A

Between December 2013 and December 2015, the average contact and spot prices for butadiene and styrene, the primary raw materials used to manufacture ESBR, decreased as follows:

	Contract	Spot
Butadiene	-46%	-35%
Styrene	-36%	-48%

Submitted by AMS

Raw Materials Pricing
Source: www.icis.com

Butadiene

BD FOB USG Contract $/lb			
Month	Low	High	Average
Jan-13	76.00	76.00	76.00
Feb-13	76.00	76.00	76.00
Mar-13	84.00	84.00	84.00
Apr-13	84.00	84.00	84.00
May-13	79.00	79.00	79.00
Jun-13	74.00	74.00	74.00
Jul-13	66.00	66.00	66.00
Aug-13	40.00	46.00	43.00
Sep-13	40.00	44.00	42.00
Oct-13	46.00	46.00	46.00
Nov-13	54.00	54.00	54.00
Dec-13	54.00	54.00	54.00
Jan-14	55.00	55.00	55.00
Feb-14	60.00	60.00	60.00
Mar-14	68.00	68.00	68.00
Apr-14	68.00	68.00	68.00
May-14	68.00	68.00	68.00
Jun-14	65.00	65.00	65.00
Jul-14	62.00	62.00	62.00
Aug-14	60.00	60.00	60.00
Sep-14	56.00	56.00	56.00
Oct-14	54.00	54.00	54.00
Nov-14	44.00	46.00	45.00
Dec-14	41.00	43.00	42.00
Jan-15	35.00	37.00	36.00
Feb-15	27.00	29.00	28.00
Mar-15	27.00	29.00	28.00
Apr-15	27.00	29.00	28.00
May-15	27.00	30.00	28.50
Jun-15	32.00	35.00	33.50
Jul-15	38.00	41.00	39.50
Aug-15	36.00	41.00	38.50
Sep-15	33.00	38.00	35.50
Oct-15	32.00	37.00	34.50
Nov-15	30.00	34.00	32.00
Dec-15	27.00	31.00	29.00
Jan-16	25.00	29.00	27.00
Feb-16	24.00	25.00	24.50
Mar-16	24.00	25.00	24.50
Apr-16	29.00	30.00	29.50
May-16	31.00	33.00	32.00
Jun-16	34.00	36.00	35.00

AVG. DEC. 2013-2015 -46%

Butadiene

BD CIF USG Spot $/lb			
Month	Low	High	Average
Jan-13	71.25	77.50	74.38
Feb-13	78.75	83.75	81.25
Mar-13	85.00	90.00	87.50
Apr-13	83.75	88.75	86.25
May-13	74.00	83.00	78.50
Jun-13	63.75	68.75	66.25
Jul-13	46.25	51.25	48.75
Aug-13	46.00	51.00	48.50
Sep-13	47.50	52.50	50.00
Oct-13	50.00	55.00	52.50
Nov-13	51.00	56.00	53.50
Dec-13	51.67	56.67	54.17
Jan-14	63.40	68.40	65.90
Feb-14	73.75	78.75	76.25
Mar-14	73.50	78.50	76.00
Apr-14	74.75	79.75	77.25
May-14	71.00	74.80	72.90
Jun-14	68.00	72.00	70.00
Jul-14	65.50	70.50	68.00
Aug-14	60.20	63.40	61.80
Sep-14	51.50	56.50	54.00
Oct-14	43.80	49.20	46.50
Nov-14	42.19	46.94	44.56
Dec-14	38.50	42.00	40.25
Jan-15	34.00	40.50	37.25
Feb-15	29.13	31.00	30.06
Mar-15	30.75	33.50	32.13
Apr-15	31.63	33.13	32.38
May-15	36.60	40.00	38.30
Jun-15	42.75	46.25	44.50
Jul-15	44.60	48.80	46.70
Aug-15	43.25	46.00	44.63
Sep-15	41.25	43.50	42.38
Oct-15	38.80	41.40	40.10
Nov-15	36.00	38.00	37.00
Dec-15	33.50	37.00	35.25
Jan-16	29.00	30.25	29.63
Feb-16	24.00	26.00	25.00
Mar-16	29.25	31.75	30.50
Apr-16	32.70	35.30	34.00
May-16	35.50	37.50	36.50
Jun-16	39.50	42.00	40.75

