MINUTES OF 9TH MEETING OF SAFIR JOINT WORKING GROUP (JWG) "TO STUDY, FORMULATE AND RECOMMEND FOR FACILITATING POWER TRADE DEVELOPMENT IN SOUTH ASIA"

DATE: 27TH JULY, 2023
TIME: 16:00 HRS (IST) ONWARDS
VENUE: ONLINE (THROUGH MS- TEAM)
LIST OF PARTICIPANTS: APPENDIX – I

1. At the onset, Dy. Chief (CERC) informed the members that Chairperson of the JWG/ SAFIR had conveyed her inability to attend the meeting due to urgent commitments and requested Chairperson, CERC to chair the meeting. However, in the absence of Chairperson, CERC and also considering seniority among the JWG members, Shri. I.S. Jha, Member, CERC was requested to chair the meeting. The JWG was also informed that in the absence of Chairperson, PUCSL, Sri Lanka, two Technical Officers (who were appointed to the Sub Group of JWG) will join the meeting to provide technical inputs during the meeting.

2. Thereafter, presiding Chairperson, JWG /Member, CERC welcomed all the members to the 9th meeting of JWG being conducted through virtual mode and appreciated the two reports being presented during this meeting and stated that the same requires more discussions.

3. Thereafter, the items were taken up for discussion

AGENDA 1: CONFIRMATION OF MINUTES OF THE 8TH MEETING OF THE JOINT WORKING GROUP (JWG).

4. Detailing the Action Taken on the minutes of the 8th meeting, Dy Chief (RA), CERC informed the JWG that the draft regulations and the Explanatory Memorandum (EM) on Common Minimum Grid Code (CMGC) were circulated to the members for their suggestions / comments. However, suggestions/ comments are still awaited from the member Countries. As regards inputs from the World Bank, they have shared a presentation which is being discussed in the meeting

5. With this update, the members approved the minutes of the 8th meeting.

AGENDA 2: HARMONIZATION OF RULES AND COMMON MINIMUM GRID CODE (CMGC)

6. The representatives of SAREP (assisting the JWG in drafting the CMGC) informed the JWG that while they had received comments from a few members of the JWG on the initial draft CMGC and EM, they have not received any additional comments on the draft circulated for the meeting. Hence, Chief (RA), CERC requested the members to provide their comments on the said drafts once again. Thereafter, the Draft Code was once again perused by JWG members for their immediate comments.

7. After perusal and deliberations, the members decided that:

a. The framework of CMGC should be limited to cross border connectivity only and need not provide grid parameters beyond the point of interconnections/ connecting sub stations. Clause 5.2 on Planning Code should be modified suitably.
b. The CMGC should be devised in such a manner that each country may take reference from this Code and develop its own version which deals with connectivity or operation related issues w.r.t cross border trade of electricity.
c. The operational range of 500 kV should be included in the CMGC.
d. The CMGC should be updated based on the latest Regulations prevailing in the member countries.
e. The EM may indicate identification/creation of nodal agency(ies) to be appointed by the Regulator or Government of each country for specific purpose which will assist in carrying out cross country transactions.
f. The composition, role and functions of such agencies required to oversee the cross-border operations may be mentioned in the Explanatory Memorandum.
g. Further comments if any, on the draft CMGC to be shared by each member country to the SAFIR Sectt. on or before 31st August 2023 so that the broad structure can be framed.

AGENDA 3: POWER MARKET DESIGN FOR FACILITATING ELECTRICITY TRADE AMONG SAFIR MEMBER COUNTRIES

8. Dy. Chief, CERC informed the members that during the 5th meeting, it was decided that the World Bank team will study the WEIM (California) model and suggest a model for replication in the SAFIR region. Also, during the 6th meeting it was decided that the World Bank team shall assist each member country for enabling inter-country and intra-country dispatch

optimisation (akin to security Constrained Economic Dispatch model which has brought considerable results in India) by carrying out a pilot study and also on the short term (upto 2025), medium term (upto 2030) and beyond (post 2030) steps to be taken on these aspects. It was also decided during the meeting then that the World Bank would carry out a study in India, Bangladesh, and Bhutan and provide a master plan for transmission line, and its financing facility.

9. Subsequently, the World Bank Team presented the model for market design conceptualised for CBET in South Asia ***(Annexure – I)***. They also informed that there are two possible pathways for the regional market development in South Asia (a) Top down "soft infra" focus pathway (b) Bottom up "Hard infra" focus pathway.

10. The World Bank suggested that the implementation of pilot based on the suggested pathways may be undertaken in two phases - Phase - I (Upto 2030) and Phase - II (2030 – 33):

11. During phase I, the following activates may be undertaken:

i) Establishment of a common methodology for the management of cross-border flows and prices.
ii) Harmonisation of rules for congestion management and transmission capacity allocation with the help of national TSOs.
iii) Development of flexible common market rules for regional trading.
iv) Defining the interfaces between the national and regional markets while ensuring usage of same data in the regional market without requiring changes to the internal organization of the national power sector.
v) Implementation of an implicit auction mechanism to optimize the utilization of the cross-border capacity as part of the price formation.
vi) Development of a reporting mechanism.

The result of the phase I would help in the implementation of Phase II of the pilot where transition to regional trading through regional market shall be undertaken.

12. Under phase 2, a new regional market would be created that shall be the national market for the non-market SA countries as well as shall act as the regional coupling platform. The Indian power exchange shall act as a counterpart to their own trades, but the regional market shall be the legal counterparts towards the other SA countries. Also, a Common database for

coupling shall be developed for the integration of Indian power exchange with regional market, allowing a full market coupling optimization. Further, development of harmonized Market Book of Rules and a tight harmonization on operational procedures shall also be carried. This will require all parties to agree on a methodology to calculate and use the interconnector capacity between the countries.

13. It was also highlighted that transition to a full regional market would require continuous interaction between "hard infra" development (increased interconnection) and "soft infra" (increased regional cooperation) models. Hence, World Bank team recommended that the regional trading market can be implemented through flexibility, organic development and learning from global experiences

14. After discussion, JWG felt that it would be desirable to start with "as is where is basis" and regional integration will evolve gradually. The JWG also decided that the World Bank should:

i. Support intra-country system/cost optimization measures to help each member country appreciate efficacy of market
ii. Draw lessons from India's experience of regional integration to form a common national grid/market, and also
iii. Study Western EIM Model (California) and other similar models as a precursor to regional market in South Asia
iv. Support capacity building in member countries for effective regional integration

15. Comments, on the presentation of World Bank may be shared by each member country to the SAFIR Sectt. by 15th September, 2023.

16. At the end of the meeting, delivering the Vote of Thanks, Chief (RA), CERC expressed deep appreciation for the SAREP team for apprising the JWG on the developments on the CMGC and the World Bank team for a detailed presentation. He extended thanks to all the member countries for their participation and contribution in enriching the discussion and to the chair for steering the meeting.

****

APPENDIX - I

LIST OF PARTICIPANTS OF THE 9TH MEETING (VIRTUAL) OF SAFIR JOINT WORKING GROUP (JWG) "TO STUDY, FORMULATE AND RECOMMEND FOR FACILITATING POWER TRADE DEVELOPMENT IN SOUTH ASIA"

27th JULY, 2023 AT 04:00 PM IST

Sl. No.	Name & Designation	Organisation
MEMBERS		
1.	Mr. I. S. Jha, Member	CERC, India
2.	Mr. Dilli Bahadur Singh, Chairman	ERC, Nepal
3.	Mr. Abul Khayer Md. Aminur Rahman, Member	BERC, Bangladesh
4.	Dr S.K. Chatterjee, Chief (Regulatory Affairs)	CERC & Convenor
5	Mr. Harpreet Singh Pruthi, Secretary	CERC
SPECIAL INVITEES		
5.	Ms. Bhagirathi Gnyawali, Member	NERC, Nepal
6.	Mr. Jigme Dorji, Chief	ERA, Bhutan
7.	Mr. Chamath Goonewardena, Director, Regulatory Affairs	PUCSL, Sri Lanka
8.	Mr. Dileepa Karunaratne, Assistant Director, Regulatory Affairs	PUCSL, Sri Lanka
9.	Mr. Shahzad Anwar, Director (Technical)	NEPRA, Pakistan
10.	Mr. Muhammad Ramzan, Dy. Director (Technical)	NEPRA, Pakistan
11.	Mr. Waleed Saleh I. Alsuraih	World Bank
12.	Mr. Waleed Tayseer A. Alhaddad	World Bank
13.	Mr. R. V. Shahi, Senior Energy Advisor	World Bank
14.	Ms. Monyl Toga	World Bank
15.	Mr. Lovemore Chilimanzi	World Bank
16.	Ms. Graeme Chown	World Bank
17.	Mr. Jonathan Hedgecock	World Bank
18.	Mr. Naoki Fujioka	World Bank
19.	Ms. Sarisha Ojageer	World Bank
20.	Mr. Pankaj Batra, Adviser	SAREP
21.	Mrs. Namrata Mukherjee	SAREP
22.	Mr. Rajiv Ratna Panda	SAREP
SAFIR SECRETARIAT		
23.	Mrs. Shilpa Agarwal, Joint Chief (Engineering)	CERC
24	Mrs. Rashmi Somasekharan Nair, Deputy Chief (Regulatory Affairs)	CERC

25	Mr. Antony P. Mathew, Asstt. Secretary	SAFIR/CERC
26	Mrs. Sukanya Mandal, Asstt. Chief (Regulatory Affairs)	CERC
27	Ashutosh Sharma, Asstt. Chief (Economics)	CERC
28.	Mr. Saurabh, Principal Research Officer	CERC
29.	Mr. Kushal Pal, Research Associate	SAFIR

The Electricity Market of South Asia

Challenges | Opportunities | Design Options| Development Pathway

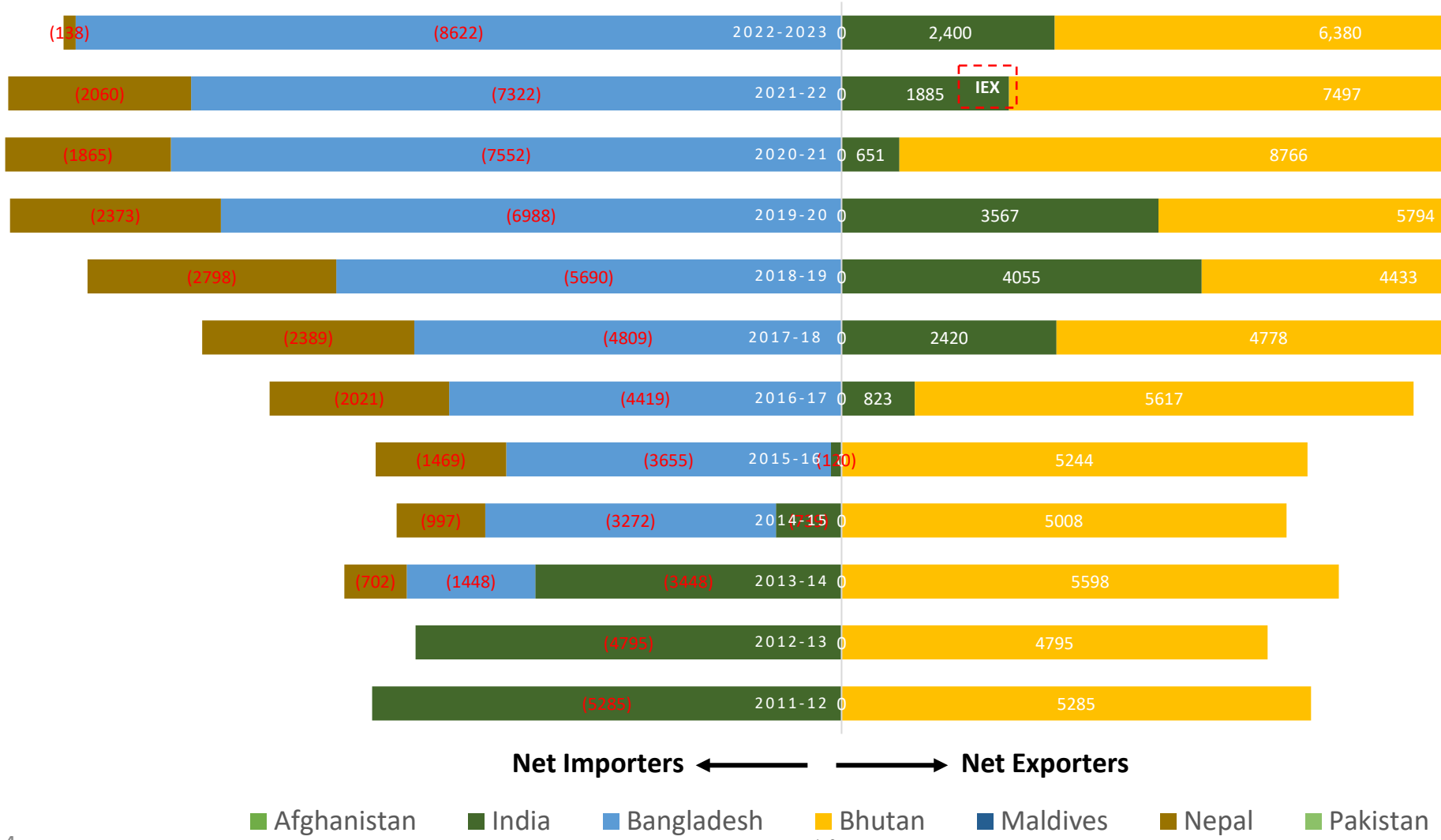
WORLD BANK GROUP

Contents

- A brief on regional electricity trade in South Asia
- Challenges to scaling-up regional electricity trading and market development in SAR
- The emerging need to scale-up grid-to-grid integration and market-based trade
- Potential Models of the Electricity Market Design for South Asia
- Recommended Regional Electricity Market development pathway for South Asia
- Examples of bottom-up trading and market development: SIEPAC and GCCIA
- Core enablers to realize the recommended pathway for the electricity market of South Asia
- Proposed high-level roadmap for the bottom-up approach market pilot; and transition to the ultimate market design

A brief on regional electricity trade in South Asia

Electricity trade in South Asia (GWh) is relatively small but on an upwards trajectory



Source: Developed by World Bank based on data from PowerGrid PPT PSRT14; and POSOCO India monthly reports

Observed regional asymmetries driving the need for a regional market

- Currently Bhutan sells energy to India under a long term bilateral contract with a low strike price, but can only buy back at the spot price in IEX, which is higher.
- A key issue affecting Nepal's ability to trade with Bhutan or Bangladesh is the lack of grid-to-grid connectivity between these countries – requires India to grant access to the transmission network between the south-east of Nepal and the other countries. Currently there is no agreed basis for doing this.
- Bangladesh wishes to import 50-70MW from Nepal via India on bilateral basis – a relatively small transaction, but currently requires multilateral agreements to be negotiated. (A regional market would have defined rules for participation.)
- Regional trade rules: no regional rules and all trade is according to India's trade guidelines
- Transmission investments recovery model: monthly transmission charge by connected country to India or part of generation tariff
- Delivery Point: Always on the Indian side (till now)
- Traders: mainly concentrated between two traders, PTC and NVVN from India

Hard Infra in SAR: Grid-to-Grid (G2G) connectivity started in 1954, incubated bilaterally by governments & executed by ministries/utilities- slow process towards full integration

	BILATERAL INTERCONNECTION	SHALLOW INTEGRATION	DEEP INTEGRATION
Regional Connectivity Architecture	**Typically starts with 2 countries, later a wider interconnected grid**	Interconnected grid involving a number of neighbouring countries	Operation of a fully synchronous, multi-country, interconnected power system
Cross-Border Trading Arrangements	**Long-term bilateral Power Purchase Agreements (PPAs)**	Long-term PPAs supplemented with short-term markets and cross-border transmission tariffs	Electricity pricing competition achieved through a range of market mechanisms (spot, day-ahead, transmission capacity auctions, ancillary services, etc.)
Technical and/or Regulatory Harmonization	**Simple rules agreed upon for the operation of the interconnected system**	Harmonization of rules, grid codes, and transmission tariffs Reciprocity, fair and non-discriminatory access to the grid and pricing	Harmonized technical standards with minimum requirements specified in regional grid code Regional governance structure including institutions, market rules and dispute resolution process
Planning and Investment Coordination	**National planning and investment**	Some coordination of national investments with optimized regional investment plan	Regional integration body empowered to require investments in agreed upon integrated regional plan (covering both generation and transmission) to be implemented
Institutional Architecture	**Simple institutional arrangements with National vertically integrated utilities (VIU) or TSO**	Number of VIU, national TSO, regional institutions	Complex institutional arrangements with different types of institutions, some national VIU or TSOs, Regional TSO, Regional Regulators, market operators, etc.

