




Big Rivers
ELECTRIC CORPORATION

Team Cumberland Presentation
April, 2017

Our Mission

Big Rivers will safely deliver competitive and reliable wholesale power and cost-effective shared services desired by the Member-Owners.

Our Vision

Big Rivers will be viewed as one of the top G&Ts in the country and will provide services the members desire in meeting future challenges.

Our Values

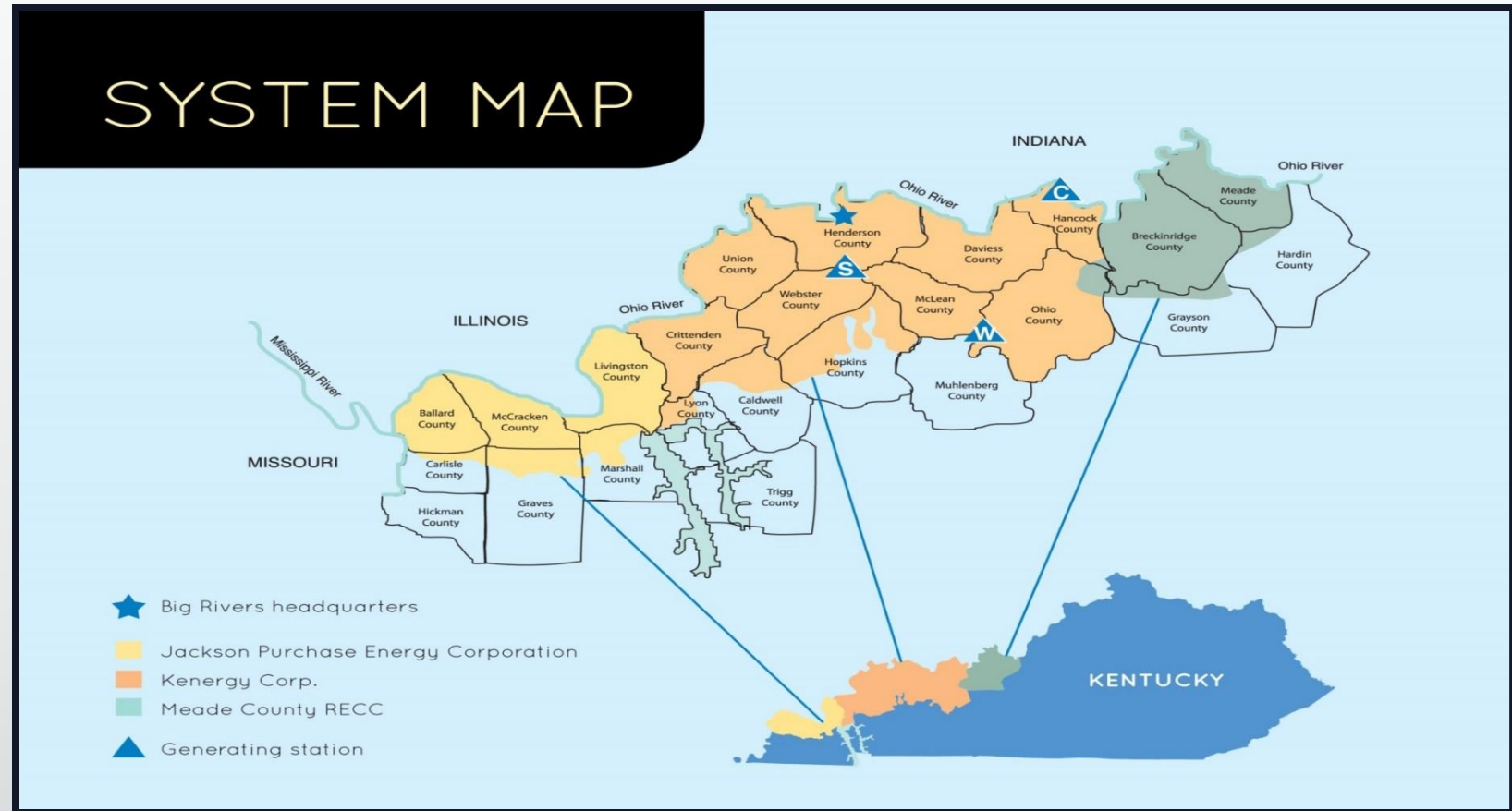
- Safety
- Integrity
- Excellence
- Member-Owners & Community Service
- Respect for Employee
- Teamwork
- Environmentally Conscious



