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Integrated Research and Action for Development

South Asia Regional Initiative for Energy Integration (SARI/EI)

Transmission and System Operation for the Regional Trade and Power Exchange Based Trade : Key Challenges and Possible Solutions

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SARI/EI/IRADE

Workshop on Power Trade through Power Exchange
23rd July 2019 at Hotel Radisson, Kathmandu, Nepal, India

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Regional Transmission System

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Existing Transmission System for Transfer of Power to Nepal

Under Cross Border Transactions power is transferred to Nepal under 3 heads:

Mahakali River Treaty : 70 Mus Annual free energy from Tanakpur HPS, on 132 KV Tanakpur-Mahendragarh ckt. In addition to this, based on requirement and season, power in the range of around 25 MW is also drawn on this line under STOA, with PTC as trading partner;

From Bihar on 132 KV and 33 KV Radial links : There are 4 Nos. of 132 KV and 4 Nos. of 33 KV Radial lines from Bihar to Nepal, on which power is transferred to Nepal. During Year 2018-19, the quantum of power was 107.31 MU [Avg. 144 MW] during July 2018 and 146.06 MU [Avg. 196 MW] during Jan. 2019.

From Muzafarpur (Bihar) to Dhalkebar (Nepal) on Regional Cross Border Link: This is a 400 KV D/C (Presently operational at 220 KV). During Year 2018-19, the quantum of power transferred to Nepal on this line was around 70 MU [Avg. 94 MW] during July 2018 & 200 MU [Avg. 269 MW] during Jan. 2019.

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Nepal Power Supply Position during last 5 Years

Total Peak Demand Met and Available Energy in Nepal

Year	Peak Demand (MW)	Annual percentage Increase	Total Available Energy (GWH)	Annual percentage Increase
2014	1201		4687	
2015	1291	7.49	5005	6.78
2016	1385	7.28	5077	1.44
2017	1444	4.26	6257	23.24
2018	1508	4.43	7057	12.79

Source : NEA Annual Report 2017-18

During last few years the % increase in Total Avail. Energy has been much higher than Peak Demand

