

**SAARC Energy Centre, Islamabad
Pakistan**

THE REPORT



Webinar on “Cross Border Electricity Trade in SAARC Countries”



9th March 2020, Islamabad

**Organized by:
SAARC Energy Centre**

March 9, 2020

**SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org**



Introduction

SAARC Energy Centre, Islamabad under its approved Programme of Activities for the year 2020 successfully conducted a Webinar on “Cross Border Electricity Trade in SAARC Countries” on Monday, 9th March 2020. Webinar Agenda is available at Annexure -I.

1. Focus of the webinar was to share the information on Cross Border Electricity Trade in South Asia to the participants and sensitise the policy/decision makers on the importance and benefits of such trade. Areas discussed were: Rationale for Cross Border Electricity Trade (CBET) and its benefits; CBET Regulations and Guidelines; Status of CBET in SAARC region and European experience of regional markets and interconnections.

Participation

2. The webinar was attended by 31 professionals representing public sector organizations, academia, private sector, and other stakeholders within and outside SAARC region. The experts from Germany, India, Nepal, and Pakistan shared their knowledge pertaining to government policies, existing practices, and international experience with regards to electricity trade between neighbouring countries. The participants list is available at Annexure-II.

Description

3. The webinar was started with welcome remarks by Program Coordinator, Mr. Ahmad Talha, Research Fellow (Technology Transfer) of SAARC Energy Centre. The technical session comprised of presentations by the expert speakers. Each presentation was followed by a brief Q & A session. The Program Coordinator read out conclusions, which were gathered during the webinar. Before closing the webinar, the Program Coordinator from SAARC Energy Centre offered remarks of appreciation to all the participants and presenters.

Technical Proceedings

4. Four resource persons from Germany, India, Nepal, and Pakistan shared their knowledge in the webinar. All the presentations delivered during the webinar are available at SEC's website (<https://www.saarcenergy.org/2969-2/>). Details of Resource Persons are available at Annexure-III and their Presentations at Annexure-IV. A brief information on the content of the delivered presentations is as follows:

Presentation 1 – Cross Border Trade of Electricity: Policy & Regulations

Mr. Abhijeet Rajendra, TATA Power Trading Company (Pvt.) Ltd. India.

5. Mr. Abhijeet, has over 12 years of experience in working in the Indian power markets. He is currently working for TATA Power Trading Company Limited. The TATA Power Company Limited is India's oldest and largest integrated private sector power utility. Mr. Abhijeet has deep understanding of Indian power markets and has commented extensively on various regulations/whitepapers including CBET. In his presentation, he discussed the status of CBET in India and policy guidelines currently in place to enable and promote CBET. He also covered current electricity trade contracts, institutional framework, tariff determination, conditions for setting up transmission interconnections, benefits of CBET, key issues and way forward for CBET.

Presentation 2 – Rationale for CBET Interconnections and Trade in South Asia

Mr. Salis Usman, National Transmission and Dispatch Company (NTDC), Pakistan.

6. Mr. Salis Usman – currently working as General Manager Power System Planning in NTDC Pakistan – has about 34 years of working experience in the power sector. He has worked in different departments of NTDC including Project Monitoring, Purchasing and Inventory Control, Design, Central Power Purchasing Agency, and Power System Planning. He apprised the participants on rationale for regional energy connectivity SAARC Energy Ring. Mr. Salis briefed the participants on the features and status of Central Asia - South Asia Power Transmission CASA-1000 project. In the end he shared his vision for coping with the challenges of power sector and emphasized the importance of SAARC initiatives for regional connectivity.

Presentation 3 – CBET in SAARC Region

Mr. Sher Singh Bhat, Kabeli Energy (Pvt.) Ltd., Nepal.

7. Mr. Sher Singh is a power sector expert having 36 years of working experience in all elements of the value chain including planning, generation, transmission, system operation and power trade. He started his presentation with objectives and status of CBET in SAARC region. He discussed about the initiatives and agreements currently in place to facilitate electricity trade between SAARC member states.

8. Mr. Sher Singh briefly explained the regulations and the infrastructure currently in place in SAARC countries for electricity trade. He emphasized the roles of regional, bilateral, and domestic instruments in accelerating the regional connectivity. He also shed some light on the reasons for inadequate trade and regional connectivity between SAARC countries.

Presentation 4 – Regional Markets: A Key Innovation in the Global Energy Transition

Ms. Elena Ocenic, International Renewable Energy Agency (IRENA), Germany.

9. Ms. Elena Ocenic has hands-on experience in solar photovoltaic project development and expertise in European electricity market regulation. She is currently exploring how innovations in enabling technologies, business models, market design and system operation can help IRENA members achieve their ambitious renewable power policy goals by mid-century. In her presentation, Ms. Elena summarised IRENA's systemic approach for the energy transition towards maximising penetration of the renewable energy sources.

10. Ms. Elena apprised the audience about the impact of regional markets on power sector. To emphasize the importance of regional markets, she presented the example of European market. She covered the gradual growth of European electricity market; the status of cooperation, interconnection, and harmonization levels; benefits and various degrees of economic efficiency resulting from regional trade; social welfare gains.

Wrap up and Conclusion

Mr. Ahmad Talha, Research Fellow (Technology Transfer), SAARC Energy Centre

11. Mr. Ahmad Talha thanked everyone for attending the event. He informed the participants that there is great potential for energy trade between SAARC countries. Following are the main conclusions:

- a. CBET is important as it offers multiple benefits. Some of them are listed below:
 - i. Optimal use of electricity infrastructure (generation, transmission system)
 - ii. Enhanced security of supply
 - iii. Allowance for higher penetration of the renewable energy
 - iv. Avoid un-necessary investment by a neighbouring country to enhance generation
 - v. Reduction of environmental costs
 - vi. Enhanced inter-regional cooperation that could result in economic and social benefits

- b. It is important that all SAARC Member States take necessary action to promote multinational regional trade of electricity. SAARC Energy Centre has always played its role to facilitate and encourage regional trade of electricity and will continue to do so by arranging events to allow deliberation on crucial aspects of regional energy trade.

Closing of Webinar

Mr. Ahmad Talha, Research Fellow (Technology Transfer), SAARC Energy Centre

12. Mr. Ahmad Talha, informed all the participants that the presentations and recording of the webinar proceedings will be available on SAARC Energy Centre's website (www.saarcenergy.org). He requested the participants to submit suggestions/comments for any further improvement of these webinars and suggest topics to SEC using the feedback survey form. He closed the webinar with a thank you note to everyone attending the Webinar.

Annexures

Webinar Agenda
Webinar on
“Cross Border Electricity Trade in SAARC Countries”
Monday, 9th March 2020

1100 – 1110	Introduction
1110 – 1130	Cross Border Electricity Trade: Regulations & Guidelines <i>Mr. Abhijeet Rajendra, The Tata Power Company (Pvt.) Ltd India.</i>
1130 – 1140	Q & A session
1140 – 1200	Rationale for CBET Interconnections and Trade in South Asia <i>Mr. Salis Usman, National Transmission and Dispatch Company Pakistan.</i>
1200 – 1210	Q & A session
1210 – 1230	CBET in SAARC Region <i>Mr. Sher Singh Bhat, Kabeli Energy Limited, Nepal.</i>
1230 – 1240	Q & A session
1240 – 1300	Regional Markets - A Key Innovation in the Global Energy Transition <i>Ms. Elena Ocenic, International Renewable Agency (IRENA), Germany.</i>
1300 – 1310	Q & A session
1310 – 1320	Conclusion and Recommendations
1320 – 1330	Closing of Webinar

Information for the participants:

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Sri Lanka
Local time	(PKT-00:30)	(PKT+01:00)	(PKT+01:00)	(PKT+00:30)	PKT	(PKT+00:45)	(PKT+00:30)

2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.
3. All participants can also submit comments/views and/or observations on the draft study report to SAARC Energy Centre through email to Mr. Ahmad Talha, Research Fellow (TT) (rftt@saarcenergy.org).

List of Participants

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Annexure-II

S. No.	First Name	Last Name	Email address
27.	Muhammad Ahmad	Yousaf	muhammad_ahmadyousaf@yahoo.com
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30.	Bhim	Gautam	journalistbhim@gmail.com
31.	Amit	Patidar	amitpatidar.1991@gmail.com

List of Presenters/Resource Persons

S. No.	Name	Designation	Organization	Email address
1.	Mr. Abhijeet Rajendra	Senior Manager	TATA Power Trading Company (Pvt.) Ltd., India	abhijeet.rajendra@tatapower.com
2.	Mr. Salis Usman	General Manager	National Transmission and Dispatch Company (NTDC), Pakistan	gm.psp@ntdc.com.pk
3.	Mr. Sher Singh Bhat	CEO	Kabeli Energy (Pvt.) Ltd., Nepal	shersingh.bhat@kel.com.np
4.	Ms. Elena Ocenic	Program Officer	International Renewable Energy Agency (IRENA), Germany	eocenic@irena.org

Presentations Delivered During the Webinar

1. **“Cross Border Trade of Electricity – Policy & Regulations”** by Mr. Abhijeet Rajendra, Senior Manager, TATA Power Trading Company (Pvt.) Ltd., India.