Serving Three Member-Owner Distribution Cooperatives

- Jackson Purchase Energy Corporation
- Kenergy
- Meade County RECC

*We power more than
116,000 homes and
businesses in Kentucky.*



Generation & Transmission

- 1,444 MW Generating Capacity Owned
- 1,819 MW Power Capacity Available
 - Henderson Municipal Power & Light (HMP&L) Station II
 - Southeastern Power Administration (SEPA) - Hydropower



Miles of Transmission Lines

Acres of Right-of-Way

More than 17,500 Poles

More than 20 Substations

Transmission Interconnections with
Neighboring Utilities

Big Rivers Cumberland Allocation

Big Rivers Dependable Capacity per contract

178 MW

Big Rivers Energy

1500 KWH per KW of contract demand (from July 1-June 30)

Maximum monthly 240 hours per KW

Minimum monthly 60 hours per KW

Big Rivers Dependable Capacity Per Revised Interim Operation and Marketing Changes 6/17/2014

154 MW

Big Rivers Energy under Revised Interim Operation and Marketing Changes

Monthly minimum 9,240 MWH

Monthly maximum 29,260 MWH

Contract Year Minimum Energy 222,500 MWH

Big Rivers uses Cumberland Allocation to offset costs for Load

MISO requires purchase of all load at Locational Marginal Price (LMP).

Big Rivers Cumberland Allocation sinks at Big Rivers load and as a Grandfathered agreement Serves to offset payment to MISO MWH for MWH.

One hour Example:

Big Rivers Load 700 MWH

LMP = \$45/MWH

Big Rivers Tagged delivery SEPA Cumberland Energy= 154 MWH

MISO Load Settlement for this hour - Big Rivers pays

700 MWH Load

Less tagged delivery sinking at Big Rivers load (154 MWH)

= 700-154 MWH * LMP \$45/MWH

= 546 MWH * \$45/MWH

=\$24,570 paid to MISO

Therefore, SEPA deliveries offset Big Rivers payments to MISO at Big Rivers' hourly LMP

Constraints on Optimizing the benefit of Cumberland Allocation

Big Rivers strives to optimize the Cumberland deliveries within constraints.

Contract Constraints

- Contract Availability (154 is the optimum under Revised plan)
- Monthly minimum and maximum MWH
- Annual MWH requirement

MISO Constraints for capacity resources

- Scheduling a minimum of 4 consecutive hours daily across peak

Price considerations for optimizing

- Schedule during highest LMP hours, within constraints
 - Minimum 4 hours/day to equal between 9,240 MWH and 29,260 MWH each month
 - $(4 \text{ hrs/day} * 30 \text{ days}) * 36 = 4,320 \text{ MWH (below contract minimum)}$