-35%

Styrene

STY FOB US Contract $/lb			
Month	Low	High	Average
Jan-13	81.75	85.75	83.75
Feb-13	81.75	85.75	83.75
Mar-13	79.50	83.50	81.50
Apr-13	77.25	81.25	79.25
May-13	77.25	81.25	79.25
Jun-13	76.75	80.75	78.75
Jul-13	77.75	81.75	79.75
Aug-13	78.75	82.75	80.75
Sep-13	80.25	84.25	82.25
Oct-13	78.25	82.25	80.25
Nov-13	75.75	79.75	77.75
Dec-13	80.25	84.25	82.25
Jan-14	84.25	88.25	86.25
Feb-14	85.00	89.00	87.00
Mar-14	83.00	87.00	85.00
Apr-14	81.00	85.00	83.00
May-14	79.50	83.50	81.50
Jun-14	78.75	82.75	80.75
Jul-14	84.75	88.75	86.75
Aug-14	81.75	85.75	83.75
Sep-14	79.50	83.50	81.50
Oct-14	77.25	81.25	79.25
Nov-14	72.75	76.75	74.75
Dec-14	62.75	68.75	65.75
Jan-15	52.00	55.00	53.50
Feb-15	50.00	53.00	51.50
Mar-15	50.00	54.00	52.00
Apr-15	56.00	60.00	58.00
May-15	60.50	64.50	62.50
Jun-15	57.75	61.75	59.75
Jul-15	60.00	64.00	62.00
Aug-15	57.00	61.00	59.00
Sep-15	49.00	53.00	51.00
Oct-15	49.00	53.00	51.00
Nov-15	49.00	54.00	51.50
Dec-15	50.00	55.00	52.50
Jan-16	48.50	53.50	51.00
Feb-16	46.75	51.75	49.25
Mar-16	49.75	54.75	52.25
Apr-16	52.25	57.25	54.75
May-16	52.25	57.25	54.75
Jun-16	51.25	56.25	53.75

-36%

Styrene

STY FOB USG Spot $/lb			
Month	Low	High	Average
Jan-13	74.69	75.25	74.97
Feb-13	77.06	77.94	77.50
Mar-13	73.55	74.70	74.13
Apr-13	71.38	72.38	71.88
May-13	71.60	72.55	72.08
Jun-13	72.81	73.56	73.19
Jul-13	75.19	76.00	75.59
Aug-13	76.35	77.20	76.78
Sep-13	76.63	77.38	77.00
Oct-13	71.69	72.56	72.13
Nov-13	70.05	70.85	70.45
Dec-13	74.08	74.67	74.38
Jan-14	77.20	77.65	77.43
Feb-14	74.25	75.50	74.88
Mar-14	71.75	73.56	72.66
Apr-14	71.13	71.50	71.31
May-14	70.05	70.85	70.45
Jun-14	72.44	73.50	72.97
Jul-14	74.50	75.00	74.75
Aug-14	71.80	72.00	71.90
Sep-14	68.75	69.25	69.00
Oct-14	67.95	68.75	68.35
Nov-14	59.69	60.19	59.94
Dec-14	43.50	45.75	44.63
Jan-15	38.00	39.25	38.63
Feb-15	42.88	44.13	43.50
Mar-15	53.13	54.31	53.72
Apr-15	54.41	55.48	54.94
May-15	58.71	60.06	59.39
Jun-15	56.50	57.00	56.75
Jul-15	54.35	54.85	54.60
Aug-15	49.06	49.81	49.44
Sep-15	38.45	38.45	38.45
Oct-15	38.32	38.57	38.45
Nov-15	38.55	39.35	38.95
Dec-15	38.25	38.50	38.38
Jan-16	37.49	38.30	37.89
Feb-16	41.11	41.41	41.26
Mar-16	47.30	47.80	47.55
Apr-16	46.63	47.04	46.84
May-16	45.55	45.80	45.68
Jun-16	42.31	43.69	43.00