Nepal Power Supply Position during last 5 Years

Share of different Sources in Total Energy Avaialble in Nepal

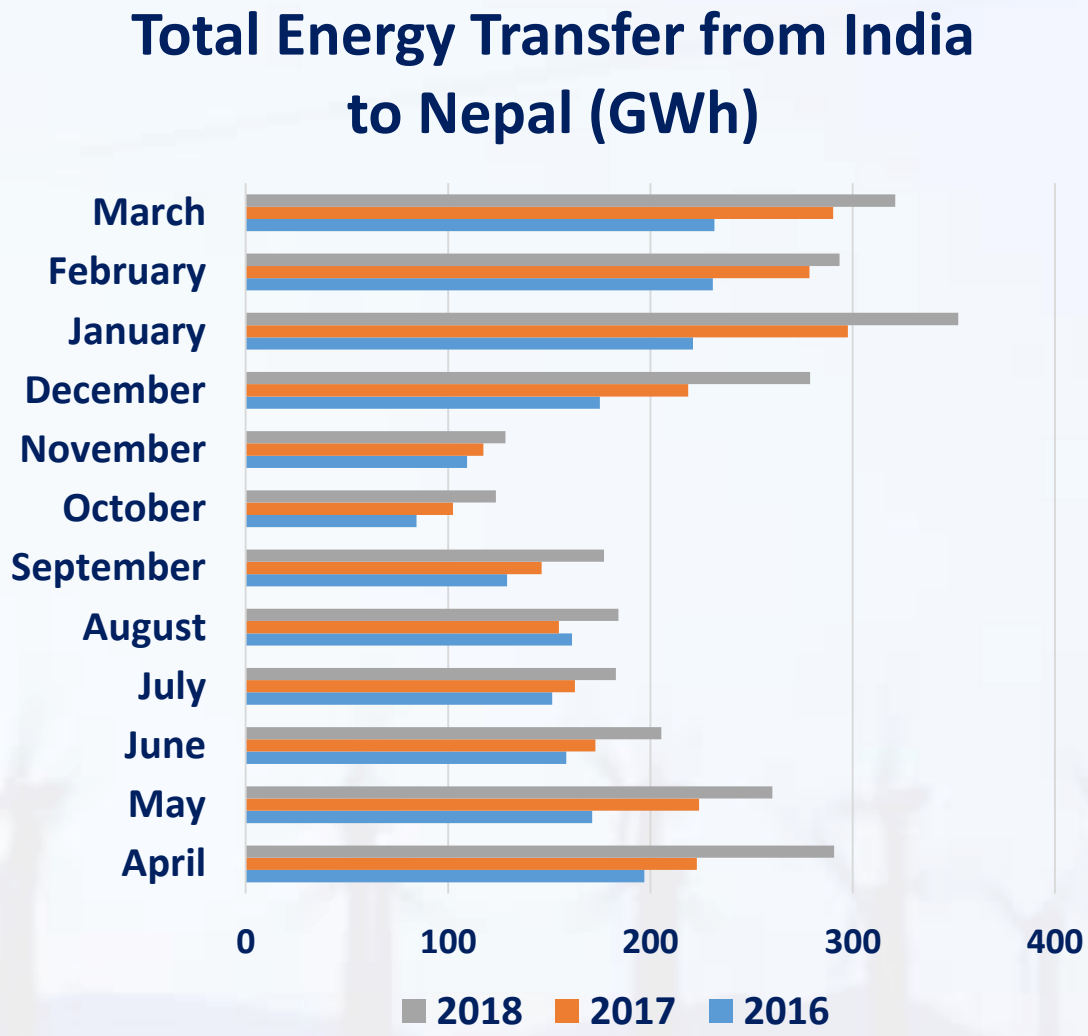
Year	NEA Hydro Gen. (GWH)	NEA Hydro Percentage Share	Power Purchase from IPPs(GWH)	IPPs Gen. Percentage Share	Power Purchase from India(GWH)	CBET Percentage Share	Total Available Energy (GWH)
2014	2288	48.82	1070	22.83	1319	28.14	4687
2015	2367	47.28	1269	25.35	1370	27.37	5006
2016	2133	42.01	1166	22.97	1778	35.02	5077
2017	2305	36.83	1777	28.40	2175	34.76	6258
2018	2308	32.70	2167	30.70	2582	36.58	7058

Source : NEA Annual Report 2017-18

During last few years the % share of CB Energy Trade and Gen. from IPPs is on increasing trend

Total Energy Transfer from India to Nepal

Total Energy Transfer From India to Nepal (GWh)			
Month	2016-17	2017-18	2018-19
April	197	223	291
May	171	224	260
June	158	173	205
July	151	163	183
August	161	155	184
September	129	146	177
October	84	102	124
November	109	118	128
December	175	219	279
January	221	298	352
February	231	279	294
March	232	290	321
Total	2021	2389	2799



During last 3 years trend in total energy during Dry/Wet period has moved from: 150%->180% ->200%