Current status in SAR: 5 to 7 bilateral cooperation mechanisms; some regional planning of transmission (e.g. India-Bhutan, India-Bangladesh) but no market design, no regional governance

Soft infra: Trade is institutionalized under parallel bilateral mechanisms to develop grid-to-grid transmission for each project with no regional cooperation platform in place

5-7 parallel bilateral mechanisms (BH,BT,IN,NP, SL)

Governance
G-to-G agreement
Overseen by JSC & executed by JWG

- JSC: Co-chaired by Power/Energy Secretaries in each bilateral mechanism
- JWG: Co-chaired by Joint Secretaries of Power/Energy in each bilateral mechanism

Project preparation Approach
JTT & JOC

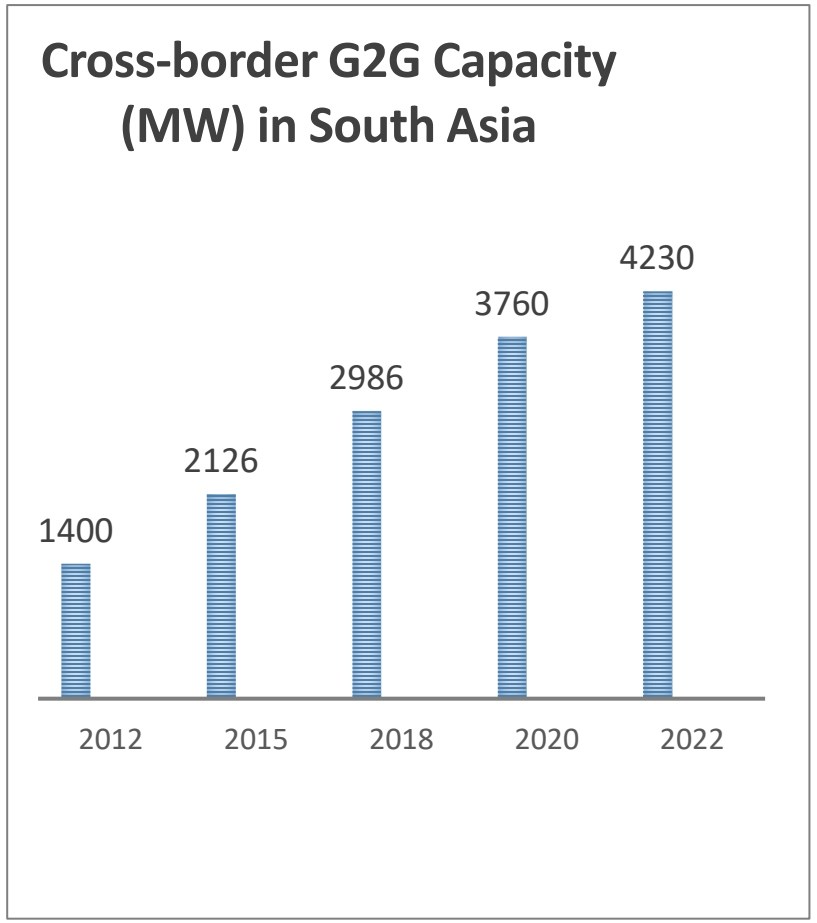
- JTT: Authority, System Planner, System Operator
- JOC : System Planner, System Operator

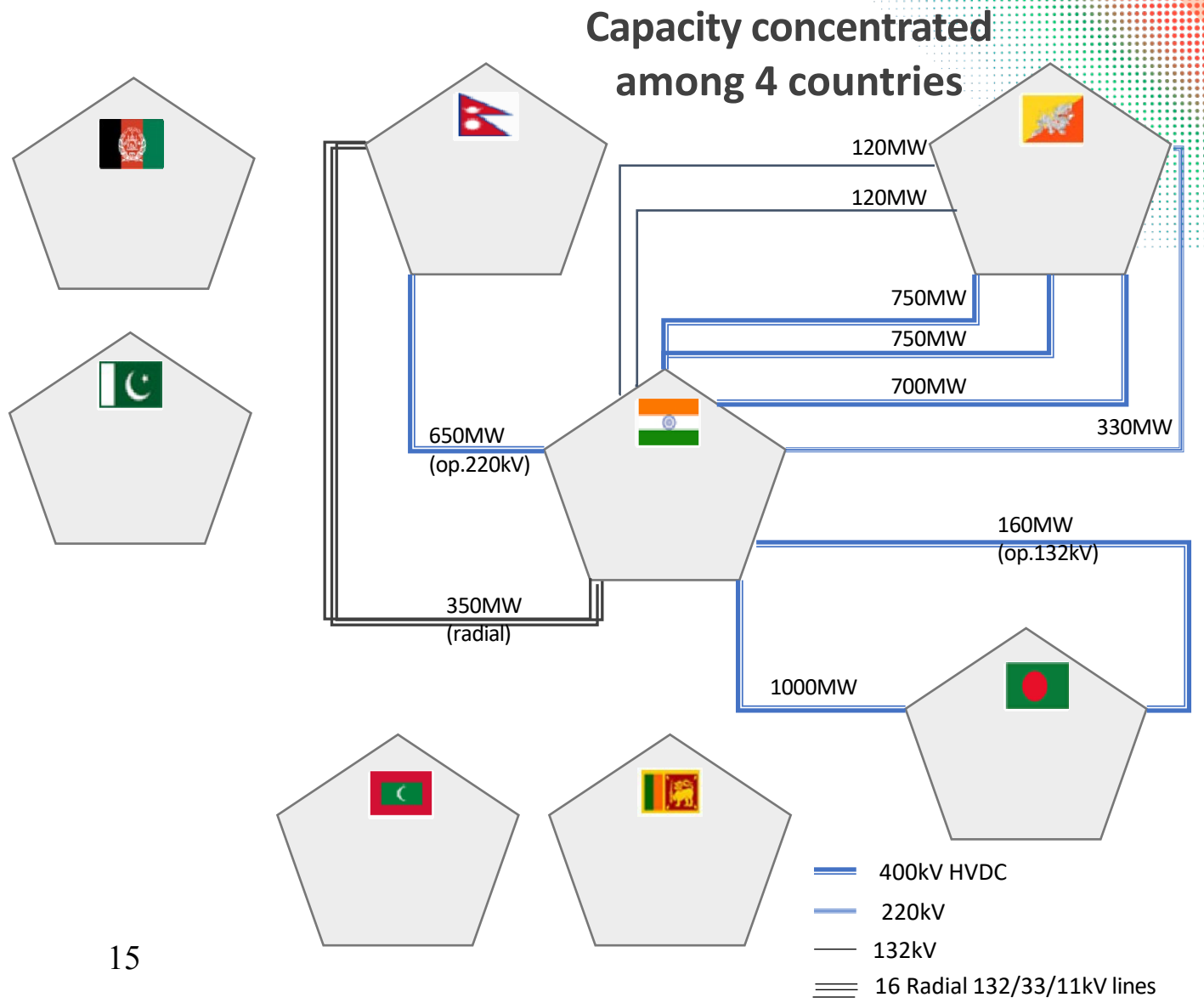
Projects Focus
Hydro & Transmission (for BT & NP)
Transmission (for BG & SL)

- Gov-to-gov driven approach and executed by Joint Steering Committee/Joint Working Group
- Cross-border transmission implemented mostly driven by hydropower development and slowly developed with Power Secretaries oversight and regular interaction between JWGs on commercial and technical aspects
- **Currently**: all cross-border transmission projects development is limited to the eastern part of South Asia, while central Asia is mostly driven by the CASA project which faces major implementation challenges
- **Bhutan-India** transmission is dedicated for each hydropower plant. No separate transmission agreement, charges are included in the PPA tariff.
- **India-Nepal** has multiple radial connections and one HVDC but all under development lines are associated with hydropower plants. Entire ttransmission charge is paid by Nepal.
- **India-Bangladesh** transmission is mainly to enable Bangladesh meets its increasing domestic demand. Entire transmission charge is paid by Bangladesh.

Challenges to scaling-up regional electricity trading and market development in SAR

Cross-border transmission capacity increased three-fold in 2012-2022 - **Yet** there is a lack of diversity in G2G connectivity in SAR and majority of the lines are to evacuate hydropower from NP & BT

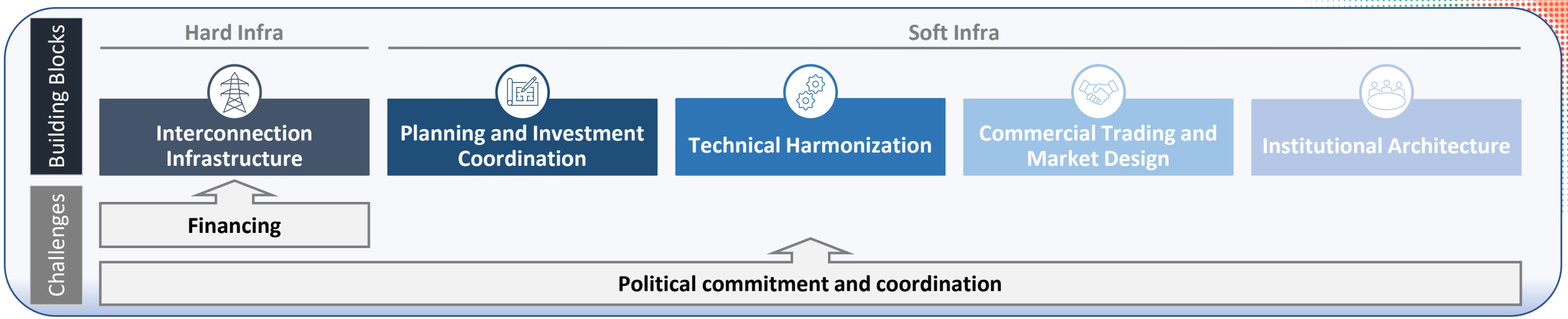




Key challenges to scale up market-based trade and transition to a regional electricity market in SAR

1. **Expansion of cross border transmission lines** is urgently needed without locking capacity to specific hydro projects+ long-term PPAs
   - Involvement of private sector varies
2. Absence of **regional institutional frameworks** with multilateral participation/jurisdiction
3. Policy and regulatory uncertainties affecting investors:
   - Long term **regional** policy uncertainties:
     - Absence of long term regional commitments/agreements on energy cooperation
     - Changing policy priorities on key investments, e.g. hydro vs renewables
   - Regulatory risks:
     - Evolving regulatory arrangements for third-party access, cross-border trading and wheeling
     - No **regionally** agreed approach to tariffs for transmission connection and wheeling
4. The need for an agreed **regional** market design and associated trading platforms

Addressing those challenges requires a tailored approach to scale up trade and gradually develop the regional market building blocks for South Asia



The approach should be evolutional, coordinated, supported and balanced to develop both hard and soft infra towards a regional electricity market in parallel to ongoing bilateral efforts to further:

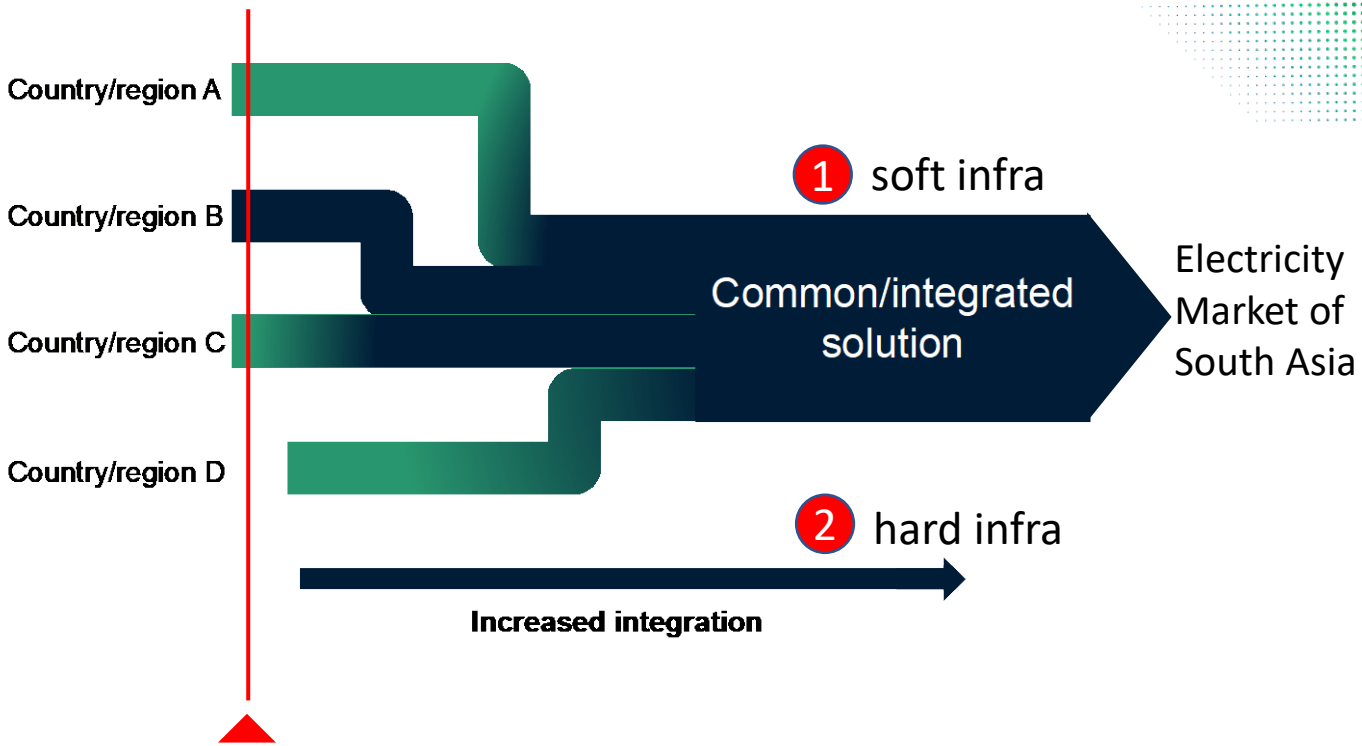
- **ensure optimal resource allocation and by this increase efficiency**
- **enhance integration of renewable generation**
- **reduce the overall cost of generation**
- **improve the security of supply**
- **an emerging catalyst for transition to low-carbon power systems**

To achieve a shared vision of a common, integrated regional market in South Asia, the approach must flexible when prioritizing both soft and hard infra development

Allowing for regional cooperation among countries that are ready, but maintaining national control of the assets

Flexibility is needed in:

- **Market design –** allowing future evolution of markets
- **Market Rules –** easy access to markets to new players
- **Market Platforms –** managing changes in the market framework
- **Legacy contracts –** respecting these
- **Market opening –** not a big bang where all join at the same time
- **Implementation-** persist when responding to emerging challenges (political, technical, economic, etc.)



Current state of Grid-to-Grid connectivity/integration & regional market development in SAR

The emerging need to scale-up grid-to-grid integration and market-based trade

High-level benefits of electricity trading in a regional market

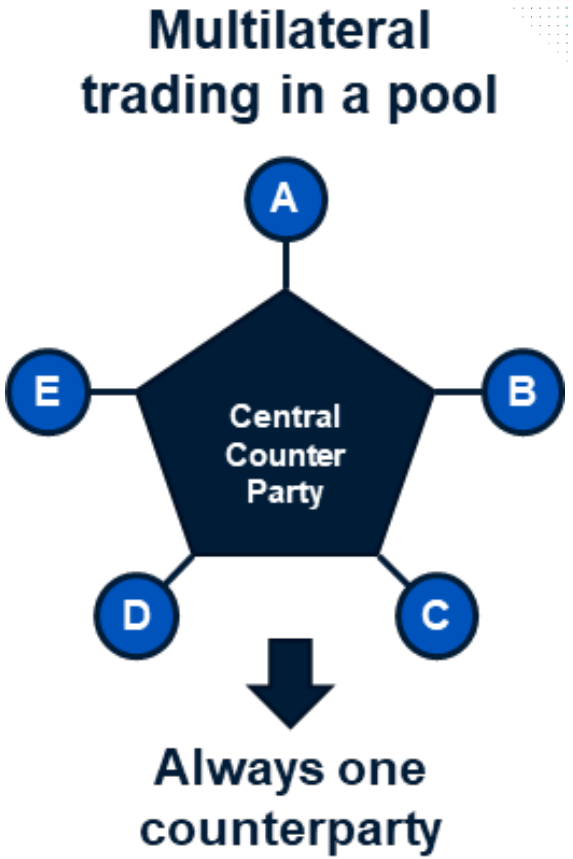
The market is a tool to enable flow of electricity in the economically best direction (from low price towards high price)

Trading through a market is simpler for utilities – only need to consider: what is my marginal cost for generation and willingness to pay for demand?

Power pools as the central counter party - utilities are given access to a bigger market and liquidity through the pool without involved in the cross-border agreements/arrangements

Social economic welfare maximization

Optimal utilization of assets and resources



Scaling up system integration and regional trade could unlock multifaceted benefits for all countries

Potential economic benefits of advanced grid-to-grid (G2G) connectivity and market-based trade in South Asia (an initial World Bank analysis)

Potential benefits	Initial Modelling outcomes
Enhanced Energy Security • Diversification of energy sources reduces reliance on a single source or country, mitigating the risk of supply disruptions	• Up to **17 new cross-border interconnections** are developed with **all 8 Countries** • This is up from just 4 Countries exchanging very low amounts of energy in the baseline scenario.
Enhanced Energy Reliability • Sharing of resources and balancing fluctuations in demand and supply across different countries leads to better frequency control and reduces the number and severity of power outages	• **Saving of up to $266 million (NPV)** over the 2022-2035 modelling period on **reserve requirements.** • **Reduces the need for developing up to 9 GW of battery energy storage systems** for supporting the supply-demand balance and other ancillary services across the region.
Cost Optimization • Resource sharing and economies of scale lead to cheaper electricity and reduced need for redundant power generation capacity	• Up to **$9.2 billion (NPV) of economic cost savings over the 2022-2035 period** • **$3.6 billion in annual system cost savings (undiscounted) by 2035**.
Renewable Energy Integration • Integration of intermittent renewable energy sources over a larger area enables stable grid operation and flexibility to accommodate variable generation	• **86 TWh of additional renewable energy generation is deployed in the region annually by 2035**, displacing a corresponding amount of energy output from fossil-fuel sources.
Market Efficiency and Competition • Competition in the regional electricity market leads to market efficiency, transparent and competitive prices and investment in cost-effective technologies	• **$3 billion (undiscounted) saving** in cumulative upfront investment by 2035 through more cost-effective technologies

Potential economic benefits of advanced grid-to-grid (G2G) connectivity and market-based trade in South Asia (an initial World Bank analysis)

Potential benefits	Initial Modelling outcomes

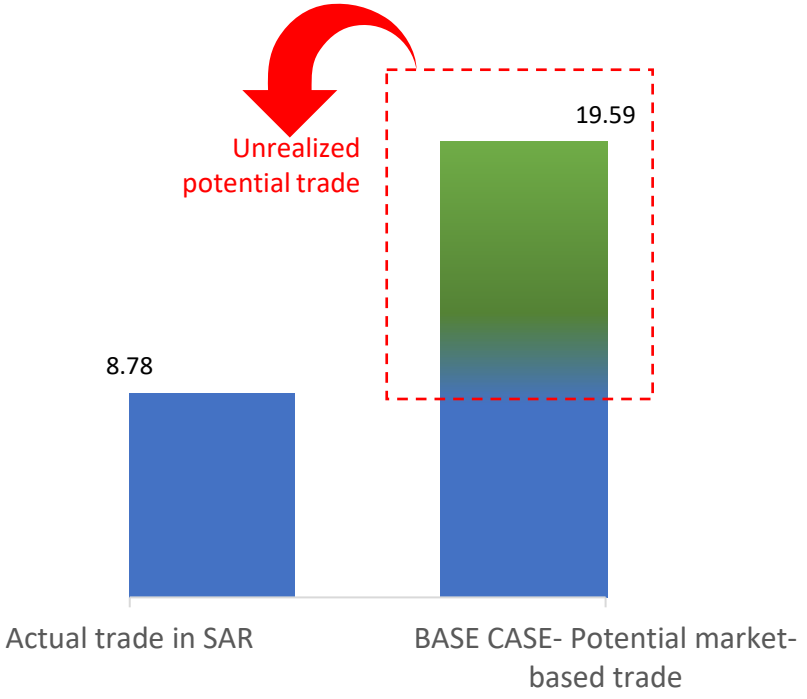
Improved Energy Resources Utilization
• Utilization of abundant resources (e.g., hydropower, natural gas, solar, wind) available but not used in different countries
	• **17 GW of additional hydropower development in Nepal and Bhutan (combined)**
	• **India is able to integrate more cost-effective renewable energy resources from Nepal and Bhutan**
	  • unlocking 8.8 GW of additional Solar PV, and displacing the need for 10 GW of storage, 11.5 GW of Wind, and 8.7 GW Gas Turbine.
	  • At the same time, India can utilize a higher share of its excess capacity to export energy to Bangladesh, Pakistan, and Sri Lanka.
	• **8GW reduction** in new coal-fired plant **in Bangladesh** and **3GW reduction in Pakistan**
	  • replaced with under-utilized dispatchable plants in adjacent Indian states
	• **Sri Lanka displaces the need for developing significant (and expensive) imported LNG terminals and CCGT plants (600 MW)**
	  • utilizing lower cost imported power from neighbouring Tamil Nadu

