and Grid Code (GC)</b>	<ul style="list-style-type: none"> <li>Update report of national PS</li> <li>Compare PS for GMS (from RETA 6440) with UTCE</li> </ul>	<ul style="list-style-type: none"> <li>Update report of national PS</li> <li>Recommend ADICA PS based on ENTSO-E requirements</li> <li>Compare ADICA PS with GMS (from RETA 6440)</li> </ul>
<b>2. Implementation Plan</b>	<ul style="list-style-type: none"> <li>Recommend synchronous power market operation with hierarchical levels of GMS coordination</li> </ul>	<ul style="list-style-type: none"> <li>Compare synchronous &amp; asynchronous connections</li> <li>Advise on HVDC technologies and approaches for open access to interconnections</li> </ul>
<b>3. Transmission Studies</b>	<ul style="list-style-type: none"> <li>Conduct system-to-system studies via bilateral GMS country initiatives</li> </ul>	<ul style="list-style-type: none"> <li>Recommend regional planning process</li> <li>Apply GTMax market model for Myanmar</li> </ul>
<b>4. Metering Arrangements</b>	<ul style="list-style-type: none"> <li>Standard regional metering arrangements (based on Final Report of RETA 6440)</li> </ul>	

# Review of Power System Issues for GMS Countries [1/2]

- Reviewed Previous Studies
- Disseminated Data Collection Questionnaires
- Conducted In-Country Update Meetings during Dec-2015 to Jan-2016
- Presented Summary Findings in Draft Report
- Circulated Draft Report for Review and Comment of WGPG Members

Table 1: *National Supply & Demand Balance*

Country/TSO 31 December 2014	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
Installed Capacity (MW)	1,620	232,040	5,560	4,104	34,668	38,776
Peak Demand (MW)	710	136,140	1,008	2,149	26,942	22,000
Total Production (GWh)	3,058	841,300	14,043	13,675	165,313	146,899
Imports (GWh)	1,803	716	1,809		12,268	2,326
Exports (GWh)		5,958	10,842		1,594	1,359
Domestic Supply (GWh)	4,861	836,058	5,010	13,675	175,987	147,866

# Review of Power System Issues for GMS Countries [2/2]

Table 2: *Transmission System Voltage*

Country/TSO 31 December 2014	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
EHV & HV Transmission Lines	230 kV  115 & 22 kV	500, 220 & 110 kV	500,230,115  35,22 kV	230, 132 & 66 kV	500,230, 132, 115 & 69 kV	500,220, 110 kV
HVDC Lines	No	800 & 500 kV	No	No	300 kV	No
Substations in Remote Control	In Phnom-Penh	Yes	Future	No	Yes	Yes

Table 3: *Grid Management using SCADA*

Country/TSO 31 December 2014	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
Organization for Operations	1 NCC	1 NCC  7 RCC	1 NCC	1 NCC	1 NCC,  5 RCC	1NCC  3RCC
SCADA	Phnom-Penh	Yes	In Progress	In Progress	Yes	Yes

# Topics of Discussion

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# Proposed Revision of GMS Performance Standards

- The following tables present GMS standards (from RETA 6440 report) that aligned with UCTE and the ADICA proposed GMS standards that are aligned with current ENTSO-E requirements.
- European Performance Standards have been slightly loosened in order to facilitate the operations of a highly meshed transmission network in Europe. These new standards are administered under the ENTSO-E.



# Proposed Revision of GMS Performance Standards

- These proposed standards will apply when a synchronous interconnection is being designed, constructed and operated synchronously.
- Currently, some GMS countries may not be able to meet every standard during certain peak hours or when a n-1 event occurs.
- The purpose of the proposed regional planning process is to identify needed internal system improvements to accommodate various synchronous cross border interconnections.

# Comparison of Recommended GMS Standards [1/5]

Table 4: *Frequency Control Standards*

	RETA 6440 Standard (UCTE Based)	ADICA Standard (ENTSO-E Based)
Nominal (Hz)	50	50
Normal Conditions (Hz)	49.5 – 50.5	49.5 – 50.5
Emergency Conditions (Hz)	47.5-51.5	47-52
Speed Governing System?	Yes	Yes
AGC (secondary response)?	Yes	Yes
Load Shedding System?	Yes	Yes
Restoration Procedures?	Yes	Yes

- RETA 6440 reports also discuss primary, secondary, tertiary and cold power reserve requirements as they relate to maintaining system frequencies in a synchronous area during an emergency situation.
- ADICA does not recommend adoption of reserve standards at this time, since the determination of reserve requirements must be calculated using detailed studies of the actual synchronous system topography under consideration.
- These studies should be performed when the interconnections forming the new synchronous area are well defined.

# Comparison of Recommended GMS Standards [2/5]

Table 5: *Voltage Control Standards*

Voltage & Conditions	RETA 6440 Standard (UCTE Based)	ADICA Standard (ENTSO-E Based)
Normal Conditions 110-230 kV	+/- 5%	+/- 10%
Normal Conditions Above 230 k	+/- 5%	+/- 10%
Emergency Conditions	+/- 10%	+/- 10%
Tools for Voltage Control	Yes	Yes

- ENTSO-E has revised the UCTE standard for Voltage Control to allow +/-10% variation for transmission lines operating below 230 kV.
- In the GMS region, the only voltage above 230 kV is 500 kV and the standard for this is also +/-10%.
- It is important to note that in the area of voltage control, ENTSO-E does not strictly hold to these ranges but allows each TSO to determine what works best for their system.

# Comparison of Recommended GMS Standards [3/5]

Table 6: *Harmonics Distortion Standards*

Voltage	RETA 6440 Standard (UCTE Based)	ADICA Standard (ENTSO-E Based)
<b>Harmonic Voltage Distortion:</b>		
-500 kV	1.5 %	1.0-1.5 %
-220-230 kV	2.5%	1.5-2.5%
-115-132 kV	2.5%	2.0-3.0%
<b>Harmonic Current Distortion:</b>		
-500 kV	1.5 %	1.0-1.5 %
-220-230 kV	2.5%	1.5-2.5%
-115-132 kV	2.5%	2.0-3.0%
<b>Voltage Unbalance</b>	1%	1%

- ENTSO-E has revised the UCTE standard for harmonic voltage and current distortion providing a range that allows more operating flexibility on meshed synchronous systems.

# Comparison of Recommended GMS Standards [4/5]

Table 7: *Maximum Fault Clearance Time Standards*

Voltage	RETA 6440 Standard (UCTE Based)	ADICA Standard (ENTSO-E Based)
500 kV	80 ms	100 ms
220-230 kV	100 ms	100-150 ms
115-132 kV	120 ms	100-150 ms

- Again, ENTSO-E has revised the UCTE standard so that maximum fault clearance times are increased and are now expressed as a range for lines operating at 115-230 kV.

# Comparison of Recommended GMS Standards [5/5]

Table 8: *Power System Studies Requirement*

Studies Required	RETA 6440 Standard (UCTE Based)	ADICA Standard (ENTSO-E Based)
-N-1 Criteria	Yes	Yes
-Load Flow	Yes	Yes
-Short Circuit	Yes	Yes
-Steady State Stability	Yes	Yes
-Transient Stability	Yes	Yes
-Voltage Stability	Yes	Yes
- Planning Software	PSS/E	Standard Not Required

- The Studies Required column in Table 8 has been maintained from the RETA 6440 study so that comparisons can be made.
- The RETA 6440 report established PSS/E as the standard software to be used for transmission planning studies and open access calculations.
- ADICA recommends that no standard be set for brand of software to be used and that emphasis be placed on establishing a uniform data conversion process.

# Topics of Discussion

1. Introduction
  - a) Past RPTCC and WGPG Efforts
  - b) Current WGPG Consultant Services
2. ADICA Proposed Performance Standards
- 3. Gap Analysis Summary**
4. Proposed GSM Regional Planning Process
5. Recommendations
6. Proposed Work Plan for 2016-2017

# Gap Analysis Process

- Country specific standards data was requested in a questionnaire sent to all GMS participants in late 2015.
- Completed questionnaire's were received from China, Thailand and Viet Nam. Partial information was received from Myanmar
- No updated information was received from Cambodia and Lao PDR; information from the RETA 6440 report was used when available and missing data is evident.
- Comments on the draft final report that have been incorporated in the final report were received from China, Vietnam and Myanmar.



# Comparison of Existing Standards in the GMS to Proposed Standards [1/5]

Table 9: *Frequency Control Data in 2014*

Country/TSO 31 December 2014	ADICA Standard	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
Normal Conditions (Hz)	49.5 – 50.5	49.5-50.5	49.8-50.2	49.5-50.5	49.0-50.5	49.5-50.5	49.8-50.2
Emergency Conditions (Hz)	47-52	47-52	49.0-50.6	47-52	48	47-52	47.5-52.0
Speed Governing System	Yes	Yes	Yes	Yes	-	Yes	Yes
AGC (secondary response)	Yes	-	Yes	-	-	Yes	Yes
Load Shedding System	Yes	Yes	Yes	-	Ministry Guidelines	Yes	Yes
Restoration Procedures	Yes	Yes	Yes	-	-	Yes	Yes

## Gaps in Standards for Frequency Control:

- All GMS countries have standards for normal and emergency conditions that meet or exceed the recommended ADICA Standard. In addition, China, Thailand and Viet Nam comply with the requirements for Speed Governing, AGC, Load Shedding and Restoration systems and procedures.

# Comparison of Existing Standards in the GMS to Proposed Standards [2/5]

Table 10: *Voltage Control Standards in Use*

Country/TSO 31 December 2014	ADICA Standard	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
<b>Normal Conditions</b>							
500 kV	+/- 10%		-0%/+10%		+/-5%	+/-5%	+/- 5%
110-230 kV	+/-10%	+6.5/-10%	+/- 10%	+/- 5%	+/-5%	+/-5%	-5%/+10%
<b>Emergency Conditions</b>	+/-10%	+15/-10%	500 kV: -5%/+10% 220 kV: -10%/+10%	+/-10%	+/-10%	+/-10%	+/-10%
<b>Tools for Voltage Control</b>	Yes	Yes	Yes	Yes	Static Compensator	Yes	Yes

## Gaps in Standards for Voltage Control:

- All GMS countries have standards for normal and emergency conditions that meet or exceed the recommended ADICA Standard of +/- 10%. The Cambodia (EDC) voltage standard for emergency conditions has not been updated for this report

# Comparison of Existing Standards in the GMS to Proposed Standards [3/5]

Table 11: *Harmonics Distortion Standards in Use*

Country/ TSO 12/31/2014	ADICA Standard	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
<b>Harmonic Voltage Distortion:</b>							
-500 kV	1.0-1.5 %	-	See Table Below	1.5%	1.5 %		3.0%
-220-230 kV	1.5-2.5%	2.5 %		2.5%	1.5%		3.0%
-115-132 kV	2.0-3.0%	2.5 %		2.5%	1.5%	1.5%	3.0%
<b>Harmonic Current Distortion:</b>							
-500 kV	1.0-1.5 %	-		1.5%	1.5%		3.0%
-220-230 kV	1.5-2.5%	2.5%		2.5%	1.5%		3.0%
-115-132 kV	2.0-3.0%	2.5%		2.5%	1.5%		3.0%
<b>Voltage Unbalance</b>	1%	1%		1%	1%	1%	3.0%

## Gaps in Standards for Harmonics Distortion:

- Each GMS country has special standards to deal with country specific harmonics distortion issues.

# Comparison of Existing Standards in the GMS to Proposed Standards [4/5]

Table 12: *Maximum Fault Clearance Time Standards*

Country/ TSO 12/31/2014	ADICA Standard	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
500 kV	100 ms	80 ms	90 ms	80 ms	80 ms	80 ms	80 ms
220-230 kV	100-150 ms	100 ms	120 ms	100 ms	100 ms	100ms	100 ms
115-132 kV	100-150 ms	140 ms	150 ms	140 ms	120 ms	120 ms	150 ms

## Gaps in Standards for Maximum Fault Clearance Times:

- All GMS countries meet the new more liberal ADICA Standards for Maximum Fault Clearance Times.

# Comparison of Existing Standards in the GMS to Proposed Standards [5/5]

Table 13: *Power System Studies Requirement*

Country/ TSO 12/31/2014	ADICA Standard	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
<b>Required Studies:</b>							
-N-1 Criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes
-Load Flow	Yes	Yes	Yes	Yes	Yes	Yes	Yes
-Short Circuit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
-Steady State Stability	Yes	-	Yes	-	-	Yes	Yes
-Transient Stability	Yes	-	Yes	-	-	Yes	Yes
-Voltage Stability	Yes	-	Yes	-	-	Yes	Yes
Planning Model Used	No Standard	PSS/E	PSD/DSP	DigSILENT	NEPLAN	DigSILENT	PSS/E

## Gaps in Standards for Power System Studies:

- Planning issues include transient stability studies in some GMS countries and data conversion methodologies to accommodate different planning software used.

# Summary of Gaps Identified Between ADICA Proposed Standards and GMS Countries' Current Standards

**This report has identified some gaps between the Proposed GMS Performance Standards and Existing Standards in GMS countries.**

- None of these gaps are serious impediments to safe and reliable operations of isolated systems or systems connected using HVDC technologies.
- However, these gaps become more important when synchronous interconnections are considered.
- In a synchronous scenario for interconnecting with a neighbor, the impact of each PS gap can only be determined by performing detailed technical planning studies that take into account the exact location of proposed interconnections and the topography of the connected generation and transmission systems.

# Topics of Discussion

1. Introduction
  - a) Past RPTCC and WGPG Efforts
  - b) Current WGPG Consultant Services
2. ADICA Proposed Performance Standards
3. Gap Analysis Summary
4. **Proposed GSM Regional Planning Process**
5. Recommendations
6. Proposed Work Plan for 2016-2017

# Robust and Reliable Regional Power Trade Requires Harmonized Planning Methodologies

- **Generation Expansion Planning Software** (OptGen, WASP, ...)
  - Determine optimal timing, size and location of future power plants
  - Typically do not represent network constraints; capture locational variations in electricity generation-prices-demand; or optimize hydro cascades, unit dispatch and trading opportunities on an hourly basis.
- **Market Analysis Software** (GTMax, SDDP, ...)
  - Optimize hydro cascades and generation dispatch
  - Determine economic benefits of regional operations
  - Prioritize investments in transmission interconnection lines
  - Determine mutually beneficial daily and seasonal power transactions
- **Transmission Planning Software** (DigSILENT, NEPLAN, PSD, PSS/E)
  - Power Flow, Dynamic Simulation, and System Stability Analysis
  - Available Transmission Capacity



# Proposed GMS Regional Planning Process



# Planning Framework for Regional Power Trade in Southeast Europe



USAID  
Economic Benefits of Integrated Operations



EU & World Bank  
Generation and Transmission Investment Study

USAID  
Detailed Transmission System Planning

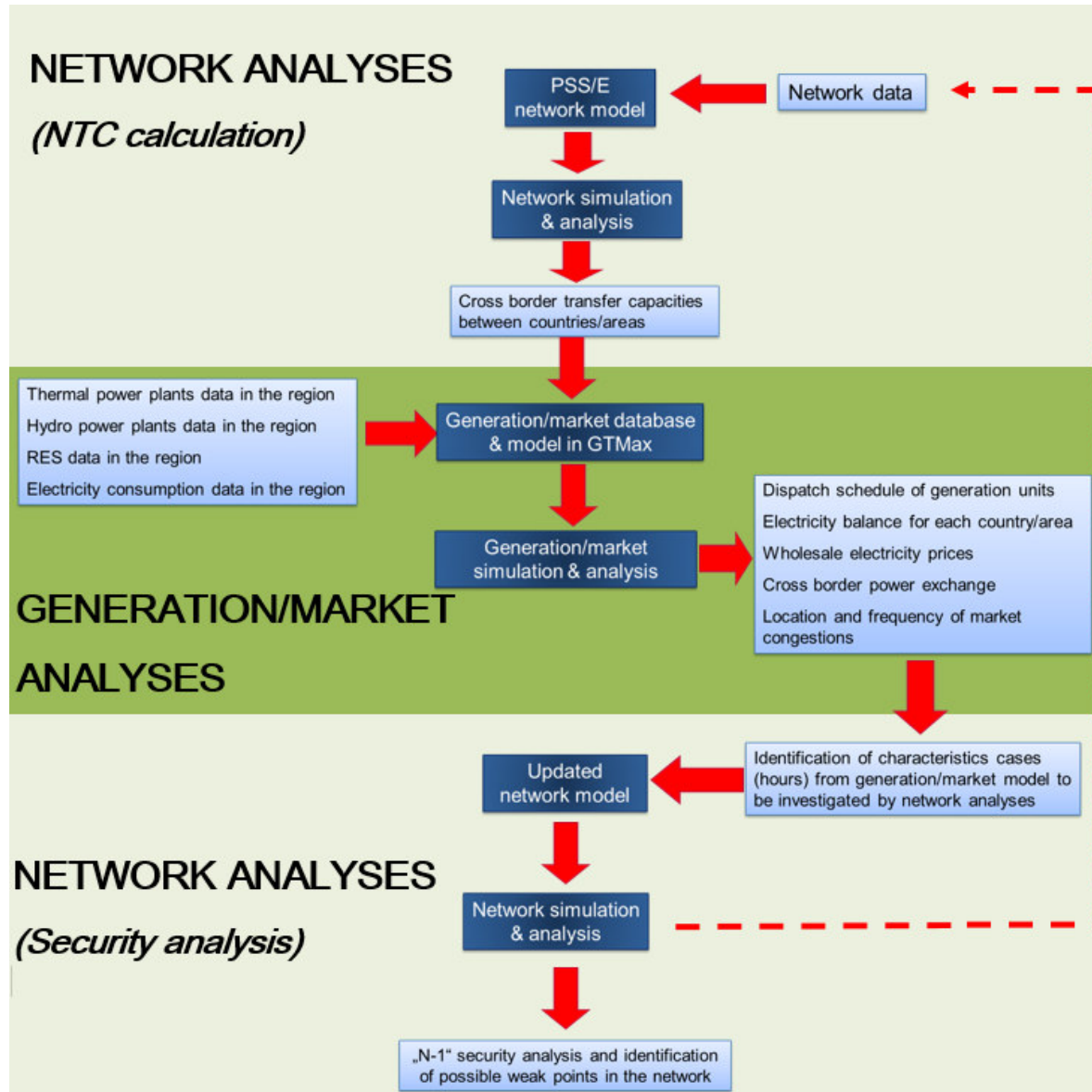


TSOs  
Identify NTC and Opportunities for Power Exchange

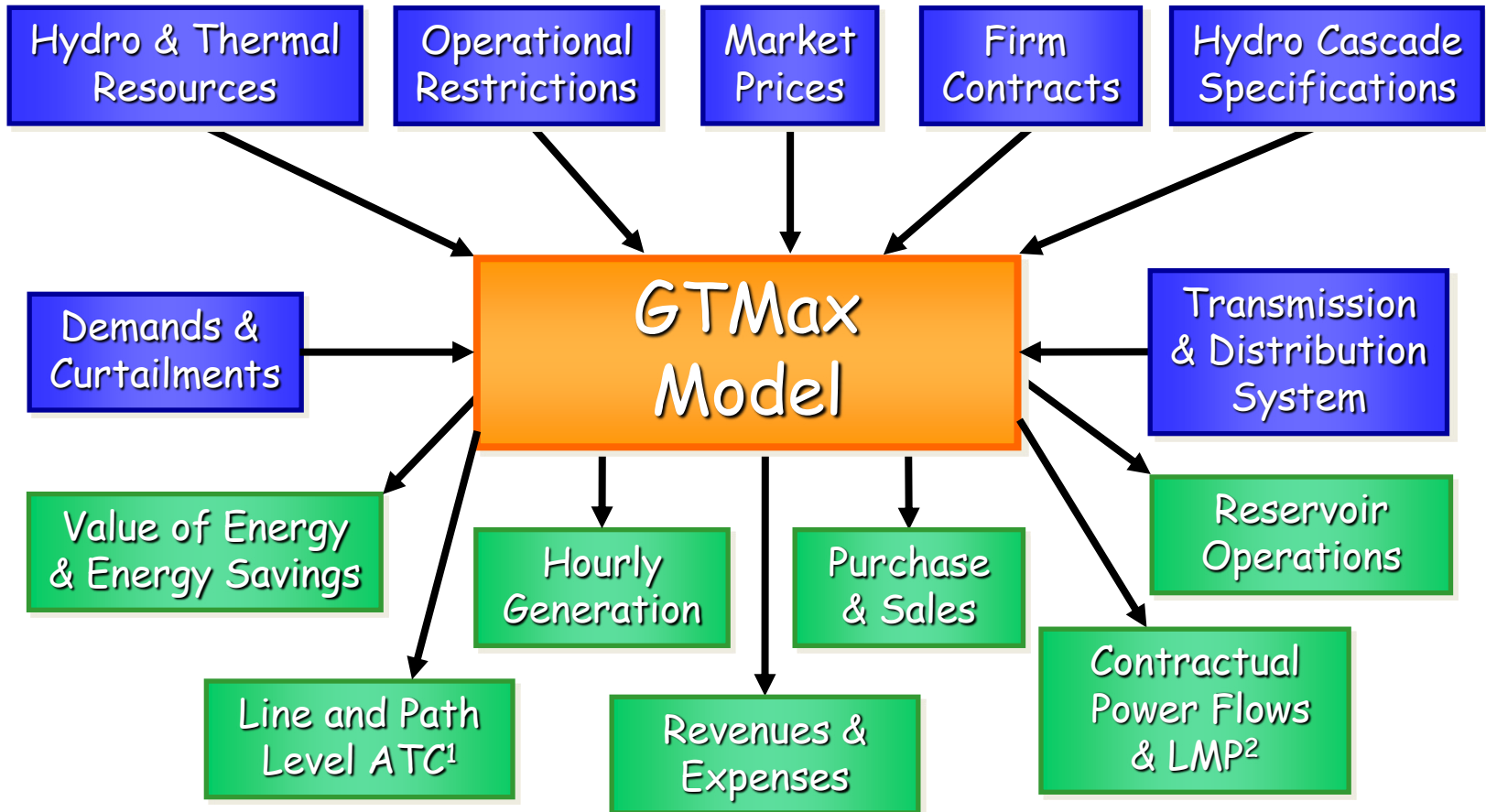


TSO Member Managed Organization for Power Trading Coordination

# Interaction between Transmission Network and Market Analysis



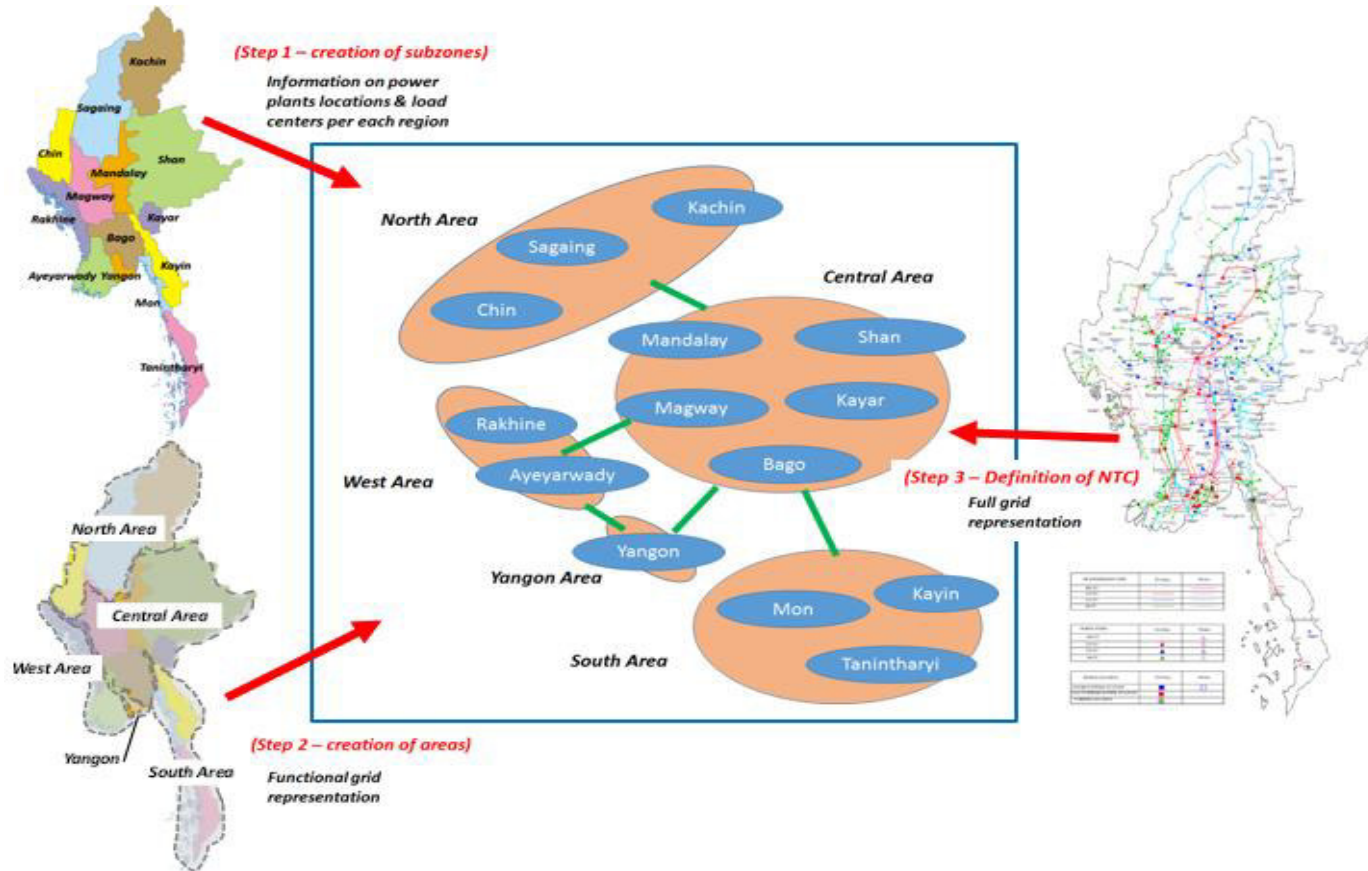
# Market Analysis Software – GTMax



1. Available Transfer Capability (ATC)

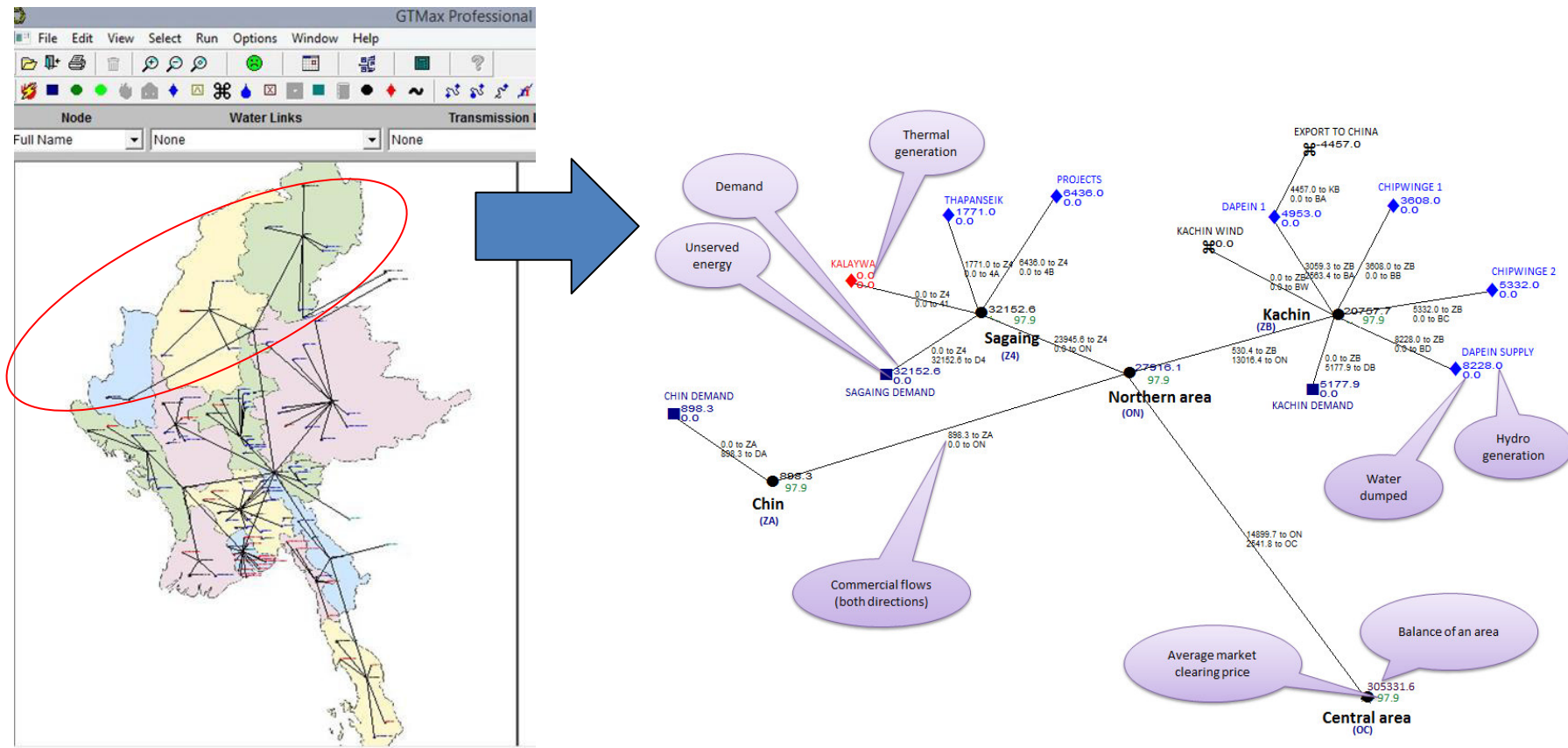
2. Locational Marginal Price (LMP)

# GTMax demonstration analysis for Myanmar – Illustration of modeling approach



1. With information from MOEE on power plants location, transmission system topology and demand for each region, create a **zonal market model for Myanmar**.
2. **Cluster subzones into five bidding areas**, among which network constraints are specified.
3. **Define Net Transfer Capacity (NTC) values** that represent network restrictions on electricity trade necessary to insure power flows and system operation within security limits.

# GTMax model topology for Myanmar



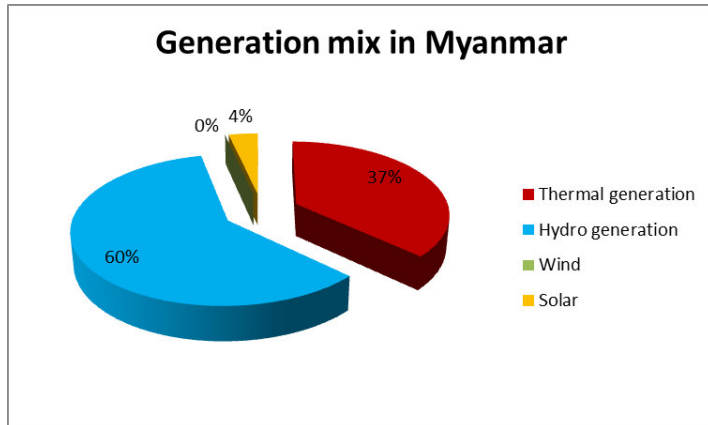
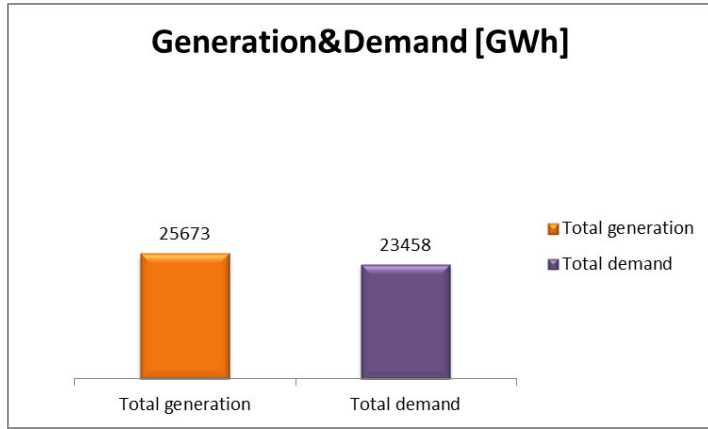
- **Connections with China:** via existing 500 KV TL to support export from HPP Shwelli 1 and 220 KV line to support export from HPP Dapein 1.
- **Connections with Thailand:** new interconnections, each with cross-border trading limit of 1500 MW, considered between Thailand and south & central Myanmar.
- GTMax hourly simulations performed for 52 weeks in 2020.