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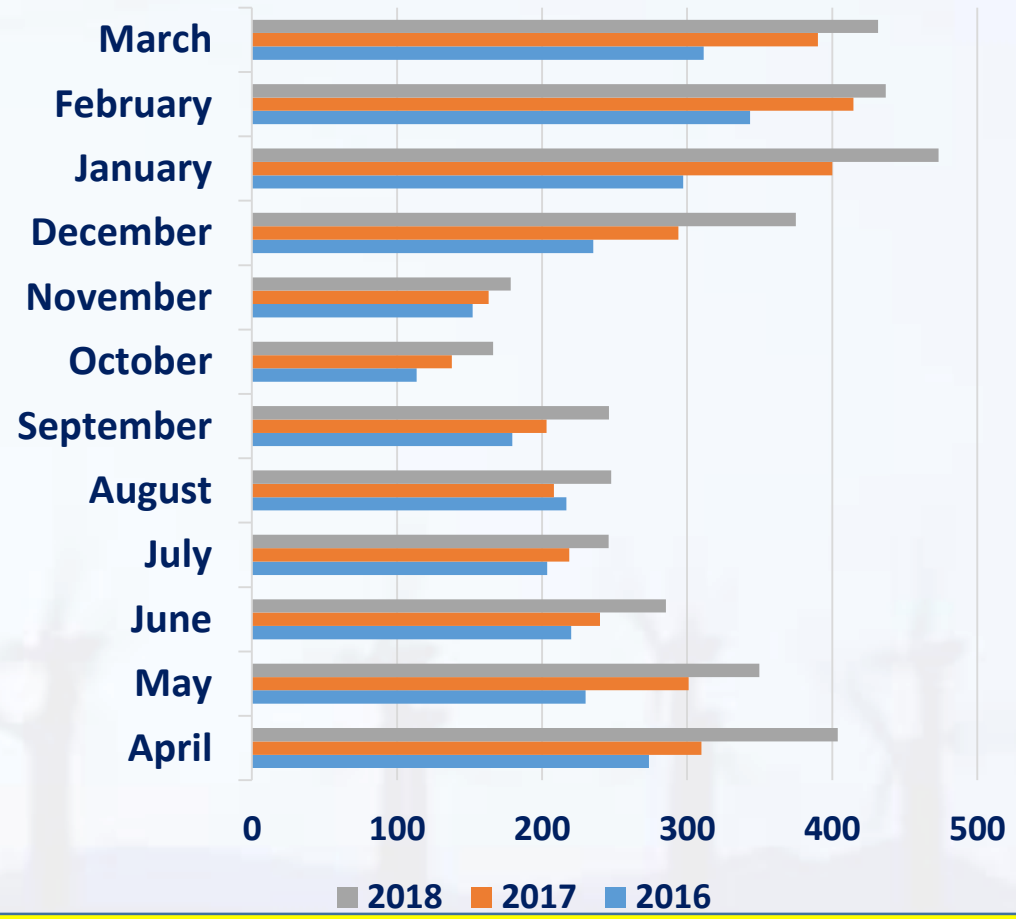
Total Energy Transfer from India to Nepal

Total Energy Transfer from India to Nepal in Avg. (MW)			
	2016-17	2017-18	2018-19
April	274	310	404
May	230	301	350
June	220	240	285
July	204	219	246
August	217	208	248
September	179	203	246
October	114	138	166
November	152	163	178
December	235	294	375
January	297	400	473
February	343	415	437
March	311	390	432



During last 3 years trend in total energy during Dry/Wet period has moved from: 150%->180% ->200%