Potential economic benefits of advanced grid-to-grid (G2G) connectivity and market-based trade in South Asia (an initial World Bank analysis)

Potential benefits	Initial Modelling outcomes
Regional Economy and Cooperation • Import and export of electricity do not only enhance energy cooperation but also economic development, diplomatic ties, and cooperation on other issues	• **4.5x increase in the volume of annual cross-border energy trade by 2035** (from 51 TWh to 227 TWh) • **Commercial value of trade** over the 2022-2035 period **24.3 billion (NPV)** • **Up to 29 GW of additional cross-border transfer capacity** (over the 12 GW of existing and planned capacity) by 2035 will require increased regional collaboration on planning and project development
Environmental benefits • Integration of renewable energy sources reduces reliance on fossil fuels and contributes to climate change mitigation	• **Up to 66 MT of annual emissions from the region are abated by 2035**. • Equivalent to a **30% reduction in total emissions from the region in 2035** when excluding India
Socio-Economic Development • Utilization of abundant resources (e.g., hydropower, natural gas, solar, wind) available but not used in different countries	• Under review

Current electricity trade is low and not achieving the full potential of trade compared to a market-based approach

Trade in 2022-2023: potential vs. actual in existing cross-border lines (TWh)



Trade flows & estimated value based on marginal costs at the zone level

Zone IDs		TWh	Millions ($)	$/MWh
Ind-Assam	BhutanE	0.2	13.1	57.7
Ind-Bihar	NepalE	1.3	77.4	58.0
Ind-Tripura	BangladeshE	1.0	68.8	68.9
Ind-WestBengal	BangladeshE	8.8	603.0	68.8
Ind-WestBengal	BhutanW	0.2	12.9	57.3
BangladeshE	Ind-Tripura	0.0	0.0	68.2
BangladeshE	Ind-WestBengal	0.0	0.0	67.1
BhutanE	Ind-Assam	1.2	72.9	59.2
BhutanW	Ind-WestBengal	5.7	328.8	57.9
NepalE	Ind-Bihar	1.1	65.5	57.7
		19.6	**1242.4**	63.43

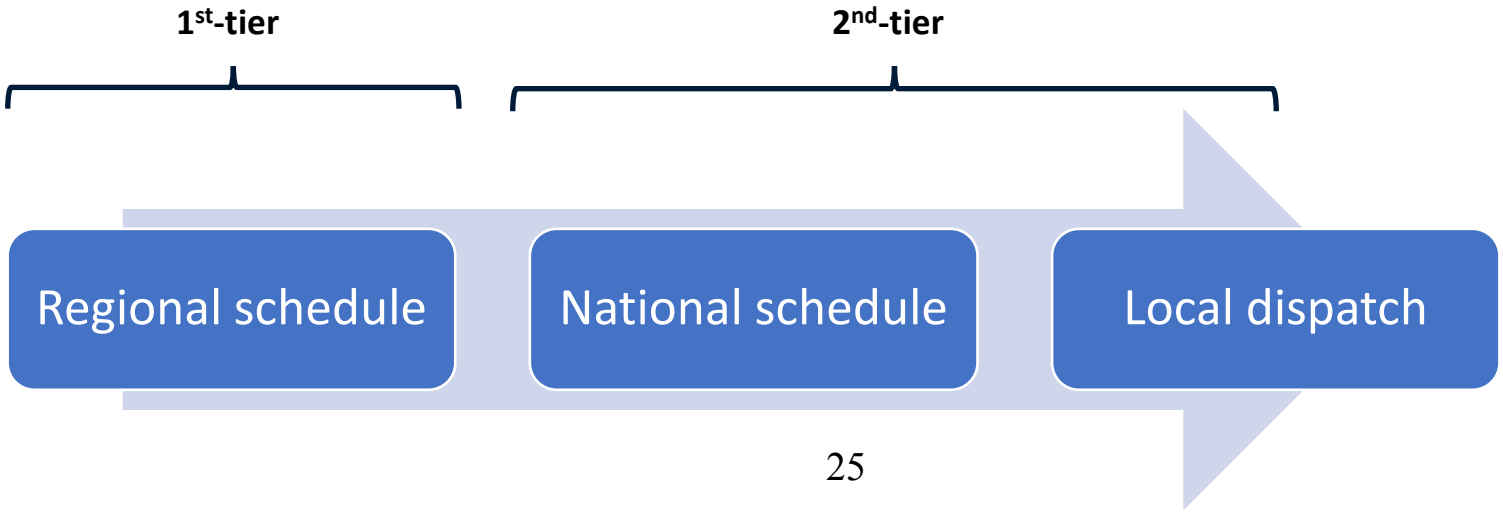
Preliminary World Bank modelling suggests potential market-based trade in SAR for 2022-2023 of **19.59 TWh** with a potential commercial value of **USD 1,242 million**

The rationale for a regional market in South Asia

The primary purpose and criteria for the design of a regional power market is **optimal resource allocation and by this increase efficiency, enhance integration of renewable generation and reduce the overall cost of generation, including increasing the security of supply.**

To achieved this the concept is based on,

- Creating economic merit orders while taking transmission constraints into account
- Short-term optimizing of the power system and formation of a dispatch schedule from a regional perspective down to the local dispatch
- “Regional market” means inter-provincial, connecting all countries in South-Asia
- The regional trading provides (all or) parts of the interconnector flows between the countries
- The result from the trades in the regional market is considered in the local dispatch together with the national schedule



A market-based trade & regional market offers incentives to countries in addressing soft infrastructure gaps to maximize trade benefits

- Countries have different approaches to unbundling
- Third party access is an essential pre-requisite to maximising access to the regional market
- A common, transparent transmission pricing method for cross-border trading is also needed
- Market organisation, membership structures and rules require development

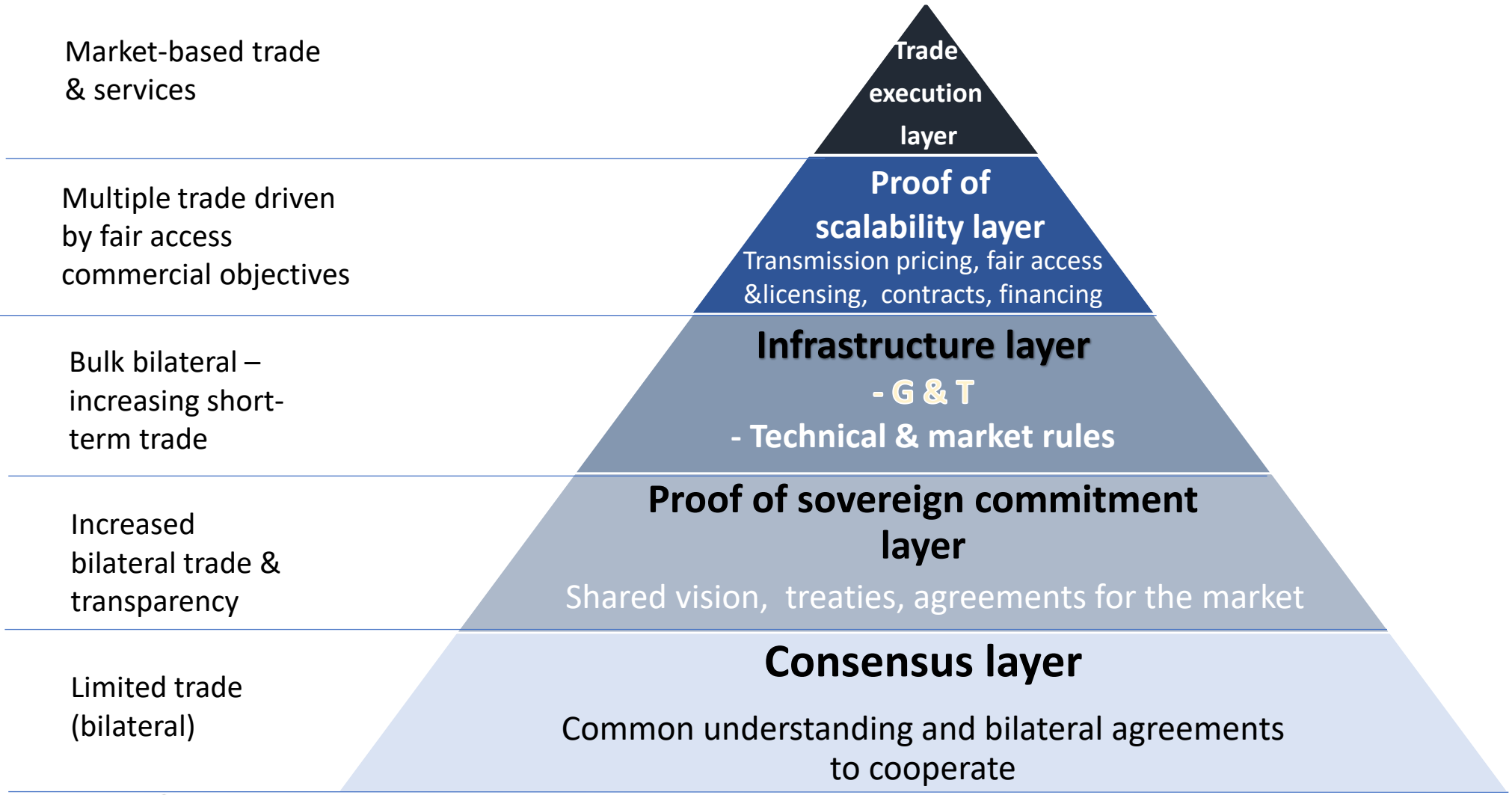
Country	Power Trading and market Structure	Single Buyer	IPPs	Non-Discriminatory Open access Framework	Transmission System operation (as part of transmission agency)	Independent transmission system operator	Competitive Power Market Power/Gas Exchange Platform	Cross-border trade under a regional market
Afghanistan	**Single Buyer** (SB)-DABS, VIU-DABS			X				X
Bangladesh	**Single Buyer** (SB)-BPDB, Multiple Seller Partial Unbundling of Transmission			X				X
Bhutan	**Single Buyer without Generation Assets** (SBWGA)-BPC, ^^Un-bundled transmission			X				X
India	**Multiple Buyer & Seller Competitive Power Market** Platform. Power Exchange (PXs) Completely Un-bundled transmission			?				X
Maldives	**Single Buyer** (SB), VIU-FENAKA			X				X
Nepal	**Single Buyer** (SB)-NEA, Multiple Seller VIU-NEA			X				X
Pakistan	**Single Buyer without Generation Assets**-CPPA-G (Market Operator)^^, Multiple Seller			?				X
Sri Lanka	**Single Buyer** (SB)-CEB, Multiple Seller			X				X

"X" Does not exit; "?" Exists with limitations

Source: USAID, 2023 & WB team updates

Potential Models of the Electricity Market Design for South Asia

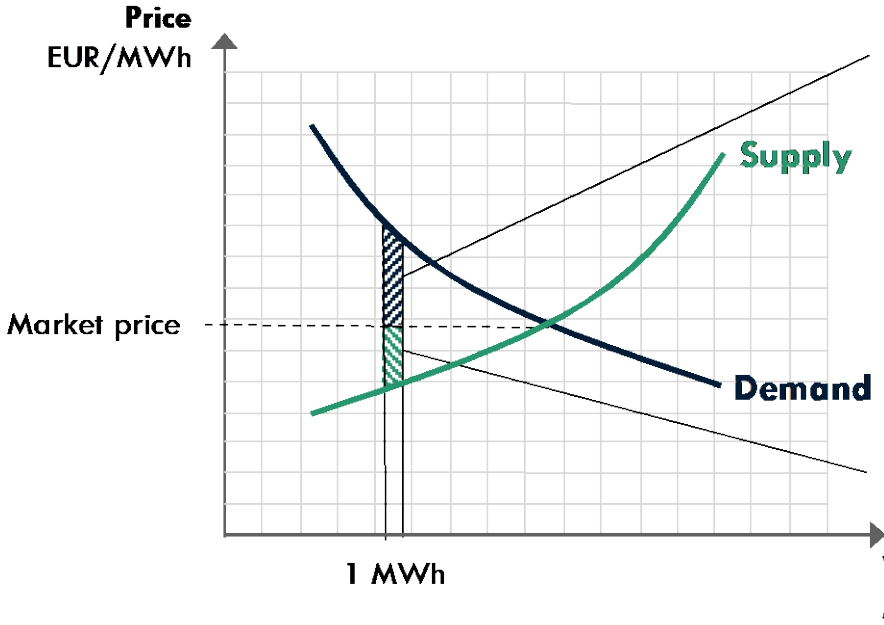
Simplified building blocks for a regional market development based on international experience



Day-ahead market – the cornerstone of any regional market

Based on marginal pricing in different bidding zones

Area between the buy and sell curves represent the total economic surplus of buyers and sellers for each hour. In addition, transmission network limitations (bottlenecks) can create bottleneck income.

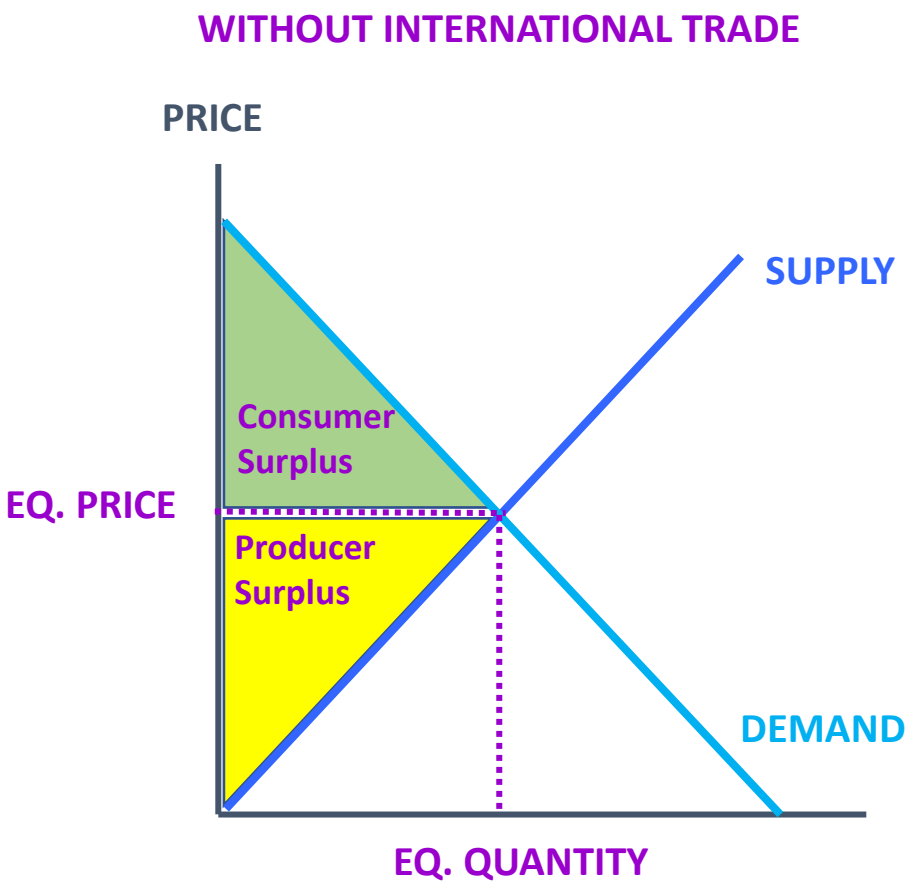


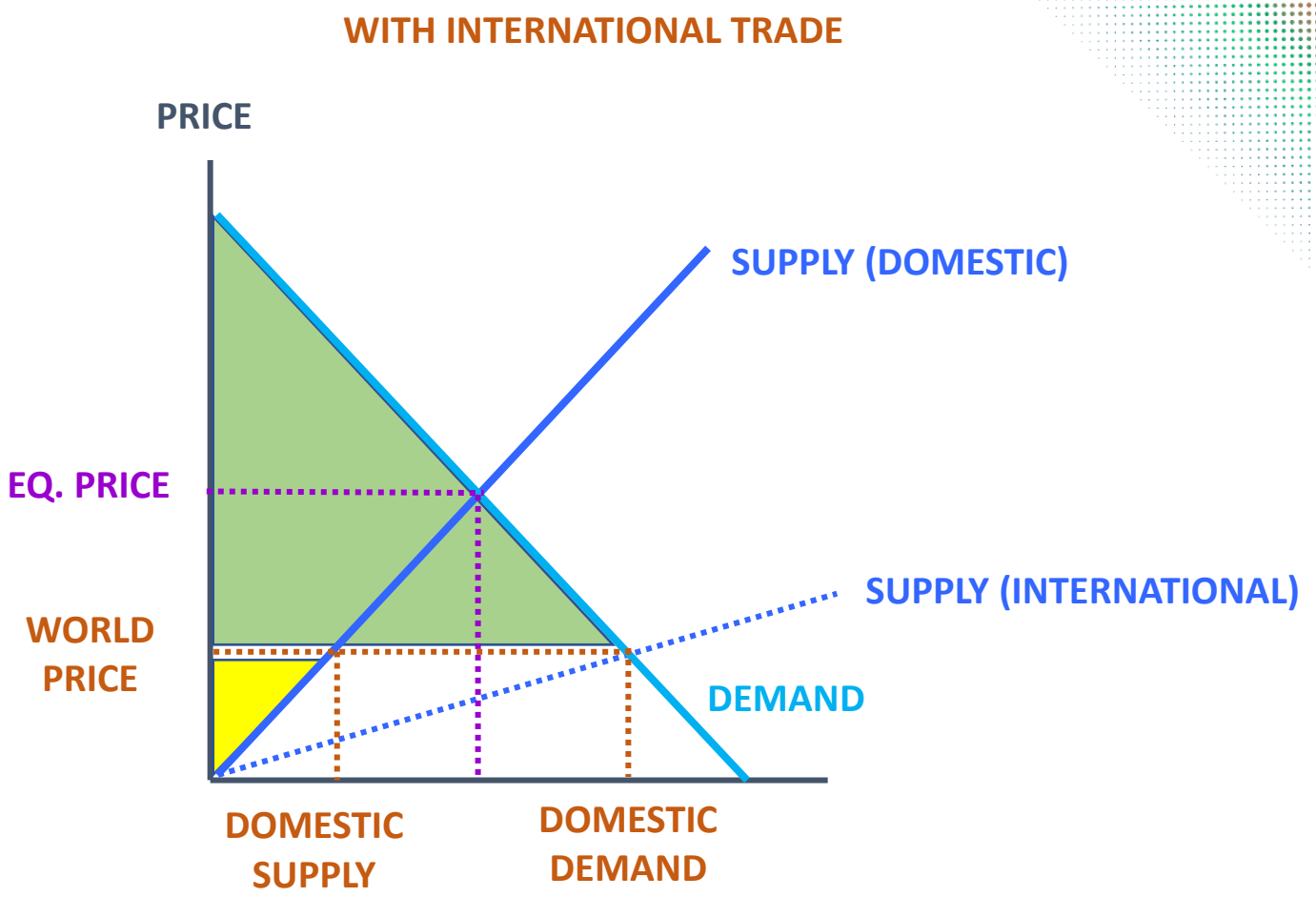
Consumer surplus = difference between the demand offer price and market price