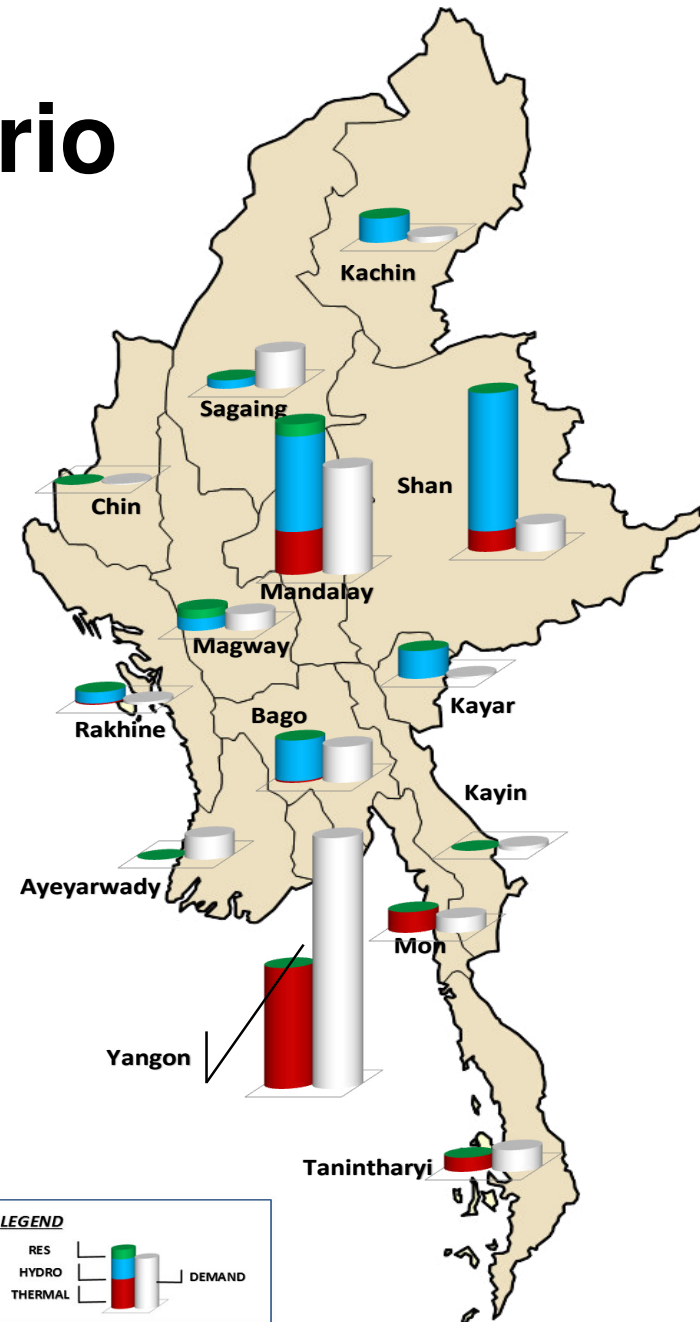
# GTMax demonstration analysis for Myanmar – Scenario Definition

Scenario comparison	Conservative scenario	Ambitious scenario
Target Year	2020	2020
Demand Forecast	Medium growth	Medium growth
Characteristics	Environmental oriented – no coal TPPs	Export oriented – new coal TPPs and large HPPs
Generation fleet development	Conservative: 1- to 2-year delay in schedule for commissioning of new plants	Ambitious: New HPPs (>1,200 MW), coal- and gas-fired TPPs, and renewables
Potential for regional interaction	Low: No new interconnection with Thailand	High: New interconnection with Thailand
Primary Goal	Demonstrate generation portfolio optimization in Myanmar under conservative generation expansion and test possibility of satisfying domestic consumption requirements	Demonstrate generation portfolio optimization in Myanmar in combination with higher regional interaction and cross-border trade

# GTMax Results – Conservative Scenario

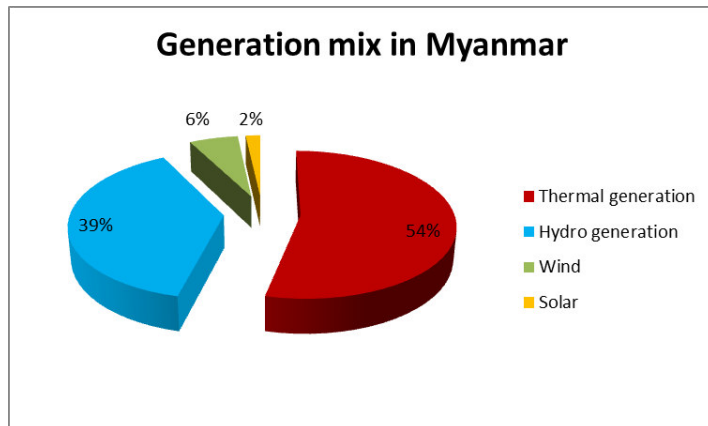
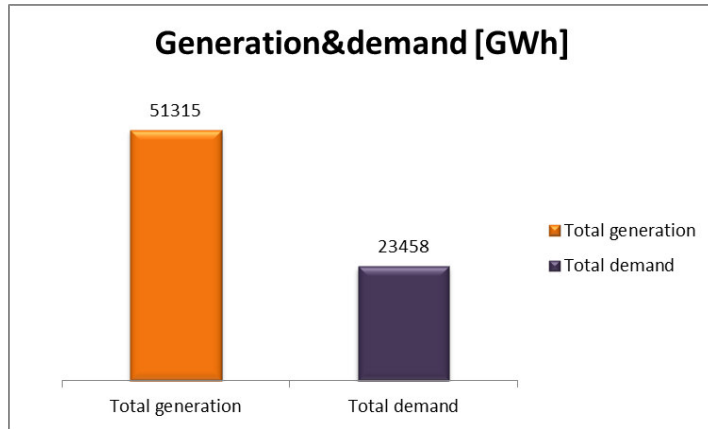


- Annual export to China: 2.2 TWh

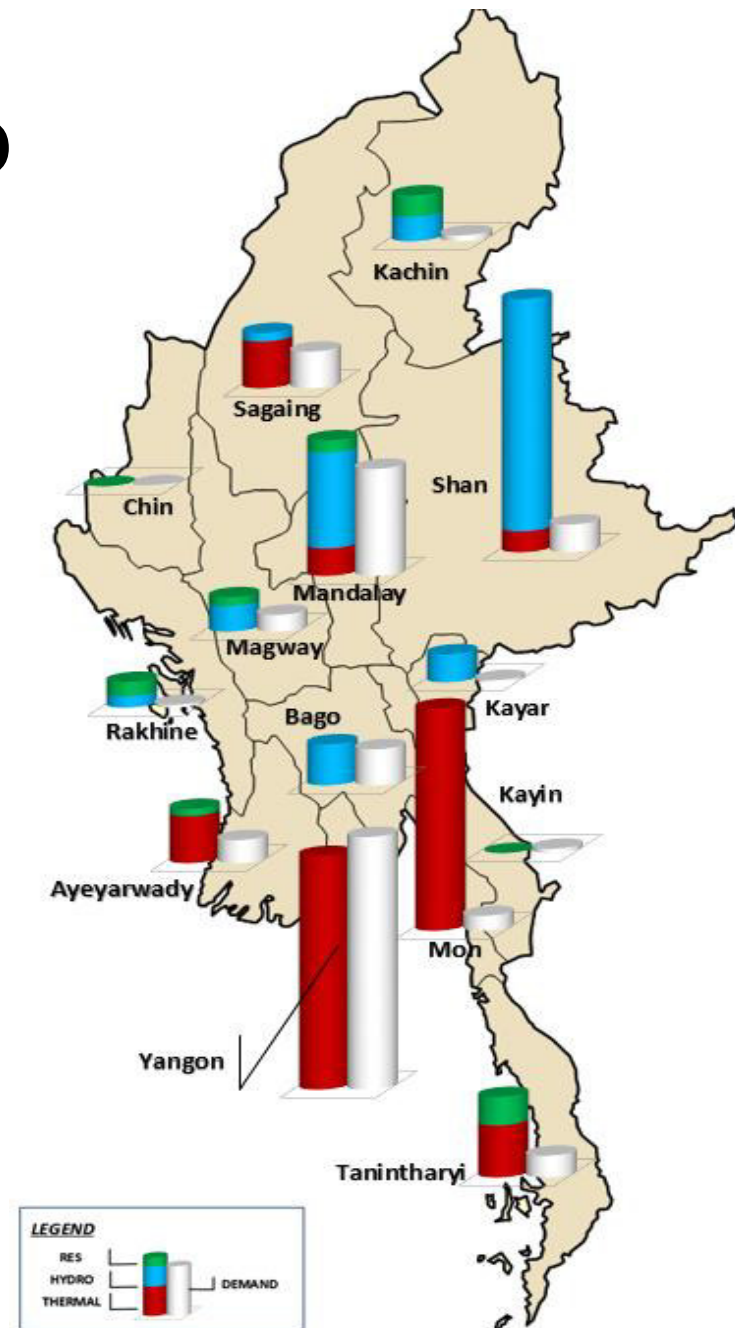




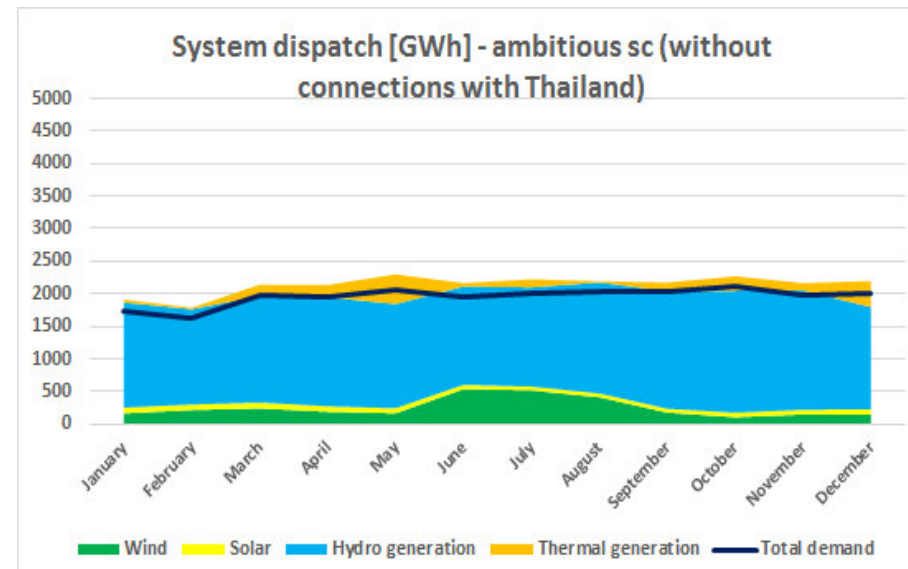
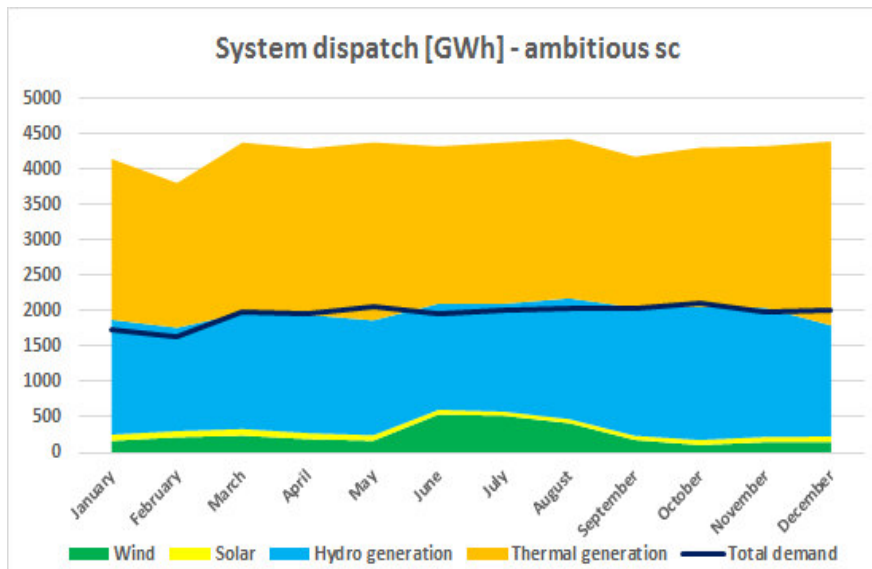
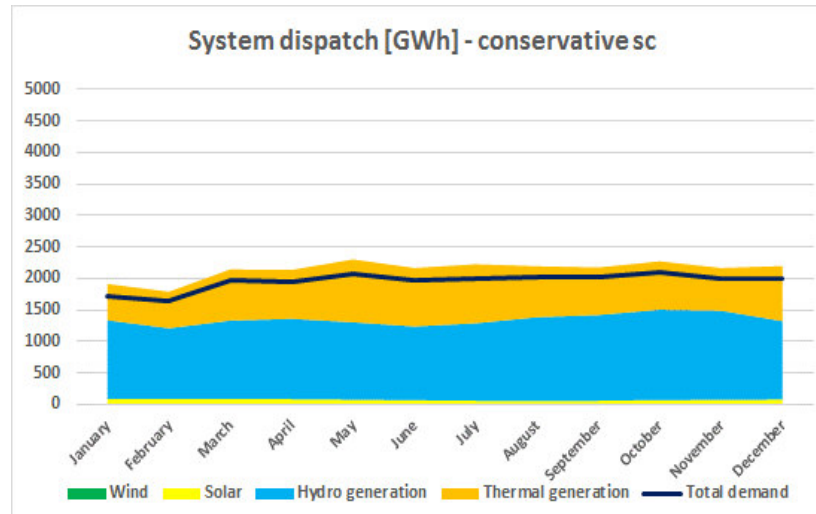
# GTMax Results – Ambitious Scenario



- Annual export to Thailand: 25.6 TWh
- Annual export to China: 2.2 TWh



# GTMax Results – Scenario Comparison



# GTMax Sensitivity Analysis – Economic Benefits from Connection with Thailand

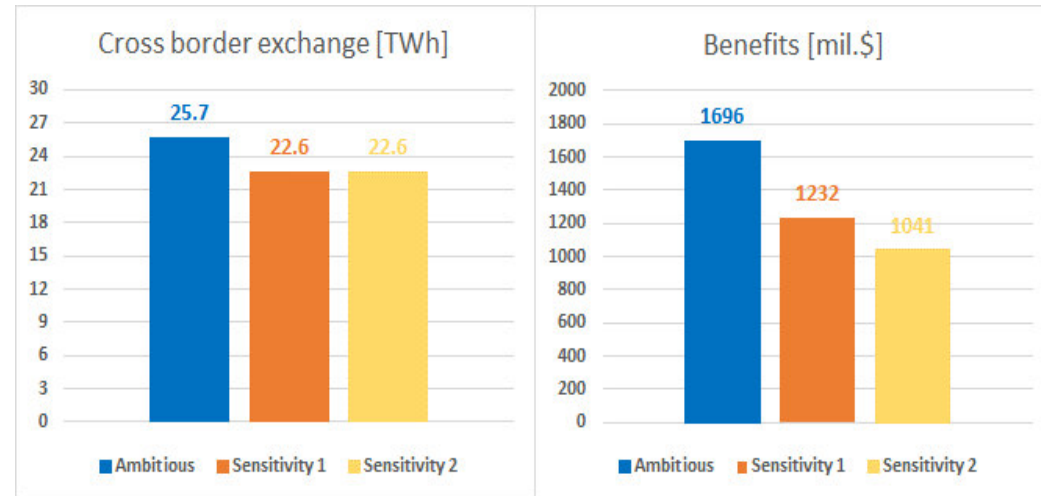
- Sensitivity analyses were conducted on price assumptions

- Sensitivity analysis 1

- ✓ Peak price 115 \$/MWh
- ✓ Off-peak price 73 \$/MWh

- Sensitivity analysis 2

- ✓ Peak price 104 \$/MWh
- ✓ Off-peak price 66 \$/MWh



- Observed level of cross border exchange is quite robust.
- Economic benefits from trade are highly sensitive to price and must be evaluated in combination with associated generation and transmission investment costs

# Next Steps for Market Analysis

Update National Power Development Plan for Myanmar:

- Conduct integrated analysis with WASP and GTMax
- Optimization study of hydro cascades

Create GMS Regional Model:

- Evaluate full potential for regional trading and economic benefits with detailed modeling of neighboring countries
- Assess potential wheeling charges

Perform transmission network analysis to support market analysis

- Detailed NTC calculations including “n-1” security analyses and dynamic analyses (using transmission planning tool e.g. PSS/E)
- Identification of internal bottle necks

# Proposed Planning Process for WGPG

## STEP 1: Develop National Load Flow Models

- Each country prepare national load flow models for the planning year of 2020 and/or 2025.
- Models will include only lines and generation expected to be in operation in the planning year.
- All national models will study the same hours of the planning year; winter maximum and summer maximum conditions

# Proposed Planning Process for WGPG

## STEP 2: Perform National Steady State and n-1 Load Flow Analysis

- Using the models prepared in step 1, perform a load flow study with all anticipated 2020 lines and generators in operation and a second study testing various contingencies (n-1 analysis).
- Each WGPG member is requested to prepare a report on these study results for presentation to the full WGPG.
- This step will identify transmission system issues that exist before any additional interconnections are considered and will answer some of the questions raised in the gap analysis

# Proposed Planning Process for WGPG

## STEP 3: Identify and Quantify Cross Border Candidate Lines

- Each GMS country will nominate candidate cross border synchronous or HVDC lines to be studied.
- The WGPG will finalize the list of lines to be studied.
- Data for each interconnecting line will be collected such as location of the line substations, voltages, circuit configuration, line length, wire size, etc.

# Proposed Planning Process for WGPG

## STEP 4: Perform Steady State and n-1 Security Analysis for each Interconnection

- Using the models developed in Step 1 and the list of interconnections developed in Step 3, develop a regional transmission planning model and apply this model to perform steady state load flow and n-1 security analysis studies.
- Studies for the selected planning year and hours will be used to quantify the impact of each interconnecting line.



# Proposed Planning Process for WGPG

## STEP 5: Identification of Cross Border Capacities

- The load flow studies performed in Steps 2 and 4 are designed to define the capacity of a transmission system for a peak or minimum load hour and the systems' ability to operate in a n-1 emergency condition while meeting the established GMS Performance Standards.
- These study results will provide a comparison of cross border capacity benefits for each line and a list of the limiting system components that created those capacities.

# Topics of Discussion

1. Introduction
  - a) Past RPTCC and WGPG Efforts
  - b) Current WGPG Consultant Services
2. ADICA Proposed Performance Standards
3. Gap Analysis Summary
4. Proposed GSM Regional Planning Process
- 5. Recommendations**
6. Proposed Work Plan for 2016-2017

# Recommendations

1. Adopt ADICA Performance Standard
2. Establish Regional Planning Process under WGPG for Future Transfer to RPCC
3. Conduct Regional Planning Study in Line with Proposed Work Plan during 2016-2017

# Topics of Discussion

1. Introduction
  - a) Past RPTCC and WGPG Efforts
  - b) Current WGPG Consultant Services
2. ADICA Proposed Performance Standards
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4. Proposed GSM Regional Planning Process
5. Recommendations
6. **Proposed Work Plan for 2016-2017**

# Proposed Work Plan for 2016-2017

## Goal and Tasks

**Goal: Establish regional planning process and conduct transmission studies to identify priority cross border interconnection opportunities for adoption at RPTCC-21.**

### **Tasks:**

1. Prepare national load flow planning models and perform national load flow and n-1 security analysis studies for the planning year of 2020.
2. Identify candidate interconnecting cross border lines that have potential to increase regional power trade for further analysis.
3. Building on outputs from Tasks 1 and 2, prepare regional load flow models and perform load flow and n-1 security analysis to identify priority cross border interconnections.

# Proposed Work Plan for 2016-2017 Timeline and Responsibilities [1/6]

## 27 June 2016 – WGPG Meeting

<u>Assigned To:</u>	<u>Action Item</u>
ADICA	ADICA will present a proposed 5 step process, as described in Chapter 5 of the final ADICA GMS report, as a way to initiate a GMS regional planning process for identifying optimum cross border interconnections to enhance regional trade.
WGPG	The first step of this process is for each country to agree to prepare a load flow model using their normal transmission planning software and national modeling data for a selected study year (suggestion is 2020 so that assumptions are realistic) and to perform a load flow and n-1 security analysis for their national system.
WGPG	The WGPG will decide what hours of the year 2020 to study (suggestion is winter and summer maximums and an agreed to minimum hour)

# Proposed Work Plan for 2016-2017 Timeline and Responsibilities [2/6]

## July to November 2016

<u>Assigned To:</u>	<u>Action Item</u>
ADICA	ADICA will work with each GMS country to coordinate modeling assumptions to assure that study results are based on consistent inputs and methodologies.
WGPG	Each WGPG participant will prepare a load flow model for the specified planning hours, perform a load flow study with all 2020 lines and expected generation in operation and a second study testing various contingencies (n-1 stability analysis).
ADICA	ADICA will provide a template to each country for reporting study results to the full WGPG at the next meeting.
WGPG	Each WGPG member will prepare a report on their study results for presentation to the full WGPG. This step will identify transmission system issues that exist before any additional interconnections are considered and answer some of the questions raised in the gap analysis

# Proposed Work Plan for 2016-2017 Timeline and Responsibilities [3/6]

## July to November 2016 (continued)

<u>Assigned To:</u>	<u>Action Item</u>
ADICA	ADICA will prepare a questionnaire to be sent to WGPG participants requesting nominations of candidate interconnecting lines and requesting specific needed technical information concerning each nomination including line beginning and ending locations, approximate route, distances, voltages and circuit configuration.
WGPG	The WGPG participants will respond to the questionnaire with nominations to be compiled and discussed in detail at the December WGPG meeting.
ADICA	ADICA will compile the candidate line questionnaire results, prepare a summary report and presentations for the December meeting



# Proposed Work Plan for 2016-2017 Timeline and Responsibilities [4/6]

## December 2016 – WGPG Meeting

<u>Assigned To:</u>	<u>Action Item</u>
WGPG	Each WGPG participant will present their national study results for 2020 peak and minimum hours in accordance with the template provided and with details on identified operational and infrastructure issues.
ADICA	ADICA will present candidate interconnection line questionnaire results for discussion, revision and approval by the WGPG
WGPG	The WGPG will approve a final list of candidate interconnections to be studied in the next period
WGPG	The WGPG will make the necessary decisions on how the approved candidate list of interconnections will be studied to identify regional benefits for each individual line and opportunities where two or more interconnections create economic and security synergies.
ADICA	Following this meeting, ADICA will compile study results and prepare a summary report highlighting needed internal system upgrades to meet agreed to GMS Performance Standards.

# Proposed Work Plan for 2016-2017 Timeline and Responsibilities [6/6]

## June 2017 – WGPG Meeting

<u>Assigned To:</u>	<u>Action Item</u>
ADICA	It is anticipated that the regional studies will identify needed internal transmission infrastructure upgrades to support the proposed interconnections. Based on these findings, cross border capacities for each interconnecting line will be presented, with and without the needed national upgrades.
ADICA	Conclusions will be drawn from the study results regarding each proposed interconnecting line and a process for prioritization will be proposed.
WGPG	Decisions will be made by the WGPG regarding needed additional 2020 studies, new 2025 studies and more detailed studies of the most promising interconnection candidates
WGPG	Next steps and future work such as capacity building, economic analysis of promising interconnection candidate lines, studies of Ancillary Services opportunities, open access and the calculation of net transfer capacities, wheeling costs and other topics of interest to the WGPG participants.

# Proposed Work Plan for 2016-2017 Timeline and Responsibilities [6/6]

## June 2017 – WGPG Meeting

<u>Assigned To:</u>	<u>Action Item</u>
ADICA	It is anticipated that the regional studies will identify needed internal transmission infrastructure upgrades to support the proposed interconnections. Based on these findings, cross border capacities for each interconnecting line will be presented, with and without the needed national upgrades.
ADICA	Conclusions will be drawn from the study results regarding each proposed interconnecting line and a process for prioritization will be proposed.
WGPG	Decisions will be made by the WGPG regarding needed additional 2020 studies, new 2025 studies and more detailed studies of the most promising interconnection candidates
WGPG	Next steps and future work such as capacity building, economic analysis of promising interconnection candidate lines, studies of Ancillary Services opportunities, open access and the calculation of net transfer capacities, wheeling costs and other topics of interest to the WGPG participants.

# ANNEX 4

**Summary of Discussions**  
**The Working Group of the Performance Standards and Grid Code (WGPG)**  
**Phu Quoc, Vietnam, 27 June 2016**

**I. Opening Session**

1. The Chair of WGPG, Mr. Prasert Sinsukprasert, Deputy Director General (DDG), Energy Policy and Planning Office (EPPO), Thailand warmly welcomed the participants to the meeting. He encouraged all members to endeavor to complete, in a timely manner, the performance standards which shall be used for Regional Transmission Network expansion planning, and operational planning, including dispatch-instructions that shall be made by the countries' transmission system operators (TSO) to direct scheduled transactions within the security limits defined in the performance standards. In addition, he focused that the connectivity of cross-border power system interconnection between Greater Mekong Sub-region (GMS) member countries, as a part of Southeast Asia Region, plays an important role in strengthening the security, and improved reliability of power supply in the GMS region. He also thanked Asian Development Bank (ADB) for the continued support and assistance with a view to creating sustainable development in the GMS region. Also, he expressed his appreciation to Viet Nam delegate for hosting this meeting.

2. The ADB in-charge of supervising WGPG work, Ms Aruna Wanniachchi, Senior Energy Specialist of ADB stated that, the consultant, Mr. Bruce Hamilton was engaged by ADB to support WGPG. Specific tasks of the consultants terms of reference (TOR) included: (i) Review and update the performance standards of GMS countries and gaps identified under the TA 6440-REG and prepare a consolidated report; (ii) Propose Performance Standards for adoption by the RPTCC to facilitate regional power trading in the GMS (TOR indicated the requirement to undertake in-depth network studies with WGPG for validation of the proposed GMS performance standards); and (iii) Propose recommendations and investment needs for each GMS country with implementable timeline to bridge the gaps and reach the recommended GMS performance standards. The consultant visited the countries and prepared a draft report with two key outputs: (i) revised performance standards, and (ii) a recommendation to update transmission plans of each country leading to an integrated planning.

3. The consultant, Mr. Bruce Hamilton revised the proposed performance standards in accordance with European Network of Transmission System Operators for Electricity (ENTSO-E) standards. He also proposed GMS countries to work on integrated planning process. In addition, the consultants presented a study carried out for Myanmar using software (GTMAX) to demonstrate how a market model can be used to optimize the operation of hydro and thermal generating units, and assessed opportunities for cross border power exchange. Software like WASP and OPTIGEN are used for long-term generation planning, and PSS/E and other software are used for transmission planning in the six countries. Market assessment software like GTMAX is not yet used in any of the GMS countries. He explained that market assessment software have the features to capture locational data such as generation and demand, and selling prices on hourly basis. The Consultant indicated once the interconnections are identified, GMS countries shall conduct similar market analysis for optimizing hydro cascades and generation dispatch to evaluate the economic benefits of regional trade and financial viability of proposed transmission interconnections, and identifying mutually beneficial daily and seasonal power transactions.

**II. Summary of Comments by WGPG**

4. WGPG members did not agree to some of the proposed GMS performance standards by the consultant. They had the concerns due to some of the proposed standards

were weaker than the existing national standards. WGPG members requested the consultant to discuss the importance of each of the performance standard in an interconnected system and appropriateness of proposed European standards in GMS. The revised performance standards that were not agreed by the WGPG are as follows.

- a. Frequency Control and Related Standards.** Table 1 provides proposed revisions. Viet Nam requested consultant to explain why the consultant expanded the system frequency at emergency conditions, what are the issues that can arise due to the expanded range. Further Viet Nam commented that the frequency standard of normal condition of Viet Nam and PRC is narrow and better than the proposed standard by the consultant and indicated the existing standards or the quality of supply cannot not be reduced. For long term and future, the frequency standard is the critical standard of regional interconnection, so it should be fit with the larger and bigger system. Viet Nam recommended frequency standard for emergency conditions be specified in subranges with associated response times and provided such ranges in table 2 for consultant's reference. Lao PDR and Cambodia provided updated information of their systems.

**Table 1. Frequency Control Standard**

Standard	Previous proposal under RETA 6440 based on UCTE	New proposal by consultants based on ENTSO-E	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
Frequency Control Standards								
Normal Conditions (Hz)	49.5-50.5	49.5-50.5	49.5-50.5	49.8-50.2	49.5-50.5	49.0-50.5	49.5-50.5	49.8-50.2
Emergency Conditions (Hz)	47.5-51.5	47-52	47-52	49.5-50.6	47-52	48	47-52	47.5-52.0
Speed Governing System		Yes	Yes	Yes	Yes	-	Yes	Yes
AGC (secondary response)		Yes	-	Yes	Yes	-	Yes	Yes
Load Shedding System		Yes	Yes	Yes	Ministry Guidelines	Ministry Guidelines	Yes	Yes
Restoration Procedures		Yes	Yes	Yes	Yes	-	Yes	Yes

**Table 2. Examples of Proposed Frequency Control Standard for Different Emergency Conditions (as guidance to the consultant)**

Power System Operating State	Containment	Time allowance	
		Stabilisation	Recovery
Normal	49,8 Hz ÷ 50,2 Hz		
Single fault in Transmission network	49,5 Hz ÷ 50,5 Hz	49,8 Hz ÷ 50,2 Hz within 5 minute	
Single fault in Generation	49 Hz ÷ 51 Hz	49,5 Hz ÷ 50,5 Hz within 1 minute	49,8 Hz ÷ 50,2 Hz within 5 minute
Multi faults, serious incidents or extreme urgency	47,5 Hz ÷ 52 Hz	49,5 Hz ÷ 50,5 Hz within 2 minute	49,8 Hz ÷ 50,2 Hz within 10 minute

- a. Voltage Control.** Consultants proposed some revisions as in Table 3. Thailand queried why the voltage standards are same for normal and emergency conditions. WGPG did not agree with the consultants revisions of voltage control standard for 500 kV under normal conditions and recommended to narrow the range to -5%/+10% instead of -10%/+10%. -10% is very dangerous which will lead to low voltages. Myanmar recommended to include a time dimension to emergency conditions. Consultant will provide further explanation in report noting that while some countries in the region may have tighter standards than what is proposed – the intent is for GMS standard to have a range that is acceptable to operations, but could include everyone eventually. Viet Nam raised the question whether the consultant assessed the criteria for connecting 220 kV and 230 kV systems. Because, the absolute voltage of some countries is different, for example, in Vietnam 110 kV and 220 kV correspond to 115 kV and 230 kV in some other countries. Beside, the Voltage standard is local standard, is not the system standard. CSG recommended that different voltage criteria should be settled for national and cross-border substations. So, the Consultant should take into account this issue to propose the suitable voltage standard (absolute value or percentage %).

**Table 3. Frequency Control Standard**

Standard	Previous proposal under RETA 6440 based on UCTE	New proposal by consultants based on ENTSO-E	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
Normal Conditions 110-230kV 500 kV	+/-5% +/-5%	+/-10% +/-10%	+6.5/-10% NA	+/-10% -0%/+10%	+/-5% NA	+/-5% +/-5%	+/-5% +/-5%	+5%/+10% +/-5%
Emergency Conditions	+/-10%	+/-10%	+15/-10%	500kV -5%/+10% 220kV +/-10%	+/-10%	+/-10%	+/-10%	+/-10%
Tools for Voltage Control		Yes	Yes	Yes	Yes	Static Compensator	Yes	Yes

- b. Harmonics Distortion.** Table 4 provides proposed revisions. WGPG members requested the consultant to explain in the report why the changes are proposed and to indicate this is an established guideline rather than a firm standard. WGPG also clarified how the renewable energy integration will impact on transients.

**Table 4. Harmonics**

Standard	Previous proposal under RETA 6440 based on UCTE	New proposal by consultants based on ENTSO-E
Harmonic Voltage Distortion		
500 kV	1.5%	1.0-1.5%
220-230kV	2.5%	1.5-2.5%
115-132kV	2.5%	2.0-3.0%
Harmonic Current Distortion		
500 kV	1.5%	1.0-1.5%
220-230kV	2.5%	1.5-2.5%

115-132kV	2.5%	2.0-3.0%
Voltage Balance	1%	1%

- c. **Maximum Fault Clearance Time.** Table 5 provides proposed revisions. WGPG members (except CSG) did not agree to consultant's revisions and recommended to tighten the maximum fault clearance time standards as 80 ms for 500 kV and 100 ms for 220-230 kV. CSG recommended that 100 ms for 500 kV to be adopted and use in the planning to ensure the interconnection is strong enough to survive severe faults. Consultant was requested to explain further and propose appropriate standards.

**Table 5. Fault Clearance Time**

Standard	Previous proposal under RETA 6440 based on UCTE	New proposal by consultants based on ENTSO-E	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
500kV	80 ms	100 ms	80 ms	90 ms	80 ms	80 ms	80 ms	80 ms
220-230kV	100 ms	100-150 ms	100 ms	120 ms	100 ms	100 ms	100 ms	100 ms
115-132kV	120 ms	100-150 ms	140 ms	150 ms	140 ms	120 ms	120 ms	150 ms

- d. **Transmission Planning Software.** In general, WGPG members did not agree with consultant's revision that there is no requirement for a common transmission planning software and proposed to adopt PSS/E or compatible software that can extract data to the integrated model.

**Table 6. Transmission Planning Software**

Study	Previous proposal under RETA 6440 based on UCTE	New proposal by consultants based on ENTSO-E	Cambodia EDC	China CSG	Lao PDR EDL	Myanmar MOEE	Thailand EGAT	Viet Nam EVN
Planning software	PSS/E	Standard not required	PSS/E	PSD/DSP	DigSILE NT	NEPLAN	DigSILE NT	PSS/E

5. WGPG indicated importance of performance standards needs to be explained. WGPG advised the performance standards cannot be arbitrary and requested consultant to update the report based on the WGPG recommendations highlighting the application of each of these standards in an interconnected system.

### III. Recommendation and Conclusion

6. ADB presented next steps (attachment 1). WGPG concluded following.
- (i) WGPG to adopt the updated GMS Performance Standards once consultant incorporate comments and revisions provided by WGPG at the meeting.
  - (ii) Countries to update national network models and system studies for a suitable planning horizon (more than 10 years) by 2017.
  - (iii) Countries to agree on the Regional Network Models (scope, methodology, software, data sharing etc.) by 2017.