AGENDA

Current Status on Indian Cross Border Trade of Electricity

Cross Border Policy – An Overview

Way Forward



CURRENT STATUS ON INDIAN CROSS BORDER TRADE OF ELECTRICITY

CURRENT CROSS BORDER TRANSACTIONS - INDIA

Country	Contracts	Type	Transmission Link
India to Bangladesh (1160 MW)	Long Term Contract with NVVNL for 250 MW	Govt. to Govt.	Baharampur (India)- Bheramara (Bangladesh) 400kV DC line (500 MW Capacity)
	Medium Term Contract of DVC with Bangladesh 300 MW through NVVNL upto Dec'19	Competitive Bidding	
	a) Sembcorp to Bangladesh (250 MW LT w.e.f. Jan'20 b) DVC to Bangladesh (300 MW LT) w.e.f. Jan'20 c) Meenakshi power to Bangladesh (200 MW LT) w.e.f. Jan'20	Competitive Bidding	
	Long term 160 MW contract Tripura in India to Comilla in Bangladesh through NVVNL	Govt. to Govt.	Tripura(India) Border- Comilla (North) 400 kV D/c line operated at 132 kV

CURRENT CROSS BORDER TRANSACTIONS - INDIA

Country	Contracts	Type	Transmission Link
India to Nepal (320 MW)	Bilateral contracts to the tune of 237 MW through NVVNL	Govt. to Govt.	400 kV Muzaffarpur (India) - Dhalkebar (Nepal) D/C line (charged at 132 kV)
	Contract with PTC upto 100 MW	Market Based	13 no.s of multiple links of 11 KV, 33 KV & 132 KV line between Nepal and India (major being Tanakpur Link)

CURRENT CROSS BORDER TRANSACTIONS - INDIA

Country	Trade Quantum and duration																																																
Bhutan to India (1450 MW) (Existing)	Govt to Govt. - Chukka (336 MW), Kurichhu (60 MW) and Tala (1040 MW), Mangdechhu (720 MW) Market based -Dagachhu (126 MW)																																																
Bhutan to India (upcoming)	<table><tr><th colspan="6">Projects under Construction</th></tr><tr><th>Sl. No.</th><th>Name of Project</th><th>Location</th><th>Installed Capacity (MW)</th><th>Firm Power (MW)</th><th>Expected COD</th></tr><tr><td>1</td><td>Punatsangchhu-II HEP</td><td>Wangdiphodrang</td><td>1020</td><td>164</td><td>2019</td></tr><tr><td>2</td><td>Punatsangchhu-I HEP</td><td>Wangdiphodrang</td><td>1200</td><td>199</td><td>2021</td></tr><tr><td>3</td><td>Nikachhu HEP (Tangsebjhi)</td><td>Trongsa</td><td>118</td><td>22.55</td><td>2019</td></tr><tr><td>4</td><td>Mangdechhu HEP</td><td>Trongsa</td><td>720</td><td>90</td><td>2018</td></tr><tr><td>5</td><td>Kholongchhu HEP</td><td>Trashiyangtse</td><td>600</td><td>113.8</td><td>2023</td></tr><tr><td colspan="3">Total</td><td>3658</td><td>589.35</td><td></td></tr></table>	Projects under Construction						Sl. No.	Name of Project	Location	Installed Capacity (MW)	Firm Power (MW)	Expected COD	1	Punatsangchhu-II HEP	Wangdiphodrang	1020	164	2019	2	Punatsangchhu-I HEP	Wangdiphodrang	1200	199	2021	3	Nikachhu HEP (Tangsebjhi)	Trongsa	118	22.55	2019	4	Mangdechhu HEP	Trongsa	720	90	2018	5	Kholongchhu HEP	Trashiyangtse	600	113.8	2023	Total			3658	589.35	
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CROSS BORDER POLICY AN OVERVIEW

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

- Ministry of Power in consultation with Ministry of External Affairs has issued the "Guidelines for Import/Export (Cross Border) of Electricity-2018 on 18th December 2018
- These Guidelines have replaced Guidelines on Cross Border Trade of Electricity issued in 2016
- The objective of these Guidelines are:
 - a. Facilitate import/ export of electricity between India and neighbouring countries;
 - b. Evolve a dynamic and robust electricity infrastructure for import/ export of electricity;
 - c. Promote transparency, consistency and predictability in regulatory mechanism pertaining to import/ export of electricity in the country;
 - d. Reliable grid operation and transmission of electricity for import/ export

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Institutional Framework

Institution	Responsibility
Designated Authority appointed by MoP, <i>CEA has been appointed as DA</i>	- Facilitating the process of approval - Laying down the procedure for approval - Coordination with Neighbouring Countries - Transmission Planning in capacity of Tr. Planning Agency
Settlement Nodal Agency	- Settlement of Charges for deviation & other charges in relation to CBET - Member of the deviation pool, reactive energy pool and other regulatory pools
National Load Dispatch Centre	- System Operator - Granting short-term open access (STOA) - Billing, collection and disbursement of the transmission charges for STOA as per sharing regulations
Central Transmission Utility	- Granting long-term access and medium-term open access - Billing, collection and disbursement of the transmission charges for MTOA & LTOA, as per sharing regulations

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Eligibility Conditions for participation in Import/Export

- Indian entities may import or export power directly or through traders from cross-border project after taking approval of Designated Authority
- In case import through bilateral agreement between two countries, GoI to designate an entity for import
- In case coal based projects, only projects generating power from imported coal or spot e-auction coal or coal obtained from commercial mining are permitted to export electricity
- Participating entities from neighboring countries can trade in Indian Power Exchanges through a licensed Indian trader**
- No restriction has been put in terms of contracts or segment in which participating entity from neighboring countries can trade

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

- Designated authority will normally allow imports only when the demand exceeds generation capacity (as available) in the country
- Similarly, Exports may normally be permitted in case of capacity being in excess of the domestic demand
- Application for approval will only be considered after the receipt of the equity pattern of ownership of the said Entity(ies) along with other details as prescribed by the Designated Authority
- Any change in ownership is to be communicated to Designated Authority

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Tariff Determination

Type	Allowable Methodology for Tariff Determination
Import by Indian Entity	• Competitive bidding • Mutual agreement between the buying Indian entity and the selling entity • The tariff may be determined by CERC as per its Regulations, for hydro projects only if approached by the generator through the Government of the neighboring country & agreed by Indian Utility • Mutually Agreed between Govts of both the countries
Export by Indian Entity	• Competitive bidding • Mutual agreement between selling Indian entity and the buying entity • Mutually Agreed between Govts of both the countries
Tariff of cross border transmission link from pooling station in India till Indian border	• Competitive bidding • Mutually Agreed between Govt. of both the countries • Determined by CERC

Tariff for import or export of electricity already determined through G2G negotiations including under Inter Government Agreements (IGA) shall continue to be determined through G2G negotiations till the expiry of the Agreement

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Transmission System

- Transmission interconnection between India and its neighbouring country shall be planned jointly by transmission planning agencies of the two countries
- Participating Entity of neighbouring country to seek connectivity, LTOA, MTOA, STOA, as the case may be, through separate applications
- Provisions contained in the STOA Regulations and Connectivity Regulations shall apply mutatis mutandis to the participating entities for cross border trade of electricity

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Transmission System

Non refundable application fees as under to be payable for connectivity, LTOA & MTOA

S.No.	Quantum of Power to be injected/off taken into/from ISTS	Application fee (Rs. in Lakh)	
		For Connectivity / LTOA	For MTOA
1.	Up to 100 MW	4	2
2.	> 100 MW – 500 MW	6	4
3.	> 500 MW – 1000 MW	12	6
4.	> 1000 MW	18	8

For LTOA, Access Bank Guarantee of Rs 5 lakh/MW valid for five (5) years from the date of operationalization of long term access to be given

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Application for Grant of Connectivity

- To be applied only by entities getting connected to the Indian grid through dedicated transmission systems
- Entity to submit approval from Designated Authority to engage into CBTE and approval for implementing the dedicated transmission system
- CTU shall process the application and grant Connectivity as per the Detailed Procedure made under Connectivity Regulations
- Upon grant of Connectivity, the Applicant shall sign a Connection Agreement with the CTU
- Grant of Connectivity shall not entitle an applicant to interchange any power with the Indian grid
- Power interchange may only be done after applying for STOA, MTOA or LTOA

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Application for Short Term Open Access (STOA)

- Application to be made to NLDC for grant of STOA
- Entity to submit approval from Designated Authority to engage into CBTE and approval to use Cross Border Transmission Link(s) in case connectivity is not through dedicated transmission lines
- NLDC shall process the Application and grant short-term open access in accordance with the Procedure made under STOA Regulations

Application for Long-Term Access and Medium-Term Open Access

- Application to be made to CTU
- Entity to submit approval from Designated Authority to engage into CBTE, approval to use Cross Border Transmission Link(s) in case connectivity is not through dedicated transmission lines and access bank guarantee

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

- Where tripartite agreement is signed for transaction across India involving two neighbouring countries, the transmission system augmentation in India for transmission of electricity across the territory of India shall be undertaken only after obtaining approval from Government of India and the Commission and the Access Bank Guarantee
- LTOA application to be processed in 120 days (in case network augmentation is required) else 90 days
 - LTOA application will be accompanied by **Access Bank Guarantee ₹ 5 Lakh/MW**
 - In case transmission network augmentation is required, fresh Access Bank Guarantee equal to cost of such augmentation to be furnished.
- MTOA application to be processed in 40 days

GUIDELINES ON IMPORT/EXPORT (CROSS BORDER) OF ELECTRICITY

Treatment of delay in Transmission system and Generation projects

- Designated Authority shall monitor the progress of generating station in neighbouring country along with transmission system for evacuation of power for cross border trade of electricity
- In case of delay in commissioning of project, generator to pay full transmission charges from the date of operationalisation of long-term access
- In case of delay in Cross Border Transmission Link, compensation to be decided by respective Governments
- In case of delay in transmission lines inside India, CTU to arrange for alternate lines or pay pay transmission charges to generating company



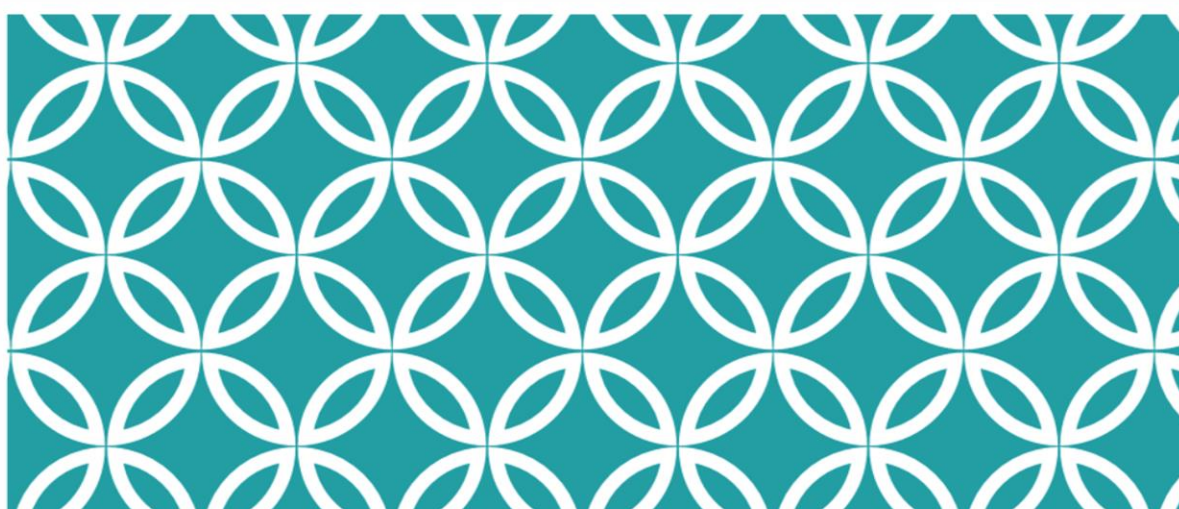
WAY FORWARD

BENEFITS OF CBTE

- Optimal Utilisation of Transmission Lines
- Ensure Security of supply
- Results in higher penetration of intermittent renewables by having hydro power from neighbouring interconnected markets due to Shared generation reserve margins
- Avoid/Defer investments in Transmission and Generation capacities
- Will pave the way for developing a single power market marked by economic integration, and the optimal use of, resources across SAARC countries
- Reduction of environmental costs by increasing availability of cleaner sources of supply (hydro, solar, wind, natural gas)
- Economic exploitation of huge hydro potential in NER of India, Nepal & Bhutan which requires access to larger regional markets for the electricity generated.
- Utilisation of stranded capacity and increase in PLF