Producer surplus = difference between the supply offer price and market price

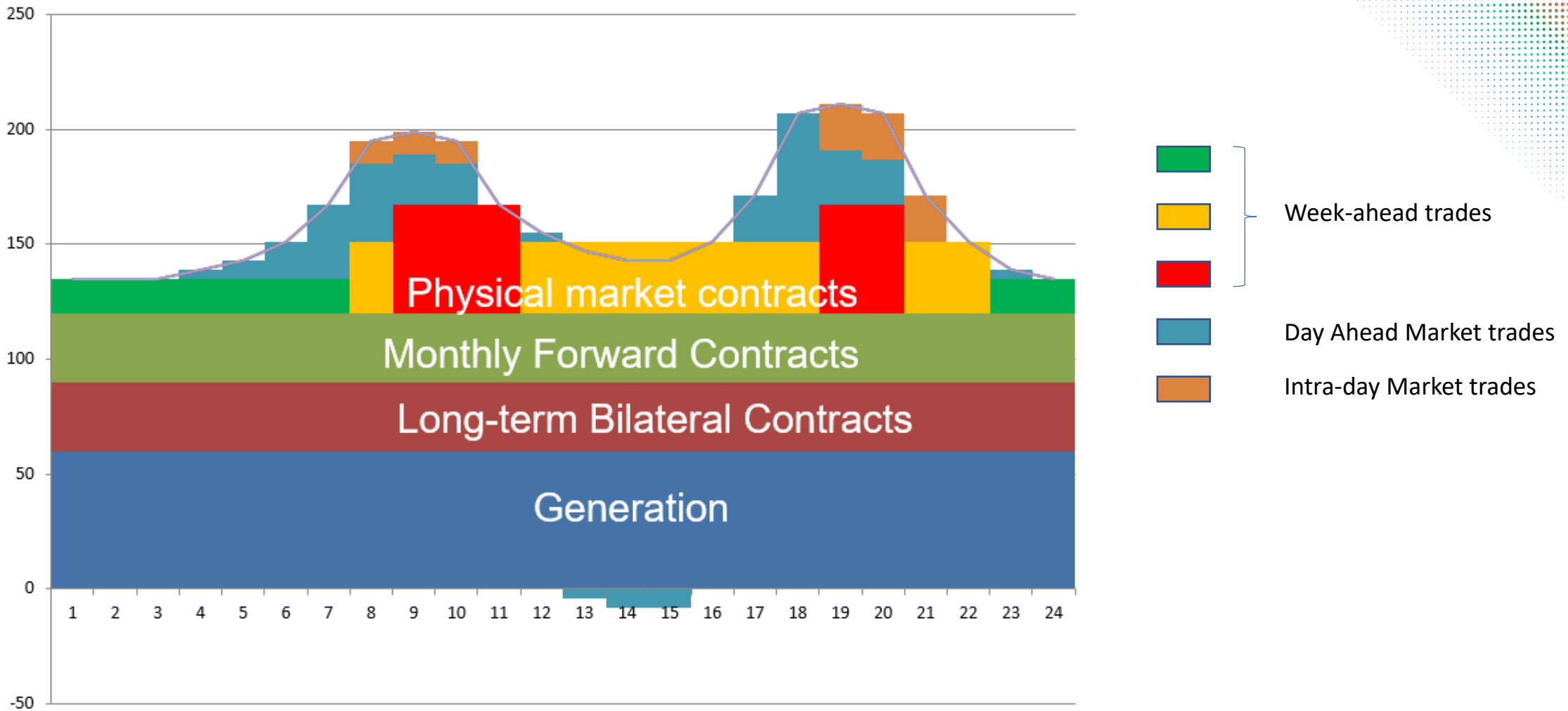
Optimising the seller and buyer surplus (while taking into account potential limitations in both orders and the transmission infrastructure) results in the maximum overall economic welfare.

Economic Benefits of trading electricity

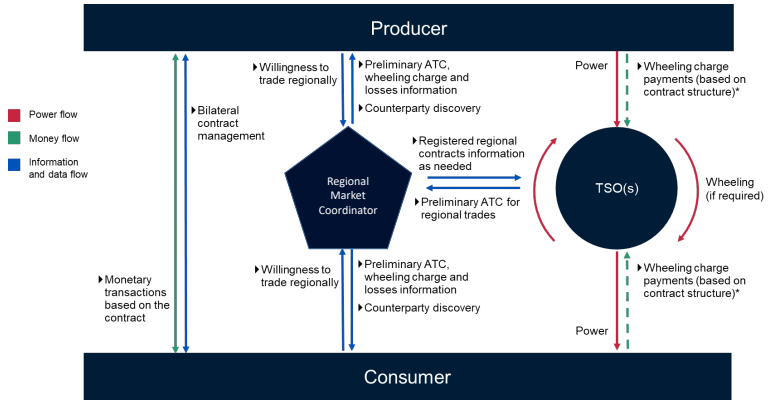




New short-term markets complement, but do not replace, bilateral contracts for SAR

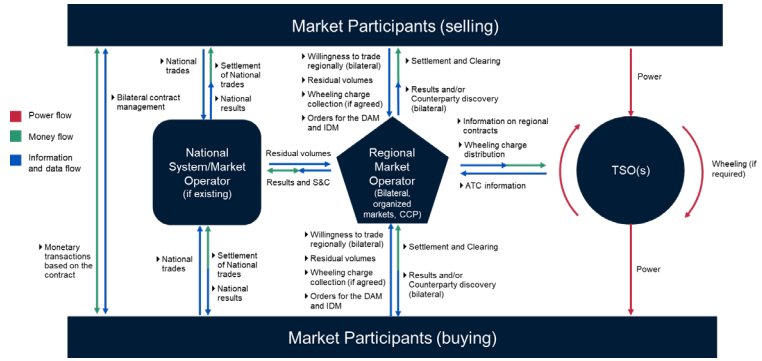


Potential models for a regional market development in South Asia



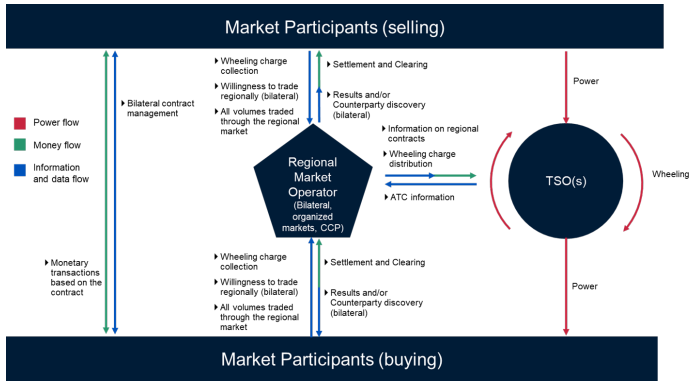
Model 1: **Standardized Regional Bilateral Trading**

- **Standard Physical contracts**
- **Announcement platform ("OTC" platform)**
- Coordination of **preliminary ATC calculation**
- **Information sharing**
- Central registry of regional bilateral contracts
- **Facilitating approval** of proposed deals among involved TSOs



Model 2: a **Secondary Regional Market**

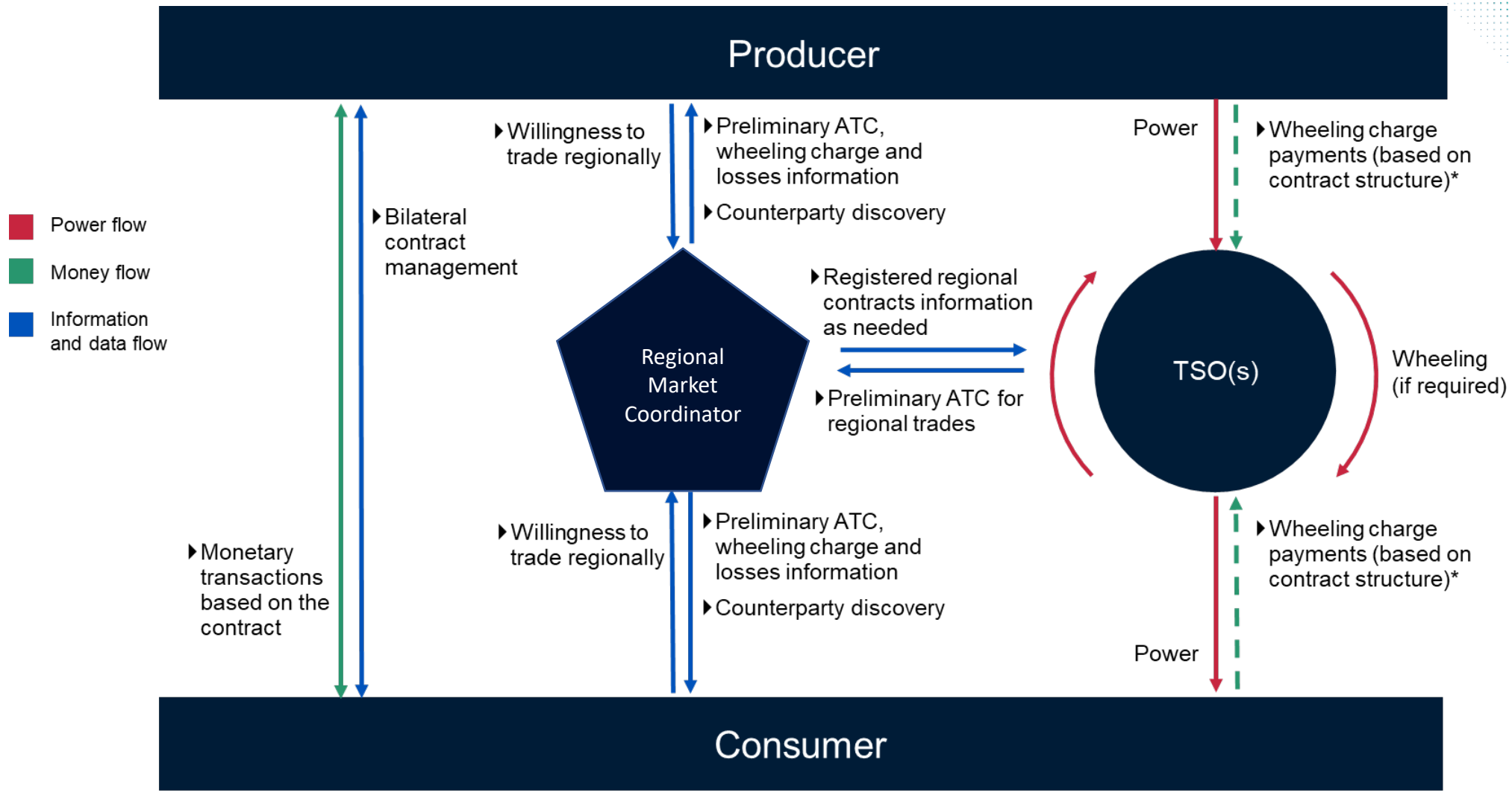
- **New regional market is created** that can accommodate the current non-market SA countries as well as those with established markets
- Agreed methodology to calculate and use **interconnector capacity**
- **Harmonized Market Book of Rules**
- **Allows a full market coupling optimization**



Model 3: a **Primary Regional Market**

- **One common market for South Asia**
- **Common rules, timelines and using the same Market Trading Platform**
- **One organisation that operates the market on behalf of all connected countries**
- **Fully harmonized platforms, rules and procedures**

Model 1 for a South-Asia regional market: Multinational Standardized Regional Bilateral Trading



Inspiration: IEA feasibility study for ASEAN energy exchange

Standardized Regional Bilateral Trading

National Market Operator(s), Utilities and potentially IPPs

- Preliminary ATC information wheeling charge and losses
- Counterparty discovery
- Announcement of willingness to trade regionally

Three-party coordination

- Verify ATC availability on proposed contacted route
- Standardized Bilateral contract management among the three parties
- Settlement of contracted volumes directly between the involved parties. Inc. wheeling charges and compensation for losses.

National Dispatch/TSOs and Balancing

- Preliminary ATC calculation result, wheeling charge and losses agreement
- Full regional overview of regional trades to update the ATC calculation with new trades.

South Asian Regional Coordinator
Harmonized Bilateral Trading

- **Standard Physical contracts** for power trading including wheeling charges
- **Announcement platform ("OTC" platform)** for counterparty discovery
- Coordination of **preliminary ATC calculation** for the involved interconnectors (TSOs are responsible for the calculations)
- **Information sharing** to market participants (preliminary ATC, wheeling charges, losses)
- Registration of existing and new regional bilateral contracts to a **central registry** to keep an updated regional overview
- **Facilitating approval** of proposed deals among involved TSOs

- Standardized bilateral contract templates
- ATC calculation methodology
- Wheeling methodologies, potentially including losses
- Third party access (TPA) agreement
- Technical and operational harmonization through regional grid code

Inspiration: IEA feasibility study for ASEAN energy exchange

Standardized Regional Bilateral Trading

Some more details on the requirements:

- Standardized bilateral contract templates*
  - Develop a standardized contract for striking the regional bilateral deals in the centralized platform
  - The template shall allow for some flexibility on terms
- Transmission Capacity management
  - National dispatchers (TSOs) will have to avail ATC information to the bilateral OTC platform to enable the regional contracting
- Wheeling methodologies, potentially including losses
  - Either a harmonized methodology is created or ensure that the regional wheeling can be calculated, collected and distributed
- ”OTC” (trading) platform for bilateral contracts
  - An IT platform needs to be developed where the willingness to purchase or sell power regionally can be expressed, based on the criteria defined in the standardized contract
  - The platform should include a registry for the concluded contracts (under confidentiality agreements), the regional market operator may share the information either anonymized or under NDAs to the national system operators for grid operation and ATC calculation purposes.

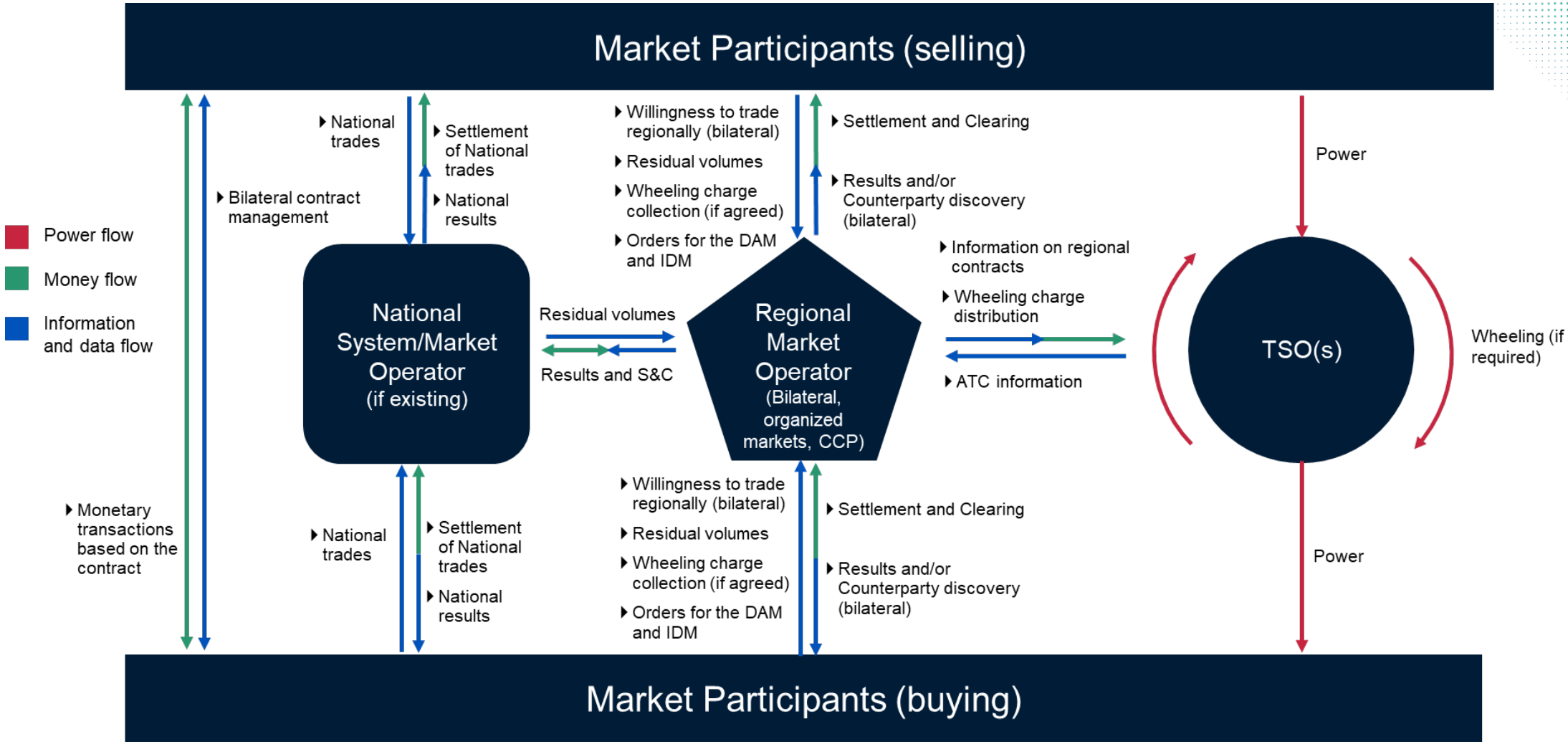
Additional related tasks:

- Legislative and regulatory gaps to be tied up
  - Legislative gap analysis to allow multinational bilateral trading
  - Import/Export license requirements
- Enabling agreements
  - Intergovernmental agreement on market-based power trade
  - Operational agreements among the TSOs for regional power trade
  - Required NDAs
- (Future) Power Market establishment and building
  - Required organizational establishment to allow centralized multinational power trading
  - Wheeling methodologies management, development and harmonization

* As an example, EFET (European Federation of Electricity Traders) has developed a set of templates that are widely used in Europe as serve as a best practice. Several OTC markets in Europe are using these as their basis, ref https://www.efet.org/ where these are available.