# ANNEX 5

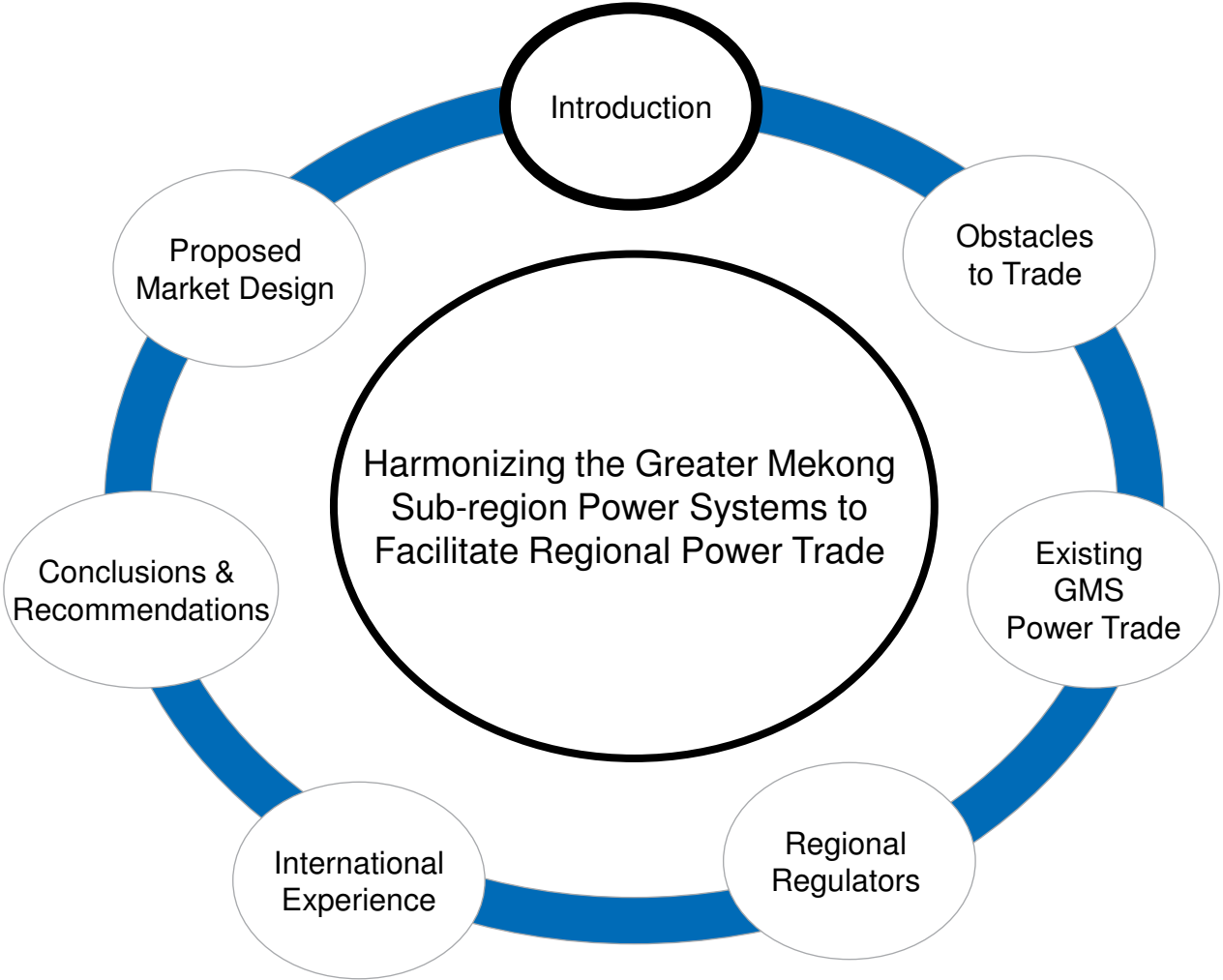


**Ricardo**  
**Energy & Environment**

**TA 8830-REG Harmonizing the  
Greater Mekong Sub-region  
Power Systems to Facilitate  
Regional Power Trade**

**RPTCC-20, 27 June 2016**

**Jonathan Hedgecock**



# Project Introduction – ADB TA 8830 Scope



- Harmonising the Greater Mekong Subregion Power Systems to Facilitate Regional Power Trade
- Key Objective: to make significant progress towards achieving Stage 2 Market Implementation, as defined in the 2008 MOU on the Road Map for Implementing GMS Cross-Border Power Trading
- Stage 2: will exist when trading is possible between **any pair of GMS countries**, eventually using **transmission facilities of a third regional country**, but constrained by available cross-border capacity (i.e. limited to the surplus capacity of lines linked to power purchase agreements)
- Focus of the work: identifying the **regulatory barriers** to the development of power trade, developing **transmission regulations** (including power trade rules and dispute resolution mechanisms) to allow **third party access to interconnections**, and **prioritising power purchase agreements** (PPAs) or similar contracts
- Supporting the work of the RPTCC and the Working Group on Regulatory Issues (WGRI), coordinating work closely with them

# Project Introduction – ADB TA 8830 Context



- Building on the work of RETA 6440: Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the Greater Mekong Subregion
  - Key deliverables from RETA 6440:
    - GMS Reference Document on Performance Standards
    - Preliminary Report on Metering Arrangements
    - Review of Regulatory Framework in GMS Countries
    - Conceptual Design of GMS Market
  - A comprehensive market design, and significant focus on technical aspects of interconnection
- TA 8830 recommendations need to be compatible with RETA 6440, but focus on practical implementation
  - Identifying barriers and making recommendations for overcoming them

# Project Introduction – ADB TA 8830 Outputs

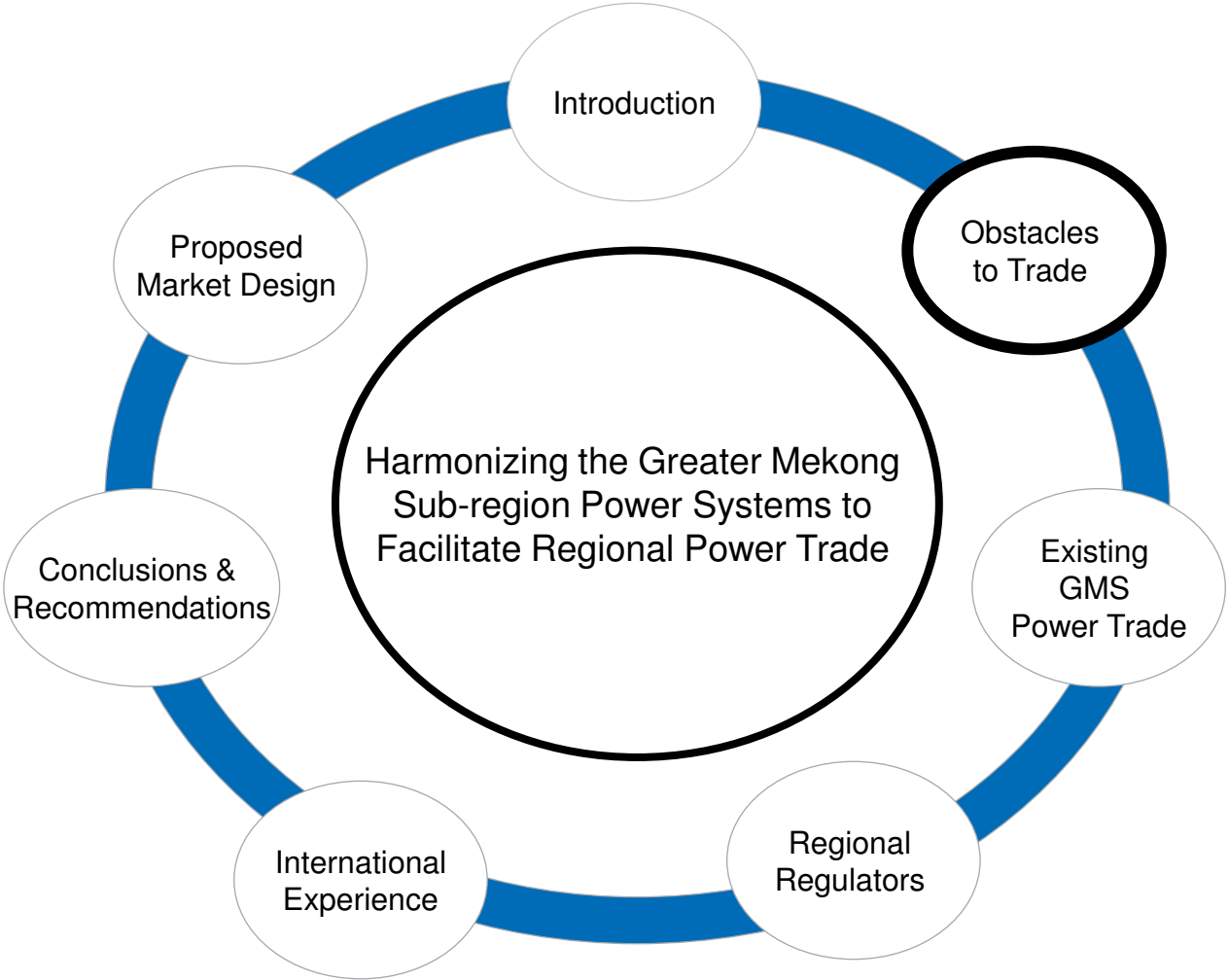


- A series of specific activities:
  - Identify **regulatory barriers**, and propose measures and institutional arrangements to address them for each GMS member
  - Recommend approaches to **harmonise regional regulatory functions**
    - Recommend guidelines for improvement of regulatory framework for mid-term trading
  - Propose approaches to introduce/enforce **Third-Party Access** in each country and regionally
    - Develop tariffs for third party access and compensation arrangements
    - Prepare a fair and transparent wheeling charge methodology
    - Prepare a fair and transparent cross-border trade compensation mechanism
  - Review proposed market design for the GMS and **propose a final design**
    - Develop power trade rules for short term cross-border trading
    - Develop power trade rules for the settlement of deviations
  - Participate in RPTCC and WGRI meetings to **disseminate findings**
  - Prepare a **knowledge product** for publication by ADB

## Project Overview – Tasks Completed to date



- A comprehensive series of meetings in GMS member countries
  - Focus on hearing GMS electricity sector experience and views on regulatory barriers
  - Identifying regional themes and country-specific issues
  - Developing country-specific recommendations for consideration
- Review of RETA 6440 market design and identification of workable steps towards implementation
- Documentation of initial findings in Draft Report to WGRI
- Review and discussion of initial comments (received from China and Vietnam)
- Preliminary work on Third Party Access issues
  - Precedent from other markets, taking account of specific characteristics of GMS
- Review of International Regulatory Structures
  - Key issue: how independent do regulatory bodies need to be?
- Interaction with HAPUA/ASEAN Energy Market Integration to look at other regional experience
- Planning next steps





## Obstacles to trade: 1. Unclear Objectives of Trade

- Key **benefits and objectives of trade are unclear** to regional utilities and potential electricity sector investors
  - Absence of regional vision/investment framework for trade between GMS members
  - Inadequate information flow between GMS and ASEAN/HAPUA
  - Political relationships and supply security concerns between GMS countries are important in influencing trade
  - Low electricity tariffs and inconsistent subsidy arrangements reduce financial returns



- **Unclear incentives** for national utilities to invest in **cross-border transmission projects**
  - Leads to lack of clarity as to which country will lead on any specific interconnection project
  - Different levels of economic development could limit trading opportunities
- **Better communication** is needed between stakeholders
  - Stronger WGRI team needed, more frequent meetings

## Obstacles to Trade: 2. Regulatory and Contractual Challenges

### Regulatory challenges:

- *Government bodies are too heavily involved in contracts with foreign generators on behalf of companies.*
- *Absence of independent regulator of electricity could hamper trading opportunities.*
- *Lack of industry restructuring could act as a barrier to trade.*
- *Some countries have a single buyer model, but not all.*
- *Regional Power Coordination Centre (RPCC) is yet to be implemented.*

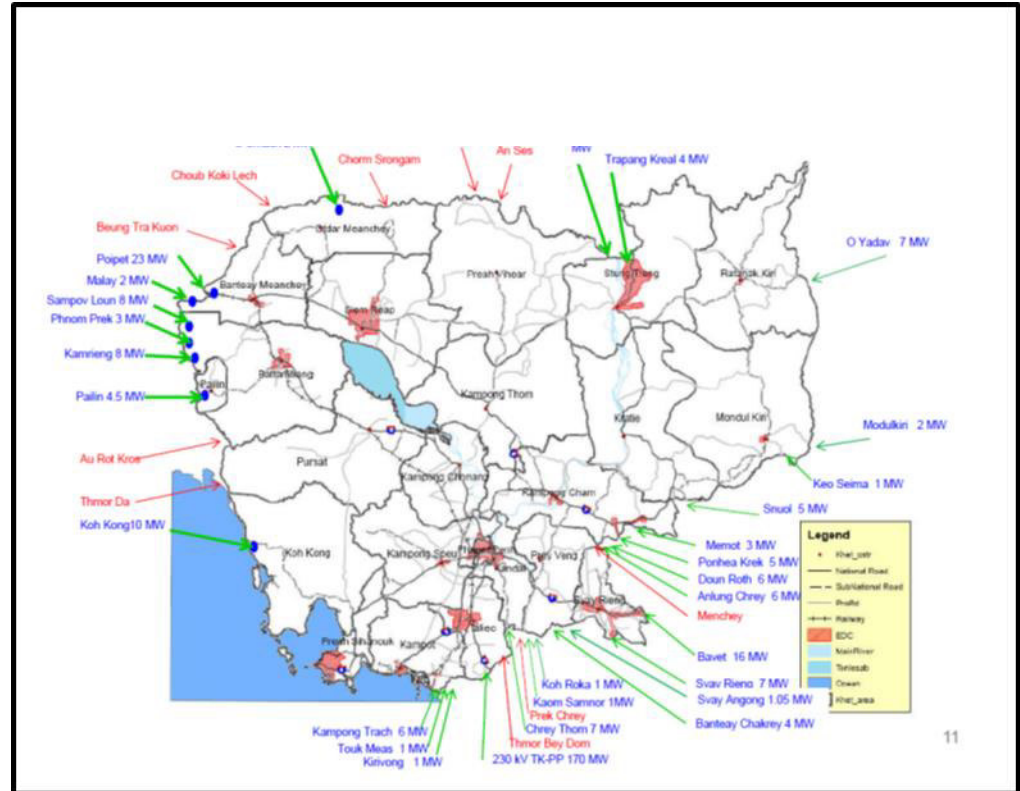
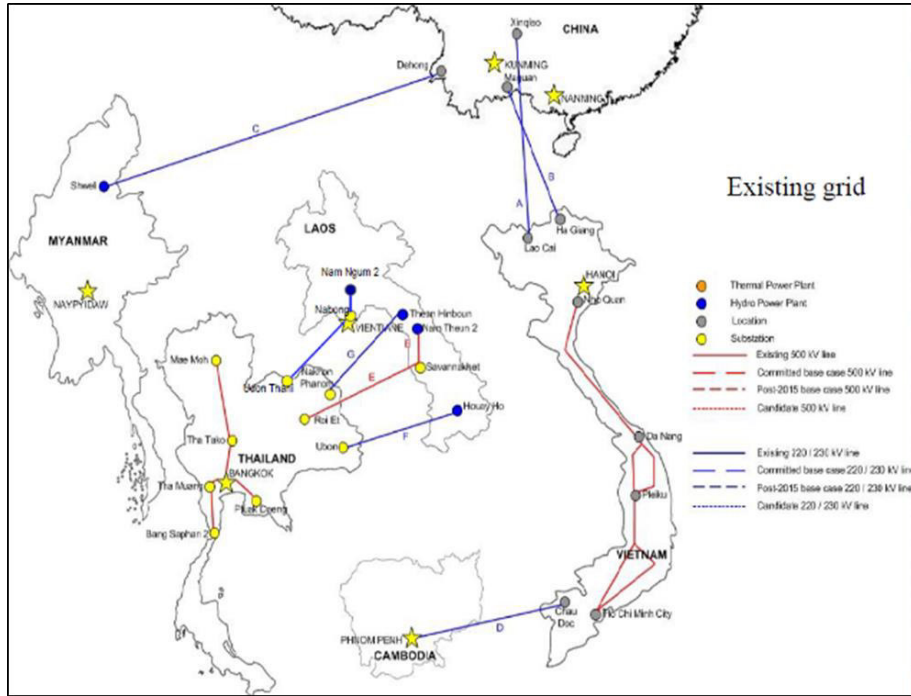
### Contractual challenges:

- *Negotiation of contracts can be lengthy and require agreement from all parties on electricity price and wheeling charges.*
- *Terms and Conditions of trading contracts can require Government approval.*
- *Absence of well-defined wheeling charge acts as a barrier to trade.*
- *Full commercial transparency of contracts is desired.*
- *Contract risk management could influence the decision to trade.*
- *Tariff issues – not all countries have cost reflective tariffs, inconsistencies in taxation and subsidy arrangements.*

## Obstacles to Trade: 3. Technical Challenges

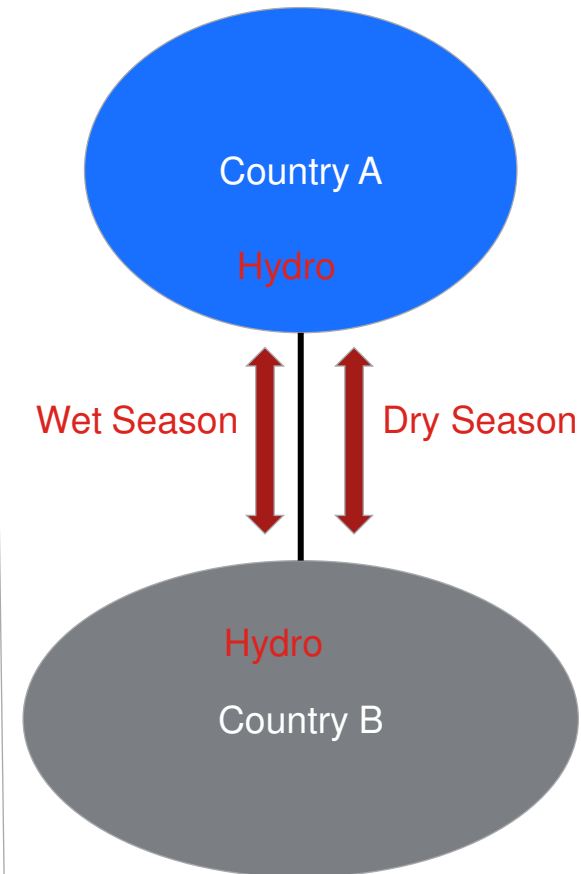
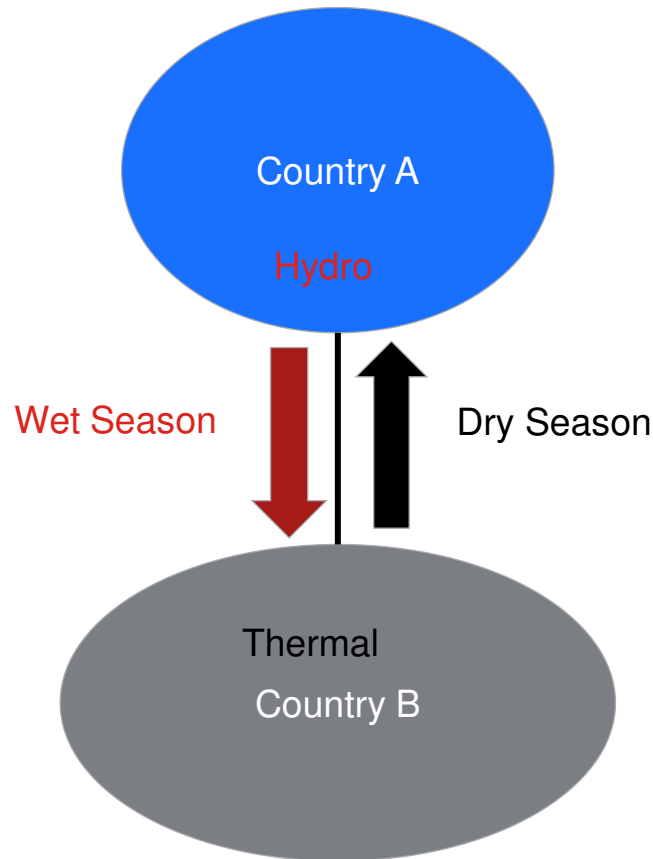
- **Differences in electricity grid codes, market rules, technical codes and technical standards limit trading**
  - Difference in voltage levels
  - Inadequate compliance with technical regulations
  - Potential stability issues between systems
- **Some countries have no clear, integrated master plan for system development**
  - Reliable dataset for transmission capacity is required for load flow studies
  - Technical studies are required to develop solutions for the connection of power plants, including identification of higher capacity (>500kV or HVDC) interconnections
  - New interconnections require complex joint studies
- **Robust grid structure is not available in some countries**
  - Substantial investments are required to achieve fully integrated systems
  - Interconnections in the “wrong place” or in areas where there is already excess capacity
- Provision needed for **real-time system security** and **sharing of reserves** across borders

# Obstacles to Trade: 3. Technical Challenges



## Obstacles to Trade: 4. Supply/Demand Balances

- In wet season, interconnected countries could have surplus power generation capacity which limits the potential for trade
- There is a need for planning studies that take into account the supply/demand balance across the region in an integrated way
- How to share transmission capacity for trading that is affected by seasonal and non-seasonal issues



## Obstacles to Trade: 5. Training and Capacity Building

- Many stakeholders believe that capacity building and training of staff is required in essential matters relating to electricity trading.
- Utility staff could provide training to their counterparts in other GMS countries.

Regional Electricity Markets, international examples

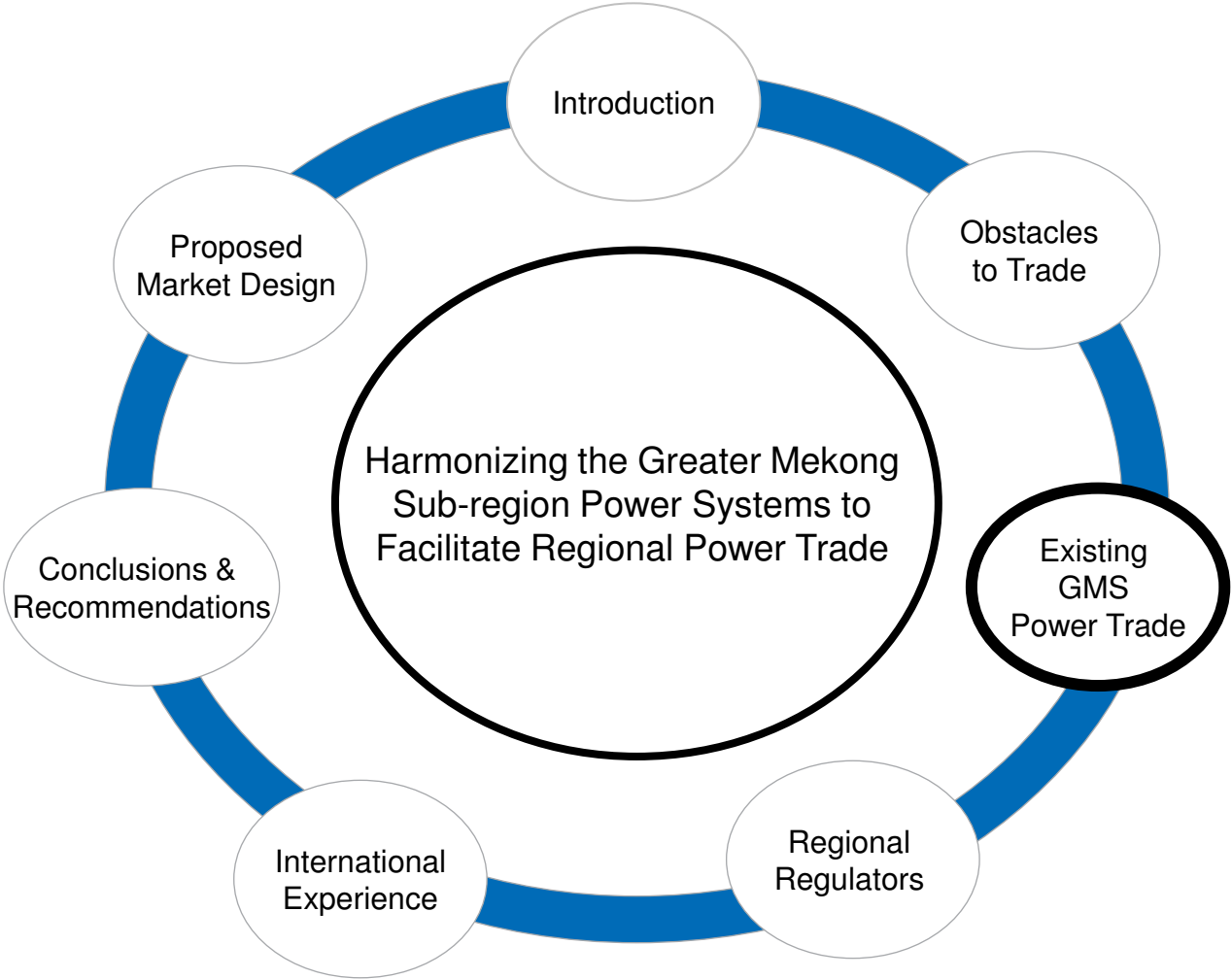
Proposed GMS Market Design

Advanced electricity trading in the GMS model

Specialist training  
TSOs

Specialist Training  
Power Producers

Specialist Training  
Power Purchasers



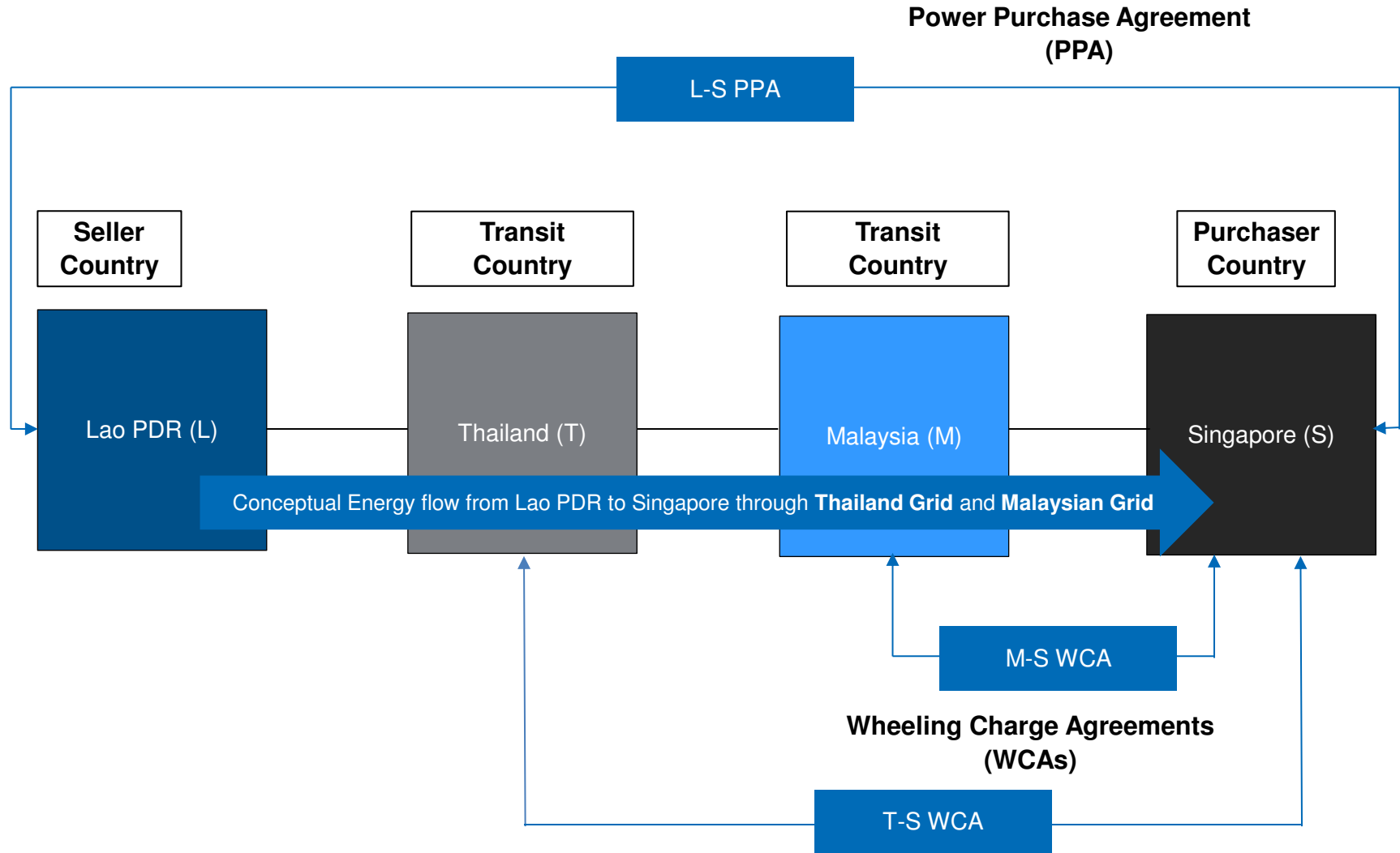
## Example of Existing GMS cross-border trade

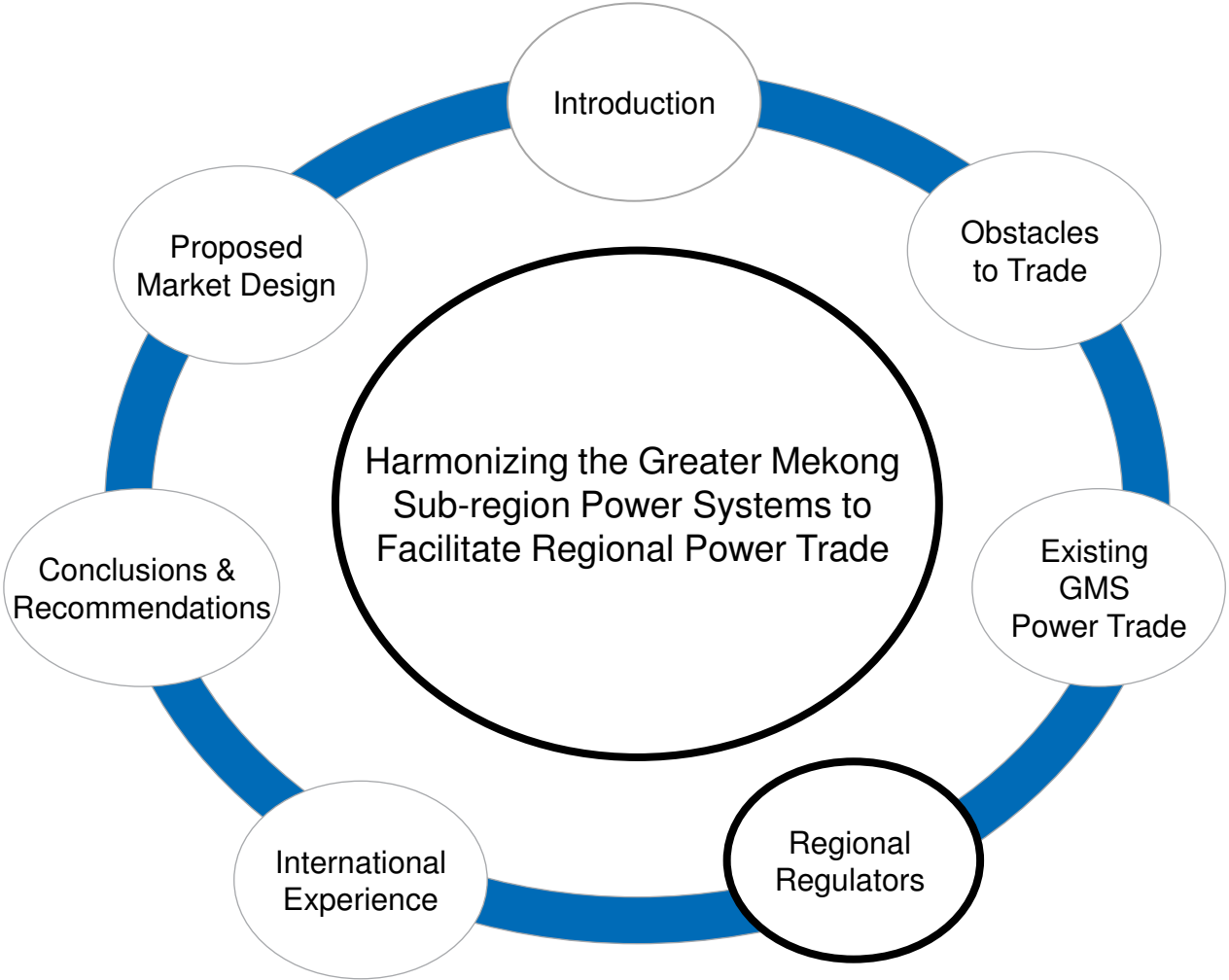
<b>Name of Plant</b>	<b>Nam Theun 2</b>	<b>Installed Capacity</b>	<b>1080 MW</b>
<b>Main Offtaker</b>	EGAT	Financial Source	26 Banks & IFIs

- The Nam Theun 2 Hydroelectric Project was built in 2010 and the project company developed a transmission line to deliver electricity to EGAT.
- Carried out under a concession agreement between the Government of Lao and the Nam Theun 2 Power Company Ltd (NTPC). This Concession Agreement allows the project company to sell the generation capacity and energy to EGAT in accordance with the EGAT Power Purchase Agreement. The company has also been allowed to sell power to EDL based on the EDL Power Purchase Agreement.
- The project company could modify the EGAT PPA and replace it with new PPA if required e.g. as a consequence of formation of a power pool in the GMS.
- The project was developed to sell electricity to EGAT through the company's transmission system at the EGAT delivery point. The company will own and operate the transmission line during the concessionary period unless the company agrees to the Government of Laos request to:
  - Allow transmission assets to be used by others a part of the Laos National Transmission Grid.
  - Allow upgrading of the transmission assets in anticipation of being incorporated into the national transmission system.