KEY ISSUES AND WAY FORWARD IDENTIFIED FOR CBTE

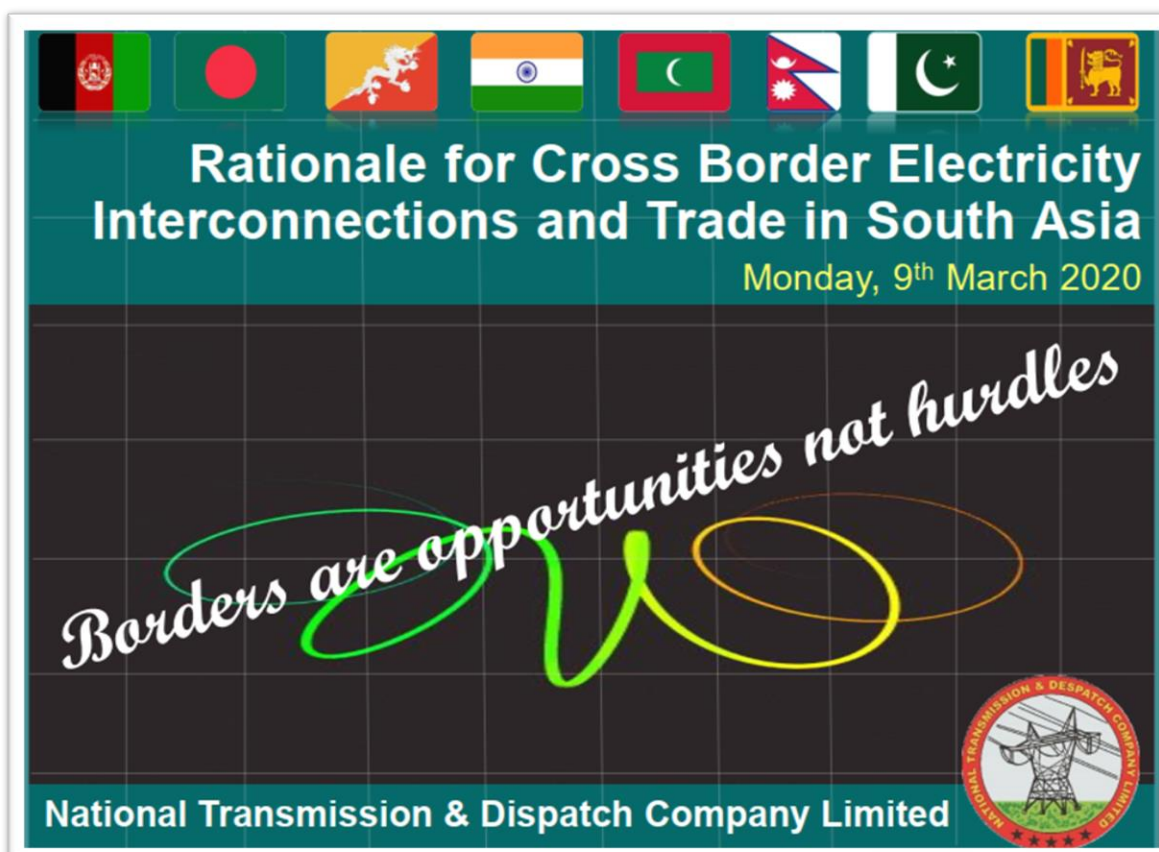
- Common approach to be adopted for setting up regulatory framework for facilitating Cross Border Energy Trade (CBET) and thus achieve transparency, consistency and predictability
- Reasonable Commercial framework
 - Energy Accounting
 - DSM responsibility
- Reliable grid operation and issues related to protection, coordination and scheduling of power
- Market access for Long Term, Medium Term, Short Term or Exchange
- Technical preparedness
- **Question of passing on the fiscal(FIT etc.) and regulatory (RPO compliance, etc.) benefits to renewable power generation stationed in different countries.**
- Market Zones to be created considering the cross border power flow dynamics
- Reliable grid operation and issues related to protection, coordination and scheduling of power



THANKYOU

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2. “Rationale for Cross Border Electricity Interconnections and Trade in South Asia” by
Mr. Salis Usman,
General Manager Power System Planning, National Transmission and Dispatch
Company, Pakistan.



Personal Introduction

Salis Usman

- Knowledge Worker
- Electrical Engineer
- IEEE Fellow
- General Manager, Power System Planning, National Transmission & Despatch Company (NTDC)
- Former Advisor Business Systems - USAID Project; Regulatory Analyst - Saudi Electric Company; and Program Leader (Energy Trade) SAARC Energy Centre
- A social activist
- **A proud learner**



Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Today's Focus

1. Intro to NTDC System
2. Rationale for Regional Energy Connectivity
3. SAARC Energy Ring
4. Connecting Central Asia with South Asia: CASA-1000
5. Scheme to Cope with the Power Sector Challenges
6. Questions and Answers



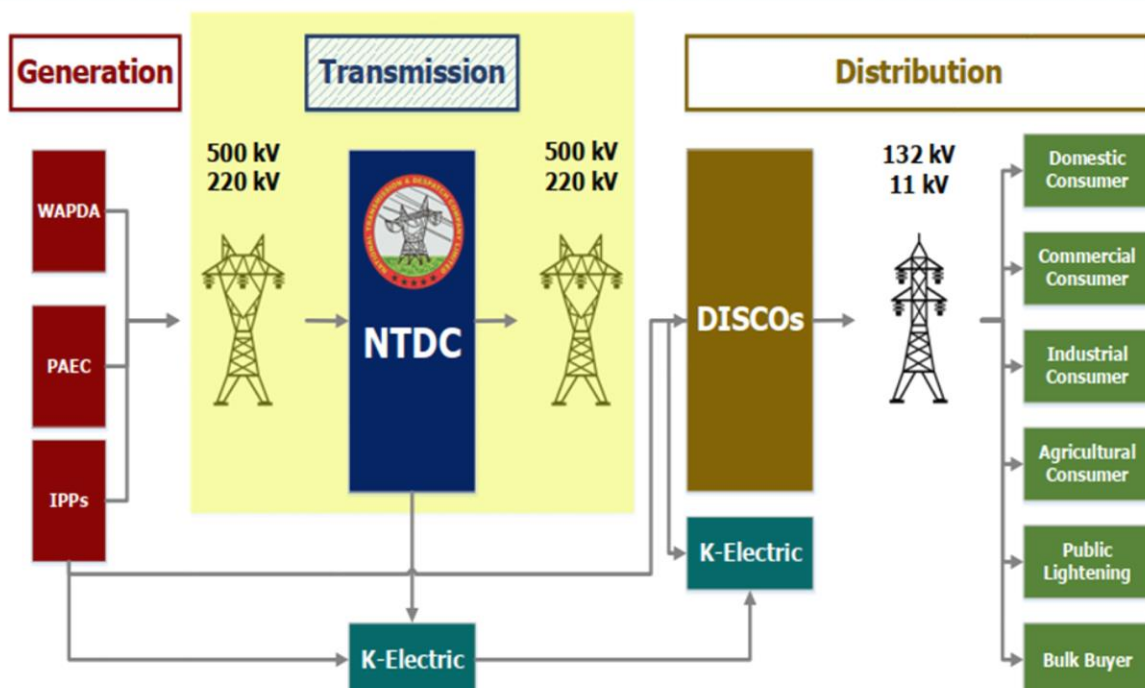
Rationale for Cross Border Electricity Interconnections and Trade in South Asia



1. Intro to NTDC System



National Transmission & Despatch Company



Rationale for Cross Border Electricity Interconnections and Trade in South Asia

NTDC National Grid 2025

Category	Grid Stations	Transmission Lines	Capacity
	Nos.	km	MVA
Existing System 2020			
500 kV	16	5,970	22,350
220 kV	45	11,322	31,060
Total	61	17,292	53,410
Future System 2025			
500 kV	24	12,633	39,150
220 kV	71	15,894	54,100
765 kV	1	500	3,600
± 660 kV	2 (Converter Stations)	890	4,812
± 500 kV	1 (Converter Station)	110	1,576
Total	99	30,027	103,238

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Long Term Forecast 2018-40

Fiscal Year	Low (4.5% GDP Growth)		Normal (5.5% GDP Growth)		High (7% GDP Growth)	
	Generation	Peak Demand	Generation	Peak Demand	Generation	Peak Demand
	GWh	MW	GWh	MW	GWh	MW
2018-19	144,665	27,072	145,674	27,261	147,188	27,545
2019-20	151,062	27,814	152,914	28,155	155,718	28,671
2020-21	158,842	28,782	161,841	29,325	166,429	30,157
2021-22	166,267	30,127	170,645	30,921	177,416	32,147
2022-23	173,178	30,889	179,142	31,953	188,476	33,618
2023-24	181,051	32,294	188,914	33,696	201,374	35,919
2024-25	188,749	33,640	198,744	35,422	214,788	38,281
2025-26	193,948	34,062	206,155	36,206	226,011	39,693
2026-27	202,763	35,610	217,664	38,227	242,228	42,541
2027-28	211,718	37,183	229,603	40,324	259,492	45,573