Inspiration: IEA feasibility study for ASEAN energy exchange

Model 2 for a South-Asia regional market: Multinational Regional Trading through a Secondary Regional Market

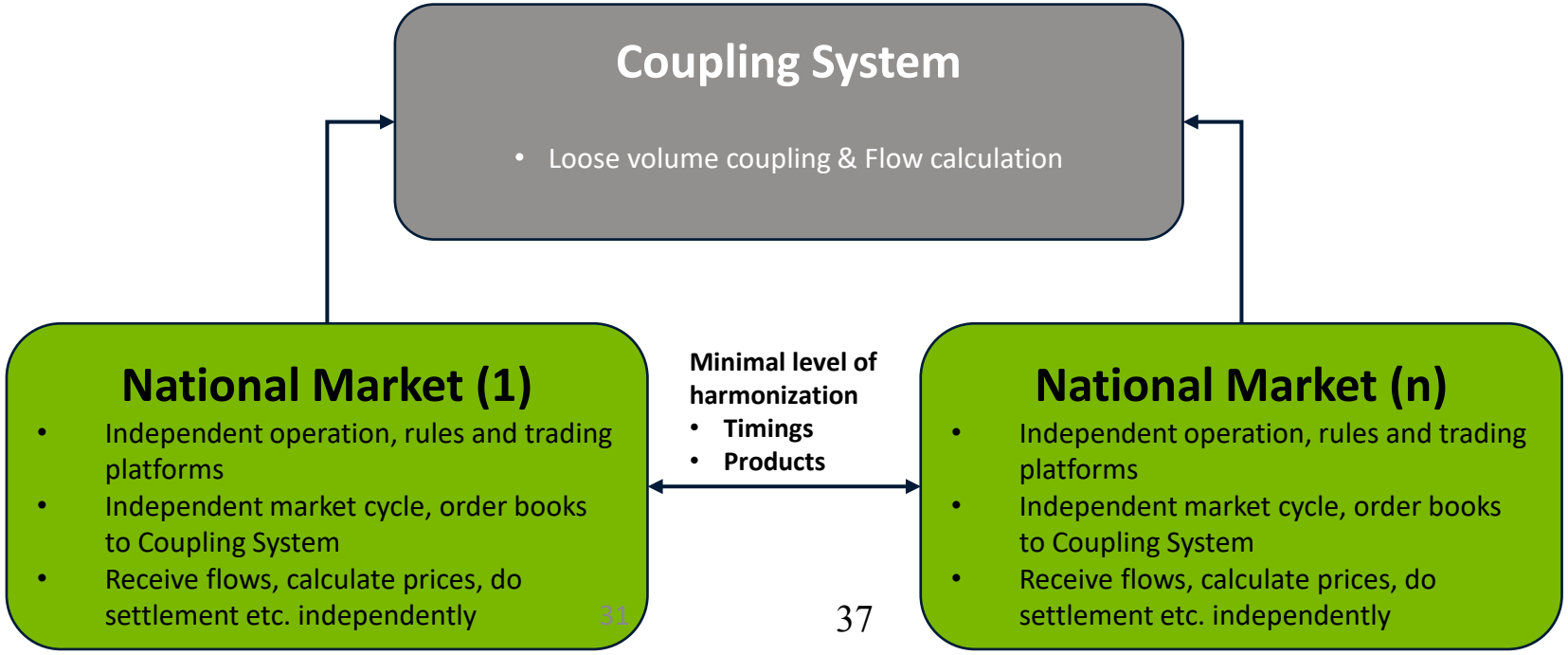


Source: IEA feasibility study for ASEAN energy exchange

Multinational Regional Trading through a regional market – Model 2a: Loose coupling model

Where each of the national markets needs its own trading platform + develop a regional coupling

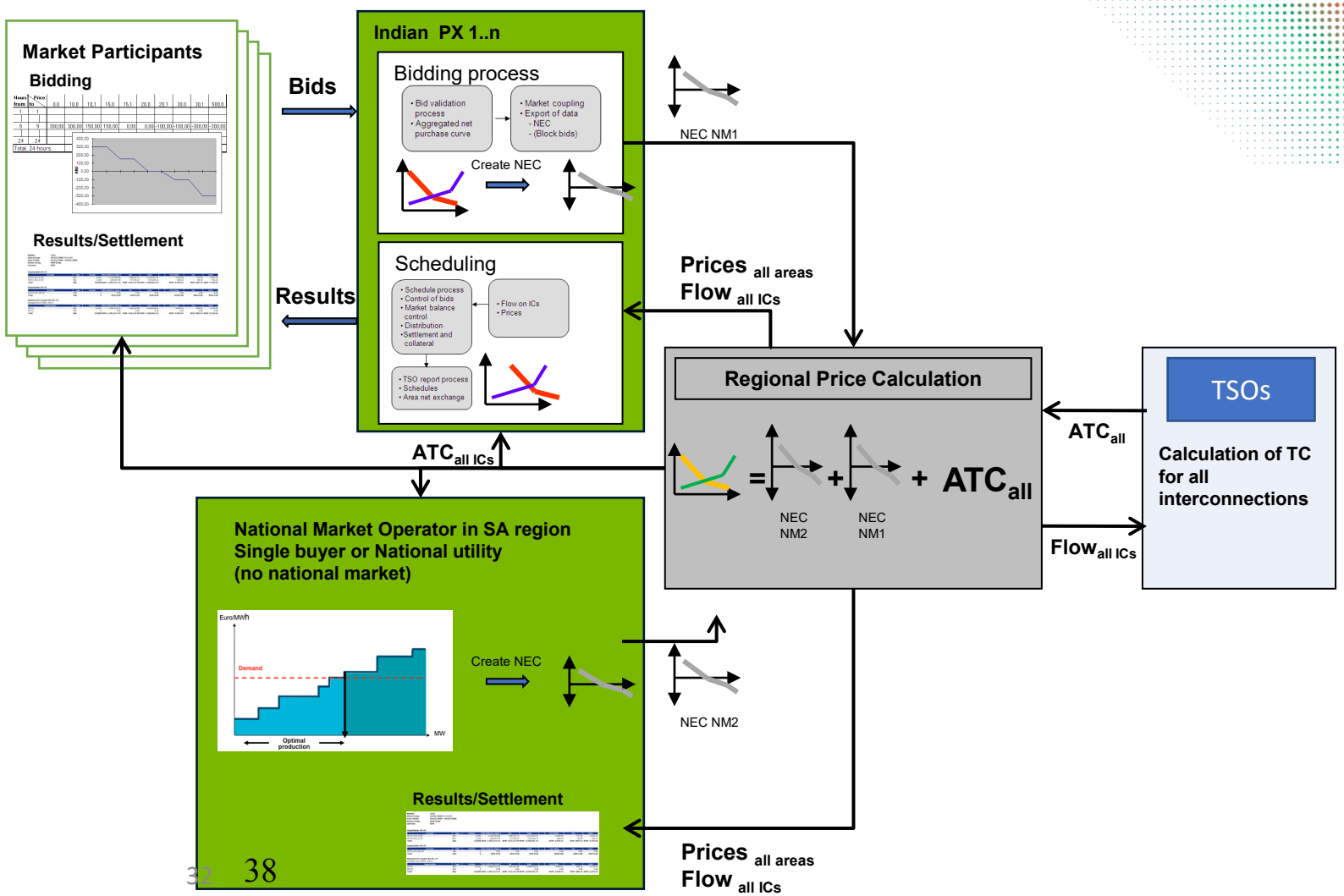
- The Indian PXs will still base their operation on their current market trading platforms;
- All other SA countries have to create, operate and maintain their own market trading platforms;
- All SA countries to agree on a methodology to calculate and use of the interconnector capacity between the two power markets;
- A Coupling System must be created to perform the coupling between the all national power exchanges/markets;
- Settlement and all other following processes are done in each power market;
- Not a full market optimization but allows the countries to “be independent”.
- Was implemented in for instance the EMCC (European Market Coupling Company) in Europe in 2010, but incurred several problems.



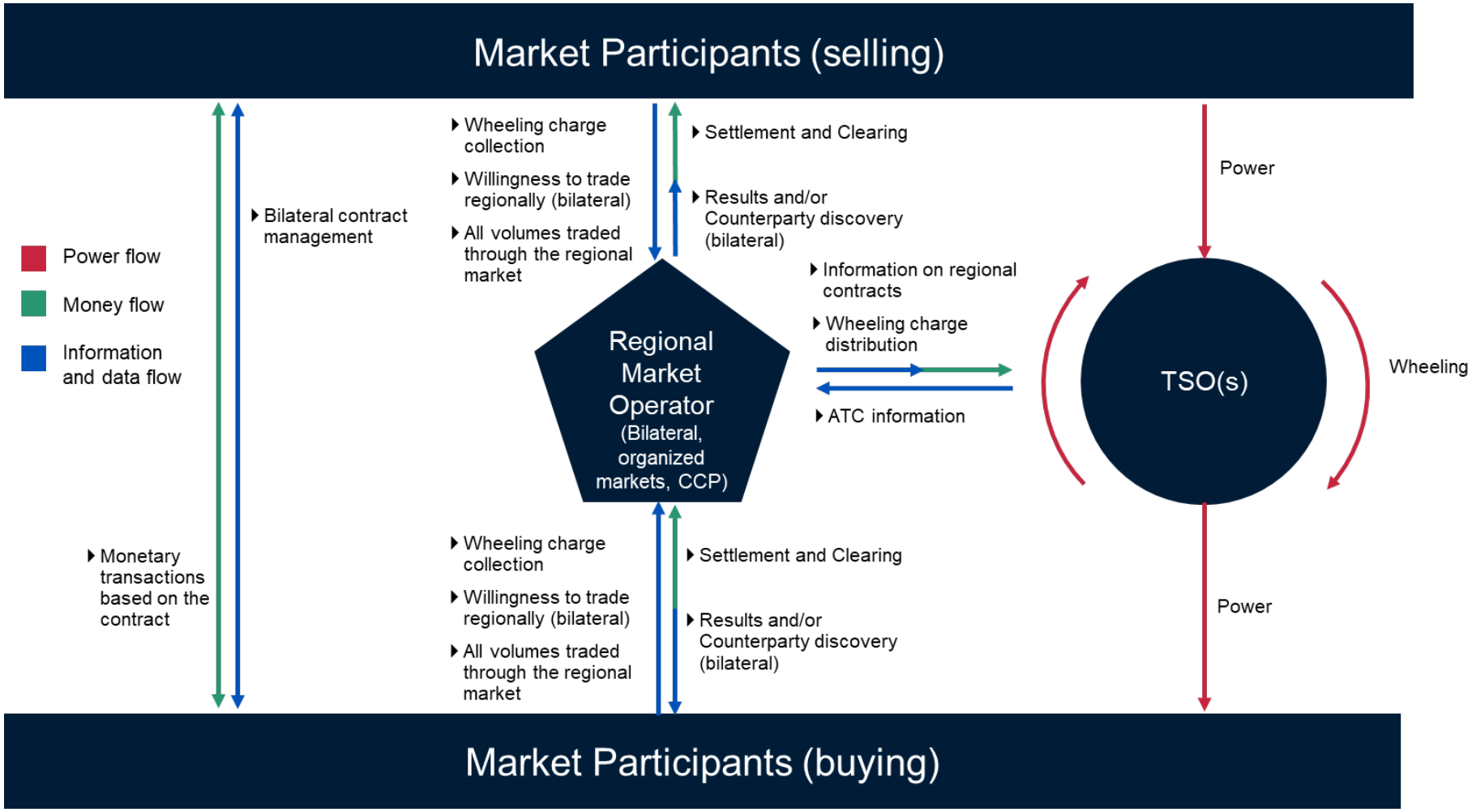
Multinational Regional Trading through a regional market – Model 2b: Tight coupling model

A new regional market is created that combines coupling and national markets

- The Indian PXs will still base their operation on their current market trading platforms;
- A new regional market is created to cater for all the current non-market SA countries;
- This new regional market will be the national market for the non-market SA countries as well as the regional coupling platform
- All parties to agree on a methodology to calculate and use of the interconnector capacity between the countries;
- Harmonized Market Book of Rules and a tight harmonization on operational procedures;
- It will allow India to still operate their respective markets with its market participant management;
- The Indian PXs will be counterparts to their own trades, but the regional market is the legal counterparts towards the other SA countries;
- Common database for coupling ;
- Allows a full market coupling optimization but still no issues for the Indian PXs.
- Similar to SAPP current model and early European model



Model 3 for a South-Asia regional market: Multi-national Regional Market



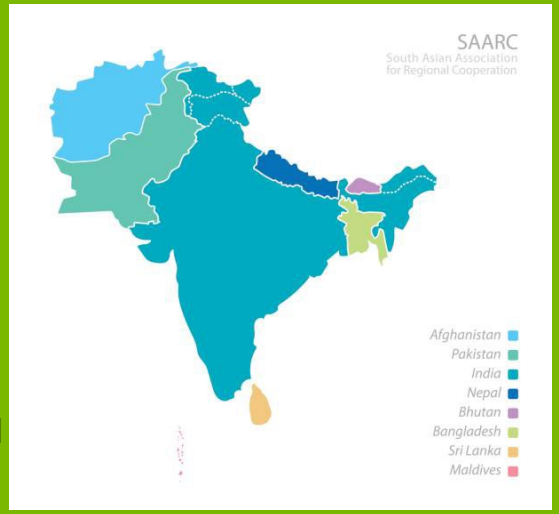
Source: IEA feasibility study for ASEAN energy exchange

Model 3 for a South-Asia regional market: Multi-national Regional Market

- One common market for South Asia based on common rules, timelines and using the same Market Trading Platform
- One organization that operates the market on behalf of all connected countries
- Fully harmonized platforms, rules and procedures

South Asia Regional PX

- Regionally harmonized market rules and market procedures
- One trading platform
- Centrally Receive transmission capacities
- Centrally Collect sales and purchase orders
- Centrally Calculate prices and flows
- Centrally Manage settlement and post trading activities



Pros and cons of different models

	Multinational Standardized Regional Bilateral Trading	Secondary Regional Market		Multinational Regional Market
	Model 1	**Model 2a** Loose Coupling	**Model 2b** Tight Coupling	**Model 3** Implicit coupling
Pro	• Today´s solution put into a more common framework • Will be easy to implement and a quick start • Could be part of a stepwise implementation	• Will ensure allow for independent market operators • Requires less harmonization	• Will allow for independency • Will deliver optimal cross-border flow • Could be based on one trading system (based on legal model) • Could be “end-game”	• Will deliver optimal cross-border flow • Will be based on one trading system • Will be optimal operational setup • Could be “end-game”
Con	• Will not deliver optimal flow or really a common market	• Complex solutions (require at least three trading systems) • Even with little harmonization, the legal setup will be complex • Will not ensure optimal flow and full benefit	• Will require tight operational coupling between the countries – will take time to implement and agree • Difference between India and the rest • Big step?	• Will require a fully common setup (too tight?) • Could mean full merging – not wanted? • Very hard politically • Too big a step?

Possible target model

Recommended Regional Electricity Market development pathway for South Asia

Starting point in South Asia : Currently all trade is bilateral with or via India, no regional market

Soft Infra

- **Regional Governance**: no regional market design nor defined regional legal framework- only SAARC Agreement (signed in 2014) is geared towards regional market (not operational)
- **Regional institutions**: none
- **Regional Regulatory framework & market rules**: no regulatory frameworks, commercial or technical rules
- **National enabling measures:** almost all countries silent on cross border trade but it is happening based on cross-border transmission bilateral agreements & facilitated by India's evolving cross-border electricity trade guidelines

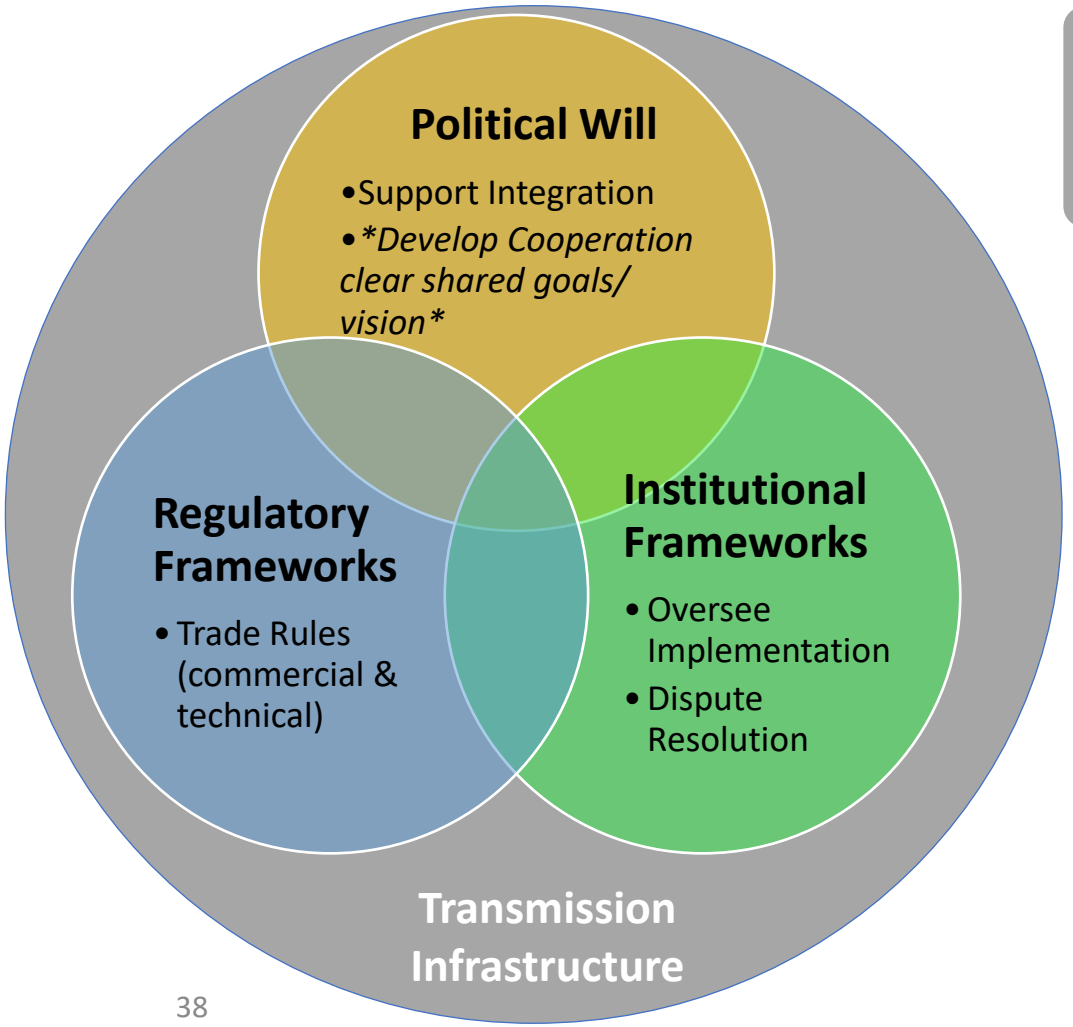
political commitment focused on bilateral transmission development