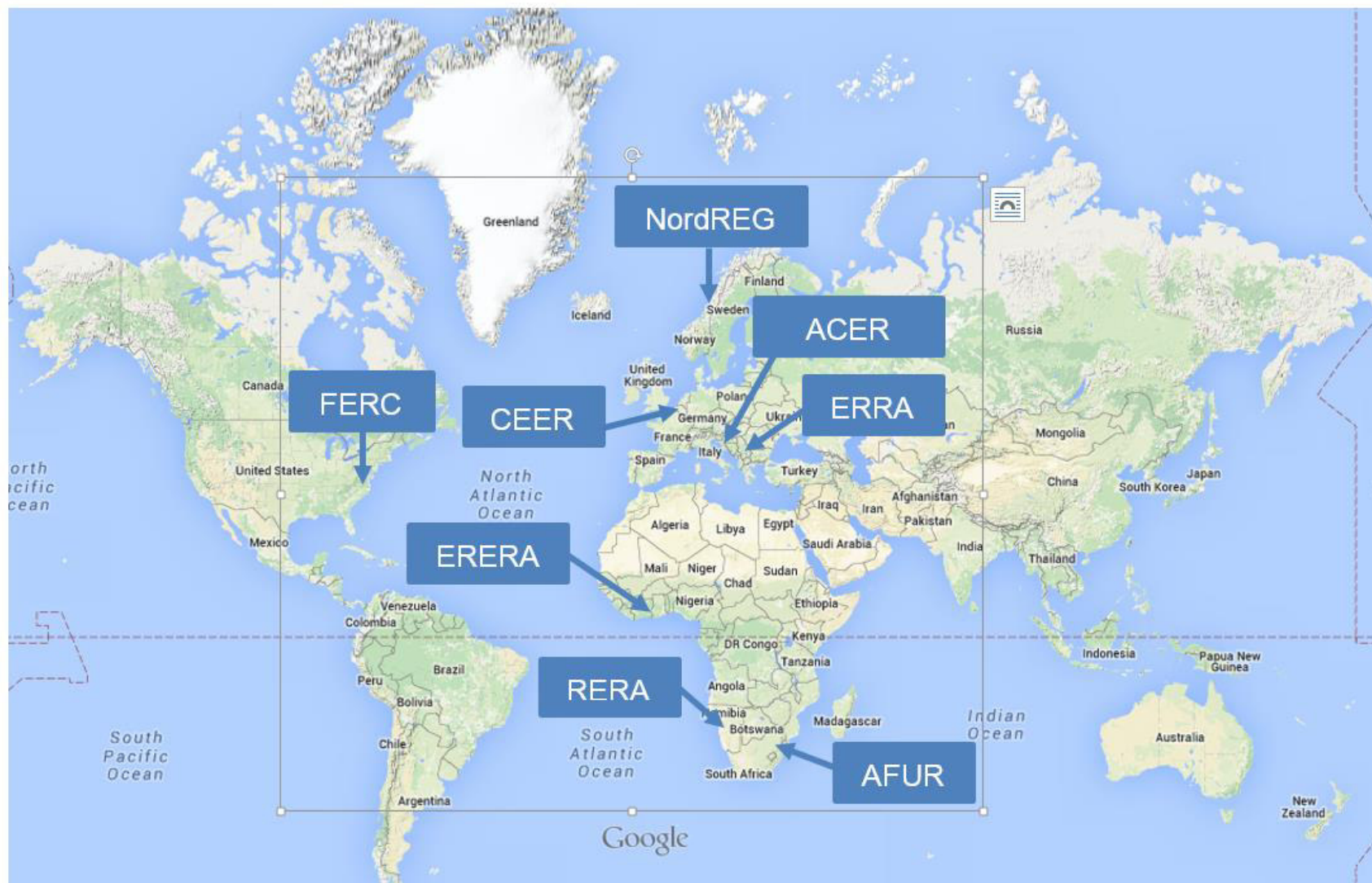


# Example of Potential Regional Cross-Border Power Projects









































# Need for a Regional Regulatory Body – roles and responsibilities



# Roles and Responsibilities of Regional Regulators

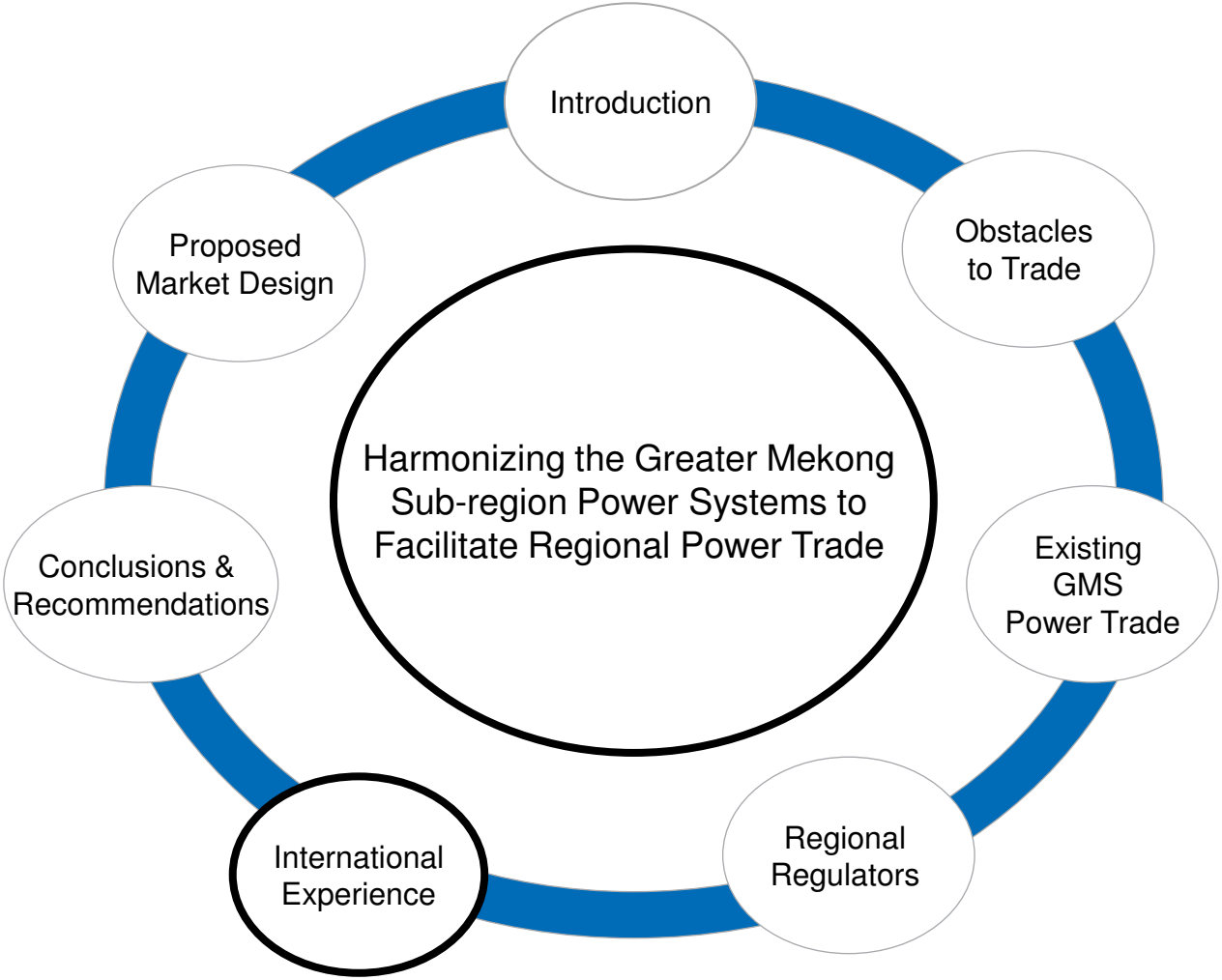
Regional Regulatory Organisation	Advisory Powers				Regulatory Powers			
	Promotional Role	Ensure Co-operation	Advice and Influential Roles	Make Guidelines	Develop Regulations	Approve or Licence	Investigates and Reviews	Binding Decisions
<b>FERC</b> USA								
<b>NordREG</b> Nordic Region								
<b>CEER</b> EU								
<b>ACER</b> EU								
<b>ERRA</b> Eurasian Region and Central Europe								
<b>RERA</b> Southern Africa								
<b>AFUR</b> Africa								
<b>ERERA</b> West Africa								

## Establishing the Regional Power Coordination Centre (RPCC) as a regional body

- In the RETA 6440 project, the consultants recommended that a permanent secretariat be established to follow up and monitor regional activities
- The project also developed the concept of a Regional Power Coordination Centre (RPCC)
- RPCC location an ongoing issue, but the **functions** of the RPCC should be pursued ahead of resolving this, in a number of ways:
  - Empowering the RPTCC working groups, particularly the WGRI and the WGPG
  - Reallocating RPCC responsibilities on a temporary basis to the RPTCC, WGRI and WGPG
    - RPTCC to play a promotional role in developing regional trade
    - RPTCC to create a Working Group on Capacity Building
    - RPTCC to develop information exchange between national Single Buyers and Regulators
    - RPTCC to re-establish the Planning Working Group
    - WGRI to work on development and approval of wheeling charges
    - WGPG to develop a standard Regional Grid Code

# The need for Independent National Regulators

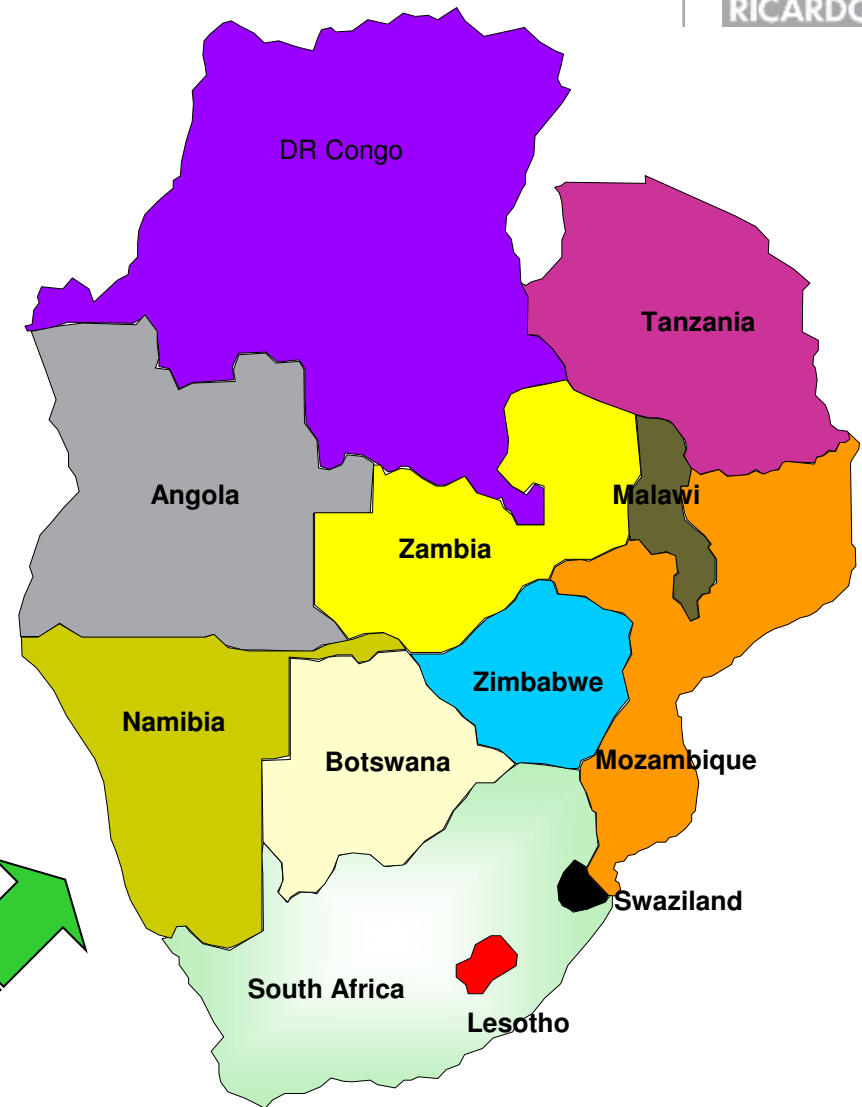
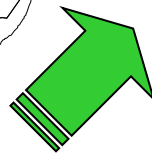
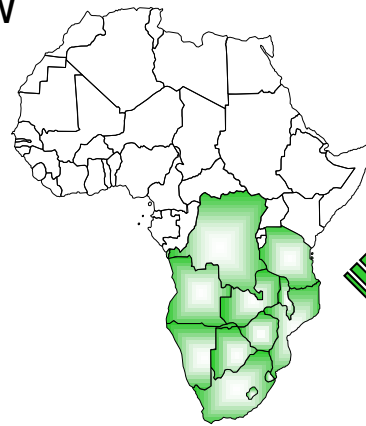
- In developing regional electricity trading, should focus on **minimal requirements for sector unbundling and institutional change**
  - RETA 6440 placed a high priority on sector restructuring, however it is important to consider what can be achieved with existing institutional structure
- Achieving regulatory independence is important, but what does this mean?
- European Union definition of an “**independent regulator**” (Article 35, 2009 Electricity Directive)
  - Legally distinct and functionally independent from any other public or private entity
  - Acts independently from any market interest
  - Does not take direct instructions from any government or other entity when carrying out regulatory tasks
  - Can take autonomous decisions independent of any political body
  - Has autonomy in the implementation of its budget allocation
  - Has senior managers appointed for fixed terms (5-7 years), renewable once
- Of these, legally distinct may be challenging, but the other criteria may be more readily achievable with clear government intent



# The Rationale for Interconnection: Case Study

## The Southern African Power Pool

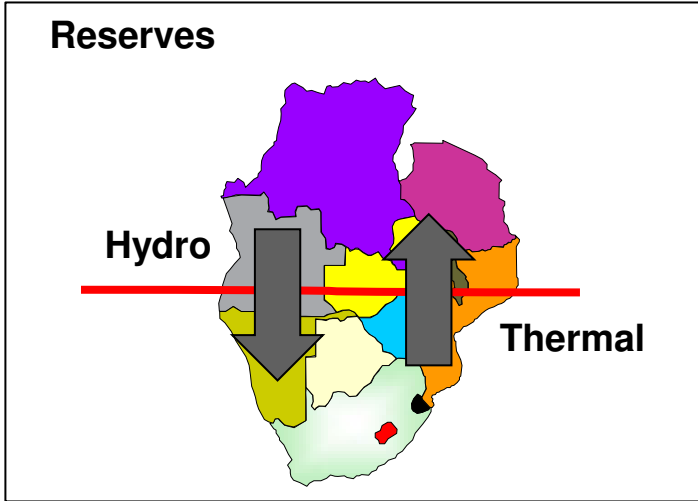
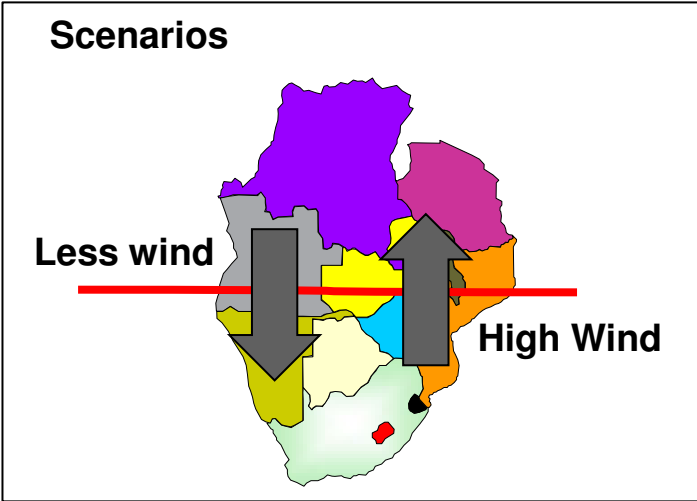
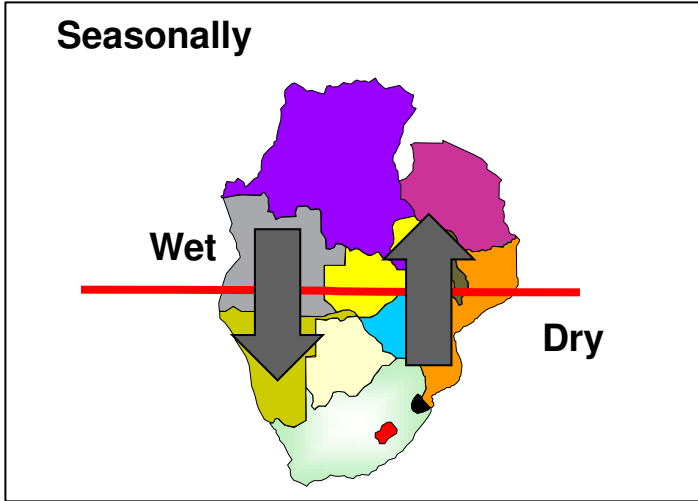
- SAPP consists of the following members:
  - 12 SADC Member Countries
  - 16 SAPP Members
  - 280 Million people
  - Installed Generation Capacity - 62 GW
  - Available Generation Capacity - 47 GW
  - Peak Demand - 55 GW
  - Consumption - 400TWh







Source: Nord Pool Consulting



# SAPP: Key objectives for interconnection



-  Complementary production
-  Security of supply
-  Cost synergies
-  Climate challenge

Source: Nord Pool Consulting

# The SAPP Transmission Network

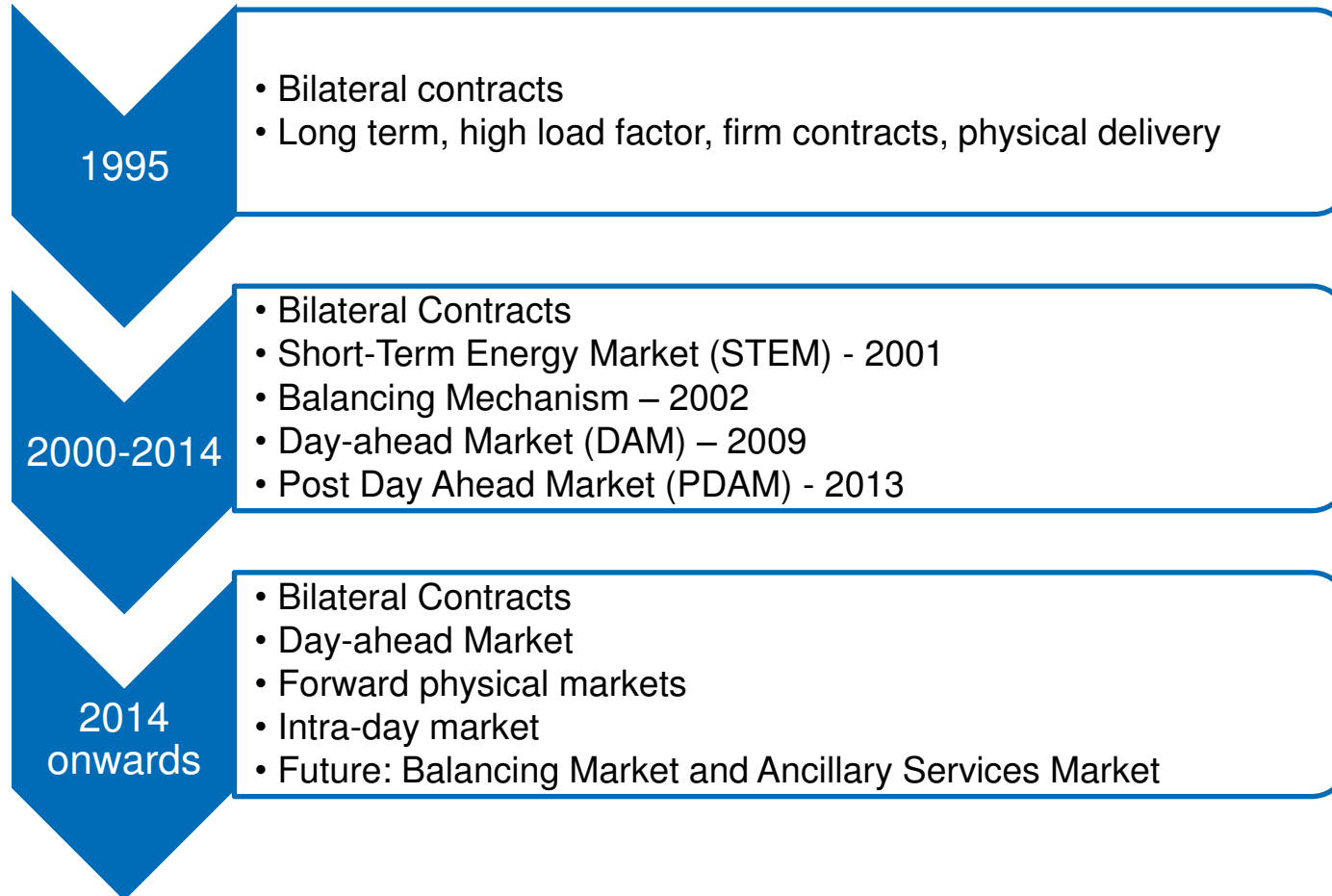


Source: SAPP

# SAPP Development

- Story of electricity trading in SAPP is one of **evolution**
- Early bilateral trades across individual interconnections
  - DRC to Zambia in 1950s
  - Zambia to Zimbabwe after construction of Kariba dam in 1960s
  - Mozambique to South Africa after construction of Cahora Bassa hydro plant (2,400 MW)
  - 1995: Southern African Power Pool (SAPP) created to facilitate greater regional trade and resource sharing
- Key components:
  - Inter-Government Memorandum of Understanding
  - Agreement between Operating Members
  - Operating Guidelines
    - System Control, System Security, Emergency Operations  
Operating Personnel, Operations Planning, Telecommunications
- No pre-conditions regarding industry structure – most trades between vertically integrated utilities

# Evolution of Trading in SAPP

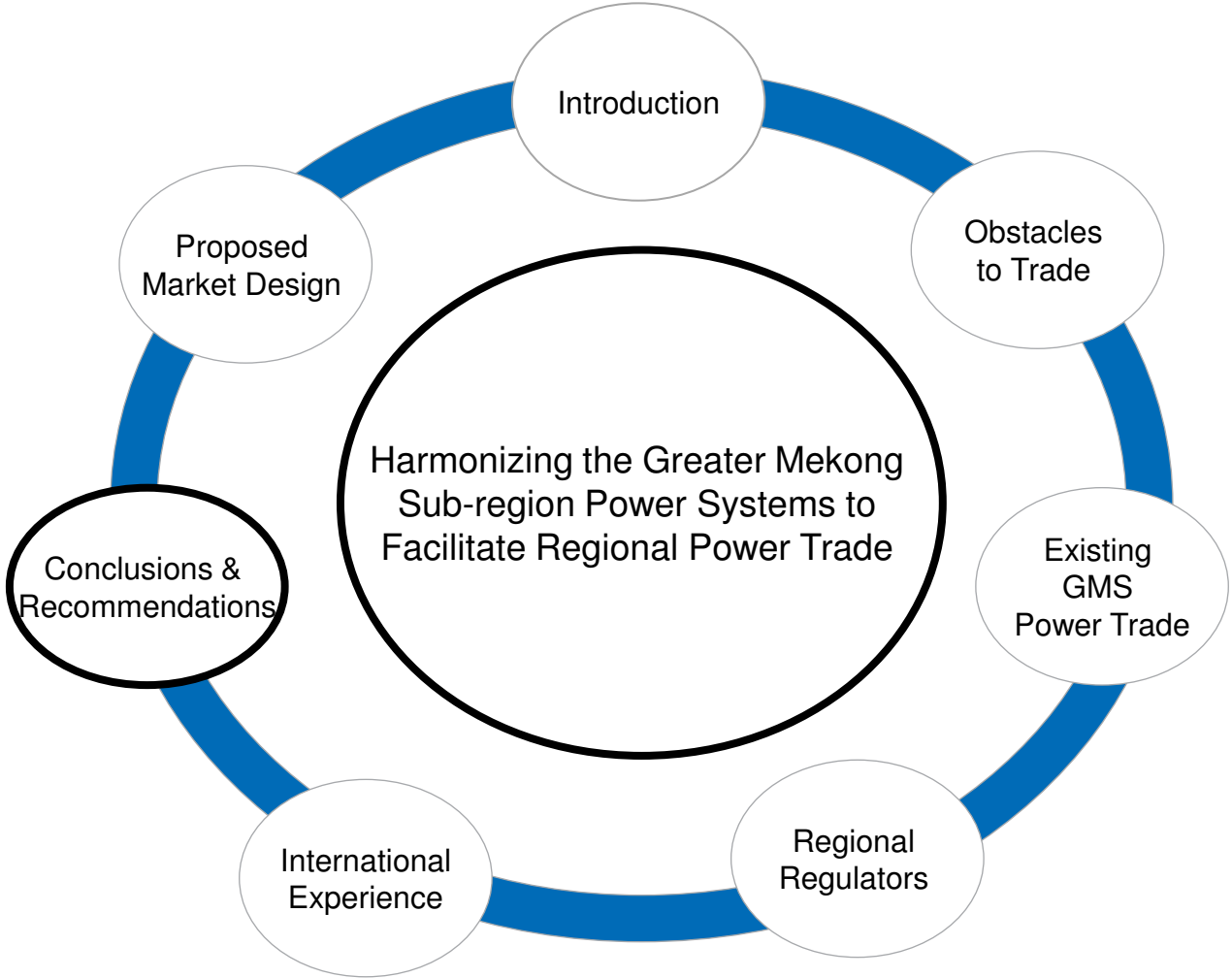


## Identifying significant differences between SAPP and the GMS

- A comparison has been made between the coverage of the SAPP Inter-Utility Memorandum of Understanding (2007) and the Memorandum of Understanding on the Guidelines for the Implementation of the Regional Power Trade Operating Agreement – Stage #1.
- Key differences:
  - Considerably more detail provided in the SAPP MOU than is the case with the GMS version
  - A number of gaps need to be filled for the GMS through additional documentation.
- Hierarchy of documentation in SAPP comprising an Agreement between Operating Members and a set of Operating Guidelines which govern the operating arrangements for trading between the member utilities. These documents, or equivalent, will be required once further trading in the GMS begins to take place.
- SAPP has a clear organisation structure defined beneath the Management Committee, consisting of a series of Sub-Committees and the Co-ordination Centre. In the GMS a subset of these functions are intended to be fulfilled by working groups. These working groups will have an important role to play in developing the market.

## Identifying significant differences between SAPP and the GMS

- The GMS MOU states that “The Executive Authorities that shall be entitled by the Government of the GMS member countries to perform the cross-border power trade among the GMS member countries and carry out all the actions needed to achieve it are the entities responsible for the generation scheduling and the supervision and control of the operations of the transmission system of each of the countries involved in the trade (referred as the Transmission System Operators)”
- SAPP permits IPPs to participate in the market as well as other identified trading bodies that are separate from the TSOs.
- The SAPP MOU makes the Co-ordination Centre responsible for managing the dispute resolution process. The GMS MOU makes this process the responsibility of the affected TSOs, and makes reference to the possibility of involving international arbitration if agreement cannot be reached between them. It is recommended that the RPTCC takes a more central role



## Recommendations for Overcoming Regulatory Barriers: RETA 6440 context

- The RETA 6440 project identified a complex electricity market model that could evolve within the GMS, which would evolve in a number of stages – these are defined as follows:
- Stage 1 focuses on PPAs being struck between generators and national single buyers, with balancing arrangements agreed locally between the generators and single buyers.
- Stage 2 envisages the introduction of a day-ahead balancing market;
- Stage 3 anticipates a day-ahead spot market in which the TSOs in the region participate as single buyers;
- Stage 4 proposes the opening up of the day ahead market and balancing market to large consumers;
- Stage 5 envisages direct contracting between generators and large consumers; and
- Stage 6 proposes the creation of a separate Market Operator with market platforms offering day-ahead and intra-day trading opportunities, as well as a forwards and futures market.



# Recommendations for Overcoming Regulatory Barriers

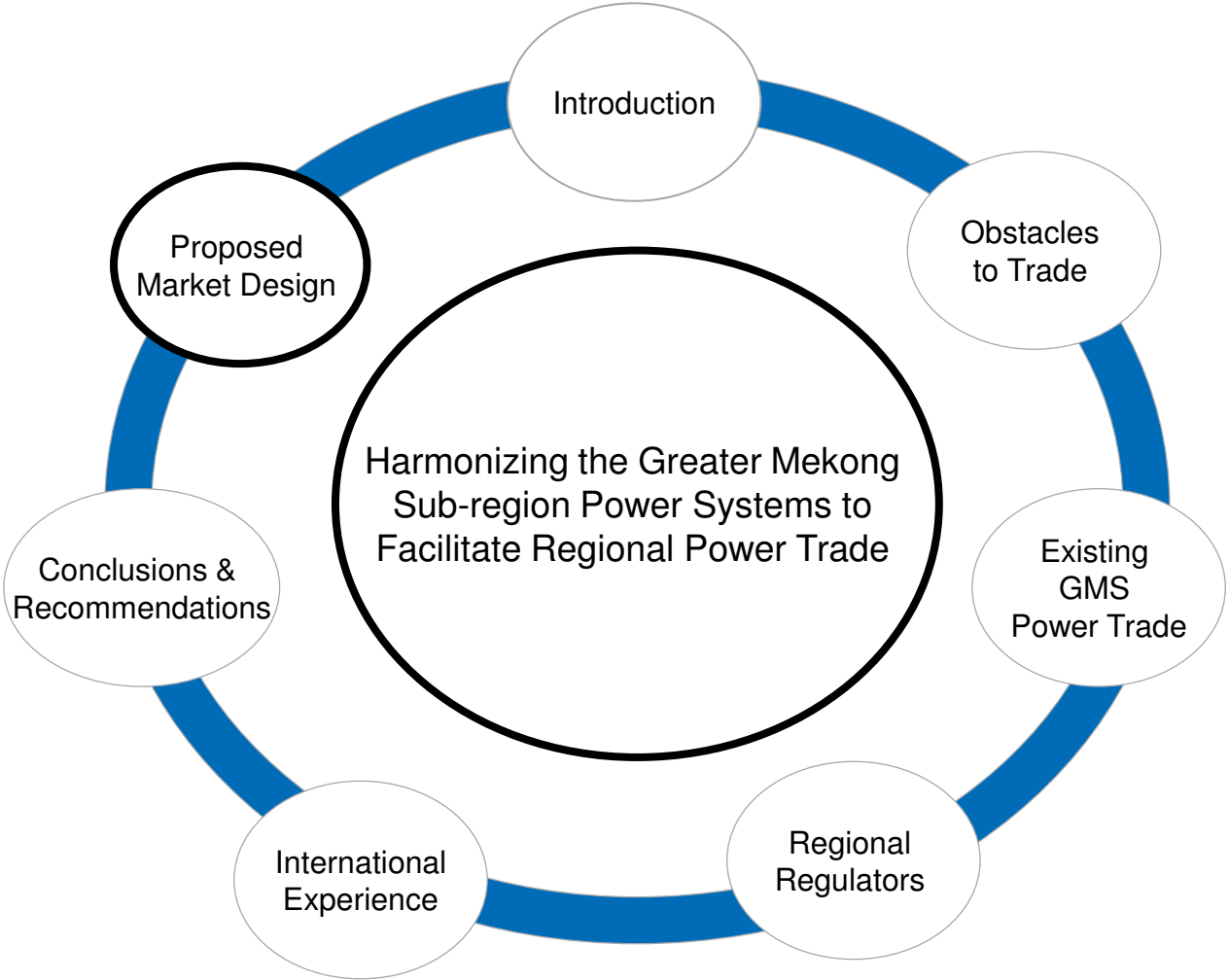
## Key Focus

- It is recommended that the current assignment focuses on Stage 1 of the RETA 6440 components, and explores what can be achieved ahead of a fully developed interconnected regional transmission system.
- **Consequently, the focus should be on enabling expanded bilateral trade to take place, either directly across borders between utilities, or through the network of a third country.**

## Recommendations for Overcoming Regulatory Barriers - regional



- **Enhanced inter-utility cooperation**
  - Strengthened RPTCC regional planning capacity
- Studies required to demonstrate the **benefits of interconnection**
- Draw on **best practice from GMS and regional interconnection projects**
  - Structure of PPAs, practicable wheeling arrangements
- Identify **a single trading party** within each country responsible for international trade
  - Single buyer, international trader...but this does *not* mean full unbundling
- Define **independent regulatory functions**, and propose greater independence of regulatory institutions
- Develop a package of measures that promotes **third-party access** to national transmission networks, to promote IPP participation
- Develop a simple structure of **transmission wheeling charges** that will support bilateral contracts and wheeling through third-party networks
- Develop core components of **trading arrangements** that can be expanded, following the principles observed in the Southern African Power Pool



## Proposed market design – recommended steps for implementation

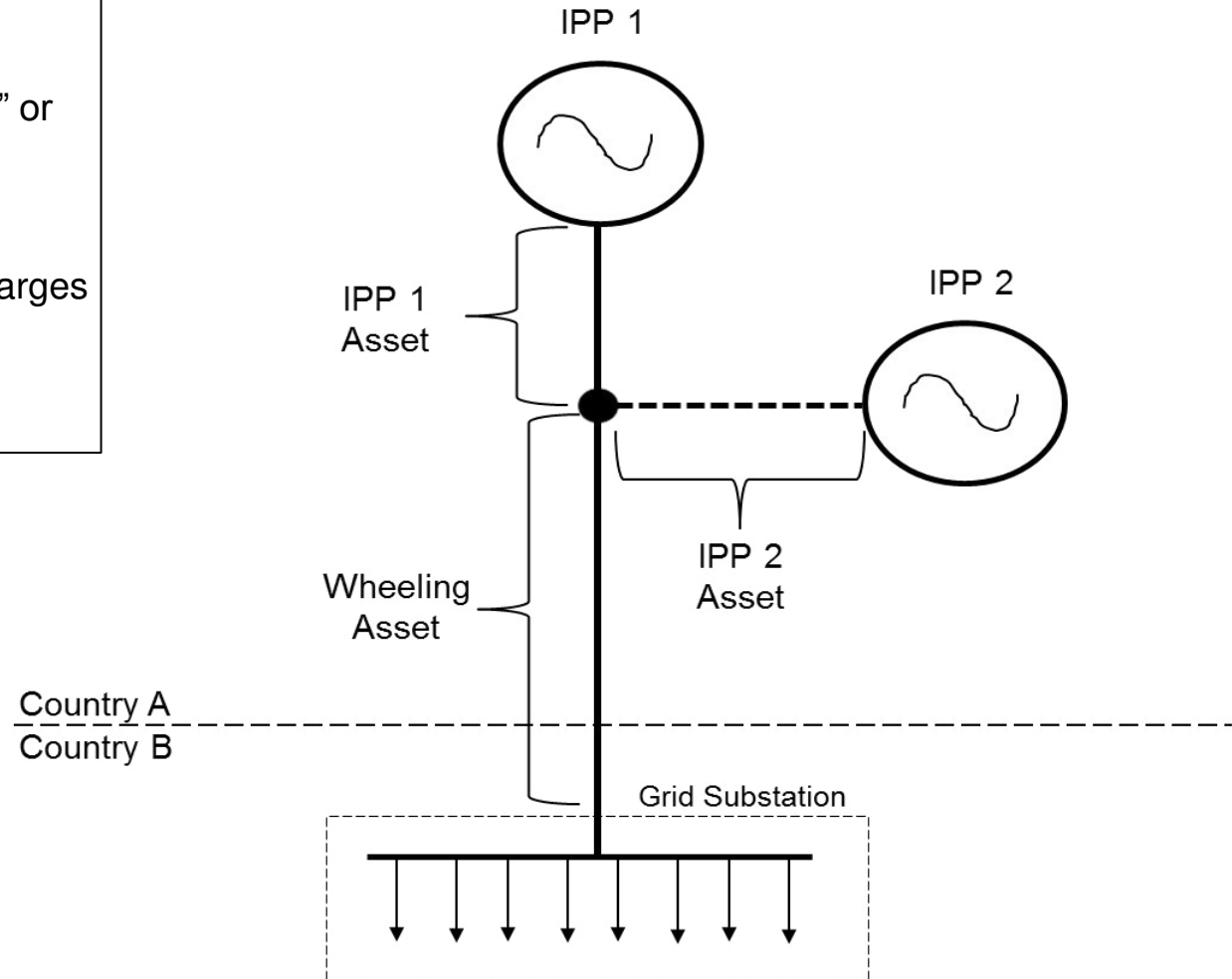


- **Long-Term / Short-Term Bilateral Contracts**
  - Physical contracts initially, based on interconnector capacity
  - Short term contracts utilising spare capacity after long-term/plant specific interconnector capacity has been allocated
- **Balancing Arrangements to be defined for Bilateral Contracts**
  - Accounting for mismatch between contracts and outturn generation/demand
- **Third Party Access**
  - Suitable technical and commercial arrangements
  - Access to existing interconnections as well as interconnected networks
- **Wheeling Charges**
  - Sharing of cross-border assets
  - Handling wheeling charges to support transit flows
- **Metering and Settlement Arrangements**
  - Defined commercial interfaces
  - Role of RPCC

# Third Party Access and Wheeling Charges

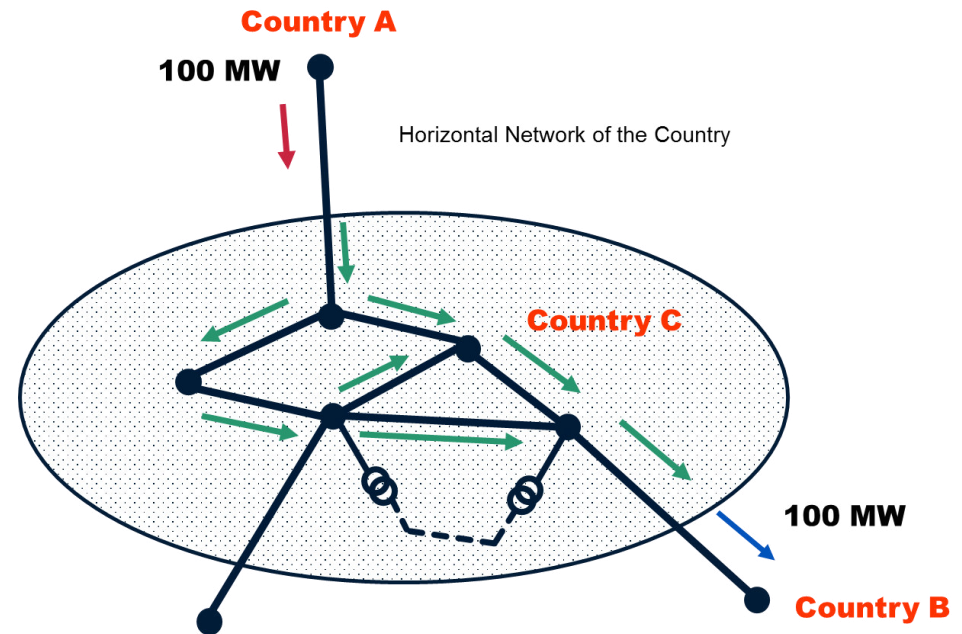
## Key issues:

- Identification of “shared use” or “wheeling” assets
- Renegotiating PPAs which incorporate transmission charges
- Capacity or energy based payments?