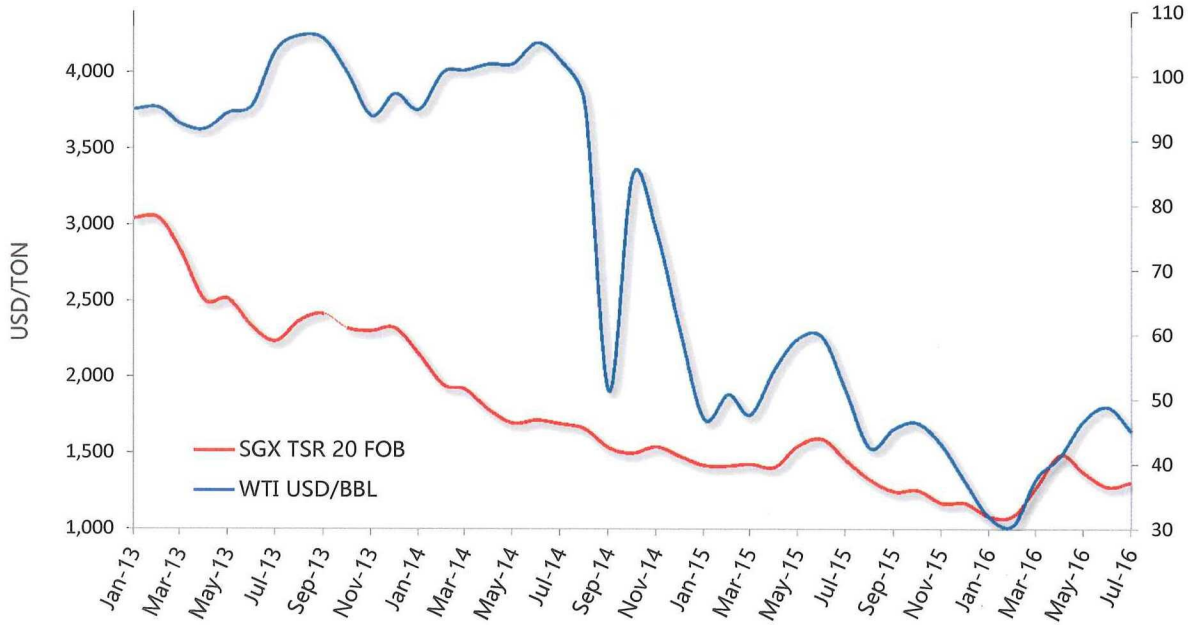
-48%

B

Between December 2013 and December 2015, the price of natural rubber, a substitute for ESBR, decreased by no less than 50%.

	WTI USD/BBL	SGX TSR 20 FOB	% Change
Jan-13	94.90	3,045	5.16%
Feb-13	95.23	3,046	0.03%
Mar-13	92.69	2,830	-7.09%
Apr-13	91.86	2,505	-11.49%
May-13	94.36	2,515	0.39%
Jun-13	95.54	2,329	-7.37%
Jul-13	104.02	2,236	-4.02%
Aug-13	106.36	2,374	6.16%
Sep-13	105.82	2,417	1.85%
Oct-13	100.58	2,321	-3.98%
Nov-13	93.88	2,304	-0.73%
Dec-13	97.31	2,322	0.78%
Jan-14	94.88	2,146	-7.57%
Feb-14	100.67	1,947	-9.28%
Mar-14	100.96	1,918	-1.50%
Apr-14	101.96	1,781	-7.15%
May-14	101.99	1,698	-4.68%
Jun-14	105.23	1,716	1.08%
Jul-14	102.51	1,693	-1.37%
Aug-14	96.05	1,660	-1.91%
Sep-14	51.36	1,535	-7.57%
Oct-14	84.55	1,500	-2.28%
Nov-14	76.07	1,542	2.85%
Dec-14	60.80	1,479	-4.14%
Jan-15	46.99	1,420	-3.98%
Feb-15	50.82	1,417	-0.21%
Mar-15	47.67	1,429	0.86%
Apr-15	54.65	1,408	-1.43%
May-15	59.44	1,550	10.03%
Jun-15	59.76	1,592	2.71%
Jul-15	51.47	1,454	-8.63%
Aug-15	42.59	1,324	-8.95%
Sep-15	45.56	1,247	-5.84%
Oct-15	46.44	1,254	0.60%
Nov-15	43.05	1,171	-6.63%
Dec-15	37.35	1,171	-0.05%
Jan-16	31.84	1,083	-7.50%
Feb-16	30.63	1,089	0.58%
Mar-16	37.78	1,277	17.26%
Apr-16	41.30	1,488	16.55%
May-16	46.80	1,370	-7.93%
Jun-16	48.88	1,276	-6.86%
Jul-16	45.13	1,310	2.63%
% Change Dec. 2013-2015	-62%	-50%	

Source: Singapore Commodity Exchange



Source: . http://sgx.com/wps/portal/sgxweb/home/marketinfo/derivatives/delayed_prices/futures

C

International Institute of Synthetic Rubber Producers Inc.

When comparing ESBR to SSBR, it is IISRP's position that "[t]he market is getting more and more demanding in the aforesaid specifications, and such performance improvements cannot be achieved with E-SBR, making a gradual trend toward the use of S-SBR inevitable."

Solution Styrene-Butadiene Rubber (S-SBR)

WHAT IS SBR?