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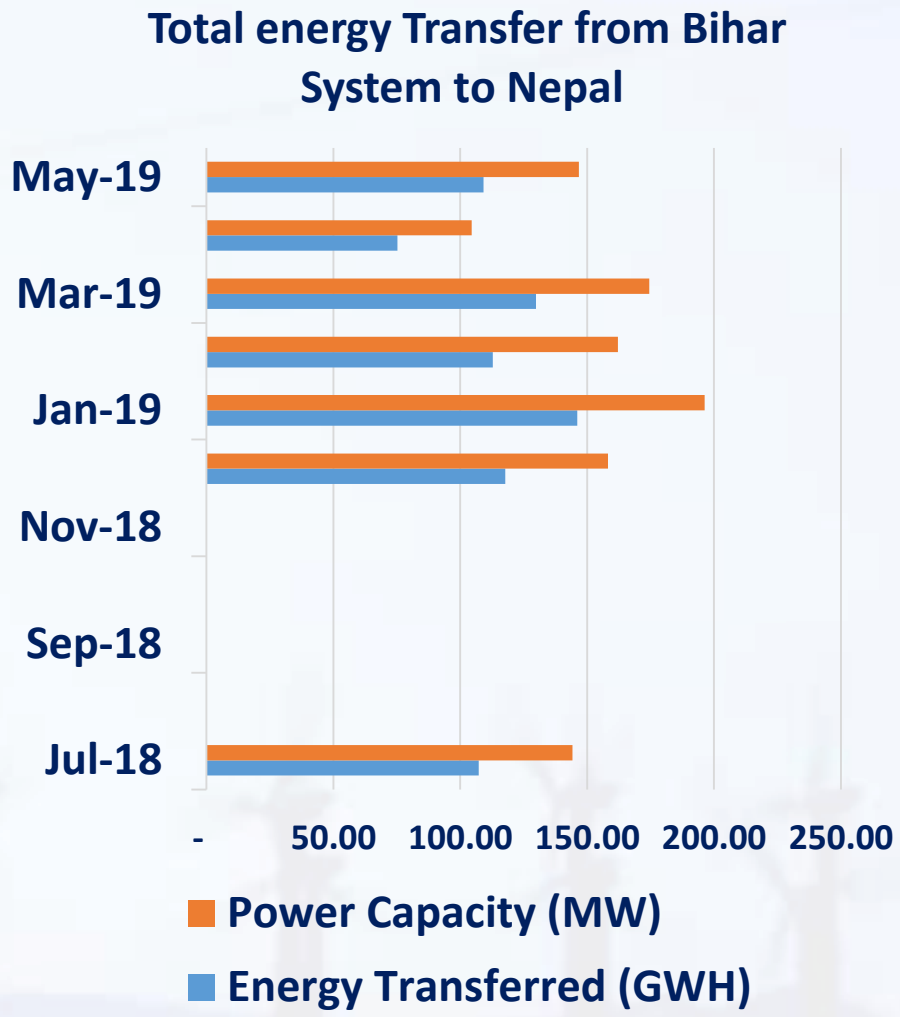
Energy Transfer from Bihar (India) to Nepal on 132 KV Radial Lines

Details of energy Transfer from Bihar System to Nepal		
Month	Energy Transferred (GWH)	Power (MW)
Jul-18	107.31	144
Dec-18	117.72	158
Jan-19	146.06	196
Feb-19	112.83	162
Mar-19	129.83	175
Apr-19	75.22	104
May-19	109.18	147



During Dry/Wet period as against the trend of 200% in whole Nepal, in area fed from Radial lines from Bihar it is only 135%

Inferences which can be arrived based on Historical data

- There is an increase in the overall share in the power purchase from IPPs:
  - ✓ A positive development towards markets;
- There is an increase in overall share in Cross Border Trades:
  - ✓ A positive step leading to economy and efficiency;
- Increase in the ratio of energy consumed during dry/wet weather:
  - ✓ A sign of natural load growth and matching transmission network;
- Low ratio of energy consumed during dry/wet weather in certain pockets:
  - ✓ A sign of constrained transmission network;
- Growth in total energy is lower than the growth in peak demand:
  - ✓ A case of suppressed and restricted load during peak conditions;