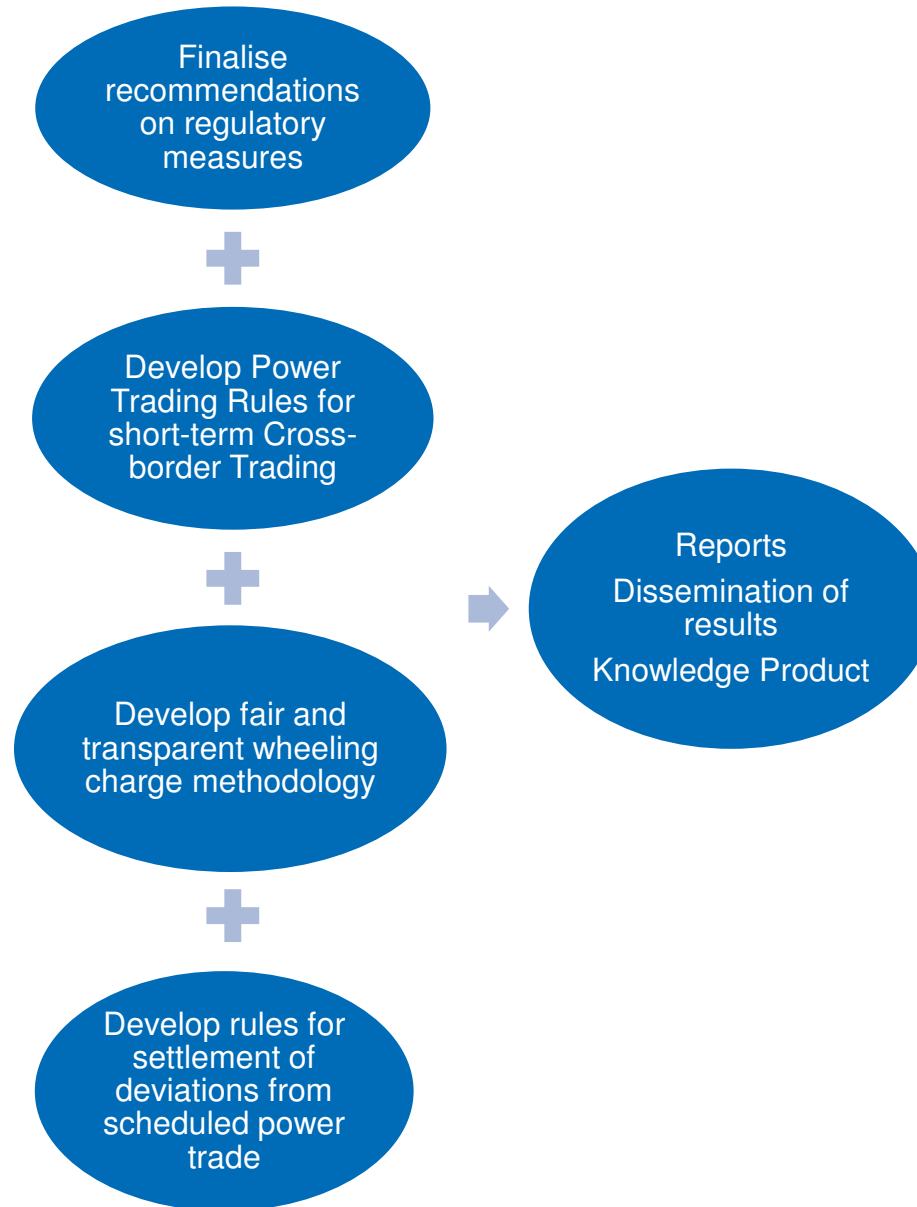


# Wheeling charge options

- Postage stamp charges
  - Independent of location
  - Good for recovery of historic costs
- Contract path methods
  - A proxy for how much transmission is used
- MW-km distance based methods
  - Based on use of the actual network assets
  - Load-based
  - Requires up to date/accurate system models
  - Forward looking (incremental-cost based) or backward looking (historic costs)



# Next steps



# Detailed Work Plan



Detailed Tasks and/or Expected Output	2015			2016												2017												
	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
(i) Work with the WGRI to complete the study identifying the regulatory barriers in GMS countries to development of the power trade and propose measures and institutional arrangements to address such regulatory barriers for each GMS member;	█																											
(ii) Recommend approaches to harmonize regulatory functions at the regional level, as reflected in the functions at each GMS member country;									█	█	█	█	█															
(iii) Propose approaches to introduce and enforce third-party access in each GMS country and at the regional level;						█						█	█															
(iv) Working with the WGRI to review the proposed market design for the GMS prepared under the TA6440-REG, and incorporate GMS countries consideration and propose a final design for adoption by the RPTCC;						█						█	█															
(v) Development of payment agreements or tariffs for third-party use to compensate countries that host flows linked to third-party trading;													█															
(vi) Develop monitoring tools, such as regulatory benchmarking reports, and transmission system operators' benchmarking and annual reports;																	█	█	█	█								█
(vii) Develop and propose for adoption power trade rules for short-term cross-border trading;									█	█	█		█				█											
(viii) Develop and propose for adoption power trade rules for settlement of deviations to scheduled power trade in grid-to-grid interconnections; and																█	█	█	█									█
(ix) Complete and recommend guidelines for improvement of the regulatory framework for midterm GMS cross-border power trading;																	█	█	█	█								█
(x) Prepare a fair and transparent wheeling charge methodology for adoption by the RPTCC;									█	█	█		█				█											
(xi) Prepare a fair and transparent cross-border trade compensation mechanism for transits;																												
(xii) Participate in RPTCC and WGRI meetings to disseminate study results and recommendations;		█																										█
(xiii) Prepare a knowledge product for publication by ADB summarizing key findings from (i) and (xii) above.																												█



# Schedule of Deliverables



Detailed Tasks and/or Expected Output	2015			2016												2017												
	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
<b>Milestones</b>																												
Report 1 - Report documenting the consolidated measures proposed to each GMS country for implementation in order to overcome regulatory barriers; proposed final market design for the GMS for adoption by the RPTCC						◆							◆															
Report 2a - Draft report documenting the proposed pricing mechanisms for wheeling charge; and for transit compensation, ready for adoption by RPTCC												◆																
Report 2b - Draft report documenting the proposed power trade rules for short-term cross-border trading, power trade rules for settlement of deviations to scheduled power trade in grid-to-grid interconnections ready for adoption by RPTCC.												◆																
Presentation of draft report 1 and 2																◆												
Comments from stakeholders of draft report 1 and 2																◆												
Report 1 and 2 draft final report																	◆											
Presentation of draft final report 1 and 2																		◆										
Comments from stakeholders of draft final report 1 and 2																			◆									
Report 1 and 2 final report																				◆								
Presentation of final report 1 and 2																					◆							
Report 3 - Knowledge Product including presentation materials, and briefing notes to be presented at the RPTCC and WGRI meeting.																												◆



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Environment  
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Surrey Research Park  
Guildford, Surrey

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# Key country specific recommendations – CAMBODIA



<b>Issue 1</b>	<b>Differing technical standards existing between the EDC and EVN networks.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Harmonisation of technical standards and the agreement of common frequency control and voltage control methodology, including detailed technical studies and development of new ancillary services definitions to improve network stability.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>EAC and EDC should establish a technical working group that can address technical standards issues and interface with the counterparts in EVN and ERAV to address the studies and control issues being experienced on the existing 230kV interconnection. This group should liaise with the WGPG as required.</li> </ul>
<b>Issue 2</b>	<b>Government approval is currently needed for international trades, which are currently entered into by EDC and by individual distribution companies.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>EDC, as the single buyer, should be permitted to enter into trades that it considers are technically and economically desirable, subject to the approval of the RPTCC and in accordance with the GMS Market Rules. EAC should be responsible for regulating EDC's performance, but not for authorising specific international trades.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>EDC should be formally established as the single buyer for trading that is carried out over HV system to system interconnections. Capacity building is required to extend EAC's role to regulating EDC's single buyer activities.</li> </ul>
<b>Issue 3</b>	<b>Distribution companies are numerous and have widely differing standards of supply quality and technical/commercial losses.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Distribution code standards are required, together with tighter regulation of distribution companies, including the threat of removing licences from those that fail to meet common, agreed standards.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Additional personnel are likely to be required in EAC to support the introduction of new distribution standards and to monitor levels of compliance by distribution companies.</li> </ul>
<b>Issue 4</b>	<b>Lack of awareness of trading international trading opportunities.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Greater coordination of national electricity plans with wider regional studies is needed, including regular interaction between EAC, EDC and the Ministry of Mines and Energy and the RPTCC/PWG.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>An International Trading Working Group could be established with participation from EAC, EDC and the Ministry of Mines and Energy, which would liaise with the RPTCC.</li> </ul>

# Key country specific recommendations – CHINA



<b>Issue 1</b>	<b>All international electricity trades require approval from central government.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>YPI, as the international trading body, should be empowered to negotiate trades with neighbouring countries without requiring government approval on a case by case basis.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Institutional changes are required to move towards an independent regulatory body having oversight of YPI's trading activities, rather than being directly involved in each contract negotiation. This brief could be potentially be given to NEA on an interim basis.</li> </ul>
<b>Issue 2</b>	<b>Absence of clear and updated regional plans showing potential economic benefits of international trades.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Regular interaction is required between CSGI, YPI and the NDRC to identify and pursue international trading opportunities.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>An International Trading Working Group should be established with participation from CSGI, YPI, NDRC and NEA, which would liaise with the RPTCC/PWG.</li> </ul>
<b>Issue 3</b>	<b>Absence of third party access to the transmission network.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Clear guidelines are needed to ensure that an international trading body or YPI has full and reliable access to the CSGI network for the purposes of international power trading. Third party access and the possible involvement of IPPs in exporting power to neighbouring countries requires active development.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Clear allocation of responsibilities for paying the transmission costs associated with power purchase and sale by the international trader/YPI is required. Regulatory measures are needed to enable the licensing of IPPs and to confirm connection and use of system arrangements to give access to the CSGI network</li> </ul>
<b>Issue 4</b>	<b>There is a lack of clear incentive for parties to come forward as the sponsors of new transmission interconnections.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>A defined methodology for wheeling charge calculation is required for the region as a whole, with licensing arrangements in each GMS country, China included, to permit private ownership of transmission assets.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Legislative and institutional measures will be needed to ensure that private developers and owners of transmission interconnection projects are permitted to connect and operate these in conjunction with the CSG system.</li> </ul>

# Key country specific recommendations – LAO PDR



<b>Issue 1</b>	<b>Insufficient discussions are taking place regarding the potential for international trade.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Regular interaction is required between EDL, DEB and DEPP to identify international trading opportunities and maintain up to date databases, planning scenarios and planning methodology.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>An International Trading Working Group should be established with participation from EDL, DEB, DEPP which would liaise with the RPTCC in a co-ordinated way.</li> </ul>
<b>Issue 2</b>	<b>High level of government involvement in IPP negotiation.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>EDL should be free to enter into commercially attractive power imports and exports with a minimum of government involvement in the decision making process. Similar arrangements are required for IPPs.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Institutional changes are required to move towards an independent regulatory body having oversight of EDL's trading activities. This brief could be potentially be given to DEB on an interim basis.</li> </ul>
<b>Issue 3</b>	<b>Absence of third party access to the transmission network.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Measures are required to facilitate sharing of cross-border transmission lines as a general operating principle, and clauses are therefore required in PPAs for IPPs to make this a right for new market entrants.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Responsibilities for operating and maintaining shared cross-border transmission assets will need to be clearly defined once these are shared by more than one party.</li> </ul>
<b>Issue 4</b>	<b>There is a need for training and capacity building to improve industry stakeholders' understanding of the opportunities for regional power trading.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>DEB should report on the successful training/capacity building initiatives that it has been involved in to the RPTCC.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>RPTCC should convene a capacity building working group to assess training needs in the different regional organisations on a regular basis and to organise training events locally or involving travel to specific international organisations of interest. DEB and EDL should liaise with this body on a regular basis.</li> </ul>

# Key country specific recommendations – MYANMAR



<b>Issue 1</b>	<b>Lack of clarity regarding the role of EPGE as a single buyer.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>A clear definition of the role of EPGE as, effectively, the single buyer for Myanmar is required.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>A clear definition is needed of the institutional relationship between EPGE, the government-owned generation in Myanmar, IPPs and international interconnectors, in order to define the contractual structure that will exist to support international trading.</li> </ul>
<b>Issue 2</b>	<b>Involvement of the Ministry of Electric Power in granting permits and lack of an independent regulator.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Limiting the role of the MEP and/or Regulatory Authority to reviewing the power trading activities of EPGE rather than being involved in the negotiation of cross-border trading contracts is recommended.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>The institutional arrangements between the MEP and the Regulatory Authority require clarification.</li> </ul>
<b>Issue 3</b>	<b>Unclear objectives of regional trade.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Regular interaction is required between EPGE, DEPTSC and the MEP to identify international trading opportunities.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>An International Trading Working Group should be established with participation from EPGE, DEPTSC and the MEP which would liaise with the RPTCC.</li> </ul>
<b>Issue 4</b>	<b>Unclear contracting arrangements for cross-border trades</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>The contractual structure for PPAs between international buyers and sellers of electricity and EPGE is unclear. Discussion is required with the RPTCC as to whether standardised PPAs based on those used for other trades in the GMS region could be applicable.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Confirmation is required as to whether EPGE will have the role of a single buyer in the Myanmar electricity sector moving forwards.</li> </ul>
<b>Issue 5</b>	<b>Confirmation of arrangements for third party access</b>
<b>Required Measures</b>	Clarification is required as to the arrangements for third party access that will exist in Myanmar in the future, and how national transmission charges will apply to IPP trades participating in cross-border transactions.
<b>Institutional Arrangements</b>	The institutional relationships between IPPs, EPGE and foreign utilities buying and selling energy across the Myanmar border require clear definition.

# Key country specific recommendations – THAILAND



<b>Issue 1</b>	<b>Insufficient discussions are taking place regarding the potential for international trade.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Regular interaction is required between EGAT, ERC and the Ministry of Energy to identify international trading opportunities and to maintain up to date databases, planning scenarios and planning methodology.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>An International Trading Working Group should be established with participation from EGAT, ERC and the Ministry of Energy which would liaise with the RPTCC/PWG.</li> </ul>
<b>Issue 2</b>	<b>Specific case studies of regional power trading need to be analysed.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>As well as studies to show the regional benefits of trading, individual demonstrations of how wheeling between pairs of countries should be undertaken as a pilot study of what is possible.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Consideration should be given to whether these studies are best performed by a Thai International Trading Working Group, or whether they should be the responsibility of a Planning Working Group within the RPTCC.</li> </ul>
<b>Issue 3</b>	<b>Inconsistencies in taxation and subsidy mechanisms regionally.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>High level government discussions are required to agree a standardised approach to the treatment of subsidies and taxation rules on electricity imports and exports, such that these are applied outside the wholesale electricity trading arrangements.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Arrangements for applying taxes and subsidies need to be resolved between the Ministry of Energy and other relevant government departments in Thailand, including the Treasury.</li> </ul>
<b>Issue 4</b>	<b>Absence of third party access to the transmission network.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>A process of evolution towards full third party access is required if the maximum degree of market access is to be provided to new generation entrants.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>In the interim, the role of EGAT as the single buyer of electricity should be defined in order that international imports can be contracted in a straightforward manner. Alternatively, consideration should be given to creating a separate international trading entity that can purchase power from EGAT and sell it onwards, or purchase imports and sell them to end consumers within Thailand.</li> </ul>

# Key country specific recommendations – VIETNAM



<b>Issue 1</b>	<b>Lack of an independent regulator.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Progress is required towards ERAV being set up as a fully independent regulator as a separate entity from the Ministry of Industry and Trade (MOIT).</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Setting up ERAV as a separate legal entity from the MOIT and defining the funding arrangements to support ERAV through licence fees from industry participants will be required.</li> <li></li> </ul>
<b>Issue 2</b>	<b>Unclear objectives of regional trade.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>Regular interaction is required between EVN, ERAV and the MOIT to identify international trading opportunities.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>An International Trading Working Group could be established with participation from EVN, ERAV and the MOIT which would liaise with the RPTCC/PWG.</li> </ul>
<b>Issue 3</b>	<b>Transparent rules are needed for cross-border trades to be handled within the VWEM.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>As the VWEM design is finalised and the proposed market rules are drafted, transparent arrangements are required to ensure that imports and exports are treated as supply and demand contracts within that market. Arrangements will also be required to cover any imbalances between scheduled interchanges on cross-border interconnectors and actual positions.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>Arrangements will be required to enable EVN and IPPs to act as counterparties to international trade through the VWEM, and for the creation of an international trader who will represent cross-border trades in the market. The identity of the VWEM operator will also need to be defined carefully, to ensure the neutrality of the market operator in relation to energy transactions.</li> </ul>
<b>Issue 4</b>	<b>Application of transmission charges within Vietnam to power imports and exports associated with cross-border interconnection.</b>
<b>Required Measures</b>	<ul style="list-style-type: none"> <li>A clear methodology is required to define the way in which transmission charges <i>within</i> Vietnam will be applied to cross-border imports and exports. The approach to be taken will need to be harmonised with international wheeling charges.</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>The methodology for applying transmission charges within Vietnam to cross-border trades will require discussion between EVN, ERAV and the WGRI.</li> </ul>



# ANNEX 6

# Working Group on Performance Standards and Grid Code (WGPG)

## GMS Regional Power Trade Coordination Committee (WGPG under RPTCC)

### Conclusion

**27 June 2016**  
**Phu Quoc, Viet Nam**

**Aruna K Wanniachchi**  
**Senior Energy Specialist**  
**Southeast Asia Department, Energy Division**

The logo of the Asian Development Bank (ADB), consisting of the letters 'ADB' in white serif font on a blue square background.

**ADB**

# Topics of Discussion

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1. Introduction
2. WGPG Activities
3. Proposed GMS Performance Standards
4. Proposed GMS Regional Planning Process
5. Proposed WGPG actions for 2016-2017

## **- Proposed WGPG Activities**

- i. GMS Performance Standards including a gap analysis**
- ii. Transmission Regulation: including the proposed GMS policies (scheduling and accounting, coordinated operational planning, communication infrastructure and data exchange) and technical coordination for transmission regulation;**
- iii. Standard Regional Metering Arrangements;**
- iv. GMS Grid Code (Operational Procedures).**

# WGPG Activities ctd..

- **GMS Performance Standards and Gaps**
- **In April 2014, ADB issued the Transmission Regulations in the form of 5 Volumes plus an Executive Summary:**
  - 1. POLICY ON SCHEDULING AND ACCOUNTING**
  - 2. POLICY ON COORDINATED OPERATIONAL PLANNING**
  - 3. POLICY ON COMMUNICATION INFRASTRUCTURE**
  - 4. POLICY ON DATA EXCHANGES - RULES TO HANDLE THE DATA - CODE OF CONDUCT**
  - 5. GLOSSARY OF TERMS**

# Proposed GMS Performance Standards

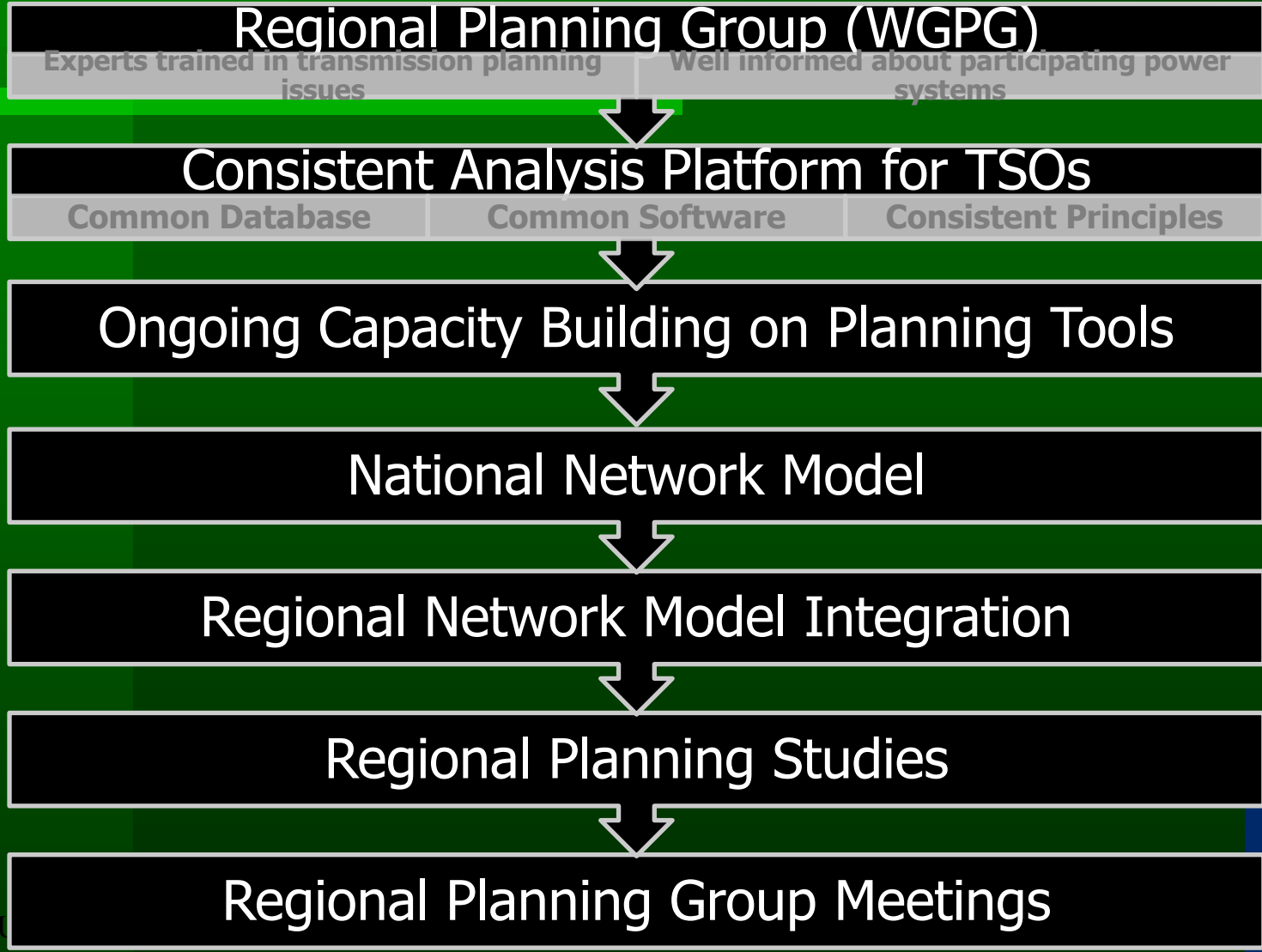
- Performance Standards of Each GMS Country and Proposed Standards for GMS (RETA 6440) – 2010

- Gap Analysis – 2014

## 2016

- Consultants updated the proposed GMS Performance Standards based on European Network of Transmission System Operators for Electricity (ENSTO-E)
- WGPG Comments – proposed revisions some of the proposals and requested to provide reasons for the proposed changes, and confirm the appropriateness of the proposed standards for GMS
- Consultants will update the proposed Performance Standards and revise the report

# New proposal - GMS Regional Planning Process



# Proposed Next Steps

1. RPTCC to adopt the update GMS Performance Standards (after incorporation of the comments and revision provided at the meeting)
2. RPTCC to recognize the importance of a GMS regional planning process to be developed further in details, for regular use in GMS at national and regional levels
  - 2.1 Countries to conduct National Network Models for next 5-10 years or beyond (2016 – 2017)
  - 2.2 Countries to agree on the Regional Network Models (scope, methodology, software, data sharing etc.) (2017)



# Systematic Approach in Achieving Other Targets?

- i. GMS Performance Standards including a gap analysis*
- ii. **Transmission Regulation: including the proposed GMS policies (scheduling and accounting, coordinated operational planning, communication infrastructure and data exchange) and technical coordination for transmission regulation;**
- iii. **Standard Regional Metering Arrangements;**
- iv. **GMS Grid Code (Operational Procedures).**

**THANK YOU**

# ANNEX 7

The background of the slide is a photograph of a power transmission tower, likely a lattice tower, silhouetted against a bright, hazy sky at sunset or sunrise. The tower's complex structure of steel beams is visible. A large blue rectangular area is overlaid on the top half of the image, and a green horizontal bar is positioned below the main title text.

# **CONCLUSION AND RECOMMENDATIONS OF THE WORKING GROUP ON REGULATORY ISSUES**

**RPTCC-20**

## Recommendations for Overcoming Barriers to trade

- **Objective: to enable expanded bilateral trade between any pair of GMS countries, using transmission facilities, either directly across borders between utilities, or through the network of a third country**
- Recommendations:
- Develop elements to enable GMS **Intermediate Market** , which include:
  - Long term and short term **bilateral contracts**
  - Expanded **third party access** for generators
  - A clear **wheeling charge methodology**
  - A **balancing mechanism** to support deviations from contract schedules
  - **Metering and settlement arrangements** to support bilateral trades

# Recommendations #1



- **Long-Term / Short-Term Bilateral Contracts**
  - Long-term contracts to continue, as in the existing situation
  - Propose rules for short-term contracts utilising spare capacity after specific interconnector capacity has been allocated to long-term contracts: i.e. propose short-term trading rules that enable opportunistic trade
  - Short-term trading rules to be developed by the Consultant, discussed with and approved by the WGRI
  
- **Third Party Access**
  - Define the licence requirements needed for transmission system owners/operators and generators
  - Define outline Connection and Use of System Agreements needed to support Third-Party Access
  - Develop proposals that give access to both existing interconnections and national networks
  - Third-party access proposals to be developed by the Consultant and discussed with/ approved by the WGRI

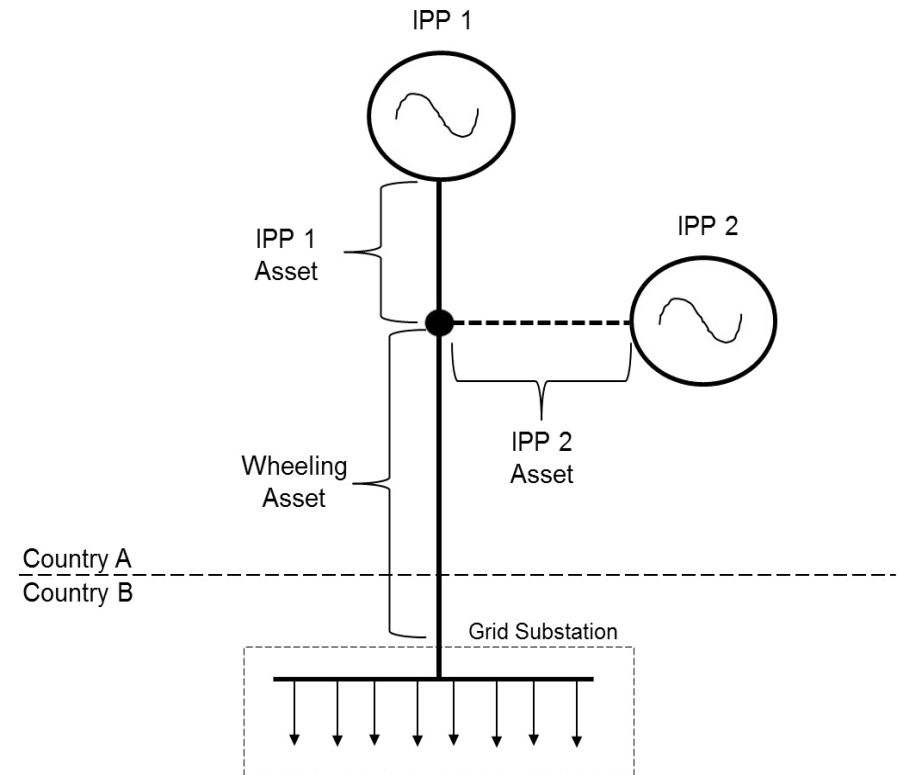
## Recommendations #2

### ● Wheeling Charge Methodology

- Define rules for identifying connection assets vs. wheeling assets
- Define methodology for sharing costs of wheeling assets
- Define methodology for recovering costs of transits
- Methodology to be selected and recommended by the Consultant and discussed with/approved by the WGRI

#### Key issues:

- Method for identifying “shared use” or “wheeling” assets
- Propose renegotiation of PPAs which incorporate transmission charges
- Methodology for capacity and/or energy-based charges
- Define methodology (postage-stamp, contract path or MW-km)
- Proposed timescales for introduction and frequency of updating



## Recommendations #3



- **Balancing Mechanism to be defined for Bilateral Contracts**
  - Recommend rules for accounting for mismatch between contracts and outturn generation/demand
  - Identify responsibilities for balancing and costs of imbalances
  - Consultant to develop recommendations for discussion and approval by the WGRI
- **Metering and Settlement Arrangements**
  - Define the commercial interfaces for short-term and long-term trades
  - Define metering points on interconnectors and at interfaces with generation and demand
  - Define the role of the RPTCC in monitoring and settling bilateral trades
  - Consultant to make recommendations for discussion and approval by the WGRI



## Working Arrangements and Programme

- ADB Consultant will undertake initial work on each of these tasks, which will be sent to the WGRI for comment.
- Consultant will then revise, and present revisions to WGRI meetings for approval
- Timeline: first 6 months
  - Draft Recommendations on **Short-term Trading Rules, Third Party Access and Wheeling Charges** to be submitted by the Consultant by the end of **October 2016**
  - WGRI members to send written comments by the end of **November 2016**
  - Revised recommendations to be discussed and approved in RPTCC-21 in **December 2016**
- Timeline: second 6 months
  - Draft Recommendations on **Balancing Mechanism and Metering/Settlement arrangements** to be submitted by the Consultant by the end of **April 2017**
  - WGRI members to send written comments by the end of **May 2017**
  - Revised recommendations to be discussed and approved in RPTCC-22 in **June 2017**

# ANNEX 8



**RETA 9003: Integrated Resource Planning (IRP) with  
Strategic Environmental Assessment (SEA) for  
Sustainable Power Sector Development in the GMS**

(Financed by the Agence Française de Développement)

28 June 2016

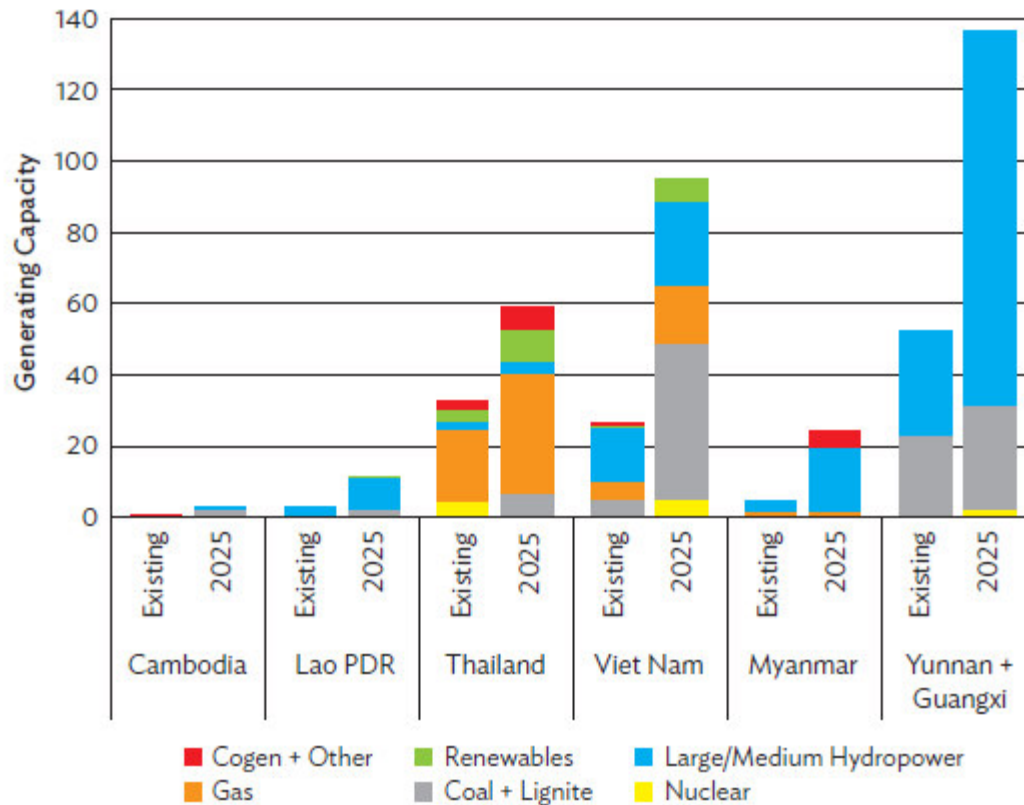
Hyunjung Lee  
hjlee@adb.org

# Contents

- 1. Background**
- 2. Progress**
- 3. Expected benefits and outputs**

# RETA 7764: Current PDPs presents high environmental and social pressures in the GMS

Figure 1. Projected Installed Capacity by Country in the Greater Mekong Subregion, Current Power Development Plan Scenario (gigawatt-hours)



Cogen = cogeneration, Lao PDR = Lao People's Democratic Republic.

Source: ADB. 2013c.