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Long Term Forecast 2018-40

Fiscal Year	Low (4.5% GDP Growth)		Normal (5.5% GDP Growth)		High (7% GDP Growth)	
	Generation	Peak Demand	Generation	Peak Demand	Generation	Peak Demand
	GWh	MW	GWh	MW	GWh	MW
2028-29	220,940	38,802	242,104	42,519	277,960	48,816
2029-30	231,142	40,594	255,989	44,958	298,670	52,453
2030-31	241,889	42,481	270,792	47,557	321,130	56,398
2031-32	253,101	44,451	286,441	50,306	345,315	60,645
2032-33	265,289	46,591	303,554	53,311	372,070	65,344
2033-34	278,069	48,835	321,710	56,500	400,940	70,414
2034-35	291,403	51,177	340,888	59,868	431,973	75,865
2035-36	305,685	53,686	361,590	63,504	465,916	81,826
2036-37	320,652	56,314	383,529	67,357	502,479	88,247
2037-38	336,293	59,061	406,719	71,429	541,779	95,149
2038-39	352,917	61,980	431,584	75,796	584,509	102,653
2039-40	370,348	65,042	457,939	80,425	630,529	110,736

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

2. Rationale for Regional Energy Connectivity

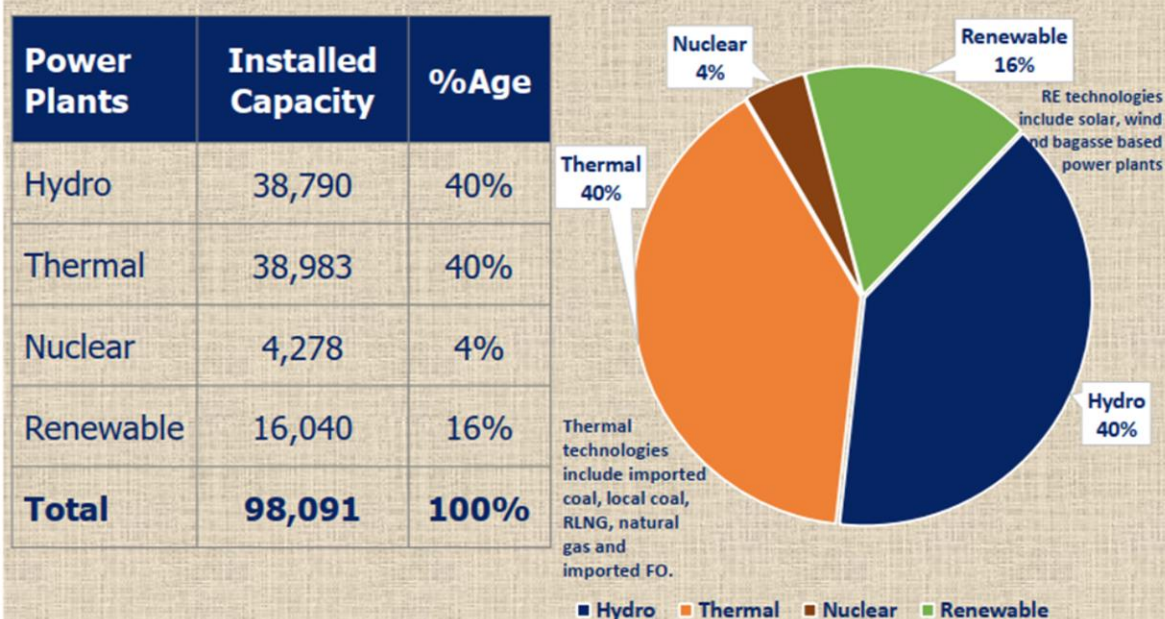


Major Features of Long term Gen Plan 2040

1. Massive utilization of hydro power (29 to 40%). ↑
2. Further balancing the overall basket price with high share of indigenous coal (2 to 25%). ↑
3. Less reliance on imported fuel i.e. coal, RLNG and RFO (48 to 13%). ↓
4. Renewables accounts for the overall share of 16% of the installed capacity (4 to 16%). ↑
5. By the year 2040, a capacity of around 9,000 MW is meant to be retired.

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Reshaping the Generation Mix 2040



Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Seasonal Demand Variation 2018-19

Month	Demand Factor
July	0.902
August	0.965
September	0.823
October	0.770
November	0.614
December	0.601
January	0.599
February	0.582
March	0.682
April	0.786
May	0.947
June	1.000

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Pakistan: Rationale for Regional Connectivity

1. Energy security due to diversity with respect to cross border interconnection
2. Generation adequacy
3. Optimal utilization of available resources (Investment can be avoided or at least delayed)
4. Interconnections offer opportunities to Pakistan for exporting energy when surplus particularly in winter when demand is low (November to March)

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Demand Complementarity in Power Systems

Member State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bangladesh	L	L	M	H	H	H	M	M	M	M	L	L
India – NE	M	L	M	L	L	M	H	H	M	H	H	M
Bhutan	H	H	M	M	M	L	L	L	L	M	M	H
India – E	L	M	H	H	M	H	H	H	H	M	L	L
Nepal	H	H	M	M	L	L	L	L	L	M	M	M
India – N	M	M	L	L	M	H	H	H	H	M	L	M
India – W	H	H	H	M	M	M	L	L	L	H	H	H
Pakistan	L	L	M	M	M	H	H	H	H	M	M	M
India – S	H	H	H	H	M	L	L	M	M	M	L	M

L Low
M Medium
H High

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

A Few Examples of Regional Interconnections

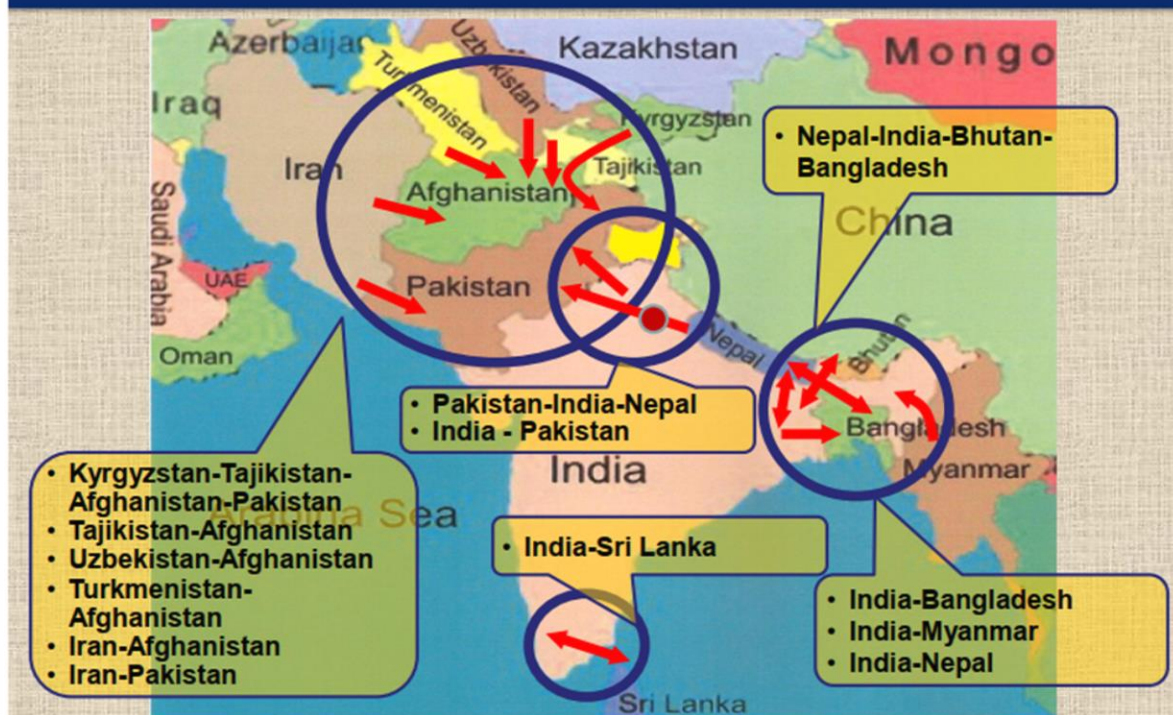
1. Middle East: Gulf Cooperation Council Interconnection Authority (GCCIA) including Bahrain; Kuwait; Oman; Qatar; Saudi Arab; and United Arab Emirates
2. European Network of Transmission System Operators for Electricity (ENTSOE)
3. Central Asian States and Pakistan (Afghanistan, Kazakhstan, the Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan) ***under study***

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

3. SAARC Energy Ring



SAARC Energy Ring: Power Grid



Rationale for Cross Border Electricity Interconnections and Trade in South Asia

SAARC Energy Ring Power Interconnection Opportunities

Grid Interconnection	Capacity (MW)
India-Bhutan	2,100
India-Nepal	1,000
India-Sri Lanka	500
India-Bangladesh	Over 1,000
India-Pakistan	500
CASA 1000	1,000 (+300)

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

SAARC: Rationale for Regional Connectivity

1. **Utilizing**, optimally, electric power resources
2. **Developing** a strong economy with good jobs, modern infrastructure, proper social services
3. **Facilitating** clean power export revenues for the certain member states and by reducing electricity shortages in other member states
4. **Delivering** reliable, affordable electricity to parts of the world that need it in summer and winter
5. **Prompting** inter-regional cooperation, investments in social services, and encourage community benefit-sharing

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

4. Connecting Central Asia with South Asia: CASA-1000



Salient Features of the Project

1. Supplying surplus central Asian power in the summers (May to Sep) to Afghanistan (300 MW) and Pakistan (1,000 MW).
2. Confirmed delivery of 4,000 GWh of energy or above
3. A World Bank study declared CASA Project as viable and beneficial, despite the security risks in Afghanistan.
4. HVDC lines from Sangtuda in Tajikistan passing through Kunduz, Pul-i-Khumri, Kabul and Jalalabad in Afghanistan and end up in Peshawar.
5. Total length of transmission lines: 750 km - 16% would pass through Tajikistan, 75% through Afghanistan and 9% through Pakistan.