Hard Infra (cross-border transmission)

- **G2G connectivity** level is still constrained by only connecting/operating via India's grid
- **Cross-border transmission planning**: bilateral opportunistic approach with a focus on short distance transmission network and utilizing hydro in BT & NP (in the future)
- **Coordination & execution**: incubated bilaterally by Governments & executed ministries/utilities
- **Business model**: Asset-in-country model; JV, PPP (BOT) with gradual increase in private sector role
- **Financing**: mostly public (inc. IFIs, ECAs), with commercial financing mainly on India's side

Trading strategies & contractual: designed for bilateral trade & dominated by long-term PPAs

The Criteria in defining South Asia market development pathway should be based on four common building blocks and tailoring these to the regional context



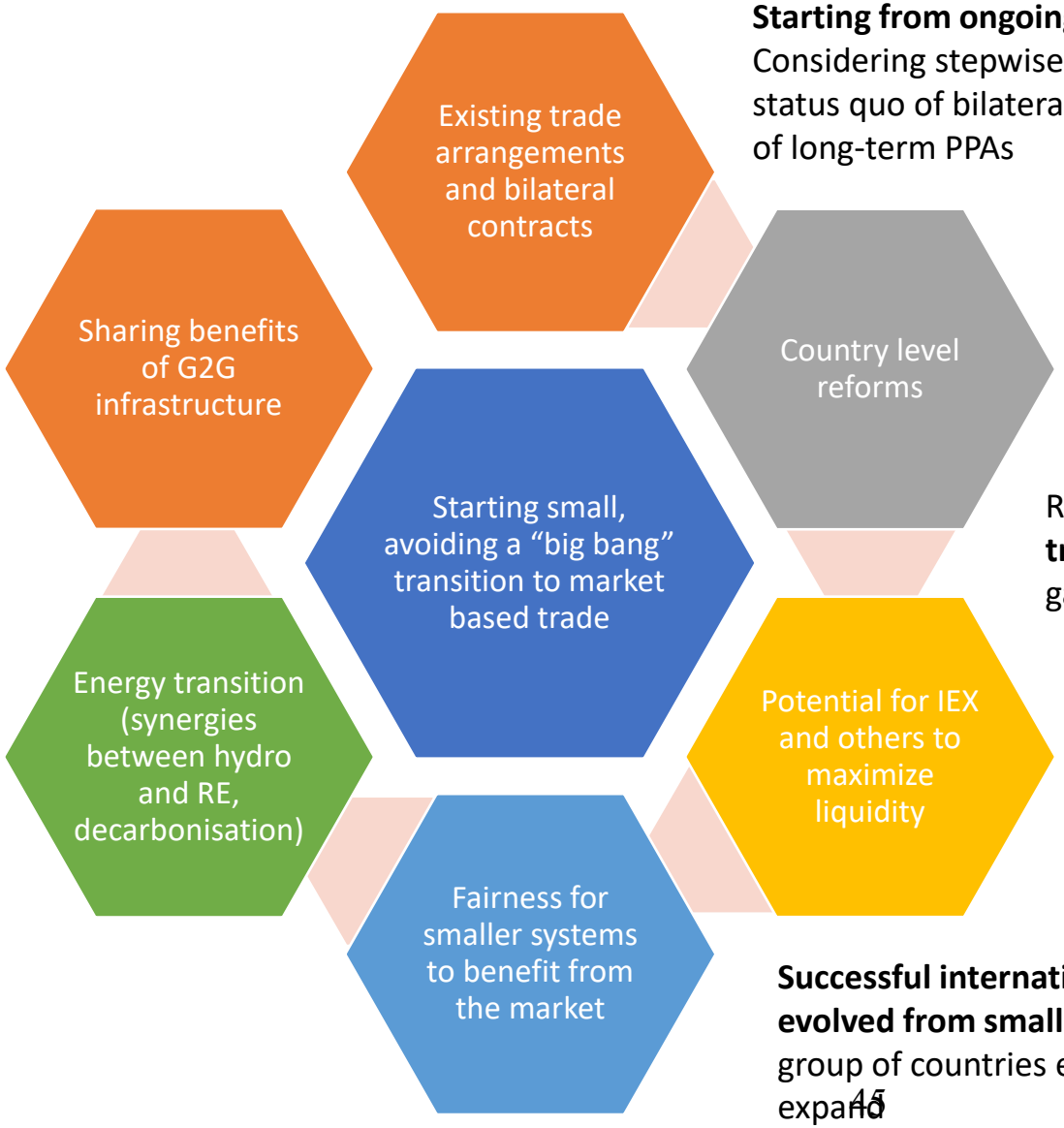
Transmission Infrastructure
Identifying the backbone transmission network at a regional level that can be utilized for trading (G2G diversity and transfer capacity)

Political will
Focusing initially with those countries that are ready to engage and test the concepts in a pilot market

Regulatory frameworks
Defining a minimum set of regional regulations (e.g. Minimum Common Grid Code currently in place) that can be built up from existing bilateral committees' practices, focusing on transmission access and pricing

Institutional frameworks
Enabling organic growth of regional bodies, once regional transition mechanism (e.g. integrating existing bilateral mechanisms) have been proven with the existing organizations

Additional factors in the market development pathway for South Asia



Starting from ongoing development: Considering stepwise development from the status quo of bilateral trading and dominance of long-term PPAs

Recognising that **some countries are already trading**, others may begin when they have gained confidence in the market

Successful international markets have evolved from small beginnings, and a small group of countries establish the market then expand

Possible pathways for a regional market development in South Asia

Top-down "soft-infra" focus

- Obtain broadly-based international political support
- Establish market governance, institutions and trading platforms drawing on international best practice
- Seek to develop market participation and liquidity

Bottom-up "hard-infra" focus

- Build on current cross-border trades
- Introduce and test standard forms of bilateral contracts
- Identify and develop multi-country regional backbone transmission infrastructure in a staged approach
- Set up Pilot Regional Market Trading Platform focusing on trade across identified interconnectors by interested parties
- Develop market governance and expand market coverage

More relevant to the current practice but developed and operated in a "regionally coordinated" basis

High level pros and cons of defined pathways

Bottom-up Hard Infra pathway		Top-down Soft Infra pathway	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
• Maximises use of existing infrastructure • Includes member countries in the first identified backbone then grow • Allows a simplified/ practical demonstration of regional trading approach on new grid-to-grid backbone(s) at an early stage • Attractive to those countries ready to expand grid-to-grid connectivity and scaling up trade • Requires minimal organisational development	• May create a two-speed system if countries are slow to engage • Structures and rules must be developed sufficiently to ensure adequate consumer protection	• Ensures robust governance • Requires all SAR countries to operationalize the SAARC Framework Agreement (for electricity) • Comprehensive organisational design • Full investigation of market design options	• Time-consuming consultation and agreement phases • Slow speed of implementation – benefits will not be realised quickly

The bottom-up a "hard infra" focus is recommended for regional market development in SAR: Key stages in pilot market development based on grid-to-grid trading backbones

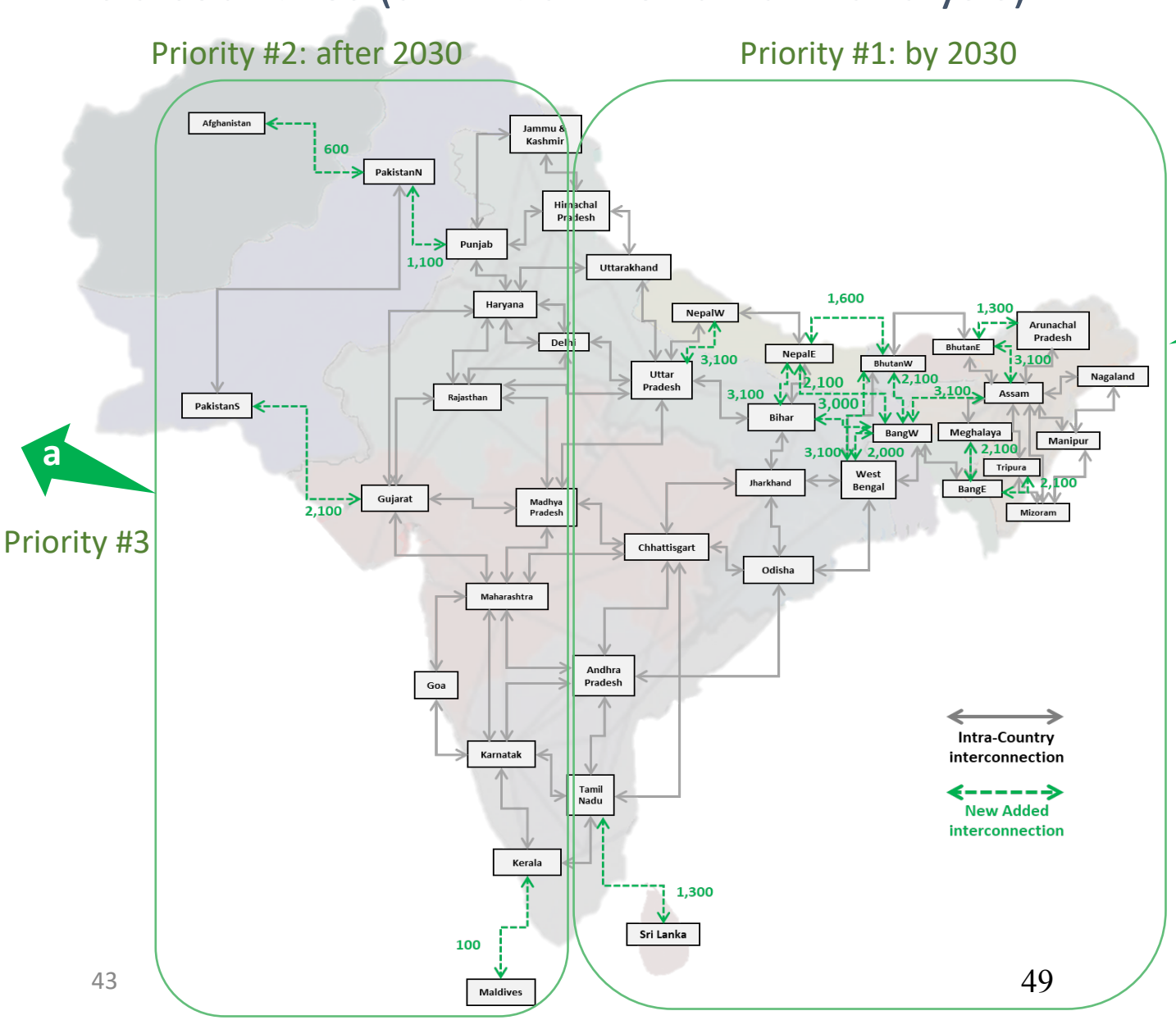
Institutional
- Work with existing utilities/organisations (existing 5 to 7 bilateral mechanisms)
- No requirement for a physical market operator at this stage – use a virtual MO model to operate the market

Legal/ Regulatory
- Basic market access/participation rules to be defined
- Confirm third party access available for market participants
- Develop and apply straightforward transmission pricing methodology

Commercial
- Develop pilot market rules
- Develop a pricing algorithm and platform
- Define market settlement procedures

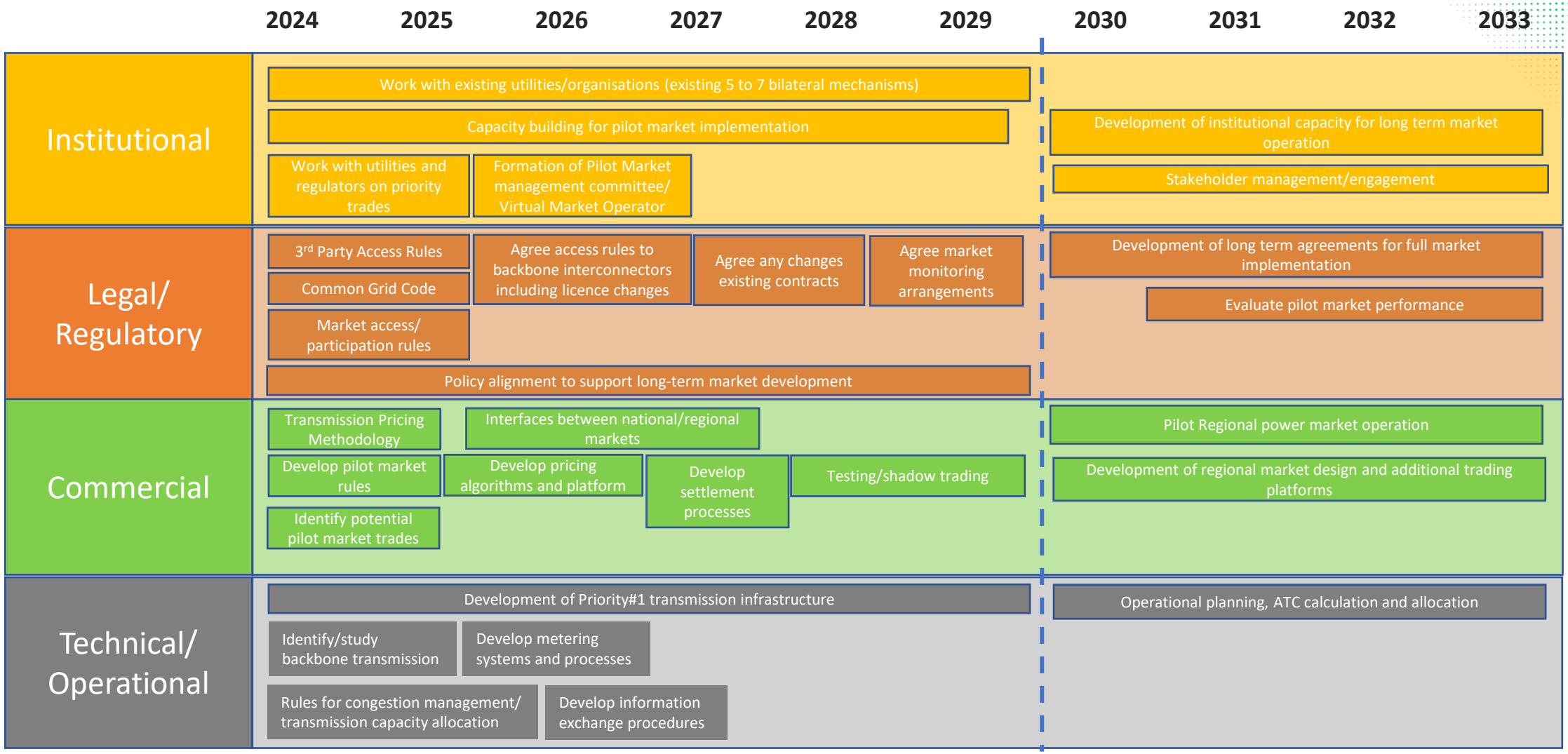
Technical/ operational
- Identify backbone transmission network hosting trades
- Build on draft Common Minimum Grid Code
- Develop agreed rules for congestion management and transmission capacity allocation
- Define interfaces between national and regional markets

Identified trade backbones to develop the Grid-to-Grid transmission among South Asia countries (an initial World Bank analysis)



1. **Backbone 1 (priority #1a)**: Constellation project by 2030 for direction connections as Nepal-Bhutan, Bhutan-Bangladesh, Nepal-Bangladesh, India (Assam) - Bangladesh-India (West Bengal) capacity transfer is up to 2000MW with exception of the latter and Nepal-Bhutan at 1000MW
2. **Backbone 2 (priority #1b)**: India-Sri Lanka by 2030, transfer capacity 1000MW
3. **Backbone 3 (priority #2a)**: : India-Pakistan (N) in 2030-2035, transfer capacity 1000MW
4. **Backbone 4 (priority #2b)**: : India-Maldives in 2030-2035, transfer capacity 500MW
5. **Backbone 5a and 5b (priority #3)**: India-PAEM in 2035-2040 | South Asia - ASEAN in 2035-2040, transfer capacity of 2000-5000MW.