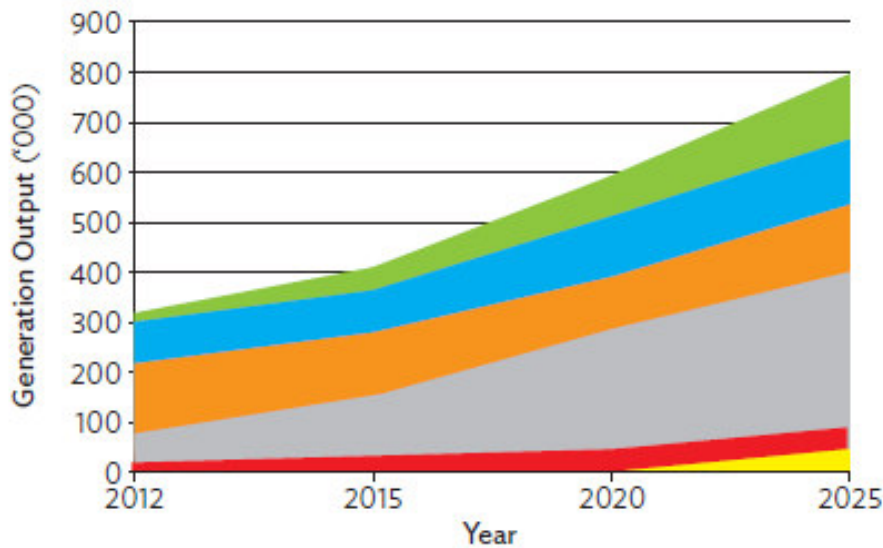
Source: ADB RETA 7764 Report

- GMS economic growth has been strong; demand for electricity growing even faster
- The total installed capacity is projected to reach 210 GW by 2025 from 120 GW in 2012
  - ✓ Notably contributed by the increase of large hydro and coal-fired generation
  - ✓ Renewable will increase by more than three times but from a very low level of 3,500 MW

# RETA 7764: Alternative PDP scenarios achieved a greater “sustainability”

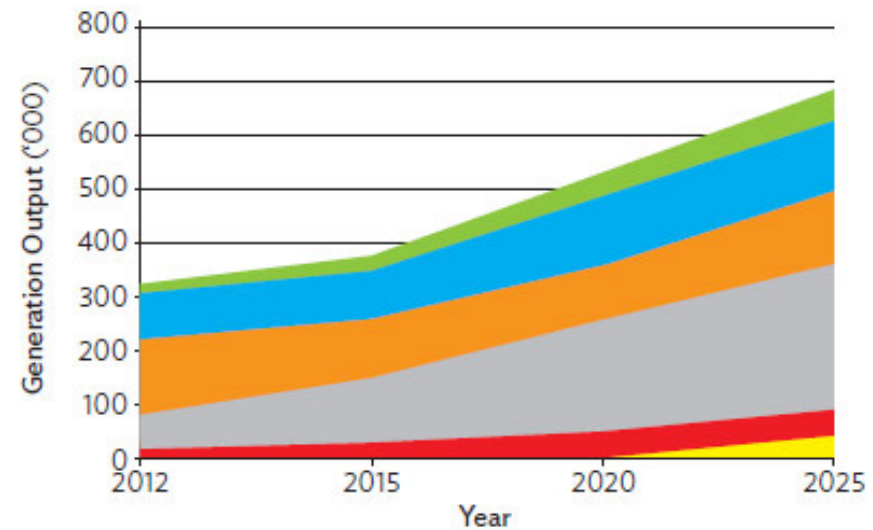
## Renewable Energy Scenario

*Global impacts displacement case*



## Energy Efficiency Scenario

*Global impacts displacement case*



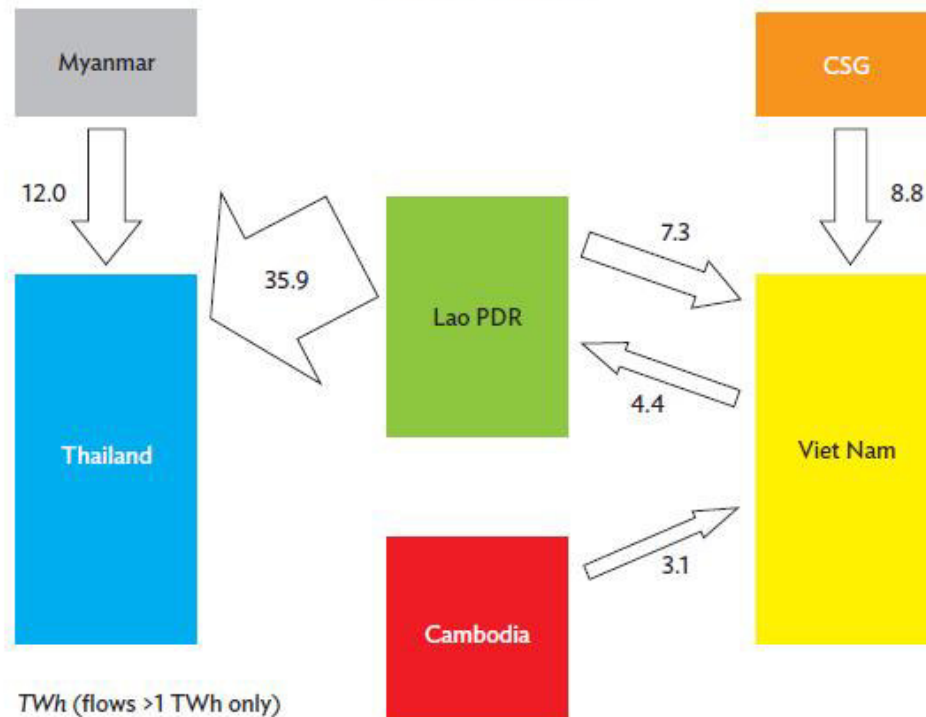
■ Renewables ■ Hydropower ■ Gas ■ Coal + Lignite ■ Cogen + Other ■ Nuclear

Source: ADB RETA 7764 Report

- RE Scenario: extra 27 GW of RE capacity can be deployed, displacing 9 GW of fossil capacity
- EE Scenario: 16 GW fossil capacity can be reduced

# RETA 7764: Cross-border interconnections assumed as in the current PDPs but without alternatives

Figure 2. Projected Cross-Border Flows in the Lower Mekong Basin, Current Power Development Plan Scenario, 2025 (terawatt-hour)



CSG = China Southern Power Grid, Lao PDR = Lao People's Democratic Republic, TWh = terawatt-hour.

Note: Only flows greater than 1 TWh are presented.

Source: ADB. 2013c.

- Increased interconnection will
  - ✓ Enable optimal use of generation resources through lower combined reserve requirements and reduction of peak generation capacity
  - ✓ Improve system reliability in response to unexpected faults
  - ✓ Increase system capacity to absorb intermittency of increased renewable energy

## Key Recommendations & Limitations

- **Recommendations**

- Apply more realistic demand forecasts considering demand side management (DSM) and energy efficiency (EE).
- Strengthen RE and EE policies, programs, and targets and align them with PDPs.

- **Limitations**

- RE and EE scenarios considered separately
- Increased regional power trade and enhanced cross-border connections not fully considered



# RETA 9003

## on applying IRP with SEA as a next phase

Time	Activities/Milestones
Nov 2014 (RPTCC-17)	Conceptualization and Consultations
Dec 2014	Viet Nam's request for country SEA assistance submitted to ADB/AFD
Jun 2015 (RPTCC-18)	Finalization of the Scope of Phase II activities and confirmation by the GMS countries
Nov 2015	ADB Approval (RETA 9003) with AfD's 1 million euro cofinancing contribution
May 2016	Engagement of Ricardo-led consulting consortium
Jun 2017 (RPTCC-20)	Vietnam Inception
2017-2019	Implementation

## Project results chain: impact and outcome

- **TA impact**
  - Increased economic, environmental, and social sustainability of power sector for greater mitigation of climate change impacts in the GMS
- **TA outcome**
  - Strengthened power sector planning using IRP and SEA, which will reflect (i) full economic costs including environmental and social costs (ii) potential efficiency improvement in power system through DSM, EE, and cross-border interconnections and (iii) national targets for RE, EE, and climate change (Intended Nationally Determined Contribution (INDC))

- **TA outputs**

1. Review and enhancement of Vietnam's IRP and SEA for PDP VIII preparation considering its INDC, RE, and EE targets and cross-border interconnection potential
2. Awareness among GMS countries increased through workshops and twinning programs, which will be designed based on gap analysis and each country's needs
3. Knowledge products developed and shared such as Vietnam's experiences in IRP and SEA and country's integrated PDP guidelines

## Concluding Remarks

- In summary, the TA aims to contribute to enhancing (i) the linkage between PDPs and national policy targets for climate change mitigation, RE and EE, using IRP and SEA in the upstream planning stage as well as (ii) the linkage between national planning and regional planning in relation to cross border interconnection.
- Inception presentation will be followed by Don Webster, Team leader for RETA 9003. Suggestions and comments from GMS countries are welcome.

# ANNEX 9

# **GMS Regional Investment Framework Implementation Plan 2014–2018 Progress Report and Midterm Review**

## **ENERGY SECTOR**

Jyotsana Varma, ADB

20<sup>th</sup> Meeting of the Greater Mekong Subregion  
Regional Power Trade Coordination Committee (RPTCC-20)  
27 – 28 June 2016, Phu Quoc, Viet Nam

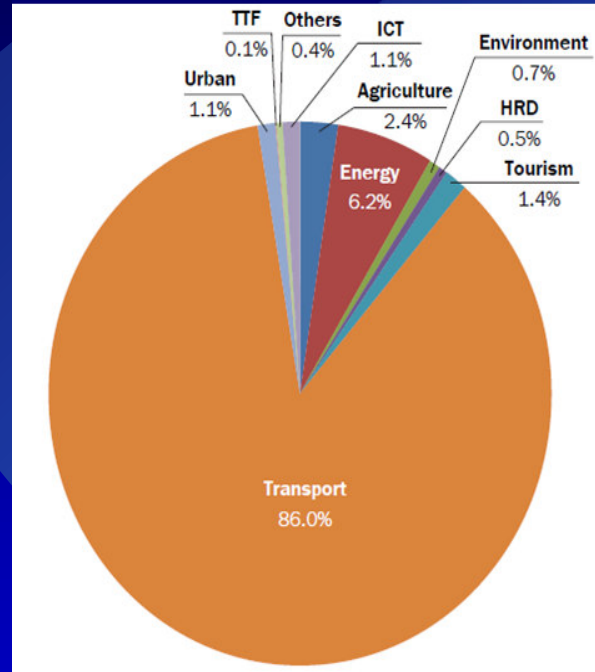


# Regional Investment Framework (RIF) 2013-2022: The Long List

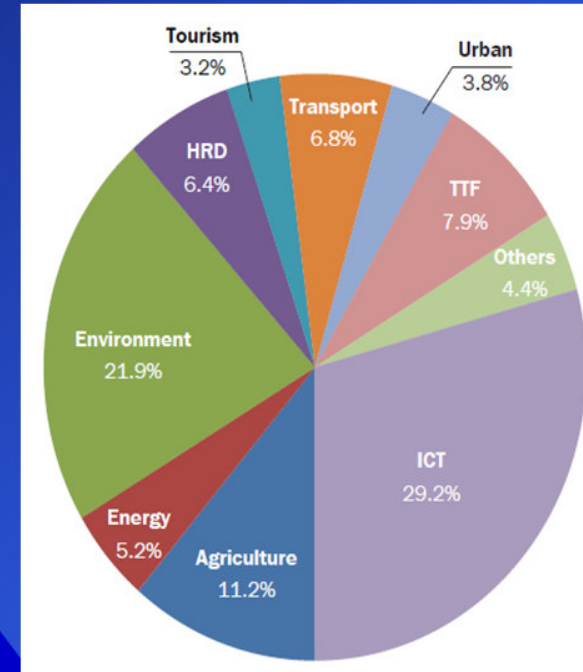


The RIF includes more than 200 projects across 10 sectors with a total investment cost of \$ 50 billion.

## RIF Investment Projects



## RIF TA Projects

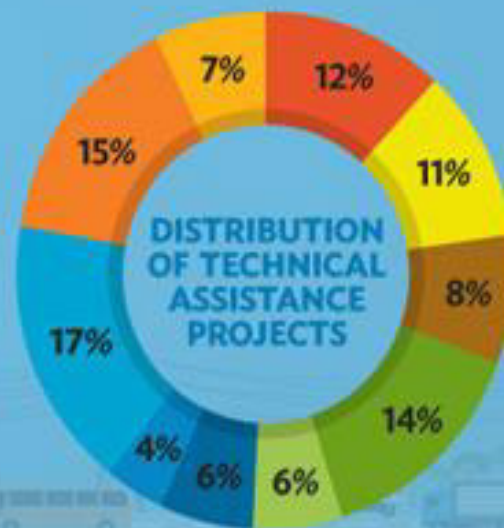
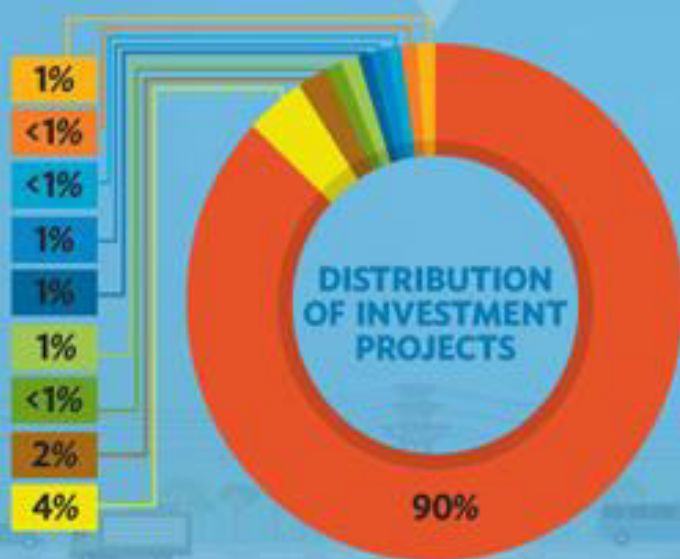


# Regional Investment Framework Implementation Plan (RIF-IP) 2014-2018: The Shortlist



The Implementation Plan puts the vision of the Strategic Framework into action, identifying 93 projects in priority areas, valued at \$30.4 billion, for full implementation by 2018.

- Transport
- Energy
- Agriculture
- Environment
- Human Resource Development
- Urban Development
- Tourism
- Information and Communications Technology
- Transport and Trade Facilitation
- Other Multisector/ Cross-border Economic Zones





# RIF-IP Table 3: Energy Priority Projects

**Table 3: Energy Priority Projects**

	Name of Project	Country Coverage	Cost Estimate (US\$ million)
<b>Investment Projects</b>			
1	Lao PDR–Viet Nam Power Transmission Interconnection (Hatxan–Pleiku)	Lao PDR and Viet Nam	218.0
2	Nabong 500 kV Substation Transmission Facility Project	Lao PDR	106.0
3	PRC–Lao PDR–Thailand 600 HVDC Interconnection	PRC, Lao PDR, Thailand	600.0–800.0
4	Reinvestigation of Thailand–Lao PDR–Viet Nam Interconnection	Lao PDR, Thailand, Viet Nam	278.0
<b>TA Projects</b>			
1	Harmonizing GMS Power Systems to Facilitate Regional Power Trade (formerly Support to RPTCC in Completion of Performance Standards, Grid Codes, Market Rules, and Subregional Transmission Expansion Plan)	All GMS countries	1.5
2	Ensuring Sustainability of Greater Mekong Subregion Regional Power Development (Phase 2)	All GMS countries	1.0
3	Development of GMS Coordination Center for Regional Power Trade	All GMS countries	3.0
4	Provision of Continuing Institutional Support for the Subregional Energy Forum	All GMS countries	1.0

GMS - Greater Mekong Subregion, Lao PDR - Lao People's Democratic Republic, PRC - People's Republic of China, RPTCC - Regional Power Trade Coordination Committee, TA - technical assistance.

Source: GMS Secretariat's compilation.



# First Progress Report Summary

## Investment Projects by Sector



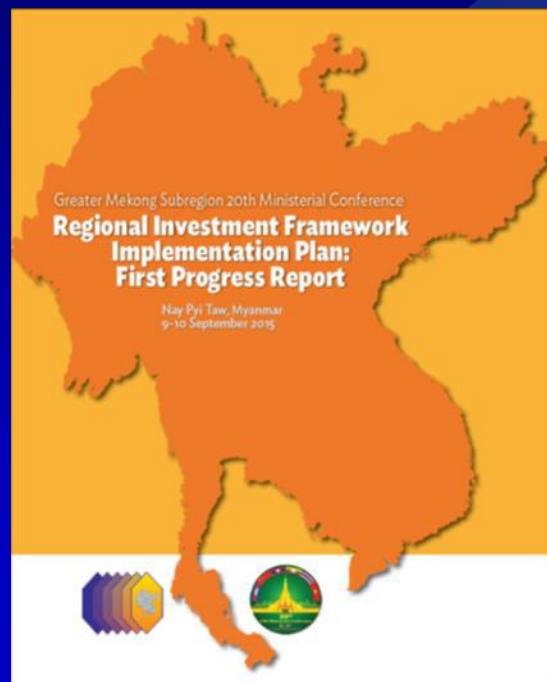
Sector	Number of projects				
	In RIF-IP	Dropped	FS Commenced	Financing available <sup>(1)</sup>	Implementation commenced
Transport	42	1	28	20	8
Energy	4	2	2	2	0
Agriculture	2	0	1	1	0
Environment	2	0	1	1	1
Human Resource Development	2	0	0	0	0
Urban Development	2	0	2	2	0
Tourism	3	0	1	1	1
Transport and Trade Facilitation	1	0	0	1	0
Information and Communication Technology	1	1	0	0	0
Other/Cross Border Economic Zones	2	0	0	0	0
<b>Total</b>	<b>61</b>	<b>4</b>	<b>35</b>	<b>28</b>	<b>10</b>

Note (1): Financing either approved or included for future financing in a country program or equivalent.



# First Progress Report Summary

## Technical Assistance Projects by Sector



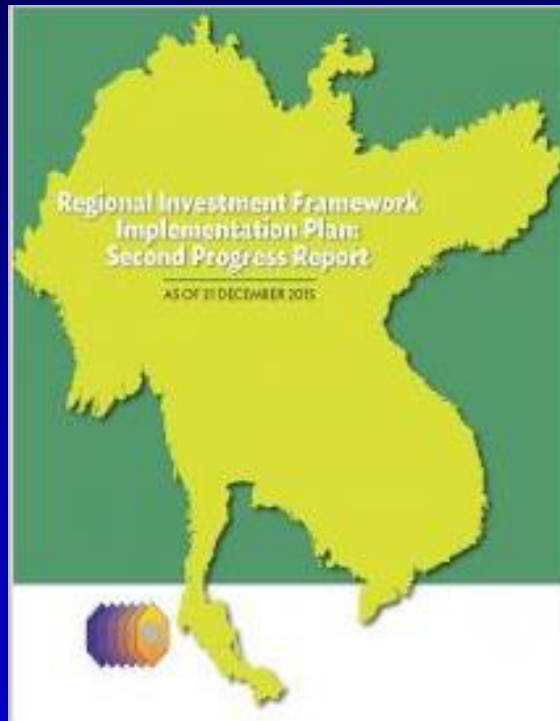
Sector	Number of Projects			
	In RIF-IP	Dropped	Financing available <sup>(1)</sup>	Implementation commenced
Transport	10	0	3	1
Energy	4	1	2	1
Agriculture	2	0	2	0
Environment	2	0	1	1
Human Resource Development	2	0	1	1
Urban Development	2	0	2	2
Tourism	3	0	2	1
Transport and Trade Facilitation	4	1	2	2
Information and Communication Technology	1	0	0	0
Other/Cross Border Economic Zones	2	0	1	0
<b>Total</b>	<b>32</b>	<b>2</b>	<b>16</b>	<b>9</b>

Note (1): Financing either approved or included for future financing in a country program or equivalent.



# Second Progress Report Summary

## Investment Projects by Sector



Sector	In RIF-IP	Dropped	FS Commenced	Financing available (1)	Implementation commenced
Transport	42	1	33	25	16
Energy	4	2	2	2	2
Agriculture	2	0	1	1	1
Environment	2	0	1	1	1
HRD	2	0	1	1	0
Urban Development	2	0	2	2	1
Tourism	3	0	1	2	1
TTF	1	0	0	1	0
ICT	1	0	0	0	0
Other/ BEZs	2	0	0	1	0
<b>Total</b>	<b>61</b>	<b>3</b>	<b>41</b>	<b>36</b>	<b>22</b>

Note (1): Financing either approved or included for future financing in a country program or equivalent.





# Second Progress Report Summary

## Technical Assistance Projects by Sector



Sector	In RIF-IP	Dropped	Added	Financing available (1)	Implementation commenced
Transport	10	0		6	3
Energy	4	1		2	1
Agriculture	2	0	2	2	1
Environment	2	0		1	1
HRD*	2	0		1	1
Urban Development	2	0	2	4	2
Tourism	3	1		3	2
TTF*	4	1		3	2
ICT*	1	0		0	0
Other/ BEZs*	2	0		1	0
<b>Total</b>	<b>32</b>	<b>3</b>	<b>4</b>	<b>23</b>	<b>13</b>

HRD: Human Resource Development. TTF: Transport and Trade Facilitation. ICT: Information and Communication Technology. BEZ: Border Economic Zone

Note (1): Financing either approved or included for future financing in a country program or equivalent



# Status of Investment Projects

Code	Project	Cost, US\$ M and Available Financing	Status – First Progress Report As of 30 June 2015	Status – Second Progress Report As of 31 December 2015
REG-ENG-01	Lao PDR–Viet Nam Power Transmission Interconnection (Hatxan–Pleiku)	<b>218.0</b> LAO: Song Da Group VIE: National Power Transmission Corporation	<p><b>LAO:</b> construction will be implemented by the Vietnamese investor for the power project. Design has been completed; upgrade of the environmental impact assessment is on-going.</p> <p><b>VIE:</b> construction of the transmission line will be implemented by Viet Nam’s National Power Transmission Corporation.</p>	<p><b>LAO:</b> The construction of the transmission line from Ban Hatxan to the border between Lao PDR and Viet Nam is being implemented by Song Da Group – the Vietnamese investor for the power project. Design has been completed; upgrade of the environmental impact assessment completed.</p> <p><b>VIE:</b> The construction of the transmission line from the Lao – Viet border to new Pleiku 500 kV substation will be implemented by Viet Nam’s National Power Transmission Corporation.</p>
REG-ENG--02	Lao PDR-Thailand Nabong 500 kV Substation Transmission Facility	<b>106.0</b> Nam Ngum 2 Power Company	<p>The private developer Nam Ngum 2 Power Company has finished technical design for the substation. The Government is reviewing the design and cost estimate.</p>	<p>The private developer Nam Ngum 2 Power Company has finished technical design for the substation. The Government reviewed the design and cost estimate. Construction of the 500 kV substation will be timed to meet the evacuation of power from the Nam Nghiep 1 hydropower plant.</p>

## Status of Investment Projects (cont'n)

Code	Project	Cost, US\$ M and Available Financing	Status – First Progress Report As of 30 June 2015	Status – Second Progress Report As of 31 December 2015
REG-ENG-03	PRC–Lao PDR–Thailand 600 HVDC Interconnection	<b>800.0</b>	The project is no longer high priority due to changes in energy demand and will not proceed. <b>To be deleted.</b>	<p style="color: magenta;">On 3 March 2016, PRC updated that the implementation time of the project is to be further confirmed by Chinese and Thai sides due to changes in energy demand from Thai side, but China Southern Grid (CSG) and the Electricity Generating Authority of Thailand (EGAT) agreed to continue discussions to promote the project in time.</p> <p style="color: magenta;"><b>Previously deleted</b> due to the report that the project is no longer high priority due to changes in energy demand and will not proceed. <b><u>To be considered at June 2016 meeting of the RPTCC for re-instatement in the RIF-IP.</u></b></p>
REG-ENG-04	Reinvestigation of Thailand–Lao PDR–Viet Nam Interconnection	<b>278.0</b>	No activity to date. The countries have agreed not to proceed with the project. <b>To be deleted.</b>	No activity to date. The countries have agreed not to proceed with the project. <b>Previously deleted.</b>

## Status of Technical Assistance Projects

Code	Project	Cost, US\$ M and Available Financing	Status – First Progress Report As of 30 June 2015	Status – Second Progress Report As of 31 December 2015
REG-EN-TA-01	Harmonizing GMS Power Systems to Facilitate Regional Power Trade (formerly Support to Regional Power Trade Coordination Committee in the Completion of Performance Standards, Grid Codes, Market Rules, and Subregional Transmission Expansion Plan) (All GMS Countries)	<b>1.5 ADB</b>	ADB/PRC financed technical assistance was approved in Dec 2014. Consultants are being selected. They will assist the working groups with developing performance standards and defining regulatory issues.	ADB/PRC financed technical assistance was approved in Dec 2014. Two international individual consultants have been engaged.  The international power transmission specialist is supporting the Working Group of Performance Standards and the international regulatory and power pricing specialist is supporting the Working Group on Regulatory Issues. The consultants have visited 6 GMS countries and held discussions with focal institutions/persons in the two respective working groups. Draft reports are being prepared to be circulated to GMS countries for in depth discussion.
REG-EN-TA-02	Ensuring Sustainability of Greater Mekong Subregion Regional Power Development (Phase 2) (All GMS Countries)	<b>1.0 AFD France</b>	The technical assistance will be financed by AFD France. The project scope was revised during the 18th RPTCC meeting in June 2015. It will be approved within 2015.	The technical assistance is financed by AFD France. The RETA was approved. Implementation plan will be discussed at the next RPTCC meeting (June 2016).



## Technical Assistance Projects (cont'n)

Code	Project	Cost, US\$ M and Available Financing	Status – First Progress Report As of 30 June 2015	Status – Second Progress Report As of 31 December 2015
REG-EN-TA-03	Development of GMS Coordination Center for Regional Power Trade (All GMS Countries)	<b>3.0</b>	No decision to date on the selection of the host location for the proposed center. The project has been deferred to 2016.	No change from 30 June 2015 update. As of 30 June 2015: No decision to date on the selection of the host location for the proposed center. The project has been deferred to 2016.
REG-EN-TA-04	Provision of Continuing Institutional Support for the Subregional Energy Forum (All GMS Countries)	<b>1.0</b>	Project has been dropped. <b>To be deleted.</b>	Project has been dropped.

# Summary of Status – Investment Projects

- Lao PDR–Viet Nam Power Transmission Interconnection (Hatxan–Pleiku); \$218 million (LAO and VIE)
  - Progress satisfactory
- Lao PDR-Thailand Nabong 500 kV Substation Transmission Facility; \$106 million (LAO)
  - Progress satisfactory
- PRC–Lao PDR–Thailand 600 HVDC Interconnection; \$800 (PRC and LAO)
  - Previously deleted (1<sup>st</sup> Progress report);
  - On 3 March 2016, PRC updated that the implementation time of the project is to be further confirmed by Chinese and Thai sides due to changes in energy demand from Thai side (2<sup>nd</sup> Progress Report); **To be considered at June 2016 meeting of the RPTCC for re-instatement in the RIF-IP.**
- Reinvestigation of Thailand–Lao PDR–Viet Nam Interconnection
  - No activity to date. The countries have agreed not to proceed with the project. **Previously deleted.**

# Summary of Status – TA Projects

- Harmonizing GMS Power Systems to Facilitate Regional Power Trade (formerly Support to Regional Power Trade Coordination Committee in the Completion of Performance Standards, Grid Codes, Market Rules, and Subregional Transmission Expansion Plan) (All GMS Countries) \$1.5 million
  - Progress satisfactory
- Ensuring Sustainability of Greater Mekong Subregion Regional Power Development (Phase 2) (All GMS Countries) \$1 million
  - Progress satisfactory
- Development of GMS Coordination Center for Regional Power Trade (All GMS Countries) \$3 million
  - No decision to date on the selection of the host location for the proposed center. The project has been deferred to 2016.
- Provision of Continuing Institutional Support for the Subregional Energy Forum (All GMS Countries) \$1 million
  - Project has been dropped

# Mid-term Review (MTR) of the RIF-IP

- Refresh the RIF-IP and review its relevance with emerging needs and developments of the GMS countries;
- Identify non-performing projects in the RIF-IP; consider taking out of RIF-IP but retain in the RIF pool; and
- Consider adding projects to RIF-IP (from RIF) or any new projects outside RIF, subject to endorsement of working group.



# Updates in the RIF IP

<b>Projects for Deletion</b>			
Project Name	Implementation Constraints	Further Remarks	Countries Involved
1.			
2.			
<b>Projects for Addition</b>			
Project Name	Reasons for Proposing Inclusion	Source: RIF/Others	Countries Involved
1.			
2.			
3.			



# Other Energy Projects in the RIF: Investment Projects (1)

Projects	Country Coverage	Indicative Timeline	Cost Estimate (\$ Million)
1. East–West Corridor Power Transmission and Distribution Project in the Lao PDR	Lao	2015-2017	50.0
2. Continued Projects in Rural Electrification and Off-Grid Power Development	CAM, LAO	2014-2017	100.0 50.0 (CAM) 50.0 (LAO)
3. Design and Funding of a Backbone Grid for the Lao People’s Democratic Republic (PDR)	LAO	2016-2020	400.0
4. Conventional Rural Electrification Programs in Myanmar	MYA	2015-2018	60.0
5. Viet Nam–PRC 500 kV Power Interconnection	PRC, VIE	After 2020	400.0-600.0 200.0 (PRC) 200.0 (VIE)
6. 500 kV Line from Mawlamyine to the Main Grid	MYA	2020	640.0



# Other Energy Projects in the RIF: Investment Projects (2)

Projects	Country Coverage	Indicative Timeline	Cost Estimate (\$ Million)
7. Demonstration of Second-Generation Biofuel Technologies and Associated Biomass Value Chains	All GMS Countries	2018-2020	80.0 (13.3 per GMS country)
8. Extension of Energy Access in Myanmar from Nodes in Thailand and in the PRC	MYA	2017-2020	10.0 (For connection to a local isolated grid) 60.0 (If distribution and connection have to be carried out)
9. Feasibility Study and Extension of the East–West Energy Corridor to Mawlamyine (as part of a concerted and planned extension of the EWEC): Myanmar	MYA, THA	2020	2.0 (For the feasibility study) 250.0-400.0 (For the interconnection)  170.0 (MYA) 80.0 (THA)



# Thank You

[www.adb.org/gms](http://www.adb.org/gms)



ADB



# ANNEX 10



**Ricardo**  
Energy & Environment

## **World Bank: GMS Power Market Development**

Presentation to RPTCC-20  
Jonathan Hedgecock,  
Dr Stuart Thorncraft, Dr Graeme Chown

27 June 2016

# GMS Power Market Development: Assessment Studies and Overall Technical Assistance Coordination

**Jonathan Hedgecock**

# Overview of the Project



- World Bank funded support to the RPTCC Working Groups
  - WGRI – Working Group on Regulatory Issues
  - WGPG – Working Group on Performance Standards and Grid Codes
- Programmatic Technical Assistance running over three years (the period to March 2018)
- Three “Strategic Pillars” and nine specific activities to support the RPTCC

## GMS Power Market Development: Assessment Studies and TA Coordination

<b>Pillar 1:</b> Assessment of Electricity Trade Alternatives	<b>Pillar 2:</b> Support to the RPTCC on Power Market Regulatory Issues	<b>Pillar 3:</b> Support to the RPTCC on Performance Standards and Grid Codes
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## Pillar 1: Assessment of Trade Alternatives

- Convening platform to catalyse dialogue
- Defining business cases for greater power market integration
- Identify and analyse 10 regional case studies

## Pillar 2: Power Market Regulatory Issues

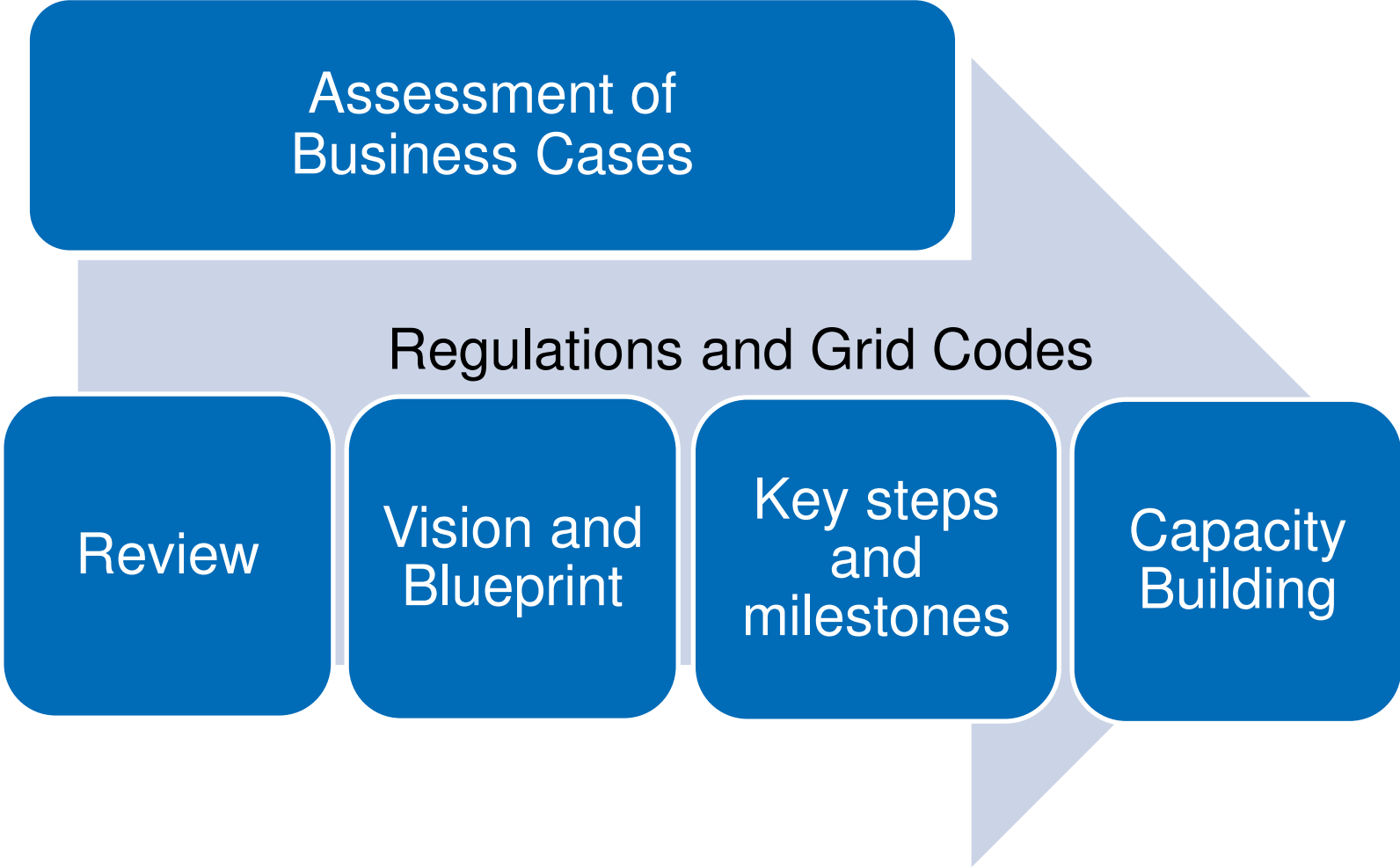
- Review of current and future institutional structures
- Review of on-going and planned power market reforms
- Review of electricity pricing policies
- Review of specific issues – third party access, licensing independence of regulators, TSOs

## Pillar 3: Performance Standards and Grid Codes

- Review Grid Codes in GMS countries
- Examine regional experience
- Literature review of global experience

- Define the Vision and Blueprint for harmonisation
- Identify key implementation steps and milestones
- Identify and deliver tailored capacity building

# Structure of Activities within Pillars 1, 2 and 3





# World Bank and ADB TA 8830 Project Interactions



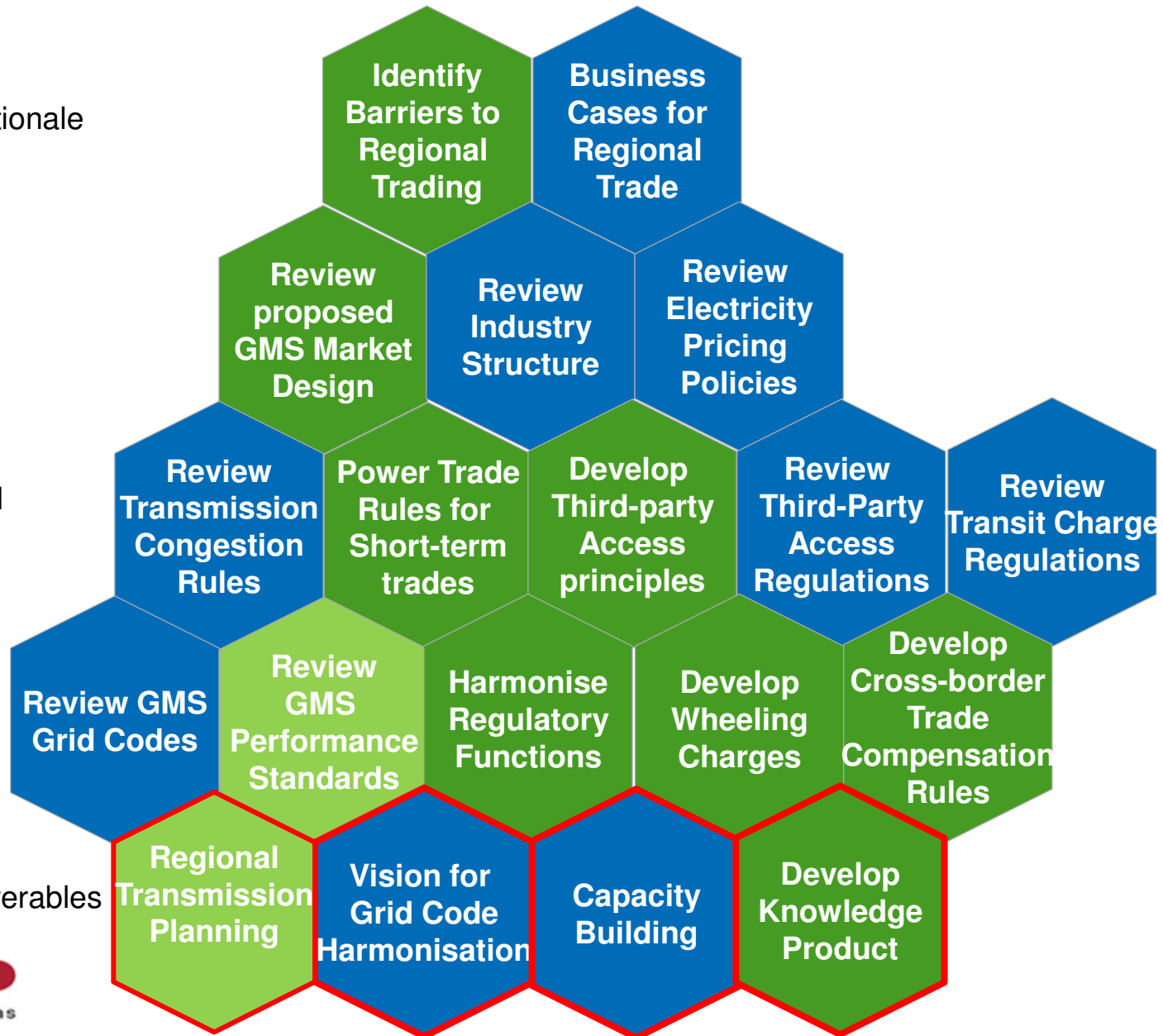
Barriers to trade/Rationale for Interconnection