Existing and Proposed 500 kV Network



Rationale for Cross Border Electricity Interconnections and Trade in South Asia

CASA 1000: Scope

The CASA-1000 project consists of:

- 750 km 500 kV HVDC Transmission Line between Tajikistan and Pakistan via Afghanistan;
- Converter stations at Sangtuda (1000 MW), Kabul (300 MW) and Peshawar
- A 477 km 500 kV AC link between the Kyrgyz Republic (Datka) and Tajikistan (Khoujand)
- AC system upgrades on existing lines

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

CASA 1000: Potential Option

1. CASA-1000 will supply power in summer months (May to Sept).
2. For the remaining period countries have planned to use the CASA system under open access provision.
3. Pakistan has also offered Russian side to participate in the CASA System through open access regime for the effective utilization of the CASA system.
4. The CASA System is capable for reverse flow of Energy. Pakistan envisions to sell back the energy during winter months (low demand in Pakistan).
5. Project would pave the way for CASAREM (CASA Regional Electricity Market).

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Current Status of CASA 1000 Project

1. Project COD: December 2022

2. Converter Station

- Land Acquisition process has been completed and Award has also been announced in favour of NTDC.
- **Boundary Wall:** The soil investigation for Boundary wall has also been completed and the results have been provided to M/S ABB and M/S Cobra for issuing the zero-reference level so that the same may be forwarded to NTDC Design team for boundary wall design
- **Transmittals Status:** CASA Documentation flow is based on ERP. All the project documents come in the form of Transmittal and RFI by official emails, which are finally uploaded to Docubin-software. 604 documents (75 Commercial, 529 Technical) have been received for the TW01 package in Pakistan, and 470 (67 commercial, 403 technical) of those have been responded.

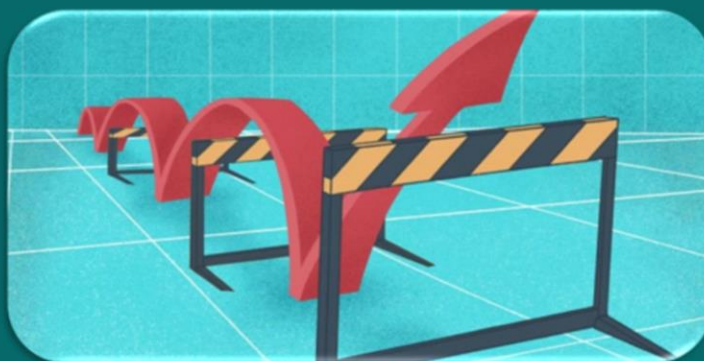
Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Progress of Converter Station, Nowshera, Pakistan

1. Possession of land by NTDC is still under process (bottleneck).
2. Tender for Boundary Wall was opened on 14.1.2020 and evaluation is under preparation
3. Electrical design of the converter station – 70% approved.
4. Manufacturing of HVDC Converter transformers has started.
5. Civil works design of the converter station shall be submitted for approval in Feb. 2020
6. Preliminary Studies for site selection of electrode station completed, soil investigation for its electrical properties is in process subsequent to which land acquisition process shall start.
7. Tender document for the 500 kV Nowshera Grid Station is on sale. The tender shall be opened on 26.3.2020. The grid station shall be used for the evacuation of the AC power from the converter station.

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

5. My Scheme to Cope with the Power Sector Challenges



Coping with the Power Sector Challenges

1. Add cheap, clean MWs through indigenous resource and indigenous technology
2. Make and sustain the grid smart
3. Interventions for the low hanging fruit: Energy efficiency and energy conservation
4. Regional Inter-connections to cater shortage as well as surplus

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

My Vision on SAARC Initiatives

Domestic energy development and bilateral cooperation alone will not solve power crisis of South Asia.

Engagements have to be multi-lateral.



Rationale for Cross Border Electricity Interconnections and Trade in South Asia

6. Questions and Answers



For your Patience



Reshaping the Power Generation Mix for Sustainable Power Sector in Pakistan

CASA 1000: Cost and Funding

1. The estimated cost of the CASA-1000 Project is US \$1170 million including US \$208 million IDC and Taxes.
2. Most of the funding for the project is being provided by the World Bank.
3. Funding for the Afghan portion (Transmission Line and Converter Station) is fully secured while there is about 20% funding gap in other countries.
4. The gap is expected to be filled due to WB's serious commitment to the project.

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

CASA 1000: Energy and Tariff

1. Tariff is energy based (US Cents/kWh) on must run basis.
2. Hydrological risk is to be borne by the Sellers, i.e., have to deliver the guaranteed energy or pay LDs.
3. Purchaser will have to pay LDs if it does not off-take the energy
4. The tariff has 3 tiers:
 - P1 for the Min Guaranteed Quantity per annum;
 - P2: for Min Guaranteed Quantity for 5 yr block;
 - P3: for Excess Quantity
5. Total yearly energy committed by the Sellers vary between 4,072 to 4,434 GWh.

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

CASA 1000: Tariff Components

1. Transmission Charge Based on Actual Bid Cost & Agreed ROI (6%): Estimate: 3 Cents/kWh; Includes:
 - Kyrgyz T/L & Tajik T/L & Converter Station Costs
 - Afghan T/L cost
 - DC & AC Operators' cost
 - Reserve Fund
 - Tajik Transit fee payable on Kyrgyz energy
2. Energy Charge (Payable to Sellers): 5.15 Cents/kWh
3. Transit Fee {Payable to Afghanistan (1.25 Cents/kWh)}
4. Total tariff is US Cents: 9.3/kWh

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

CASA 1000: Capacity and Energy

1. CASA-1000 Transmission Line (T/L) to Nowshera would be capable of delivering 1300 MW.
2. 1000 MW is Pakistan's share and 300 MW is Afghanistan's share; however, the Afghan share may be available for Pakistan as Afghanistan may not need the power in near future).
3. Total capacity will be available for Pakistan and Afghanistan will get their share through separate line between Tajikistan and Afghanistan (2017).
4. However Pakistan will be obligated to take only 1000 MW while additional 300 MW will be optional.

Rationale for Cross Border Electricity Interconnections and Trade in South Asia

3. “Cross Border Trade of Electricity in SAARC Region” by Mr. Sher Singh Bhat,
CEO, Kabeli Energy (Pvt.) Ltd., Nepal.



**X-BORDER TRADE OF ELECTRICITY
IN SAARC REGION**

Sher Singh Bhat

X-BORDER TRADE OF ELECTRICITY IS SPECIAL

S. No.	Particulars	Details
1.	Specific Nature of Electricity as commodity	▪ It is intangible commodity and cannot be checked at the custom point for custom clearance. ▪ It cannot be stored and has to be consumed at the moment it is generated. ▪ It needs a hard wire connection from generation to point of consumption.
2.	Item list of general trade agreements exclude electricity due to its specific nature.	▪ Typical Agreement/s between/among the countries for X- Border trading of electricity.
3.	Pre-requisites for X- border trade of electricity	▪ Separate bilateral, sub-regional, regional agreement/s for X- Border trade of electricity ▪ Agreed market mechanism (rules) by trading countries ▪ Requisite transmission fabric of hardwires

WHY DO STATES WISH X-BORDER TRADE OF ELECTRICITY?

OBJECTIVE - 1

- Balancing (managing surplus and deficits) the TOD and seasonal demand and supply in the national power systems of SMS.
- Trading in relatively small volumes, short term nature

OBJECTIVE - 2

- Harness the energy sources available as comparative advantage in SMS for export of electricity and attain economic growth through it.
- Trading intended for relatively larger volumes, long term.

OBJECTIVE - 3

- Take advantage of price arbitrage in two national markets

X-BORDER TRADING OF ELECTRICITY AMONG SMS: STATUS

- Currently Bhutan, Bangladesh & Nepal having X-border transaction of electricity with India.
- But this transaction is mostly under G2G facilitation.
- Most power transactions with India are routed through Indian public sector trader (NVVN).
- India have demonstrated strong preference to bilateral G2G for X- border transaction of power.
- Transaction between any other two countries needs use of Indian transmission system.
- But SMS have not been successful to garner this support from India.
- So level of X-Border trading of electricity in SAARC Region is not up to mark.
- Indian preference for bilateral G2G impeding electrically interconnected SAARC region as a whole.

INITIATIVES TO ENHANCE ELECTRICITY TRADE AMONG SMS

Despite poor regional connectivity and trading of electricity, initiatives undertaken in following 4 directions to enhance level of electricity trade among SMS:

1. Regional and Bilateral Agreements for energy cooperation and trade of electricity.
2. Development of requisite X- Border Infrastructure for connectivity and trade.
3. Ramification of domestic systems of SMS to adapt X-border power trade.
4. Regional and bilateral instruments to gear up connectivity and trade through frequent communications.

AGREEMENTS FOR ENERGY COOPERATION AND TRADE OF ELECTRICITY

- **At Regional Level**
 - SAARC Intergovernmental Framework Agreement on Energy Cooperation
- **At Bilateral Level**
 - Umbrella Agreement on cooperation between India and Bhutan
 - Power Trade Agreement between Nepal and India
 - Agreement between Bangladesh and India for cooperation

DEVELOPING REQUISITE X- BORDER INFRASTRUCTURE TO FACILITATE TRADE

- **Between India and Bhutan:**
 - Tala – Kholga - Binnagurhi- New Siligurhi 400 kV D/C line in operation
 - Tala – Pagli / Malbase – Binnagurhi – New Siligurhi 400 k V D/C Line in operation
- **Between India and Nepal :**
 - Muzaffarpur-Dhalkebar 400 k V line in operation but still in radial mode
- **Between Bangladesh and India :**
 - Behrampur –Bheramaara 400 k V DCBTB in operation
- **Between India and Sri Lanka:**
 - Madurai – Anuradhapura +/- 400 k V HVDC Bi-pole including Dhanushkodi - Talaimannar submarine cable. Still at conceptual level.

RAMIFICATION OF DOMESTIC SYSTEMS TO ADAPT X-BORDER POWER TRADE

- **Amendments in domestic regulations**
 - MOP(GOI) Memo dated Dec 18, 2018 on X-Border imports.
- **Reinforcements of domestic infrastructure**
 - Reinforcement in Muzaffarpur Substation (India) and related transmission lines to facilitate the power flow through Muzaffarpur-Dhalkebar 400 k V line.

But these reinforcements are not sufficient.

INSTRUMENTS TO ACCELERATE CONNECTIVITY AND TRADE

• **Regional Level**

- SAARC Energy expert Group: has not been effective

• **Bilateral level**

- Joint Steering Committees, Joint Working Group, Joint Technical Committee formed under the respective bilateral agreements

• **Domestic Level**

- Domestic Task forces have been formed to support the bilateral and regional working groups.