Preliminary timeline - the Bottom-up Hard Infra pathway shows a practical approach towards the ultimate market design model for SAR



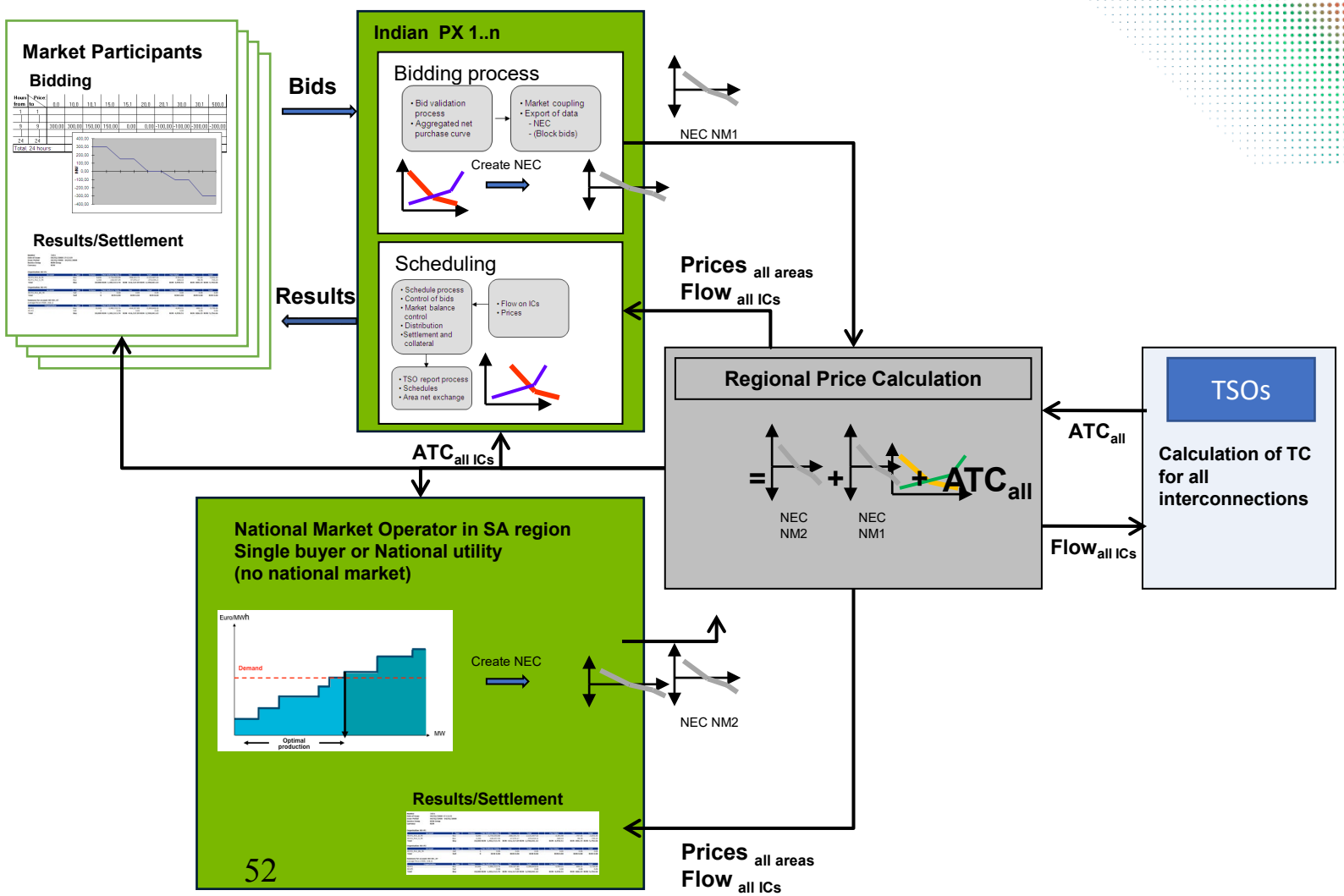
Key stages in pilot market development in 2023-2030 in readiness for Backbone Transmission Project #1 completion in 2030

- The starting point in a regional market is to establish a common methodology for the management of cross-border flows and prices
- Harmonized rules for congestion management and transmission capacity allocation – how to manage flows on the borders needs to be agreed upon, the national TSOs will play a vital role
- Common market rules for regional trading – flexible rules that cover the regional (not national) trading
- Define the interfaces between the national and regional markets – ensuring the same data is used in the regional market without requiring changes to the internal organization of the national power sector
- Use of an Implicit auction – meaning that the result shall optimize the utilization of the cross-border capacity as part of the price formation
- Reporting – important data for all participants available for all at the same time

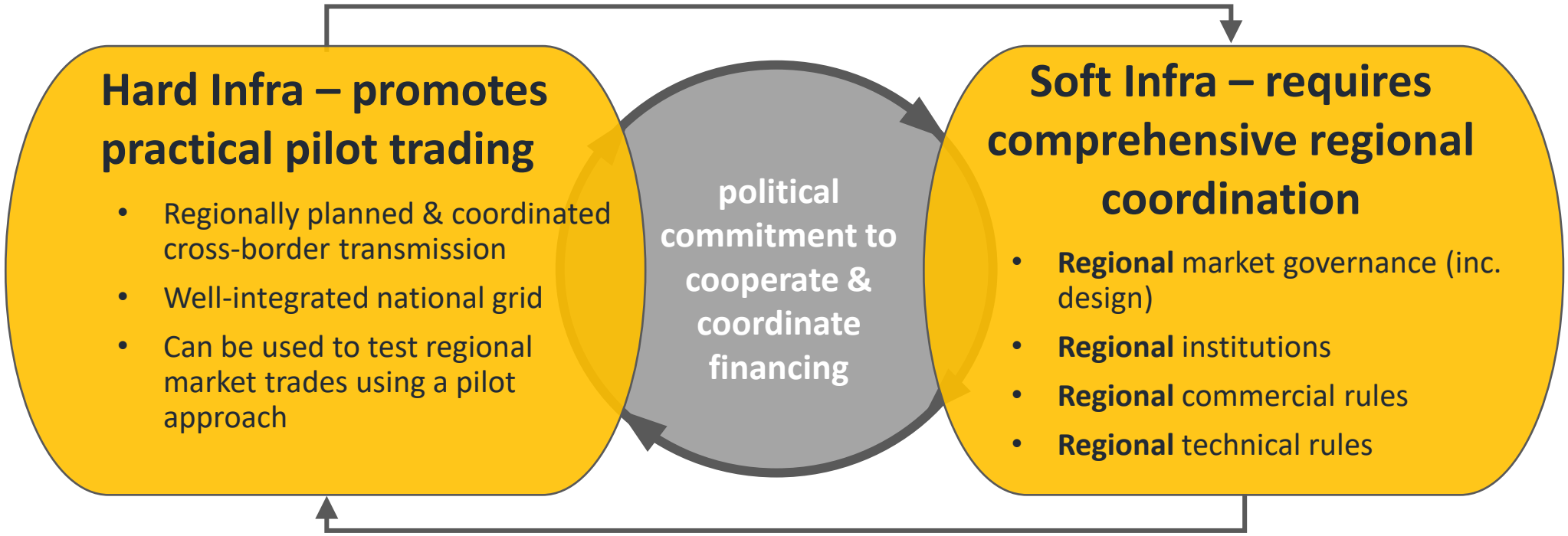
Their transition to a Regional Trading through a regional market – Tight coupling model facilitated by continued backbone infrastructure development

A new regional market is created that combines coupling and national market

- The Indian PXs will still base their operation on their current market trading platforms;
- A new regional market is created to cater for all the current non-market SA countries;
- This new regional market will be the national market for the non-market SA countries as well as the regional coupling platform
- All parties to agree on a methodology to calculate and use of the interconnector capacity between the countries;
- Harmonized Market Book of Rules and a tight harmonization on operational procedures;
- It will allow India to still operate their respective markets with its market participant management;
- The Indian PXs will be counterparts to their own trades, but the regional market is the legal counterparts towards the other SA countries;
- Common database for coupling ;
- Allows a full market coupling optimization but still no issues for the Indian PXs.
- Similar to SAPP current model and early European model



Transition to a full regional market requires **continuous interaction** between hard infra development (increased interconnection) and soft infra (increased regional cooperation)



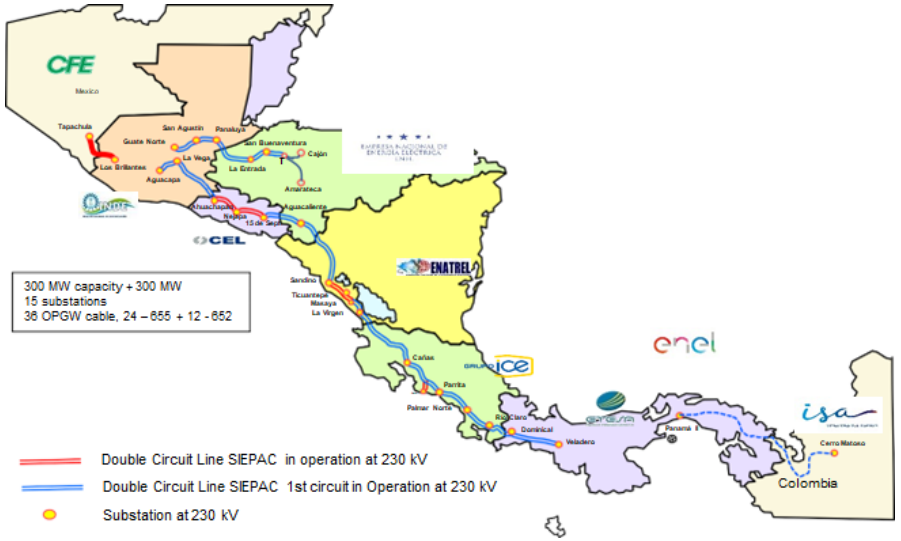
mutually reinforce each other towards a regional market development if political commitment to cooperate on shared goal/vision is in place upfront

Examples of bottom-up trading and market development: SIEPAC and GCCIA

SIEPAC Establishment

- Establishment was initially driven by desire for regional cooperation and sharing of resources
- Regional market was to be based on actualisation of South – North (Panama to Guatemala) transmission interconnection (SIEPAC) involving 6 Central American Countries (Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama)
- A Steering Group with Senior Government officials from all countries was established to spearhead development – 1987
- Central American Electrification Council (CEAC) the regional planning body was established in 1989
- Marco Treaty (founding doc for regional market) signed by all governments in 1996 and ratified in 1998
- Development of legal framework – 1996 to 2005
  - Institutionalisation
  - Structures
  - Roles and responsibilities
- Cooperative establishment of Regional Electricity Market (REM) agents
  - EPR – JV owner and operator of SIEPAC interconnection (hosted in Panama) - 1999
  - EOR – Market and Interconnection Operator in coordination with TSOs (hosted in El Salvador) - 2001
  - CRIE – Regional Regulator (hosted in Guatemala) - 2000
  - CDMER – Council of Directors i.e. Energy Ministers for coordination and political economy leverage

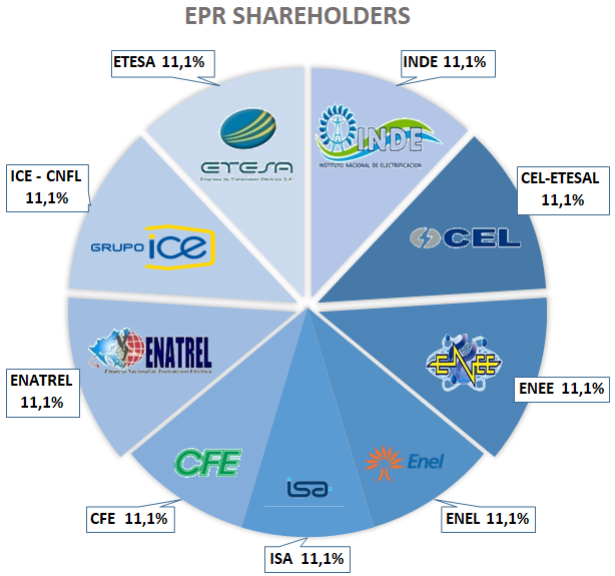
Relevant example of successful backbone G2G projects developed to facilitate regional market development: SIEPAC of Central America



SIEPAC has two main objectives:

1. The establishment of a ***Regional Electricity Market (MER) – a 7th market*** – a regional regulator (CRIE) and a regional operator (EOR)

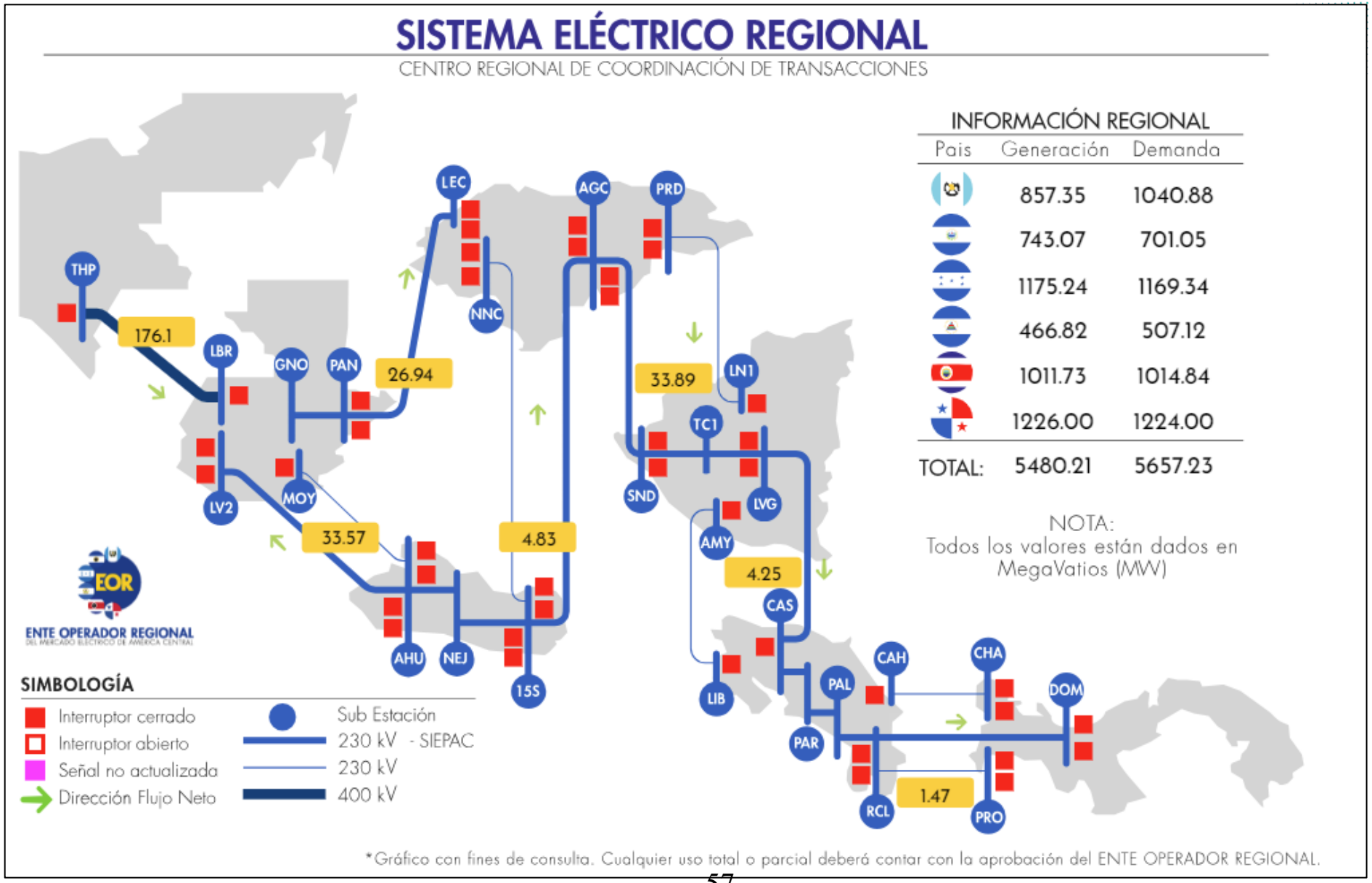
2. The development of the first regional transmission system, the SIEPAC Line, crossing Central America.



A PPP Structure

- The Empresa Propietaria de la Red (EPR), is a PPP SPV formed to design, engineer, construct, and own 1,793 km of a 230 kV interconnector, 300MW capacity all along the interconnection from Guatemala to Panama, upgradable to 600MW with second line
- The 6 public companies of the region hold 66.7% of the shares
- A private company, ENDESA (Spain) holds 11.1% of the shares
- Two other regional government-owned transmission companies: ISA (Colombia), and CFE(Mexico).

SIEPAC Infrastructure



Source and real time data: www.enteoperador.org

SIEPAC Market Operations

- Types of Markets
  - Multi-nodal DAM hourly contracts
    - ✓ Buy and sell bidding
    - ✓ Locational marginal pricing
  - Bilateral Contracts
    - ✓ Physical contracts
    - ✓ Financial contracts
  - Balancing market
  - REM is considered the 7th market above the 6 national markets

- Multiple market participants
  - Generators
  - Transcos
  - Distributors
  - Marketers
  - Qualified large power users

- Open access
  - Transmission pricing and allocation methodologies set by CRIE
  - Use of system charges (average and marginal participation)
    - ✓ Variable costs – nodal price residual and revenues from capacity auctions
    - ✓ Toll charges based on actual flow
    - ✓ Complementary charges to all users for unrecovered costs
    - ✓ Basically Nodal (SRMC) and locational methodology

SIEPAC challenges

- Asymmetry in market development among member countries
  - Countries are at different developmental and utility restructuring stages
  - Level of private sector participation in the industry is different in different countries
  - Guatemala is connected to Mexico which is 6 times the size of the 6 countries
  - Panama is connected to Colombia which is also bigger that the 6 countries' capacity
- Limited transfer capacities
- Only Guatemala and Panama are exporters
- Delayed actualisation of the Mesoamerican project – connecting all the way to South America

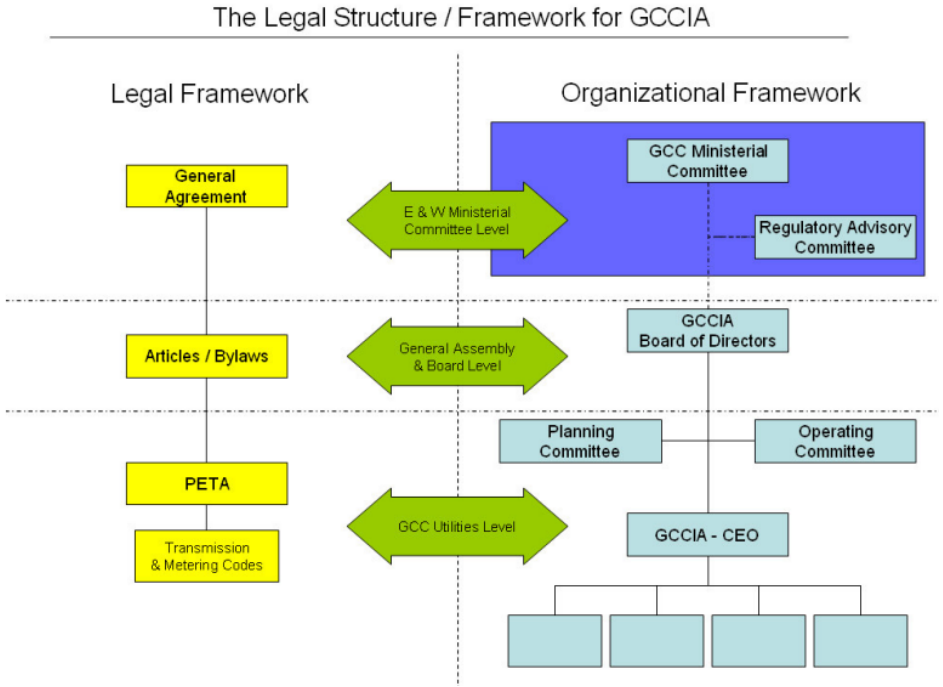
GCCIA shareholding/governance details (a joint stock company subscribed by the 6 Gulf States)

- Established in July 2001 by a Royal Decree No. M/21.
- ***Created with the main objective of reserve sharing and trade was not a core driver until recently due to increasing role of renewables and increasing countries' interest to share resources regionally***
- Owned by the six GCC Countries the authorized share capital is USD 1.1bn divided into 1,100,000 shares of USD 1,000 each share.
- The Authority is managed by a (twelve member) Board of Directors; each member country is represented by two members. The Chairmanship is rotated among the member states every three years.