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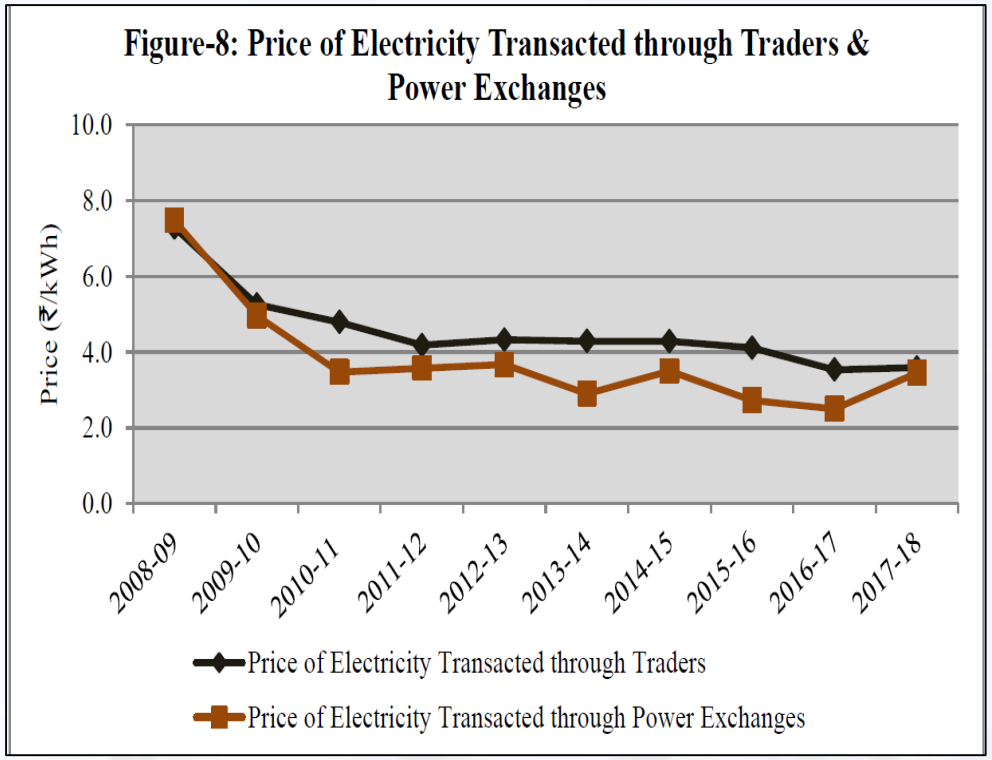
Market Based Trade in the Region

Prices of Electricity in India transacted through Traders & PXs : Last 10 Years

Year	Price of Electricity transacted through Traders (₹/kWh)	Price of Electricity transacted through Power Exchanges (DAM+TAM) (₹/kWh)
2008-09	7.29	7.49
2009-10	5.26	4.96
2010-11	4.79	3.47
2011-12	4.18	3.57
2012-13	4.33	3.67
2013-14	4.29	2.90
2014-15	4.28	3.50
2015-16	4.11	2.72
2016-17	3.53	2.50
2017-18	3.59	3.45