It has been observed that bilateral instruments have been functional but the regional instruments are almost defunct.

REASONS FOR POOR CONNECTIVITY AND TRADING AMONG SMS

1. Geographical proximities not supportive for X-Border Trade

- Except Afghanistan, all SMS have common border with India.
- No other countries have common borders except Pakistan and Afghanistan.
- India is at the King Pin position for X-Border Trade of Electricity among SMS

2. Infrastructure

- Certain X-border infrastructure has been developed between India and other few countries in last few years to facilitate bilateral trade with India.
- But this also does not facilitate third country trade or regional trade.

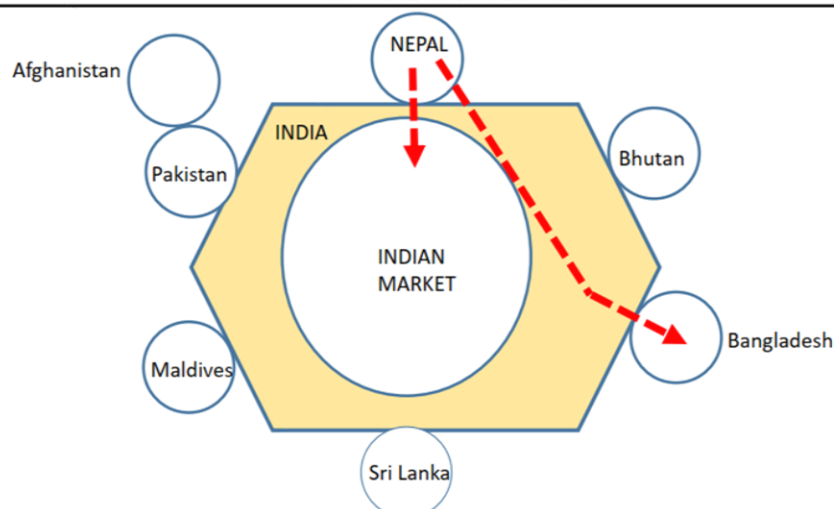
3. Careful Indian Move

- India has been treating electricity as strategic commodity with its neighbors.
- For that reason India has strong preference over bilateral trade in G2G model.
- India has been ring fencing its domestic market through internal regulations allowing limited access to selected SMS to it and that also through G2G facilitation.

4. Geo-political Relations Factor

- Indo-Pakistan geo-political relations are not supportive to regional trade of electricity.
- Indian bidders (service providers or developers) in negative list in international bids in Pakistan.
- India seemingly adopts bilateral G2G option to reciprocate it in electrical connectivity and trade.

GEOGRAPHICAL PROXIMITIES NOT SUPPORTIVE FOR X-BORDER TRADE



INCONSISTENT INDIAN POLICIES

Event	Details	Remarks
Indian Import Policy 2009-2014	Classified electricity as import restricted item	Market concealed for import
SAARC summit in 2011	Signed SAARC IGFA on Energy cooperation but remained reluctant to gear it up	Positive signal but pull back in action
Indian Import Policy 2014-2019	Excluded electricity from the list of import restricted item	Positive signal
Indo-Nepal Power Trade Agreement 2014	India signed Power Trade Agreement with Nepal in 2014 but remained reluctant to actually implement it.	Positive signal but pull back in action
Increased export to Nepal through 400 k V D-M line	Volume of export to Nepal increased but all export routed through NVVN intercepting the export through PTC in past.	Only G2G model
MOP (GOI) Memo of December 18, 2018	These internal guidelines seemingly allowing export of power by neighboring countries to India and to third market through Indian Grid	Seems push forward
Union Budget 2020	Imposed BAT on import of electricity in India	Push back

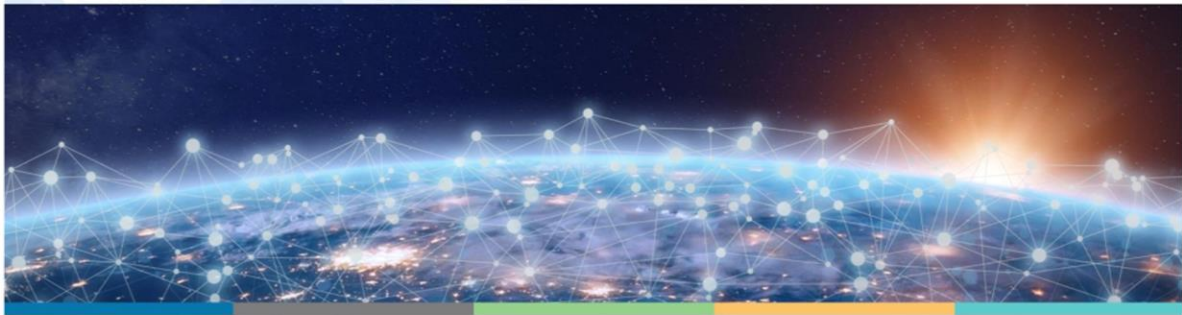
MY CONCLUDING IMPRESSION

- Selected SMS already making power transaction with India under bilateral G2G arrangement using this opportunity for objective no. 1 i.e. balancing the system.
- India is moving very carefully on opening its domestic market to neighboring SMS. A good experience and comfortable situation on bilateral G2G transactions may lead to third country transactions among selected/limited SMS in future.
- Once India agrees to provide its transmission system for third country transactions of selected/limited SMS in practical terms, such SMS can exercise objective no.2 i.e. harnessing the resources for economic growth.
- With these two experiences, India might open its domestic market to selected/limited SMS and then trading for third objective i.e. price arbitrage may be realized.
- But SAARC Regional Power Exchange, SAARC Regional Electricity Market, SAARC Regional Grid have been and may remain as a good academic exercises for long time in future also unless there is dramatic change in geopolitical relations among SMS. Although trading among selected limited SMS may grow in accordance with Indian preference but very slowly.

THANKS

4. “Regional Markets: A Key Innovation in the Global Energy Transition” by Ms. Elena Ocenic

Programme Officer, International Renewable Energy Agency (IRENA), Germany



Regional markets

A key innovation in the global energy transition

Elena Ocenic
Webinar on Cross-border Electricity Trade in SAARC Countries, 9 March 2020

Agenda



- 1. IRENA's systemic innovation approach for the energy transition**
- 2. Regional markets**
- 3. Pan-European electricity market**

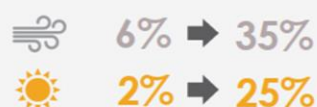
1. IRENA's systemic innovation approach for the energy transition

Wind & solar PV at the core of the energy transition

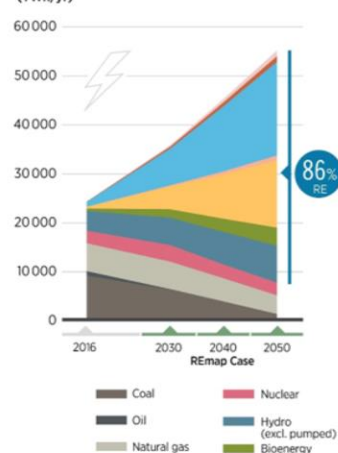
Cost reduction
2010 – 2018



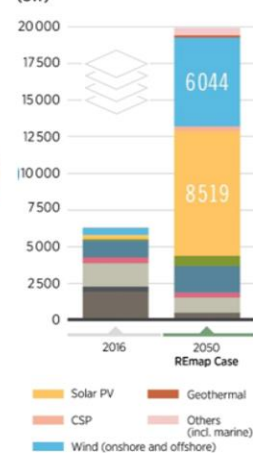
Onshore wind & solar PV share in
generation mix (2018 vs. 2050)



Electricity generation
(TWh/yr)



Total installed power capacity
(GW)



Sources: IRENA (2019), Global energy transformation: A roadmap to 2050, IRENA (2019), Renewable Power Generation Costs in 2018

Innovation knowledge products

Innovation Landscape Report for wind & solar PV integration + 30 Innovation Landscape Briefs

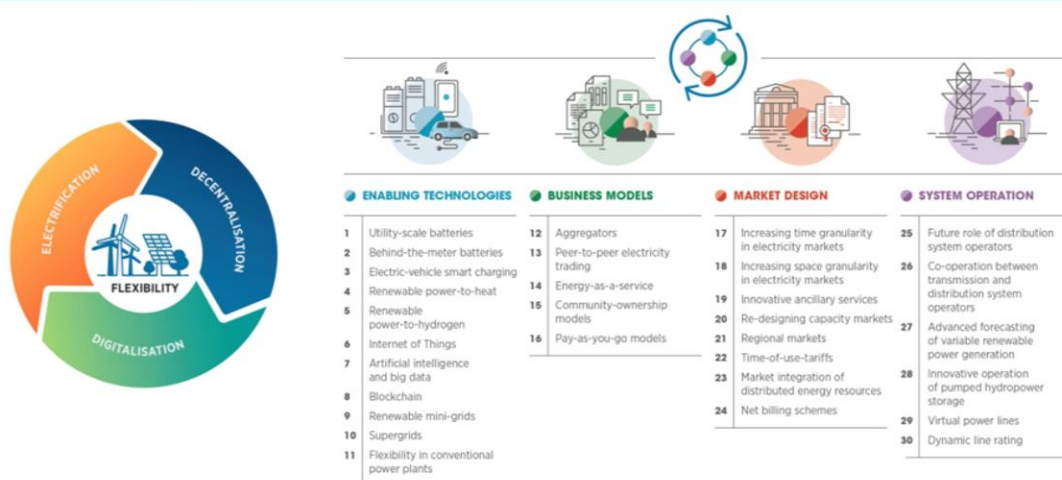
+ Swedish innovation case study



Sources:
IRENA (2019), Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables
IRENA (2020), Innovative solutions for 100% renewable power in Sweden