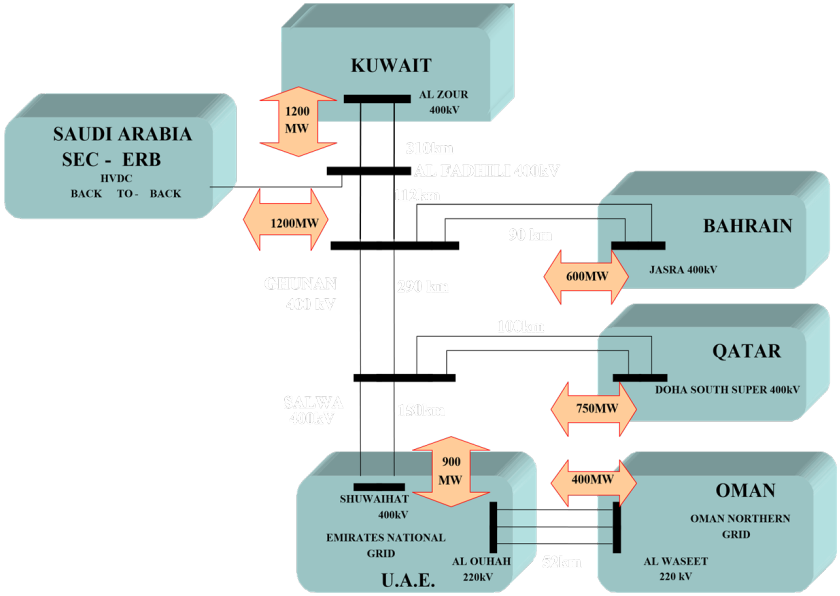
Founders	No. of Shares	Nominal Value	Percentage
United Arab Emirates	169,400	$169,400,000	15.40%
Kingdom of Bahrain	99,000	$99,000,000	9.00%
Kingdom of Saudi Arabia	347,600	$347,600,000	31.60%
Sultanate of Oman	61,600	$61,600,000	5.60%
Stage of Qatar	128,700	$128,700,000	11.70%
State of Kuwait	293,700	$293,700,000	26.70%
Total	1,100,000	$1,100,000,000	100.00%

GCCIA – principal issues that had to be resolved

- Agreement and participation by six GCC countries
- Demonstration of feasibility
- Creation of the GCC Interconnection Authority
- Agreement on cost sharing and financing



Source: "The GCC Power Grid: Benefits & Beyond", GCCIA



Source: ICF

GCCIA – initial justification on reduction of operating reserve requirements

- Reduce generation reserves;
- Provide power exchange and strengthens supply reliability;
- Strengthens and improves the operational and economic efficiency of the electricity power systems;
- Promoting utilities to construct larger generation units to share extra generated power;
- Provide opportunities for industrial customers and utilities to shop around for more attractive supply of power;
- Adoption of technological development and use the best modern technologies;
- Providing long-term environmental advantages by reducing waste emissions from increasing generation plants.

Capacity Benefits to the Year 2028

Isolated System requirements

Load (MW)	Total Installed Capacity	Reserve (MW)
93 781	105 781MW	12 085

Interconnected System requirements

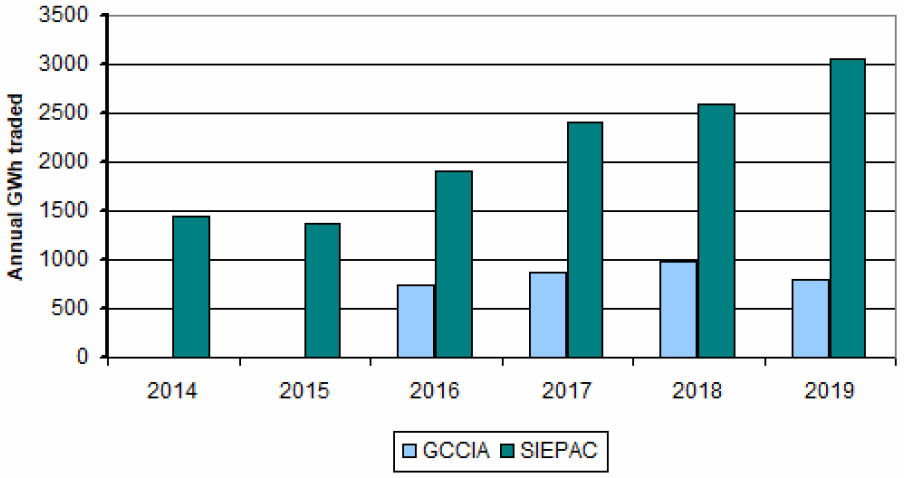
Load (MW)	Total Installed Capacity	Reserve (MW)
93 781	100 726MW	6 945

Source: GCCIA

Comparison of key features – SIEPAC and GCCIA

- SIEPAC development was market driven
- Accompanied by sector reform in the participating countries (soft infra developments)
- Structured as a PPP (i.e. with private sector participation)
- Compared to the GCCIA, utilization has been high, justifying the addition of the second circuit.
- Because the SIEPAC backbone is linear, trades between two northern neighbors can occur at the same time as trade between two neighbors in the south, so total utilization can exceed 100%.
- GCCIA has 4x the transfer capacity of SIEPAC, but traded volume in GCCIA is only 1 tenth of SIEPAC trades in 2014-2019.
- The total trading benefit in 2017 alone exceeded the $505million initial investment
- Estimated cost for expansion to 600 MW transfer capacity 2 x230kV throughout is $250 million. The project has already recovered its costs, and is now in positive cash flow as a revenue source for its shareholders.
- The PPP approach for transmission is not untested: SIEPAC (and others) demonstrate its economic and financial viability. But market and dispatch transparency is key.

Comparison of traded energy



Comparison of transfer capacities

Transfer capacity, MW	1200	300		
	GCCIA	SIEPAC	GCCIA	SIEPAC
	GWh	GWh	Utilization	
2014	0	1440	0%	55%
2015	0	1370	0%	52%
2016	734	1900	7%	72%
2017	874	2400	8%	91%
2018	973	2600	9%	99%
2019	800	3050	8%	116%

Learning from international emphasizes the need for soft infra development to support robust long-term institutional and governance frameworks

Regional Power Pool/Market	# of countries/ states	Main governance framework
European Electricity Market	8 (1951, UCPTE); 24 (1999, UCTE) 35(2009 onwards, ENTSO-e)	Regional bodies empowered by European Union Directives to coordinate regional operations with decentralized dispatch: European Union Directive 96 / 92 towards common rules for the internal market in electricity; Security Package to enforce multilateral agreement; 3rd Energy Package
South African Power Pool (SAPP)	17	A regional body with clear functions formulated under Inter-Governmental Memorandum of Understanding (IGMOU) that grants its mandate to facilitate power trade among countries via Inter-Utility MOU
Eastern African Power Pool (EAPP)	12	A regional body with clear functions formulated under Inter-Governmental Memorandum of Understanding (IGMOU) that grants its mandate to facilitate power trade among countries via Inter-Utility MOU
Pan-Arab Electricity Market (PAEM)	18 of which 16 signed the MOU in 2017	An Electricity Ministerial Council empowered to approve the regional governance documents (MOU, Legal Agreement, Commercial Agreement, Technical rules)
SIEPAC	7	A Framework Treaty established the Regional Electricity Market (REM), the creation of the SIEPAC line, and the regional organisations part of REM, which include Regional Operations Entity (EPR), the Regional Operating Entity (EOR), the Regional Commission for Electrical Interconnections (CRIE) and the Board of Directors of the Regional Electricity Market (CDMER)
Western Energy Imbalance Market (WEIM)	11 US states	The Western Energy Imbalance Market (WEIM) is governed by a five member body with shared authority from the ISO Board of Governors on rules specific to participation to the WEIM. Designed by regional stakeholders, members of the governing body are nominated by a committee of western stakeholders.
PJM	13 US states plus the District of Columbia	PJM is a membership organization, providing services on a non-profit basis to customers that are members of PJM. The corporate structure works through the interaction of the PJM Board of Managers, member organizations and stakeholders. The PJM Board of Managers works in conjunction with the Members Committee.

Core enablers to realize the recommended pathway for the electricity market of South Asia

Third Party Access – key components

Transmission Licence

- Governing the ownership and operation of the national transmission network and the associated interconnection assets – issued to Transmission System Owner/Operator
- Should specify that granting Third Party Access to IPPs is a licence condition

Transmission Connection Agreement (TCA)

- Entered into between each transmission connected generator and the TO or TSO in each country.

Transmission Use of System Agreement (TUOSA)

- Entered into between each generator that will be using the national transmission system for export purposes

Regional Grid Code/procedures

- Harmonised technical standards, including provisions for synchronous operation, requirements for generators, specific provisions for HVDC

Transmission Pricing – main requirements

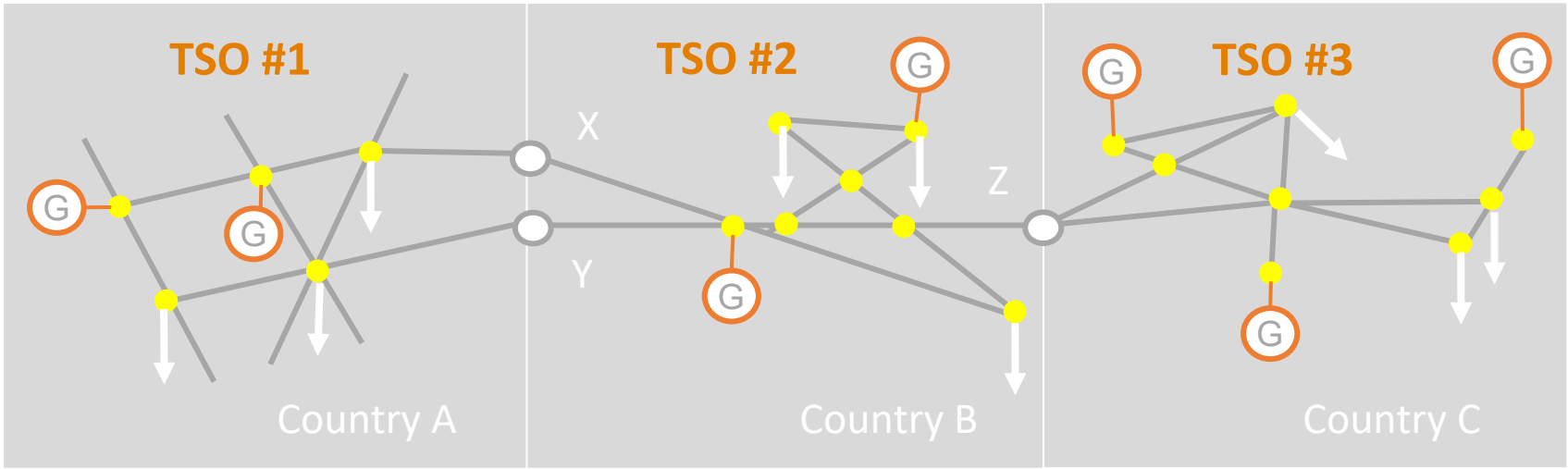
- For pilot trading using the backbone system, calculate explicit charges for using interconnectors outside India, as per the CBTL approach in the Indian regulations
- Apply Point of Connection (PoC) charges at interfaces with the Indian Inter-state network
- For the full implementation of the regional market model, extend the PoC “hybrid” methodology as specified in the Indian CBTE regulations to all participating networks
  - This permits the identification of revenues due to each TSO/line owner
- This mirrors the evolutionary approach taken in other markets, e.g. SAPP
  - Add sophistication as experience grows and systems become more fully integrated

Transmission pricing – key principles from Indian regulations

- Import tariffs for Indian Entities shall be determined through competitive bidding or mutual agreement
  - Tariff for import from hydro generation projects shall be determined by CERC as per Tariff Regulations
- Export tariffs shall be determined through competitive bidding or mutual agreement
- Both are subject to transmission or wheeling charges through the Indian grid – see next slide
- Tariffs determined through Government to Government negotiations shall continue to be determined through these negotiations until expiry of the Agreement
- Tariff for Cross Border Transmission Link (CBTL) from the pooling station in India to Indian border shall be determined through:
  - Competitive bidding;
  - Government to Government negotiations; or
  - By CERC

Average and Marginal Participation method – as used in the calculation of Inter-state Transmission PoC Charges in India and proposed for Southern African Power Pool

- Use of Average and Marginal Participation methods – as per the India Inter-State transmission charging method, comparable with the new SAPP methodology
- In the marginal participation method, 1MW is added to a generation node and taken out at all the relevant demand nodes identified from an Average Participation analysis
- The demand nodes act as multiple slack nodes (and vice versa), hence the calculation is not dependent on any one slack node
- Several load flow scenarios are considered to define the starting conditions, with appropriate weightings
  - Scenarios could vary depending on seasons, hydrological conditions, and demand period (peak/off-peak)
- Results in nodal charge for generators and nodal charge for demand



Transmission Wheeling Charges in Southern African Power Pool

Postage stamp charges

- 7.5% of value of wheeling transaction
- 15% if transiting two countries

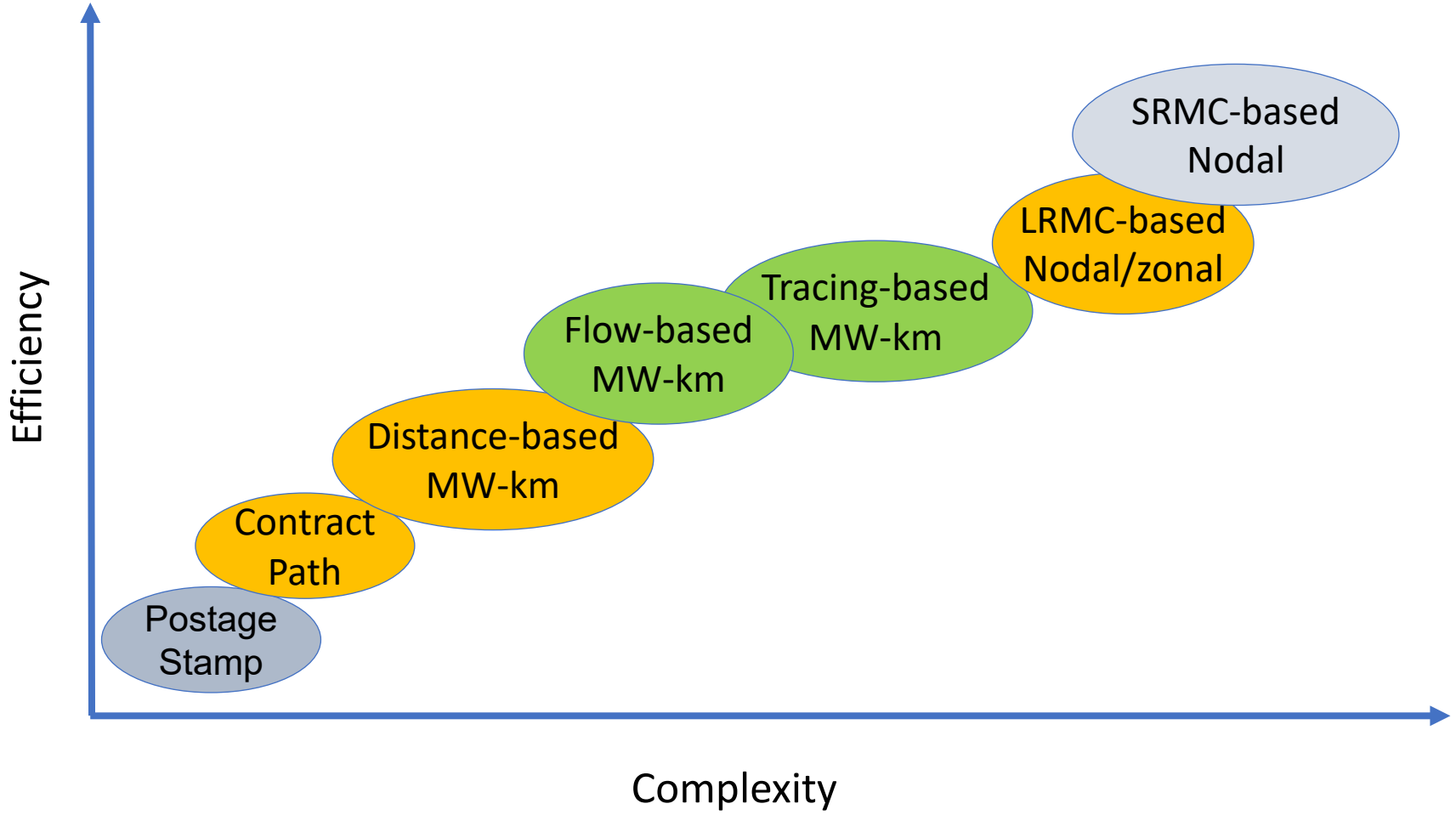
MW-km flow-based charges

- Taking account of physical wheeling path between buyer and seller
- Load-flow based calculations
- Standardised asset values across the SAPP network
- Compatible with bilateral and short-term trading

Entry and Exit Charges

- Average and Marginal Participation Method
- No defined counterparty to the trade
- Compatible with Day Ahead and Intra-day Spot Markets

The complexity/efficiency trade-off in network pricing



Proposed high-level roadmap for the bottom-up approach market pilot; and transition to the ultimate market design

The main stages of the evolutionary process to pilot the regional market and establish the ultimate market design

2023-2025

Step 1: Status quo to regional bilateral trading

(Status Quo to "Bottom-up")

- Harmonize bilateral trading agreements
- Agree on basic common transmission charging methodology
- Work with existing institutions to develop pilot market proposals
- Establish regional market data website
- Capacity building on future market development

2025-2030

Step 2: Preparation for pilot market trading on "hard infra" transmission backbone(s)

- Prepare national regulatory changes
- Harmonize national regulations to regional market
- Develop pilot market trading rules
- Develop pilot market trading platform & working groups
- Capacity building on future market development

2030- onward

Step 3: Pilot market operation and long-term market development

- Pilot market trading
- Establishment of the regional market as an entity
- Common operational procedures for all
- Implement a more market-supportive transmission pricing
- Product and market evolution will continue
- Continuous capacity building

Evolution towards regional competitive market in South Asia

THANK YOU