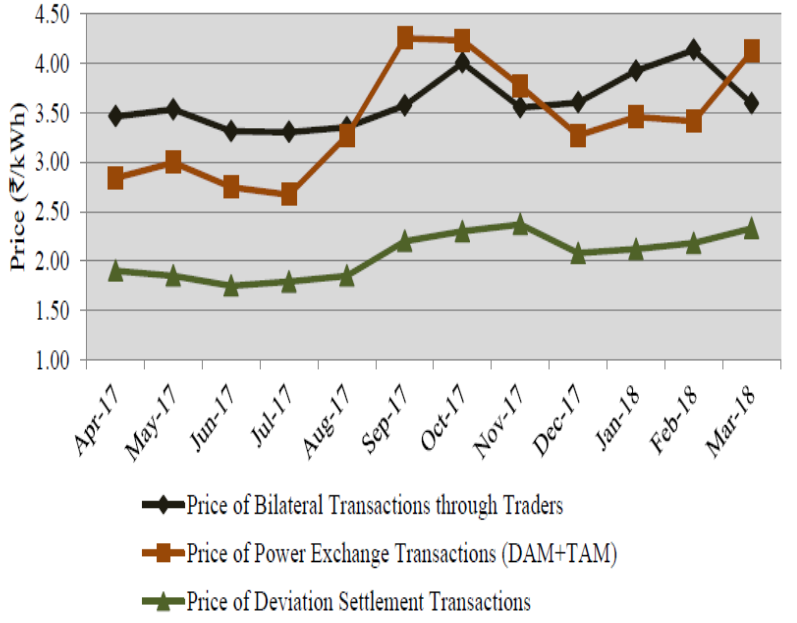


Source : CERC Market Monitoring Cell

Prices of Short Term Transactions of Electricity in India : Year 2017-18

Period	Bilateral through Traders				Power Exchange		DSM
	RTC	Peak	Off-peak	Total	IEX	PXIL	All India Grid
Apr-17	3.57	3.21	2.98	3.46	2.83	2.79	1.90
May-17	3.64	3.47	3.16	3.53	2.98	2.99	1.85
Jun-17	3.25	3.88	3.32	3.31	2.73	3.36	1.75
Jul-17	3.26	4.30	3.38	3.30	2.65	3.52	1.79
Aug-17	3.31	3.77	3.39	3.35	3.24	3.21	1.85
Sep-17	3.70	3.97	3.14	3.57	4.25	4.01	2.20
Oct-17	4.03	4.20	3.93	4.00	4.26	3.94	2.30
Nov-17	3.48	5.54	3.77	3.55	3.76	4.04	2.37
Dec-17	3.65	-	3.37	3.60	3.25	3.38	2.08
Jan-18	4.18	-	3.38	3.92	3.44	-	2.12
Feb-18	4.24	-	4.02	4.13	3.42	2.12	2.18
Mar-18	4.09	5.25	4.58	3.59	4.10	3.90	2.33

Figure-16: Comparison of Prices of Bilateral, Power Exchange and DSM Transactions in 2017-18



Source : CERC Market Monitoring Cell

Prices of Electricity in India transacted through Traders & PXs : April 2019

Table-3: PRICE OF ELECTRICITY TRANSACTED THROUGH TRADERS, APRIL 2019		
Sr.No	**Item**	**Sale Price of Traders (₹/kWh)**
1	Minimum	3.01
2	Maximum	7.30
3	Weighted Average	5.15
Source: Information submitted by trading licensees		

Table-5: PRICE OF ELECTRICITY TRANSACTED THROUGH POWER EXCHANGES, APRIL 2019			
Sr.No	**ACP**	**Price in IEX (₹/kWh)**	**Price in PXIL (₹/kWh)**
1	Minimum	1.80	2.01
2	Maximum	11.84	4.24
3	Weighted Average	3.33	3.71
Source: Information submitted by IEX and PXIL			

Source : CERC Market Monitoring Cell

Key System Requirements _ Market Based Trade

- Metering Arrangements;
- Data & Communication Facilities;
- System Recording Instruments;
- Protocol towards Event Information;
- Reactive Power Compensation;
- Cyber Security;
- Principles towards treatment of transmission losses;
- Provisions towards System Operation Fee & Charges;
- Metering, Energy Accounting & Settlement;

Power Exchange based Trade and related issues

- Stringent time line for submission and clearing of bids
- Market splitting and addressal towards transmission congestion
- Suspension of market in case of unforeseen contingent conditions
- Need towards continuous monitoring of prevailing prices
- Applicability of deviation charges and need for load forecasting

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Deviation Settlement Mechanism (DSM) Price linked to ACP in Power Exchange

DSM Price Vector — P is ACP in PX

Average Frequency of the time block (Hz)		Charges for Deviation (Paise/kWh)
Below	Not Below	
	50.05	0.00
50.05	50.04	**1xP/5**
50.04	50.03	**2xP/5**
50.03	50.02	**3xP/5**
50.02	50.01	**4xP/5**
50.01	50.00	**P**
50.00	49.99	**50.00+15xP/16**
49.99	49.98	**100.00+14xP/16**
49.98	49.97	**150.00+13xP/16**
49.97	49.96	**200.00+12xP/16**
49.96	49.95	**250.00+11xP/16**
49.95	49.94	**300.00+10xP/16**
49.94	49.93	**350.00+9xP/16**
49.93	49.92	**400.00+8xP/16**
49.92	49.91	**450.00+7xP/16**
49.91	49.90	**500.00+6xP/16**
49.90	49.89	**550.00+5xP/16**
49.89	49.88	**600.00+4xP/16**
49.88	49.87	**650.00+3xP/16**
49.87	49.86	**700.00+2xP/16**
49.86	49.85	**750.00+1xP/16**
49.85		800.00