Big Rivers Schedule

Week of 11/6/16 through 11/12/16

Big Rivers Electric Corporation Big Rivers Weekly Schedule of SEPA Power

Week of: 6-Nov-2016 to 12-Nov-2016															Thursday Date	
															3-Nov	
Hour	Hour	Sunday	Sunday	Monday	Monday	Tuesday	Tuesday	Wednesday	Wednesday	Thursday	Thursday	Friday	Friday	Saturday	Saturday	Capacity
Ending	Ending	Sunday	DA LMP	Monday	DA LMP	Tuesday	DA LMP	Wednesday	DA LMP	Thursday	DA LMP	Friday	DA LMP	Saturday	DA LMP	36
(CST)	(EST)	11/6/2016		11/7/2016		11/8/2016		11/9/2016		11/10/2016		11/11/2016		11/12/2016		
24	1		19.38		17.76		19.59		20.96		18.89		18.75		21.30	
1	2		18.36		16.10		18.42		19.65		18.67		18.40		19.76	
2	3		17.75		15.85		17.92		19.29		17.12		17.84		19.21	
3	4		17.68		16.24		17.67		19.26		16.43		17.63		18.58	
4	5		17.98		17.55		18.21		19.73		18.78		18.48		19.31	
5	6		18.36		20.57		20.60		22.27		21.12		20.61		19.75	
6	7		20.04	36	35.02	36	30.67	36	31.64	36	27.31	36	25.64		22.28	
7	8		21.79	36	30.47	36	28.83	36	32.91	36	29.62	36	29.64		24.07	
8	9		25.38	36	27.20	36	27.30	36	31.19	36	27.57	36	27.29		24.13	
9	10		24.54	36	26.50	36	26.74	36	30.01	36	26.53	36	26.96		24.61	
10	11		23.35	36	27.38	36	27.15	36	29.99	36	26.87	36	27.52		24.00	
11	12		22.48	36	26.75	36	26.66	36	28.88	36	26.33	36	28.04		22.93	
12	13		22.38	36	26.62	36	25.73	36	27.99	36	25.94	36	26.74		22.05	
13	14		22.57	36	26.75	36	25.36	36	27.30	36	25.39	36	26.18		21.69	
14	15		22.34	36	26.52	36	24.13	36	25.77	36	25.13	36	25.85		20.40	
15	16		22.68	36	26.92	36	25.13	36	26.40	36	23.82	36	24.22		20.10	
16	17		23.78	36	26.68	36	24.45	36	25.70	36	24.33	36	25.64		20.87	
17	18	36	29.55	36	33.40	36	30.05	36	32.24	36	30.25	36	32.82	36	24.75	
18	19	36	28.82	36	39.07	36	35.15	36	34.50	36	30.55	36	35.36	36	25.92	
19	20	36	26.08	36	31.66	36	28.91	36	29.31	36	26.27	36	30.18	36	24.01	
20	21	36	23.63	36	27.54	36	26.52	36	27.16	36	25.59	36	26.35	36	22.45	
21	22		22.09		24.81		24.83		24.51		23.01		24.37		22.02	
22	23		20.50		22.88		22.60		22.77		21.09		22.97		20.57	
23	24		19.33		21.17		21.97		20.48		19.07		21.62		19.82	
	Total	144		540		540		540		540		540		144		

Daily average LMP at BREC Load	22.12	25.48	24.77	26.25	23.99	24.96	21.86	Weekly total
Optimum: schedule 4 highest LMP hours at full capability								
Highest 4 hour average LMP	27.06	32.92	30.16	31.44	28.17	31.18	24.28	
Optimum Offset \$ if 154 MW SEPA	\$ 16,667	\$ 20,277	\$ 18,577	\$ 19,366	\$ 17,350	\$ 19,205	\$ 14,958	\$ 126,400
Instead, Scheduled 36 MW Available Energy to meet constraints								
Avg LMP during Scheduled hours	27.02	29.23	27.52	29.40	26.77	27.90	24.28	
Actual Offset \$	\$ 3,891	\$ 15,785	\$ 14,860	\$ 15,876	\$ 14,454	\$ 15,063	\$ 3,497	\$ 83,426