5

30 key innovations for wind & solar PV integration

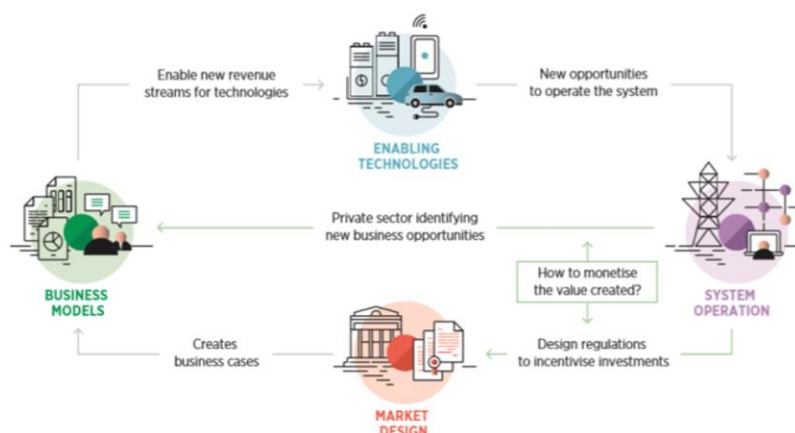


Sources: IRENA (2019), Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables

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Systemic innovation approach

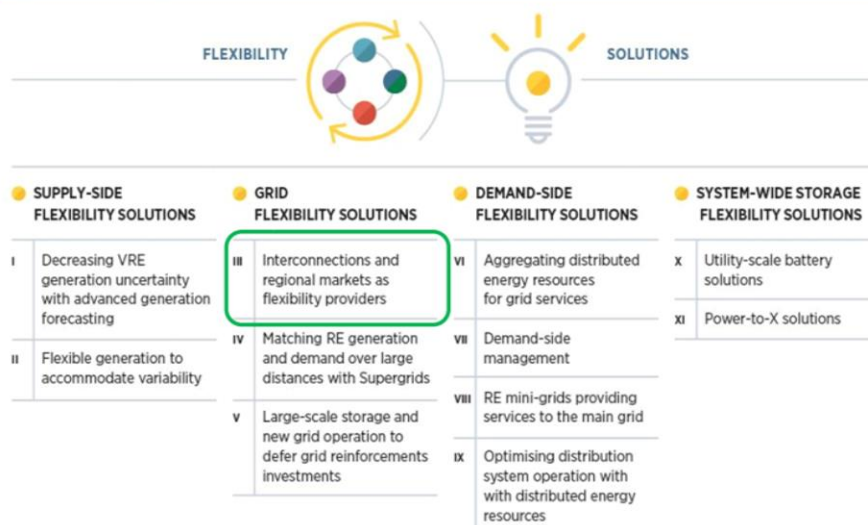
SYSTEMIC INNOVATION IS NEEDED
FOR AN INTEGRATED RENEWABLE ENERGY SYSTEM



Source: IRENA (2019). Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables

7

Solutions are combinations of innovations



11 solutions explored in depth in the report, including advice on their suitability and impact.

Source: IRENA (2019). Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables

8

Interconnections & regional markets as flexibility provider



Source: IRENA (2019). Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables

9

2. Regional markets



10

Different levels of regional market integration

Market integration level	Interconnectivity level	Trading arrangements	Harmonisation rules
Early stage of market integration	Physical interconnection between two countries	Long-term, bilateral, over-the-counter (OTC) ³ power purchase agreements (PPAs)	Simple rules agreed for the operation of the interconnected system
Shallow market integration	Physical interconnection between several neighbouring countries	Long-term PPAs supplemented with short-term wholesale markets	Harmonisation of market rules, grid codes, and transmission tariffs
Deep market integration	Full synchronous operation of a multi-country interconnected system	Well-functioning markets with competition achieved through trading in different timeframes and various markets (OTC vs. power exchanges, capacity vs. power markets, day-ahead vs. intraday markets, etc.)	Regional regulatory agencies, regional market operators and harmonisation of market rules, grid codes, and transmission tariffs



Source: IRENA (2019), Innovation landscape brief: Regional markets

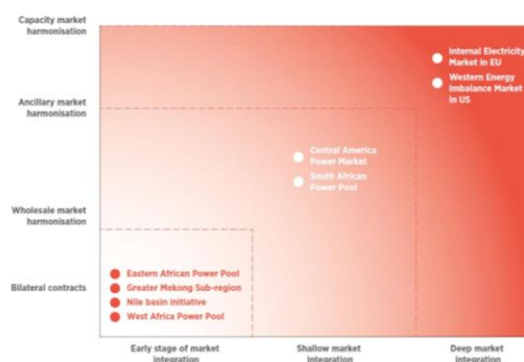
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International examples

Regional market	Participating countries/systems	Year of establishment
Central America Power Market ¹	6 countries: Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama	2013
European Union ²	23 countries (day-ahead market): Austria, Belgium, the Czech Republic, Germany, Denmark, Estonia, Finland, France, Great Britain, Hungary, Italy, Lithuania, Latvia, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Slovenia, Slovakia and Sweden 14 countries (intraday market): Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, Norway, the Netherlands, Portugal, Spain and Sweden	1990s (NordPool was created) 2018 (XBID Project - intraday market)
Eastern Africa Power Pool ³	10 countries: Burundi, the Democratic Republic of Congo (DRC), Egypt, Ethiopia, Kenya, Rwanda, Tanzania, Libya, Uganda and Sudan	2005
Greater Mekong Sub-region ⁴	6 countries: Kingdom of Cambodia, Guangxi Zhuang Autonomous Region and Yunnan Province of the People's Republic of China (PRC), Lao People's Democratic Republic (Laos PDR), Union of Myanmar, Kingdom of Thailand and the Socialist Republic of Viet Nam	1995
South African Power Pool (SAPP) ⁵	12 countries: Angola, Democratic Republic of Congo (DRC), Tanzania, Malawi, Zambia, Zimbabwe, Mozambique, Swaziland, South Africa, Lesotho, Namibia, Botswana	1995
Western Energy Imbalance Market (EIM), United States ⁶	8 active members: Idaho Power Company, Powerex, Portland General Electric, Puget Sound Energy, Arizona Public Service, NV Energy, PacifiCorp, CAISO and Balancing Authority of Northern California/SMUD	2014

Sources:

1. Navarete (2016)
2. ENTSO-E (2018c)
3. The Eastern Africa Power Pool (2016); Olingo (2018)
4. Asian Development Bank (2016)
5. SAPP (2016)
6. WesternEIM (2019)



Source: IRENA (2019), Innovation landscape brief: Regional markets

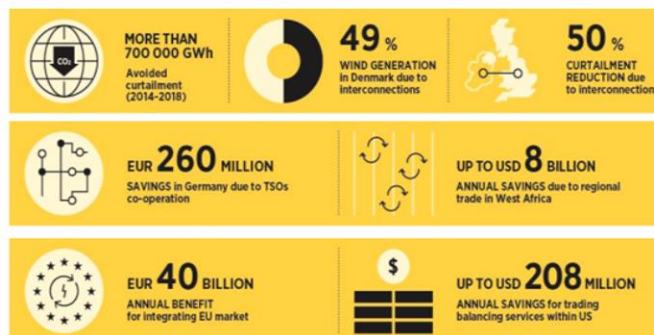
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Impact of regional markets for wind & solar integration



BENEFITS

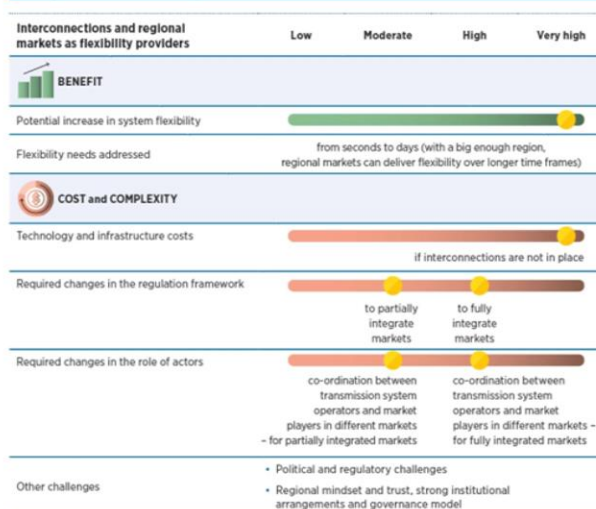
- Increased flexibility through expanding balancing area
- Advantages of spatial complementarity of VRE generation
- Co-ordinate generation planning
- Reduce system operation cost



Sources: IRENA (2019), Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables

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Costs, benefits & complexity for the implementation



KEY ENABLING FACTORS

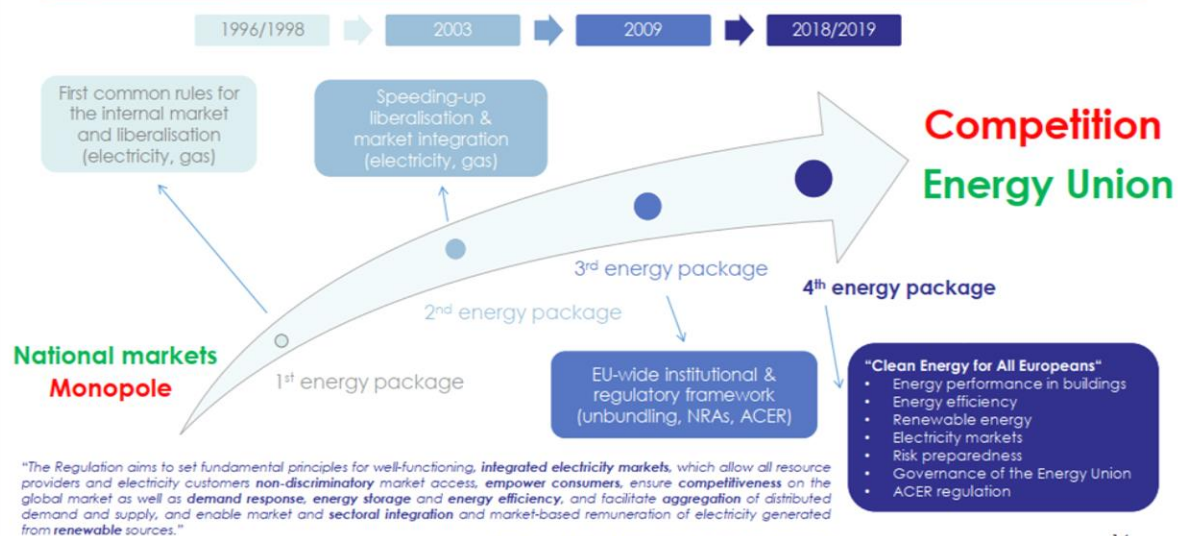
- Physical interconnections with sufficient capacity
- Regional mindset, strong institutional arrangements and governance model
- Robust IT system for market operation