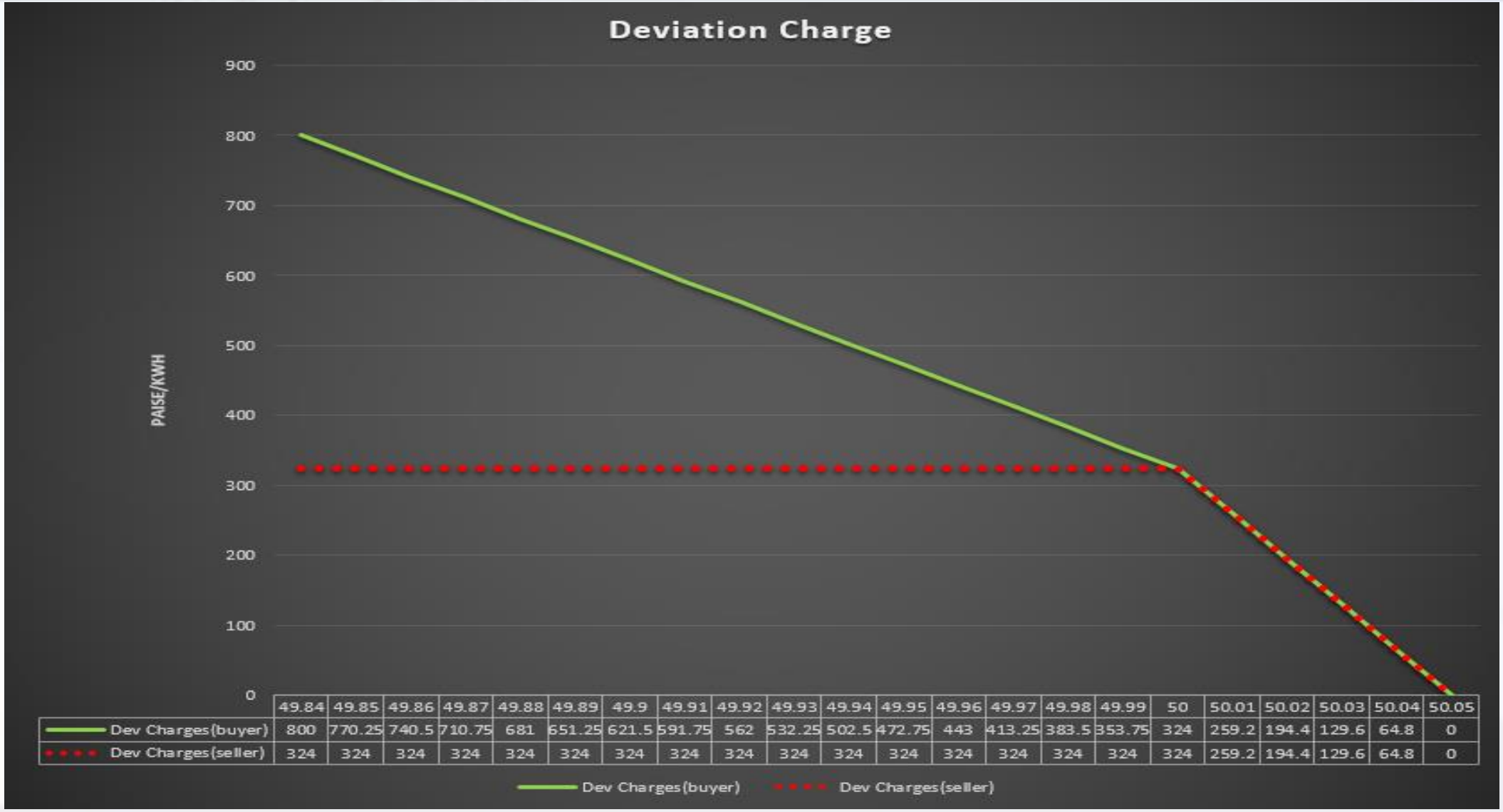
DSM Price linked to PX Clearing Price:

- **Daily (simple) Average Area Clearing Price (ACP) discovered in the Day Ahead Market segment of power exchange shall be considered the Price at 50.00 Hz.**
- **The maximum ceiling limit applicable for average Daily ACP shall be 800 Paisa/kWh.**
- **The Deviation Settlement Mechanism (DSM) vector will have dynamic slope by connecting points as below:**
  - ✓ **50.05 Hz (zero);**
  - ✓ **50 Hz. (daily simple average ACP);**
  - ✓ **49.85 Hz (Rs. 8 per unit);**

Additional DSM Charges:

- **Additional Charge 1 – Additional DSM charge shall be leviable for crossing block wise volume limits;**
- **Additional Charge 2 – Additional DSM charge shall be leviable for violation of sign change stipulation;**

Deviation Charges Vector



	49.84	49.85	49.86	49.87	49.88	49.89	49.9	49.91	49.92	49.93	49.94	49.95	49.96	49.97	49.98	49.99	50	50.01	50.02	50.03	50.04	50.05
Dev Charges(buyer)	800	770.25	740.5	710.75	681	651.25	621.5	591.75	562	532.25	502.5	472.75	443	413.25	383.5	353.75	324	259.2	194.4	129.6	64.8	0
Dev Charges(seller)	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	259.2	194.4	129.6	64.8	0

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Extracts from ERPC Website in respect of Deviation Charges

सत्यमेव जयते

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
पूर्वी क्षेत्रीय विद्युत समिति
Eastern Regional Power Committee
14, गोल्फ क्लब रोड, टालीगंज, कोलकाता-700033
14 Golf Club Road, Tollygunj, Kolkata-700033

आई एस ओ : 9001-2008
ISO : 9001-2008

Tel No. :033-24239651, 24239650 FAX No.:033-24239652, 24239653 Web: **www.erpc.gov.in**

NO: ERPC/COM-II/ABT-DC/ 2184 - 2218 Date: 30.05.2019

To
As per List

Sub: Statement of Deviation Charges including Additional Deviation Charges, RRAS, FRAS & SCED Settlement Account for the period from 06.05.2019 to 12.05.2019.

http://erpc.gov.in/ui-and-deviation-accts/

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Extracts from ERPC Website in respect of Deviation Charges

EASTERN REGIONAL POWER COMMITTEE

KOLKATA

ABT based Deviation Charge Account

For the period 06.05.19 TO 12.05.19

AS PER 4TH AMENDMENT OF DSM, 2018 W.E.F. 01/01/2019

(All figures in Rs. Lakhs)

UTILITIES AND DEVIATION CHARGES PAYABLE BY THEM	DEVIATION CHARGE (in Rs. Lakhs)		ADDITIONAL DEVIATION CHARGE DUE TO VIOLATION OF BLOCK WISE VOLUME LIMIT (in Rs. Lakhs.)	ADDITIONAL DEVIATION CHARGE DUE TO VIOLATION OF SIGN CHANGE (in Rs. Lakhs.)	FINAL DEVIATION CHARGE (in Rs. Lakhs)	
	RECEIVABLE	PAYABLE			RECEIVABLE	PAYABLE
A	B	C	D	E	F	G
INTER- NATIONAL						
NVVN-BD		41.26403	4.45213	123.79210		169.50827
NVVN-NEPAL		14.79009	4.36109	4.05025		23.20142
TPTCL		37.37994	1.91428			39.29422

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Key Takeaways and Way Forward

- ❑ Strong Cross Border Connections can bring in Regional Economy & Efficiency;
- ❑ For strong connectivity connections need to be made at multiple points;
- ❑ Within Nepal internal system there is a need for strong interconnections;
- ❑ There is a need to operate the whole system as one interconnected Grid;
- ❑ Transactions through market can bring in overall economy and efficiency;
- ❑ For enabling market based trade metering and other requisites are essential;
- ❑ A close eye need to be kept on deviations and accurate load forecasting;
- ❑ Enabled Regional Common Information System/MIS can help enhancing CBET;

THANK YOU