Market Design and Industry Structure

Network Access and Charging

Network Regulation

Outcomes and Deliverables



# World Bank and ADB TA 8830 Project Interactions



Barriers to trade/Rationale for Interconnection

Market Design and Industry Structure

Network Access and Charging

Network Regulation

Outcomes and Deliverables





# World Bank and ADB TA 8830 Project Interactions



Barriers to trade/Rationale for Interconnection

Market Design and Industry Structure

Network Access and Charging

Network Regulation

Outcomes and Deliverables

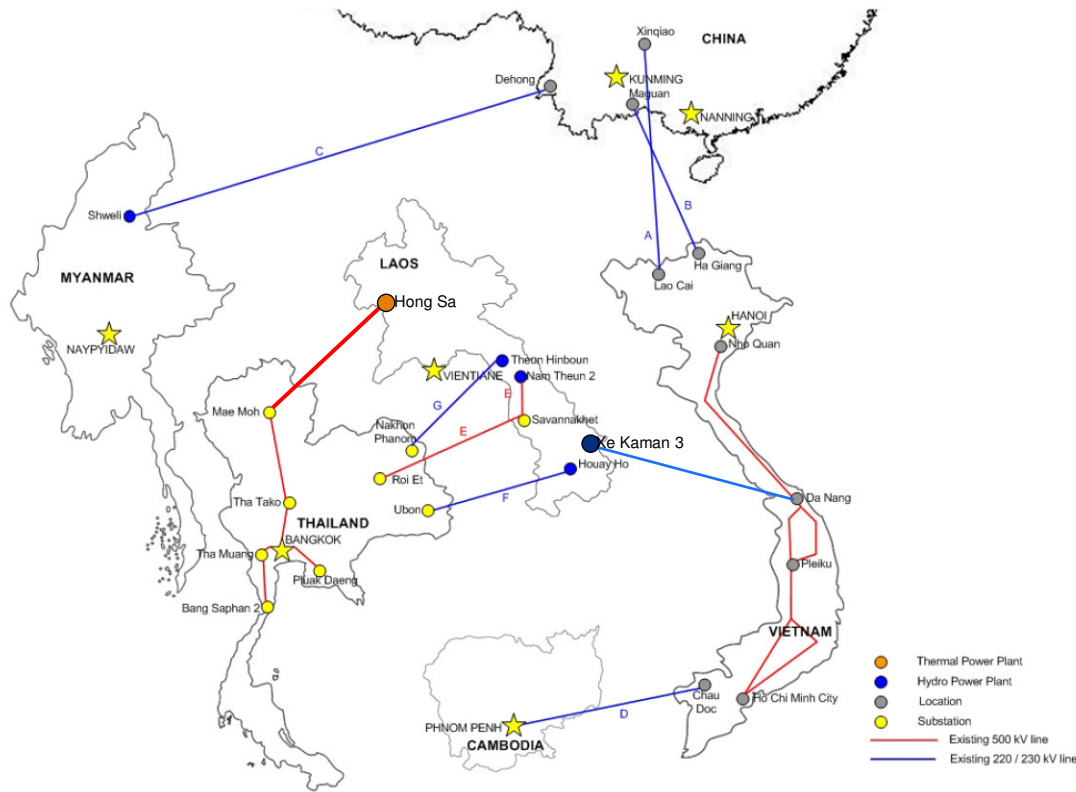


# Task 1: Defining business cases for greater power market integration in the GMS

Dr Stuart Thorncraft

- Task 1 objective is to establish ten (10) **business cases** to enhance power market integration in the Greater Mekong Subregion (GMS)
- Each business case relates to a transmission project investment that offers the highest potential for accelerating electricity trade in the region
- 10 business cases will be developed over 2016 and 2017 and successively presented to the convening platform stakeholders including energy policy-makers, regulators, utilities and potential investors to facilitate discussion and obtain feedback
- Based on the feedback and interest the 10 business cases will be ranked and prioritised based on not only their potential to accelerate electricity trade in the GMS but also those that are most likely to be of commercial interest to prospective project investors

# GMS Interconnection: Current and Planned Projects



## Existing Projects

From	To	Name	MW*
Lao PDR	Thailand	Theun-Hinboun	434
Lao PDR	Thailand	Houay Ho	152
Myanmar	PRC	Shweli	600
Lao PDR	Thailand	Hongsa	1878
Lao PDR	Viet Nam	Xekaman 3	250
Lao PDR	Thailand	Se Xet 1	45
Lao PDR	Thailand	Se Xet 2	76
Lao PDR	Thailand	Xelabang	5
Lao PDR	Thailand	Nam Ngum 1	155
Lao PDR	Thailand	Nam Ngum 2	615
Lao PDR	Thailand	Nam Theun 2	948
PRC	Viet Nam	Xinquao – Lao Cai	300
PRC	Viet Nam	Maguan – Ha Giang	200
Vietnam	Cambodia	Chau Doc – Phnom Penh	200

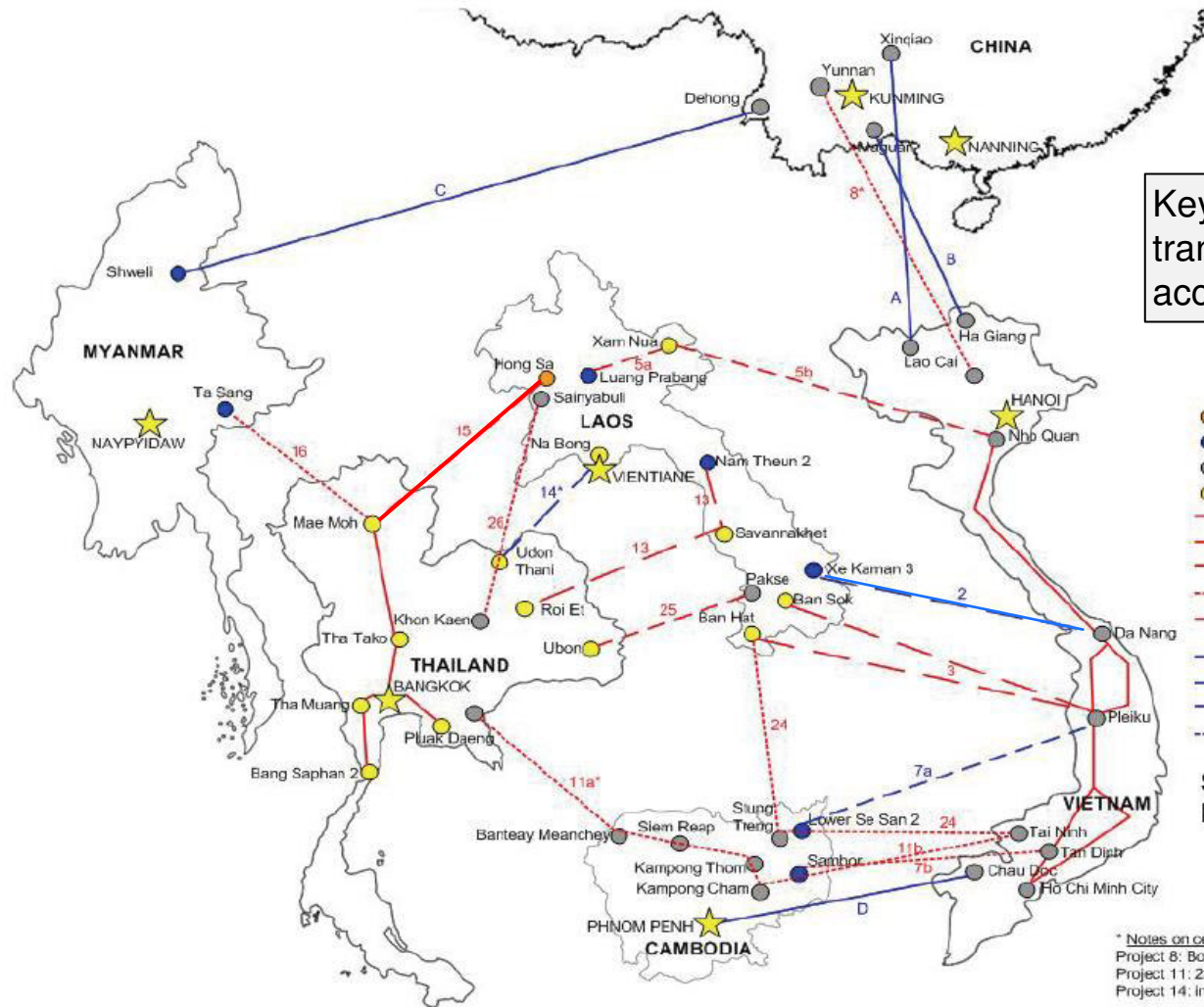
\* Nameplate rating of project, not all of the output is necessarily exported.

## Committed Projects

From	To	Name	MW*
Lao PDR	Vietnam	Xekaman 1	300
Lao PDR	Vietnam	Xekaman 4	80
Lao PDR	Thailand	Xe-Pian Xe-Namnoi	354
Lao PDR	Thailand	Nam Ngiep 1	290
Lao PDR	Thailand	Xayaburi	1220
Lao PDR	Thailand	Monsoon Wind	600

\* Nameplate rating of project, not all of the output is necessarily exported.

# RETA 6440: GMS Master Plan Study & Transmission Roadmap



Key issue is to identify and prioritise the transmission projections that best accelerate electricity trade

- Thermal Power Plant
- Hydro Power Plant
- Location
- Substation
- Existing 500 kV line
- - - Committed base case 500 kV line
- - - - - Post-2015 base case 500 kV line
- · - · - Candidate 500 kV line
- · - · - Generic 500 kV line
- Existing 220 / 230 kV line
- - - Committed base case 220 / 230 kV line
- - - - - Post-2015 base case 220 / 230 kV line
- · - · - Candidate 220 / 230 kV line

Source: RETA No 6440 - GMS Master Plan Study 2008- 2010

\* Notes on certain projects  
 Project 8: Both HVAC and HVDC are being considered for this project  
 Project 11: 230 kV and 500 kV are being considered for this project  
 Project 14: in 2015 the voltage level is due to be raised to 500 kV

## Economic Assessment

- Identification of system benefits for a given transmission option compared to a non-transmission project counterfactual
- Evaluation of the cost of transmission investment vs. benefits delivered to power systems
- Benefits may include: dispatch efficiency (e.g. fuel cost savings) and deferral of investment
- Identification of the beneficiaries for project is *very important for business case development – who gains?*

## Technical Assessment

- Reliability benefits delivered by shared reserves
- Leverage diversification in load and generation availability (hydro + RE) – hedging against drought conditions
- Loss reductions and avoiding transmission overloads in national grids
- Stability improvement (enhance system inertia, avoid inter-area oscillations etc.)

## Commercial Assessment

- Extent to which the project enhances power trade in the region: bilateral trading vs. multi-lateral trading
- Ease with which regulatory frameworks can enable commercial arrangements to be entered into to support trading
- Ease with which a business model that can support required investment can be identified and ease of “investor buy-in”

## Environmental Factors

- Avoided emissions and other externalities
- Better utilisation of existing infrastructure and systems

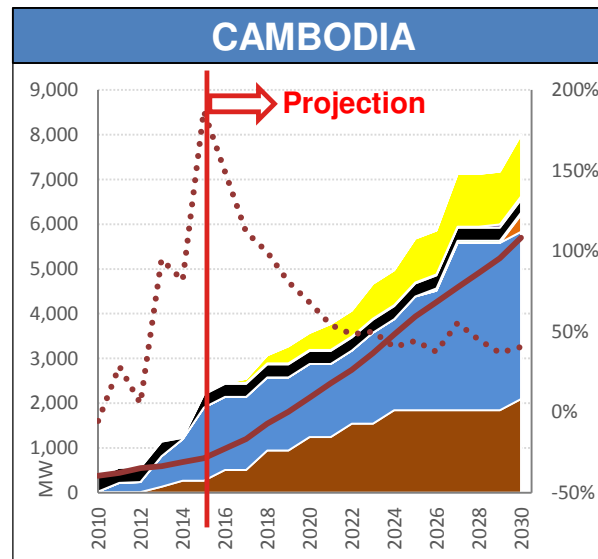
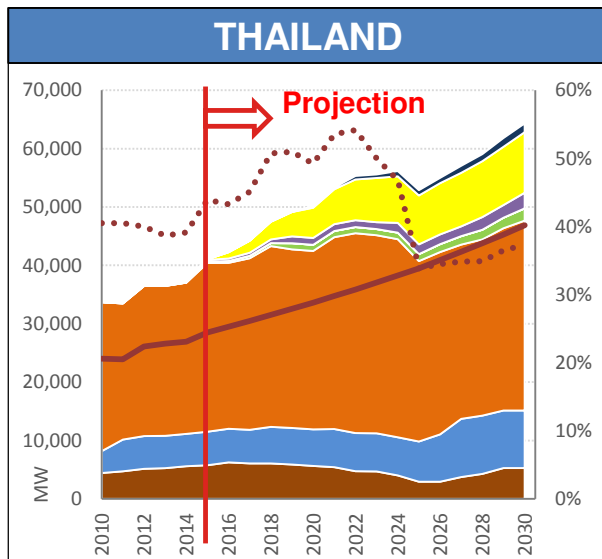
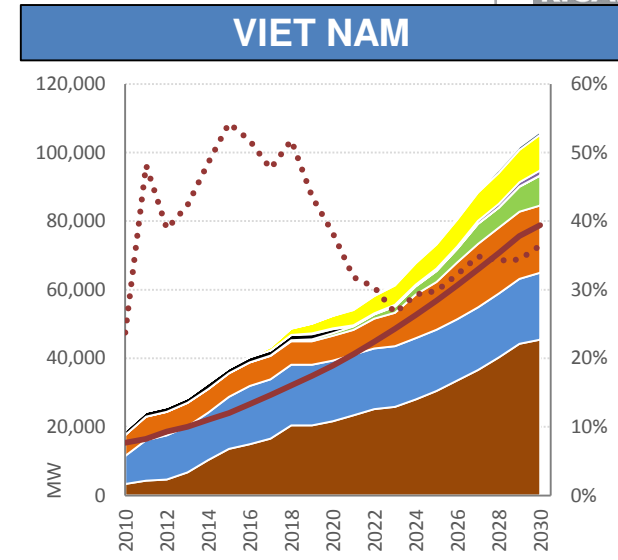
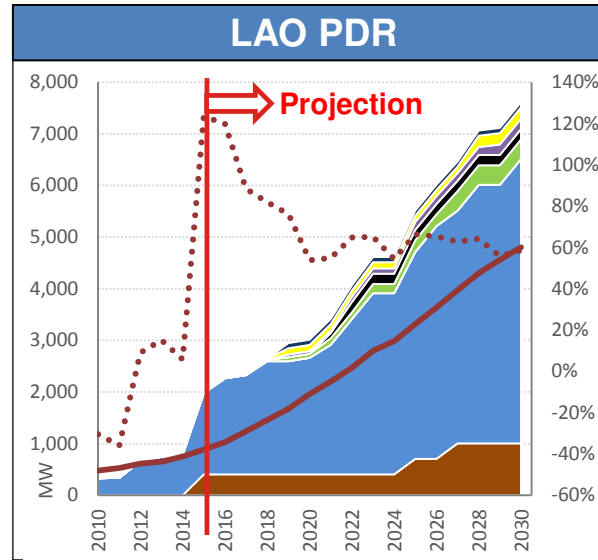
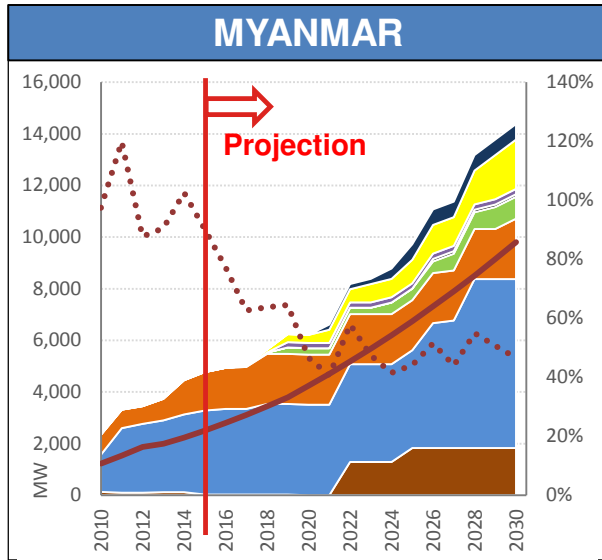
# Each Country's Unique Situation Matters



- Identification of surpluses and deficits:
  - When and where are there generation surpluses
  - When and where are there shortages of generation
  - When and where is demand growth anticipated
  - Structure of existing transmission system
  - What will the situation look like in 2020, 2025, 2030, ...
- Identification of transmission options
  - Interconnection of large power systems vs. issues around interconnection of small transmission networks
  - “Piggy-back” transmission projects in place to support a generation project that is dedicated to supplying MWs to a neighbouring power system
  - National grid strengthening – augmentation of national grid may support regional trade
- Therefore need to evaluate each country's current situation and need to examine transmission options over a range of scenarios



# Business as Usual Outlooks (Based on Assessment of PDPs)



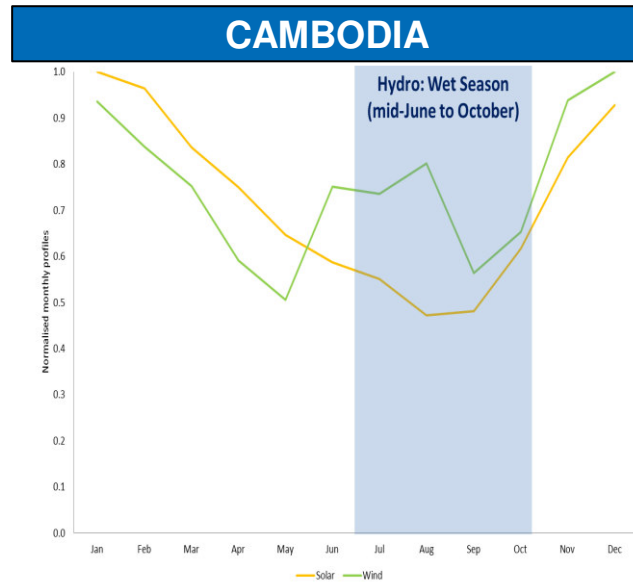
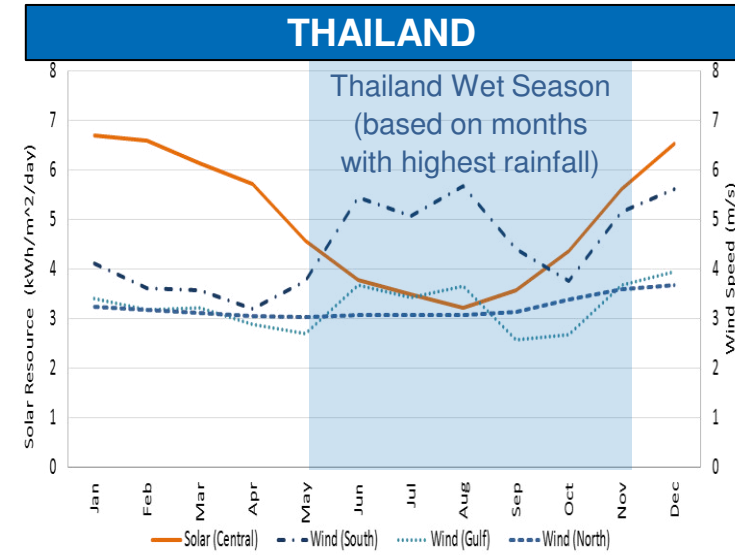
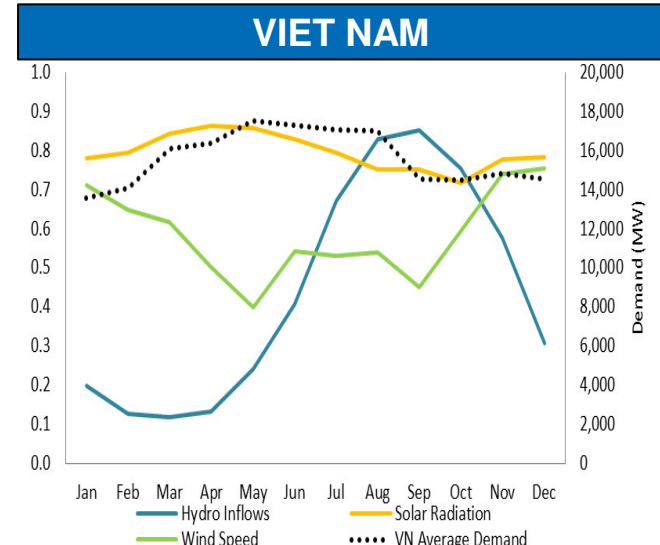
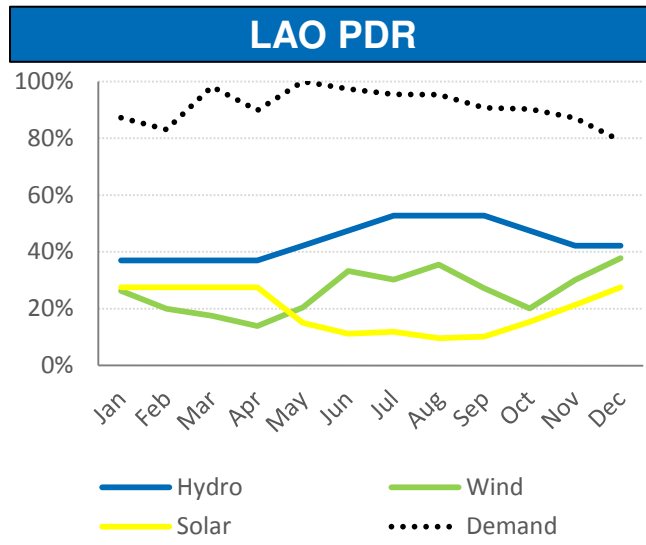
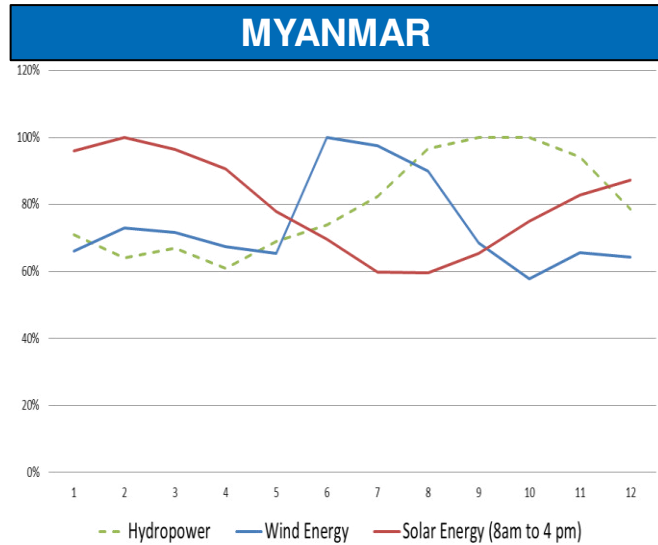
- Coal
- Gas
- Diesel/FO
- Solar
- Demand
- Hydro
- Wind
- Bio
- Hydro ROR
- ⋯ Reserve Margin (%)

Note: assessments are based on publicly sourced information and Consultant's estimates as of mid-2015. Updating is required + inclusion of PRC





# Diversity of Conditions: Demand, Hydro, Wind and Solar

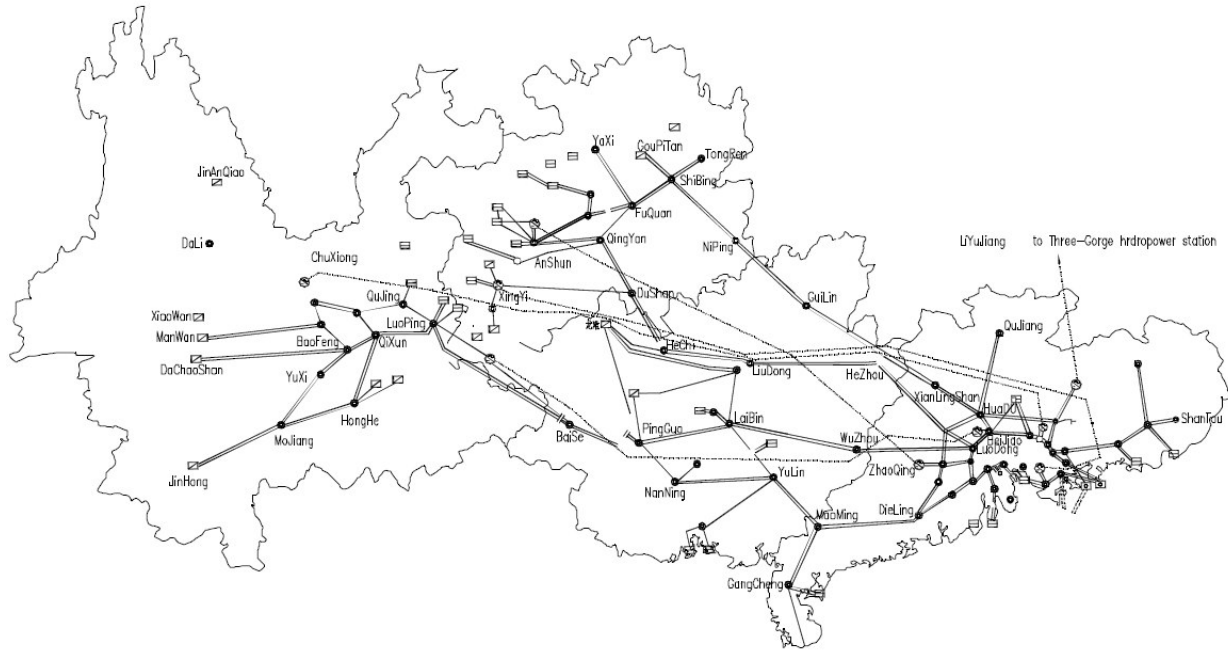


Transmission projects enable diversity in conditions between national systems to be exploited – important to ensure this benefit is reflected in business case development

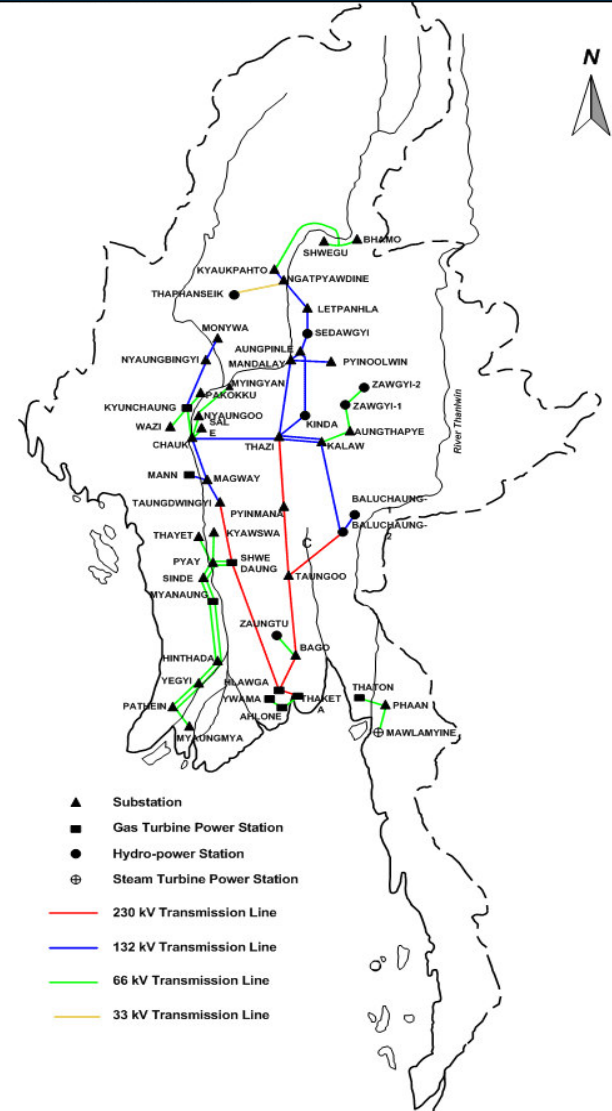


# Existing Transmission Systems of GMS Countries (1/3)

## PRC

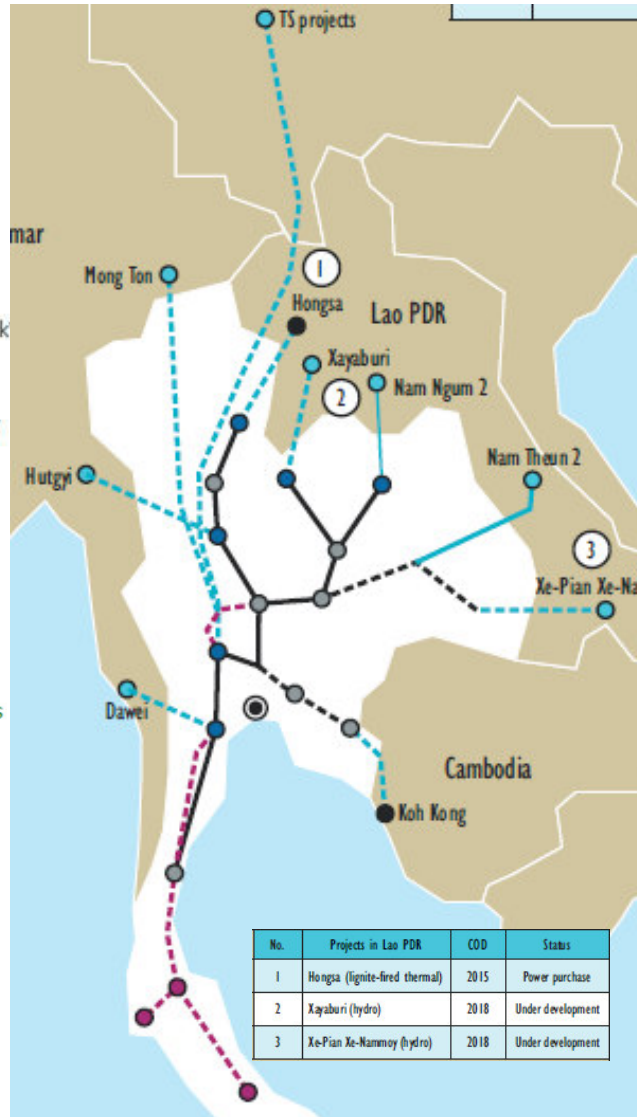
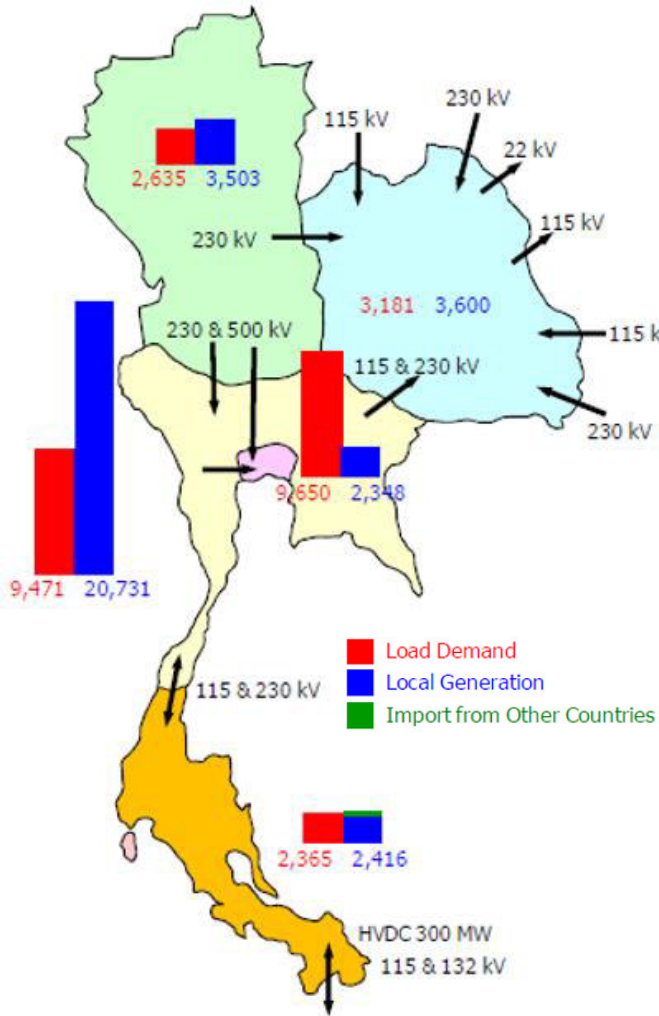