Sources: IRENA (2019), Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables
IRENA (2019), Innovation landscape brief: Regional markets

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3. Pan-European electricity market

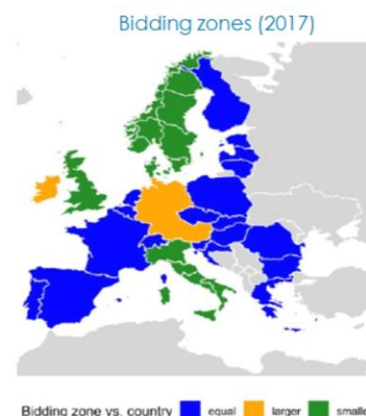
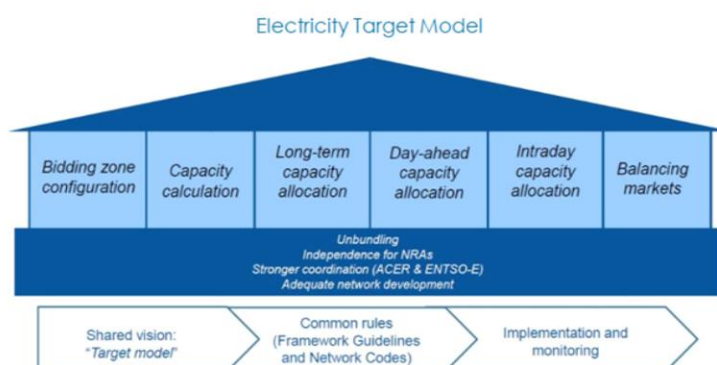
Policy context



Reg. 2019/943 on the internal market for electricity

16

Overview of the Internal Energy Market



„Efficient decarbonization of the electricity system via market integration requires systematically **abolishing barriers to cross-border trade** to overcome market fragmentation and to allow the Union energy consumers to fully benefit from the advantages of integrated electricity markets and competition.”

Reg. 2019/943 on the internal market for electricity

Source: IRENA – Energy Community Joint Workshop on Grid Integration of Variable Renewable Energy Sources, 7 November 2018

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Implementation status in the EU...

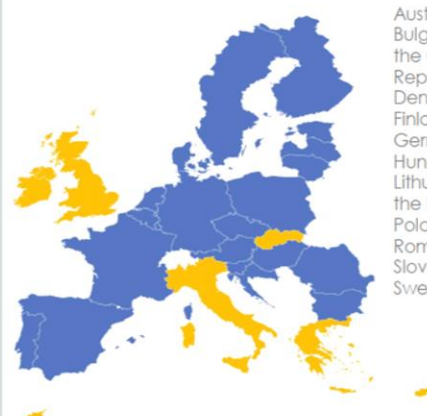
Day-ahead market coupling 26 countries

Austria, Bulgaria, Belgium, Croatia, the Czech Republic, Germany, Denmark, Estonia, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, UK



Intraday market coupling 21 countries

Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Lithuania, Norway, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden



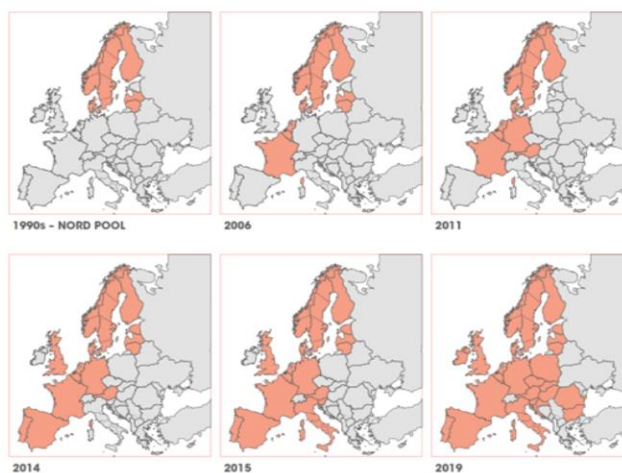
Source: ACER (2019), Market Monitoring Report, Electricity Wholesale Markets Volume

■ Coupled ■ Not coupled

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...achieved gradually over time

Gradual integration of the European regional wholesale market (day-ahead timeframe)

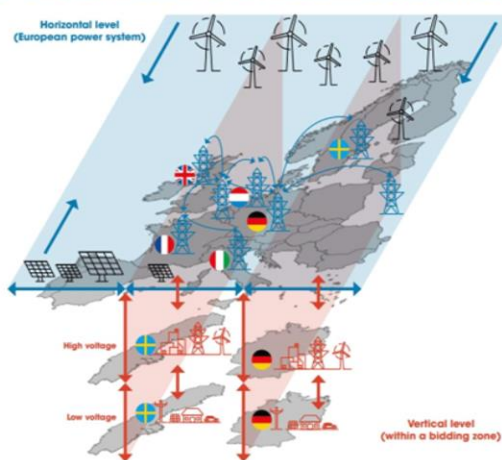


Sources: IRENA (2020), Innovative solutions for 100% renewable power in Sweden

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Cooperation, interconnection & harmonization levels

Horizontal and vertical dimensions of the interconnected European power system



Source: Adapted from IEA-OGAN, 2019

Disclaimer: Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

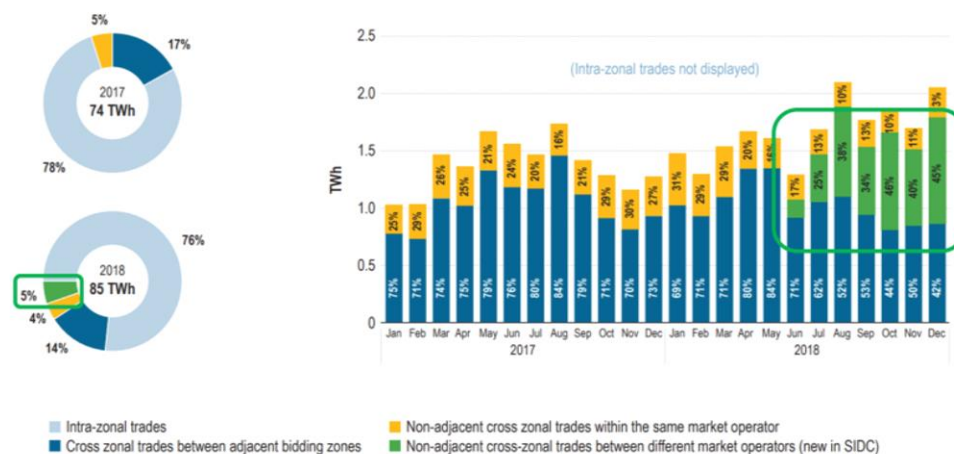
Sources: IRENA (2020), Innovative solutions for 100% renewable power in Sweden

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Benefits include trades between non-adjacent borders



Share of total traded volumes in intraday markets in Europe (2017-2018)



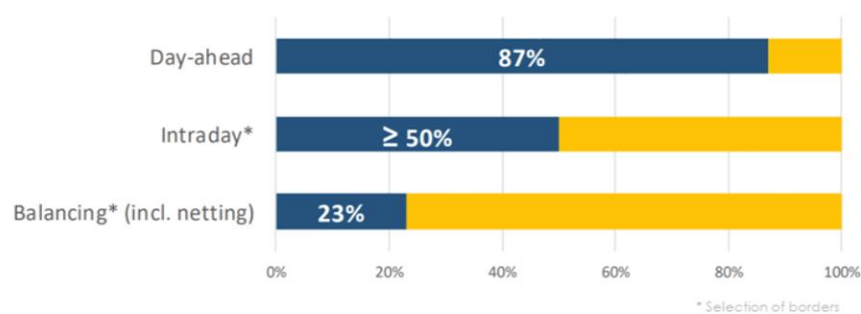
Source: ACER (2019), Market Monitoring Report, Electricity Wholesale Markets Volume

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Various degrees of economic efficiency observed



Efficient use of interconnectors in various timeframes, 2018 (%)

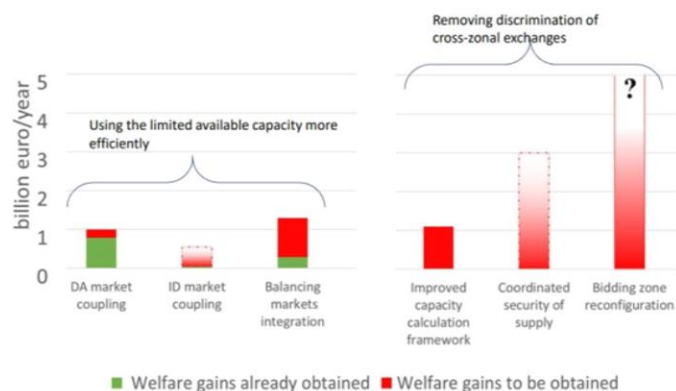


Source: ACER (2019), Market Monitoring Report, Electricity Wholesale Markets Volume

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Social welfare gains still to be obtained

Social welfare benefits obtained and to be obtained from actions to increase European market integration



Source: ACER (2019), Market Monitoring Report, Electricity Wholesale Markets Volume

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4. References

New webinar series



#IRENAinsights

Tuesday, 17 March 2020, 10:00–10:30 CET

***"Innovations for 100% renewable power:
a systemic approach"***

Registration:

<https://www.irena.org/renewables/Knowledge-Gateway/webinars/2020/Jan/IRENA-insights>

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Save-the-date



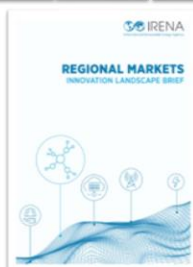
IRENA INNOVATION WEEK 2020

**8-10 September 2020
Bonn, Germany**

<https://www.irena.org/events/2020/Sep/IRENA-Innovation-Week-2020>

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Selection of further reading



- IRENA (2019), Innovation Landscape for a renewable-powered future: *Solutions to integrate variable renewables*: [Link](#)
- IRENA (2019), Innovation Landscape Briefs:
 - ✓ Market design briefs: [Link](#)
 - Regional markets: [Link](#)
 - ✓ Enabling technologies: [Link](#)
 - ✓ Business models: upcoming
 - ✓ System operation: upcoming
- Innovative solutions for 100% renewable power in Sweden: [Link](#)

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**Thank you very much for
your attention!**

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