Weekly Opportunity Cost = Optimum Offset less Actual Offset \$42,974

Big Rivers Schedule 9/18/16 through 9/24/16

Higher market prices – even more lost opportunity

Big Rivers Electric Corporation Big Rivers Weekly Schedule of SEPA Power																Thursday Date		
Week of:		18-Sep-2016				to				24-Sep-2016						15-Sep		
Hour	Hour	Sunday	Sunday	Monday	Monday	Tuesday	Tuesday	Wednesday	Wednesday	Thursday	Thursday	Friday	Friday	Saturday	Saturday	Capacity	73	
Ending	Ending	Sunday	DA LMP	Monday	DA LMP	Tuesday	DA LMP	Wednesday	DA LMP	Thursday	DA LMP	Friday	DA LMP	Saturday	DA LMP			
(CST)	(EST)	9/18/2016		9/19/2016		9/20/2016		9/21/2016		9/22/2016		9/23/2016		9/24/2016				
24	1		21.40		20.73		21.94		21.38		21.06		22.27		21.89			
1	2		20.09		19.18		20.61		20.03		19.36		20.27		20.02			
2	3		18.25		18.72		19.83		18.94		18.18		19.17		19.10			
3	4		18.15		19.02		19.92		19.10		18.71		19.78		18.68			
4	5		18.87		21.78		21.26		21.24		20.86		21.76		19.86			
5	6		19.44		27.34		25.53		25.71		25.38		25.88		21.00			
6	7		20.82		28.74		27.27		26.53		26.36		27.35		22.13			
7	8		22.45		29.36		27.26		26.79		25.97		26.82		23.25			
8	9		24.37		31.70		29.06		28.60		29.08		29.27		25.31			
9	10		26.42		33.95		32.16		33.58		33.13		33.49		26.80			
10	11		28.63		38.08		37.33		38.00		37.65		35.54		28.36			
11	12		31.48		43.58		40.97		42.05		42.46		40.43		32.07			
12	13		35.48		47.73		46.77	73	47.93	73	48.99	73	45.35		34.94			
13	14		40.44	73	56.62	73	54.46	73	58.02	73	57.75	73	52.06	73	38.20			
14	15	73	45.34	73	65.65	73	65.58	73	70.07	73	66.08	73	61.39	73	43.86			
15	16	73	47.54	73	68.99	73	70.16	73	73.16	73	69.80	73	62.36	73	46.52			
16	17	73	46.15	73	62.68	73	61.22	73	66.87	73	63.27	73	53.53	73	43.74			
17	18	73	38.21		51.10		49.16	73	51.86	73	52.08	73	42.43		37.98			
18	19		34.40		42.21		42.78		43.79	73	46.54		39.08		34.55			
19	20		35.46		43.13		39.53		43.31		45.30		37.21		33.43			
20	21		29.15		37.41		32.93		35.37		34.51		30.58		27.93			
21	22		26.15		31.09		28.98		29.12		28.38		27.30		25.58			
22	23		22.88		26.56		24.65		24.16		24.69		25.32		24.16			
23	24		22.53		24.61		22.95		23.03		23.37		23.52		23.54			
	Total	292		292		292		438		511		438		292				
Daily average LMP at BREC Load			28.92		37.08		35.93		37.03		36.62		34.26		28.87			
																Weekly total		
Optimum: schedule 4 highest LMP hours at full capability																		
Highest 4 hours average LMP			44.87		63.49		62.86		67.03		64.23		57.34		43.08			
Optimum Offset \$ if 154 MW SEPA Available		\$	27,638		\$	39,107		\$	38,719		\$	41,290		\$	35,318		\$	248,173
Instead, Scheduled 73 MW Available Energy to meet constraints																		
Average LMP during Scheduled hours			44.31		63.49		62.86		61.32		57.79		52.85		43.08			
Actual Offset \$		\$	12,939		\$	18,538		\$	18,354		\$	26,857		\$	23,150		\$	141,946
																Weekly Opportunity Cost = Optimum Offset less Actual Offset	\$106,227	

Limitations on Availability of Dependable Capability reduce benefits of Cumberland hydropower

Cumberland hydropower allocation is optimized when maximum availability is *scheduled during hours of highest cost.*

When available allocation is reduced, Big Rivers must schedule during hours when prices are lower.

Reduced availability of Cumberland power one week in November cost Big Rivers over \$40,000 in opportunity cost.

This was a week of low prices and low volatility. When volatility is higher, the opportunity costs grow.

Capacity limitations are costly, too.

For Planning Year 2016-17 (June 1, 2016- May 31, 2017)

Big Rivers Contract Capacity: 178 MW

Big Rivers Revised Capacity: 154 MW

Volume Lost Capacity: 24 MW

MISO Zone 6 Capacity Clearing Price: \$72/MW-Day

Big Rivers Lost Capacity cost Planning Year 2016-17 \$630,720

Questions?

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