## Myanmar

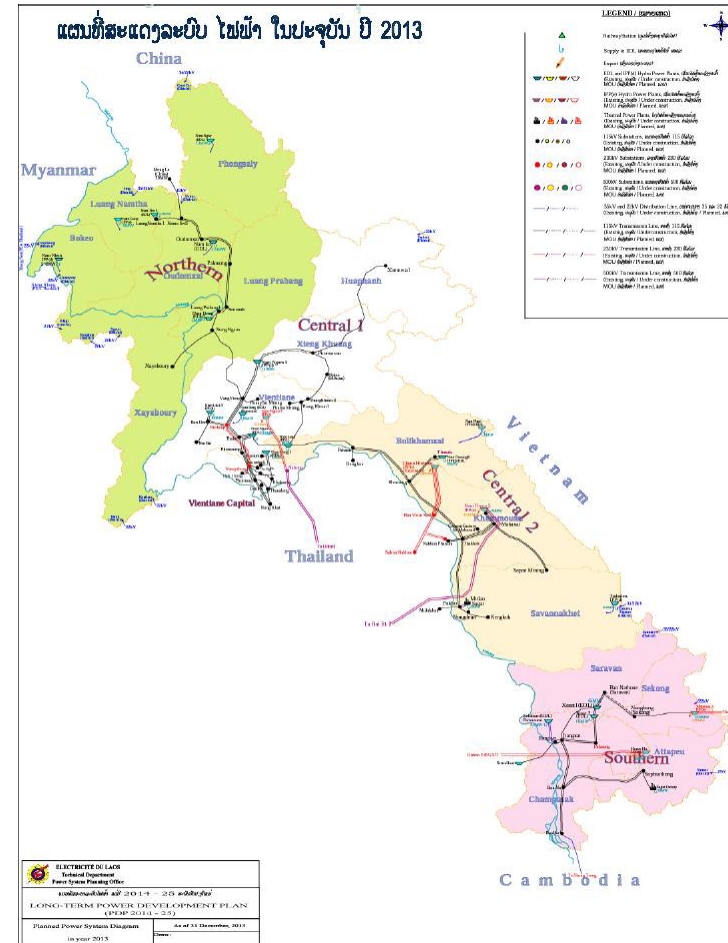


# Existing Transmission Systems of GMS Countries (2/3)

## THAILAND



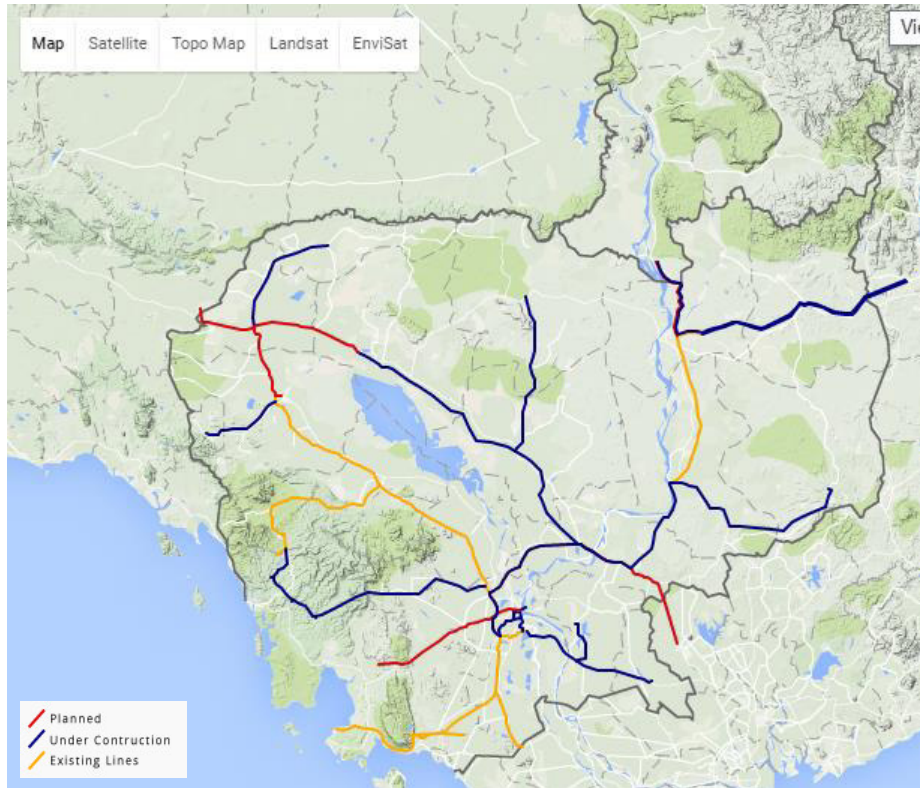
## LAO PDR



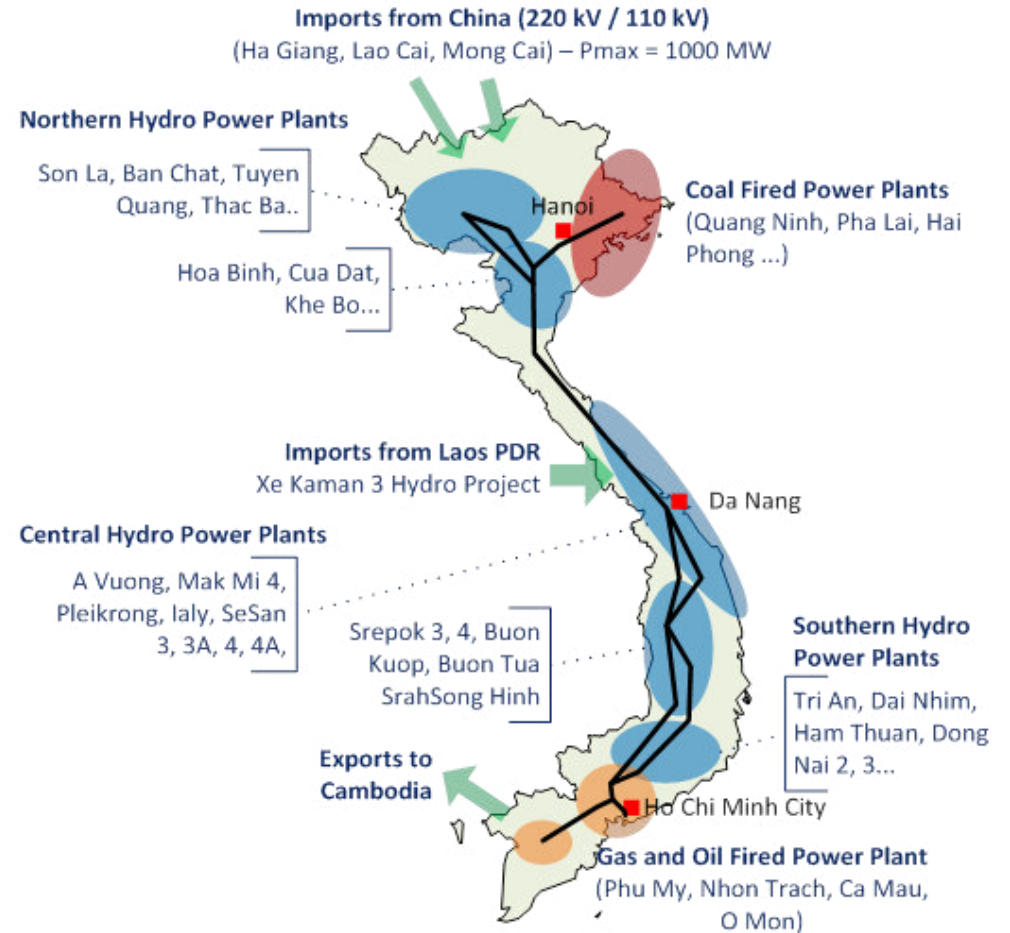


# Existing Transmission Systems of GMS Countries (3/3)

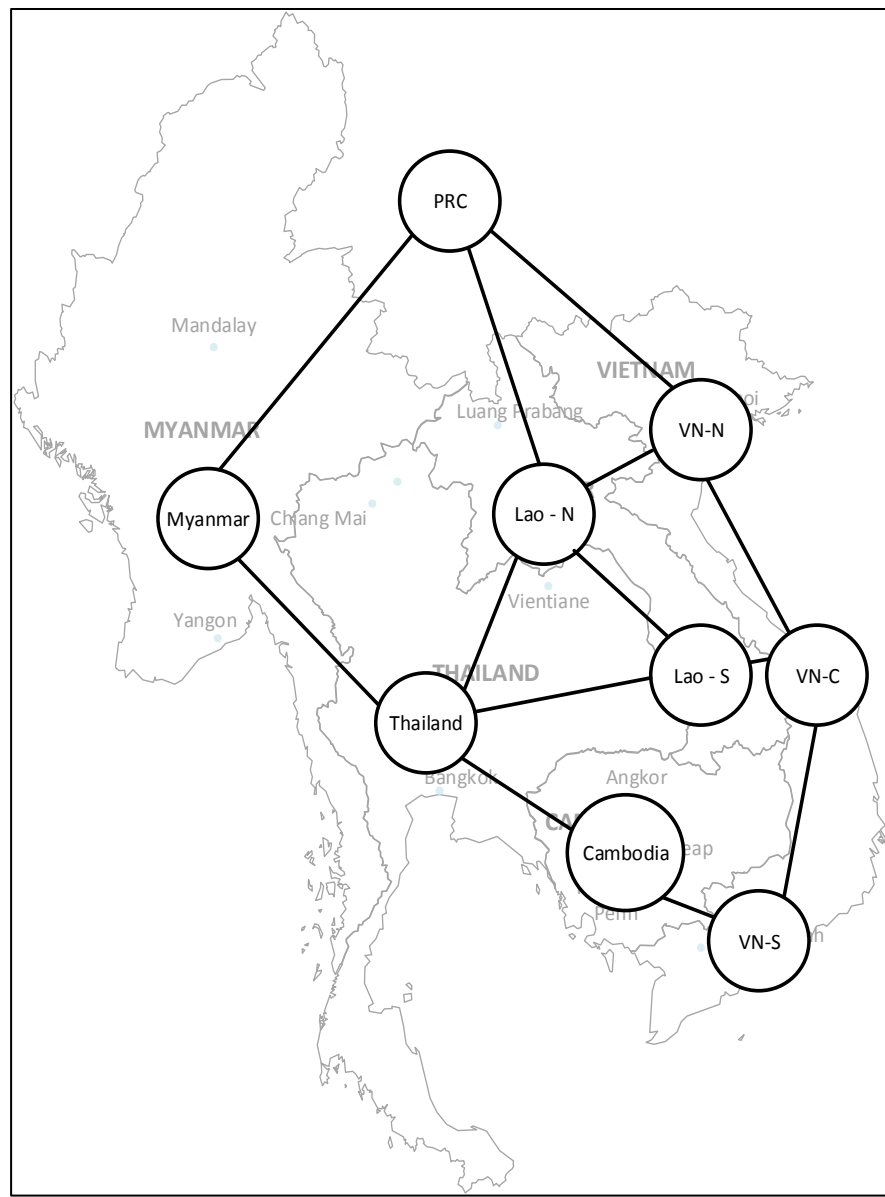
## Cambodia



## Viet Nam



# Regional Transmission Model for Economic Benefit Assessment



# Modelling Framework Required for Economic Assessment

- Scenarios
  - Business as usual outlooks based on PDPs
  - Potentially examine:
    - Drought conditions (will demonstrate reserve sharing benefits)
    - Higher renewable energy integration scenarios
- Key inputs:
  - Generators + existing (regional) transmission system
  - Demand
  - Fuel prices
  - Hydro seasonality to reflect wet and dry seasons
  - Transmission option(s) of business case being evaluated
- Key outputs:
  - Fuel costs, operational costs and capital costs
  - Transmission flows (regional level)
  - Emissions

# Task 1: Business Case Format – Final Goal



Aspect	Business Case 1	Business Case 2	Business Case 3	...	Business Case 10
<b>Economic Assessment</b>					
Project Cost					
Dispatch Benefits					
Hydro storage utilisation					
Avoided generation investment					
Avoided transmission investment					
...					
<b>Technical Assessment</b>					
Reserve sharing benefits					
Power system loss reduction					
Feasibility of implementation					
....					
<b>Commercial Feasibility:</b>					
Trade enhancement					
Supports bilateral trade					
Supports multilateral trade					
Commercial arrangements					
....					
<b>Social and environmental benefits:</b>					
Avoided emissions					
Avoided / deferred externalities					
....					

- The business cases will highlight practical issues associated with enhancing regulatory arrangements for those business cases that we assess to have the greater (Task 2) and harmonisation of Grid Codes (Task 3)
- Identification of the higher priority business cases could provide a way for prioritising regulatory arrangements and/or enhance technical codes



# Task 2: Review of current Power Market Regulations in GMS countries

Jonathan Hedgecock

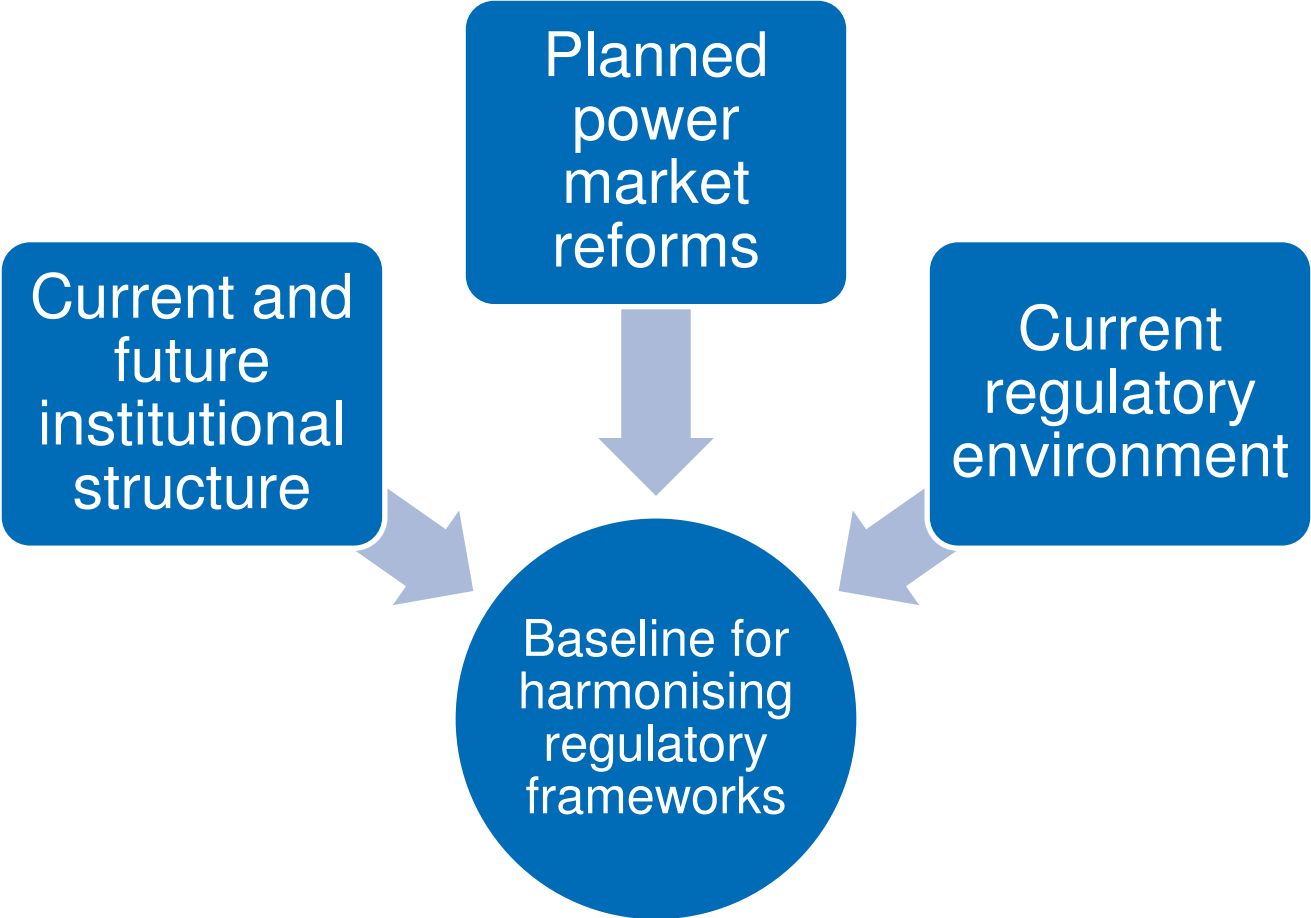
## Task 2: Review of current Power Market Regulations Objectives

- The deliverables of this task will help regional regulators (or other equivalent organisations) in four key areas that are essential to the expansion of regional power trade:
  1. developing common rules for regional interconnections, including **harmonised grid codes** – common technical standards are a key element in enabling the interconnection of national networks;
  2. **ensuring open access rights by avoiding discriminatory treatment** of cross-border transactions.
    - Creating an environment where access to interconnector capacity, both existing and future, can be granted on a non-discriminatory basis will be essential to ensuring the development of regional electricity trading;
  3. designing and adopting appropriate rules for **management of limited interconnector capacity**, i.e. dealing with situations in which transmission congestion arises; and
  4. developing economically efficient, transparent and straightforward **locationally varying transmission tariffs**, to ensure that adequate revenues are recovered to support investment in cross-border interconnection capacity.

## Task 2: Review of current Power Market Regulations

### Key Activities

- Review of the **current and future institutional structure** of the electricity sector in each GMS country
- Review of **on-going and planned power market reforms**, including literature review summarising relevant global experience
- Review of **electricity pricing policies** in the GMS countries
- Review of the **regulatory environment**, particularly regarding
  - Third Party Access to transmission and distribution
  - Permits and licensing requirements for third parties to participated in electricity trading
  - Administrative independence of regulators and TSOs
- Focusing on establishing a **baseline for harmonising regulatory frameworks**
  - Developing common rules for regional interconnections
  - Ensuring open-access rights
  - Managing transmission congestion
  - Designing efficient/transparent network tariffs



# Industry Structure and Regulatory Environment



Ministry of Energy

## Vertically Integrated Utility

- Generation
- Transmission
- System Operation
- Distribution
- Wholesale Supply
- Retail Supply

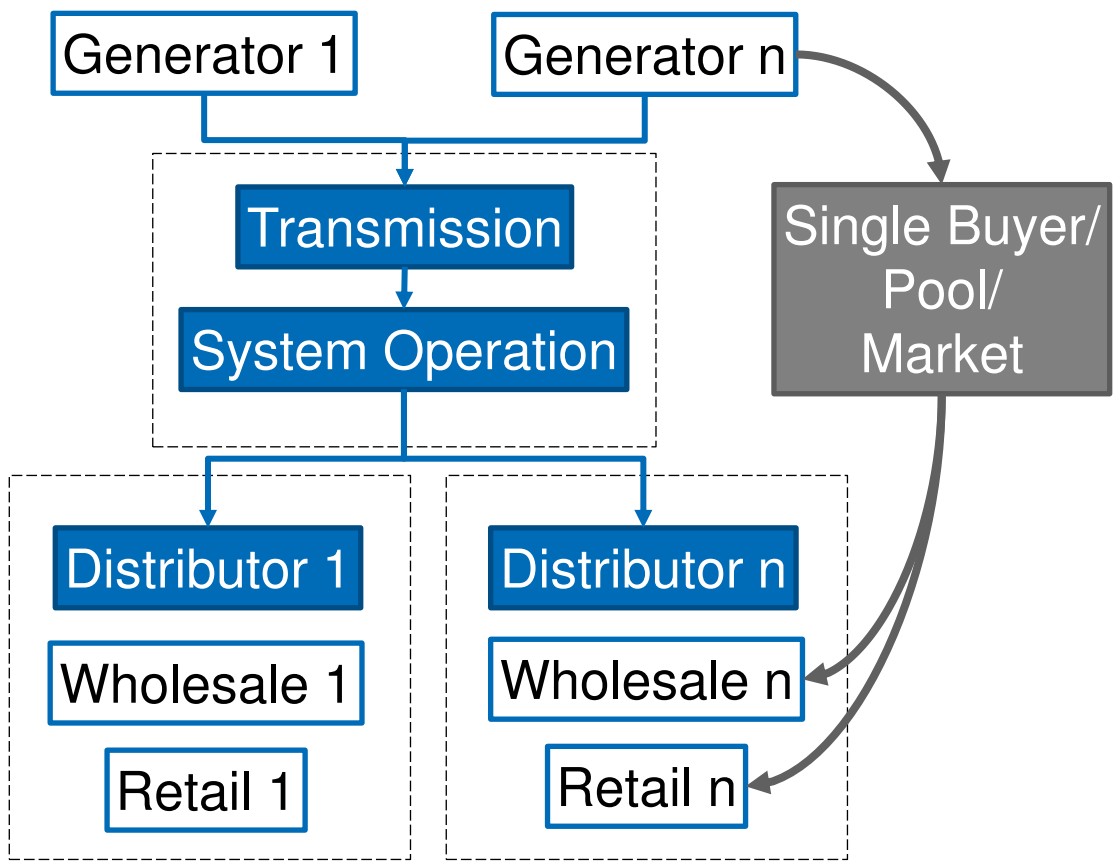
Ministry of Energy

Regulator

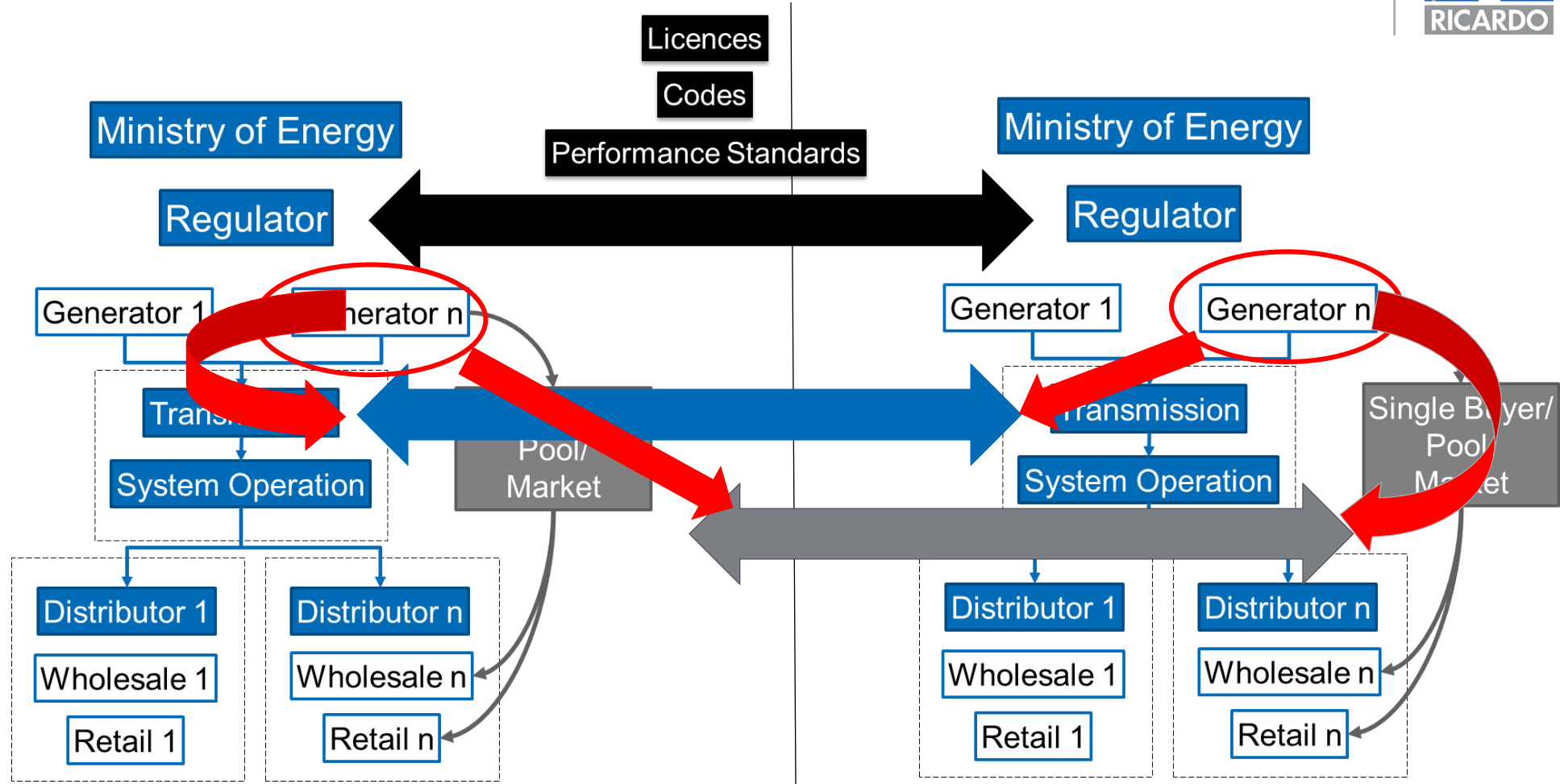
Licences

Codes

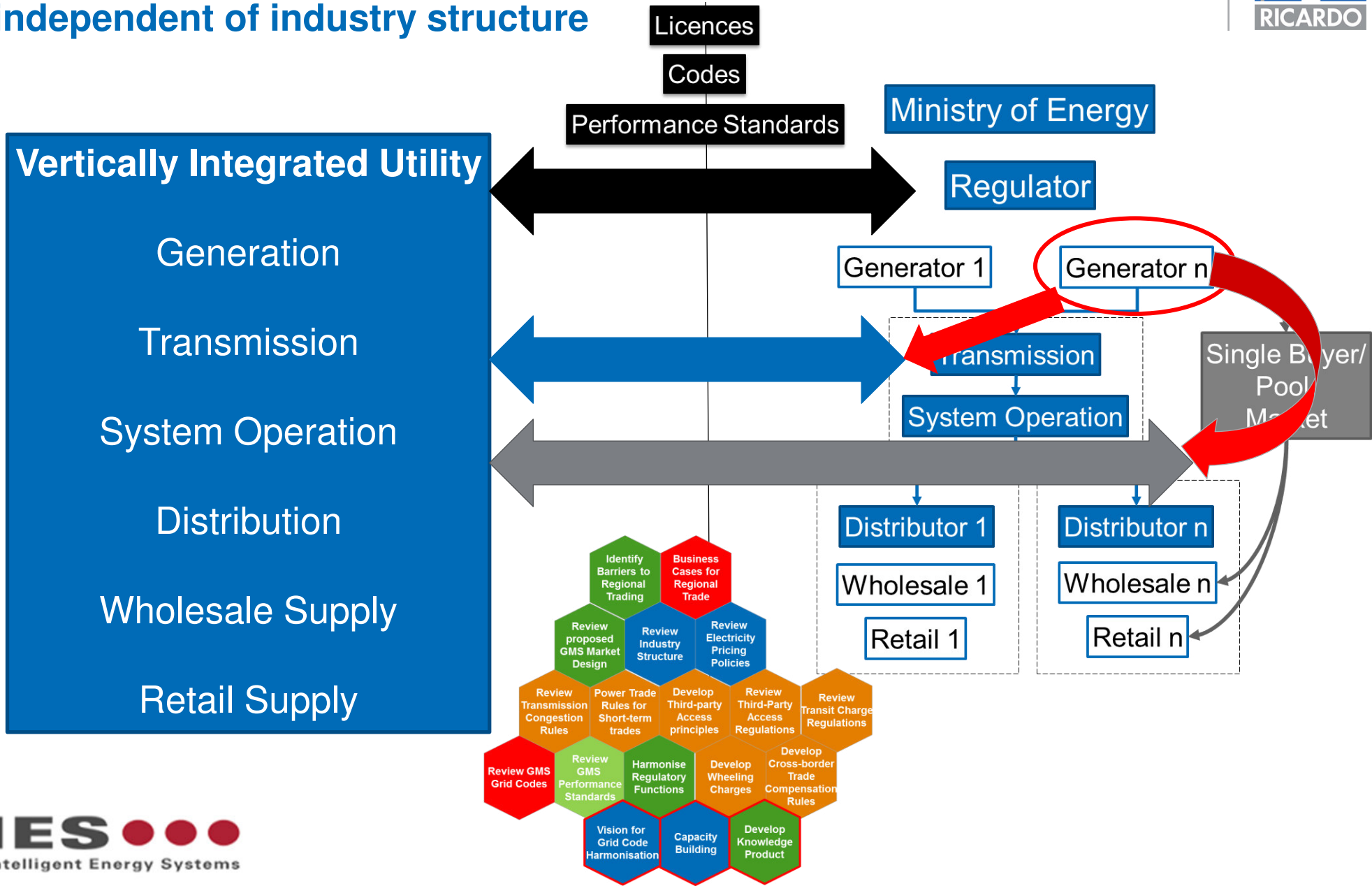
Performance Standards



# Harmonising Regulatory Frameworks



# Harmonising Regulatory Frameworks - independent of industry structure



## Task 2: Review of current Power Market Regulations

- Initial focus is on data collection/information gathering
- Discussions needed with WGRI members regarding provision of the following key information:
  1. The institutional structure of the electricity sector;
  2. On-going and planned future market reforms;
  3. Electricity pricing policies;
  4. Electricity licensing and “third party access” rules;
  5. A copy of the Grid Code or equivalent for each country.
- Focus on obtaining the practical information that is needed to enable a swift assessment of the current status of the power sector in each country
- National consultants will be engaging with relevant industry stakeholders to assist in information collection and synthesis



# Task 3: Review of current grid codes in GMS countries

Dr Graeme Chown

## Task 3 Objectives

- The key objective is to **review the grid codes in the GMS countries** and establish the baseline for Activity III-2.
  - Harmonised grid codes are needed for developing common rules for regional interconnections.
- The second key objective is a **literature review** summarising the relevant **global experience**.
- The third key objective is to assess TA needs for **capacity building** with regard to the harmonisation of grid codes.
- The final objective is the **draft terms of reference** for Pillar 3 activities 2 and 3, which feed from the above objectives.

## Typical Grid Code sections

- **Introduction, Glossary and Definitions:** provide a general introduction to the Grid Code, its purpose and general requirements; address policy, legal framework, glossary of terms, definitions, etc.
- **Governance and general conditions:** address administrative and management aspects of the Grid Code, procedures and entities that make the rules, provisions for the amendment of the Grid Code as well as resolution of disputes and procedures associated with derogations and exemptions.
- **Network (Connection) rules:** specify minimum technical connection, design, and operational requirements for existing and potential generators, distributors, and end-use customers, and the standards used to plan and develop the transmission system.
- **Planning and Information rules:** describe the process and standards for planning and development of the grid.
- **Metering rules:** specify coordination, tariff and energy trading metering requirements at the different levels of voltages and further clarifies responsibilities of parties on installations and maintenance of metering equipment

## Typical grid code sections - continued

- **System operations rules:** specify the responsibilities and roles of the participants associated with the operation of the interconnected power system in real time.
- **Scheduling and Dispatch rules:** specify rules for preparation of an indicative least cost generation schedule; control, scheduling and dispatch rules; procedures and requirements for system frequency control power transfers.
- **Market rules** (if bilateral trading is allowed): define interfaces between technical rules and the operation of the electricity trading rules.
- **Information exchange rules:** specify obligations of parties to the provide and exchange information pertaining to the implementation of the Grid Code; include a unified list of all data and agreements required by the grid owner/system operator from users, and vice versa, such as Grid Connection Agreements, Ancillary Service Agreements and Transmission Uses of Services.
- **Connection requirements** for non-synchronous connected renewable power plants: specifying voltage, fault ride through, frequency, reactive power, power quality, protection requirements for non-synchronously connected renewable power plants

## Appreciation of Key Issues

- Alignment to international standards such as the IEC
- Defining a common set of definitions and terms – eg spinning reserve
- Recognition of interconnection and controlling interconnection power flows
- Recognition of interconnection trading rules in system operator, and scheduling and dispatch codes
- New technical requirements such as damping inter area oscillations, protection settings co-ordination and network planning

## International experience

- Interconnections reviewed will be ENTSOE (Europe), NERC (USA), GCC (Middle East), South Africa as part of SAPP (Southern Africa Power Pool), and Nigeria as part of WAPP (West Africa)
- Review to include:
  - Structure of regulatory organisations, market structure impact on the code
  - Structure of code/s – sections of codes
  - Quality of Supply – voltage, frequency, inter area oscillations, inadvertent power flows
  - Security of Supply – operating reserves, planning criteria, protection co-ordination, under frequency load shedding, black start and restoration
  - Use of international standards – generator frequency and voltage capabilities, power quality standards,
  - Renewable energy requirements – fault ride through,
  - Additional system operator and market operator functions
  - Economic criteria (if any)

## Assessment needs for capacity building

- Questionnaire to be sent to stakeholders
  - Identifying interconnection experience in various GMS countries
- Gap analysis of training needs
- Report on training needs for capacity building

# Task 4: Capacity Building Services and Dissemination

Jonathan Hedgecock



## Task 4: Capacity Building Services and Dissemination

- This activity will focus primarily on the requirements for capacity building with regard to the harmonisation of power regulatory frameworks and Grid Codes in GMS countries.
- It will then deliver tailored capacity building services to the GMS countries (primarily, Laos and Myanmar).
- A study tour will be organised to a relevant part of the world with comparable sizes and similar issues of low access and low interconnectedness: we propose the East African Power Pool (EAPP),
- Liaison with two other technical consultants to be appointed by the World Bank, providing follow-up activities on regulatory harmonisation and performance standards and Grid Codes.
- Follow-on consultancies to be formulated in the context of the findings of this current assignment, as well as drawing on the activities of the parallel ADB consultancy work.

# Next Steps

Jonathan Hedgecock

- **Task 1 – Business Cases for Interconnection:**
  - Discussion of the current status of the OPTGEN model with the GMS country representatives
  - Development of the first note on three of the 10 proposed regional case studies, based on a review of potential interconnection projects in the GMS region
  - Scheduling of a discussion with relevant GMS country representatives of the first note.
  
- **Task 2 – Review of Power Market Regulations**
  - Data collection, focusing on:
    - 1. The institutional structure of the electricity sector;
    - 2. On-going and planned future market reforms;
    - 3. Electricity pricing policies;
    - 4. Electricity licensing and “third party access” rules;
    - 5. A copy of the Grid Code or equivalent for each country.
  - Discussion of logistical arrangements with WGRI members

- **Task 3 – Review of current Grid Codes**

- liaising with the GMS member countries to obtain current Grid Code documentation;
- conducting a review of these Codes to identify the areas in which there are common standards already in use
- completion of the review of international/regional Grid Code examples to highlight best practice in Grid Code harmonisation
- mobilisation of the national consultants to engage with industry stakeholders and explore capacity building requirements in relation to technical and procedural factors associated with Grid Code harmonisation
- the preparation of the Draft Task 3 Report

- **Task 4 – Capacity Building**

- identification of the appropriate choice of venue for the study tour, gathering views from the stakeholders in the GMS country organisations involved in the RPTCC as appropriate.

Thank you



Jonathan Hedgecock  
Ricardo Energy & Environment  
1 Frederick Sanger Road  
Guildford GU2 7YD, UK

[jonathan.hedgecock@ricardo.com](mailto:jonathan.hedgecock@ricardo.com)

# Project Timelines



	Task	
<b>Task 1</b>	Start of the Assignment	May 31, 2016
	1 <sup>st</sup> meeting of the PTA: stakeholder engagement.	June 27-28, 2016
	Summary of key take-away messages/ feedback during the 1 <sup>st</sup> meeting	July 15, 2016
	Meeting to present and discuss first note on 3 regional case studies/projects	August 2016
	2 <sup>nd</sup> meeting of the PTA: presentation of the second note on 3 regional case studies/ projects	Nov. 15, 2016
	Summary of key take-away messages/ feedback during the 2 <sup>nd</sup> meeting	Nov. 30, 2016
	3 <sup>rd</sup> meeting of the PTA: presentation of the third note on 4 regional case studies/ projects	March 15, 2017
	Summary of key take-away messages/ feedback during the 3 <sup>rd</sup> meeting	March 30 2017
	Ranked list of potential regional projects that would be more likely to proceed	April 15, 2017

Tasks 2-3	Task	
	Inception Reports (Tasks 2-3)	June 20, 2016
	Review and Comments	
	1 <sup>st</sup> meeting of the PTA: stakeholder engagement and information gathering for Tasks 2-3	June 27-28, 2016
	Draft Reports (Tasks 2-3)	30-July-16
	Review and Comments	
	Final Reports (Tasks 2-3)	15-Oct-16
	Review and Comments	
	2 <sup>nd</sup> meeting of the PTA: presentation of the final reports.	Nov. 15, 2016



	Task	
<p><b>Task 4</b></p>	<p>Providing logistics support for the delivery of capacity building services (to be executed by two separate consultants) and coordination of bi-annual meetings.</p>	<p>Around March and November of each year</p>
	<p>Coordinating the organisation of a study tour</p>	<p>In FY2017</p>