SBR stands for Styrene – Butadiene Rubber, that is a random copolymer from the aforesaid monomers. There are two major types of SBR, Emulsion SBR (E-SBR) and Solution SBR (S-SBR), based on the different manufacturing process. The peculiar nature of the insertion of butadiene on the growing chain, ie the 1,4 and 1,2 additions, together with the two possible 1,4 addition isomers, cis and trans, suggests that it would be more appropriate to refer to SBR as a four-monomer copolymer. This remark acquires a particular meaning if we consider the physical and rheological characteristics of the finished polymer. The balance between the structural unit content of styrene, 1,4 and 1,2 butadiene along the chain is the most important parameter affecting the Tg of the material. Most interestingly, the concentration of 1,4 trans units has a strong influence on the strain induced crystallization of the rubber, which means a reinforcing effect on the tensile ultimate properties: in this sense, natural rubber shows a strain induced crystallization behavior. Moreover, the relative concentration of 1,4 and 1,2 units may influence the thermal stability of the polymer. The oxidative degradation of the rubber starts from the addition of oxygen on a double bond: if the double bond id part of the main chain, as in the case of 1,4 units, the reaction will lead to a chain scission.

THE DEVELOPMENT OF NEW POLYMERS FOR TIRE INDUSTRY

Some of the requirements which have to be met during the development of a new polymer / formulation for tire production are:

Processability
Green strength, tack strength
Low hysteresis
Skid resistance, abrasion resistance, rolling efficiency
Thermo-oxidative stability
Low cut growth rate
Low cost.

In recent years, because of the interest in fuel savings, technological efforts developed in tire rubbers showing the lowest dissipation of energy, namely, the lowest rolling resistance, highest traction during braking and highest wear resistance (low abrasion).

The present, most important trends in the study and development of SBR rubbers (especially Solution SBRs, because of their high synthetic flexibility, in comparison with Emulsion SBR) for tire applications are:

Modification of the macrostructure (ie width of the Molecular Weight Distribution (MWD); presence, concentration and distribution of Long Chain Branching (LCB)) and of the microstructure (ie monomer composition ratio, control of the addition of butadiene units)

Research of suitable functionalization agents, in order to achieve specific chemical interactions with the filler (carbon black and/or silica). Moreover, it is worth mentioning that a functionalized rubber may show an improved adhesion onto certain substrates, namely the steel cords of the tire carcass.
In both cases, the goal is to improve the rheological behavior of the polymer in all the various phases of its "service life", namely:

The preparation of the compound, searching for the best possible compromise between the quality of mixing and the mixing time. In this sense the flow characteristics of the rubber are of the utmost importance and the macrostructural features are the practical tools by means of which the rheological parameters are controlled (ie pseudoplasticity, extensional viscosity, swelling, etc.). Also the interaction with the filler plays an important role. Moreover, We must mention the search for additives / modifiers that can be added to SBR at the compound stage to improve properties.

The ease of processing, which could be defined as the facility, for a certain material, to be melted, conveyed and shaped even into complex items, without an excessive consumption of energy and time and without any significant change in its final characteristics (ie degradation). The vulcanization process is crucial in SBR manufacturing and must be considered as part of the overall processing cycle

The end use behavior of the manufactured. In case of tires and, in particular, of the treads, We are talking about the "solid state properties"; in this sense, the most important characteristics are the dynamic properties showed in the different service situations, the mechanical characteristics (ie tensile strength, elongation at break) and the resistance to abrasion. The polymer microstructure (via the Tg), together with the homogeneity and quality of the vulcanized compound, influences the dynamic properties and the resistance to abrasion, while the mechanical behavior is strongly related to the polymer macrostructure (molecular weight distribution - MWD, long chain branching - LCB) and to the final result of the vulcanization.

It would be correct to add to the former points the efforts to modify the S-SBRs from the point of view of the process itself: the tendency is to increase progressively the monomer / solvent ratio in order to reduce the cost for the solvent recovery and treatment and to cut the emission of low molecular weight hydrocarbons (ie n-hexane, cyclohexane, traces of the residual monomers) into the environment. The logical target would be to develop a solvent-free, mass polymerization of styrene and butadiene, based upon anionic initiators. A processing machine like the extruder (or something resembling it) seems to be the better answer to the problems associated to mass polymerization, that is run-away reactions, the conveying of fluids whose viscosity changes of several orders of magnitude during the polymerization reaction and the recovery or residual monomers.

E-SBR COMPARED TO S-SBR.

There is a growing competition between E-SBR and S-SBR grades. And the very beginning of their development, S-SBRs suffered from processing problems, due to their narrow MWD. As the matter of fact, the main problem for S-SBR to overcome has always been the non – interchangeability with the E-SBRs commonly used by the tire producers: the limited number of grades coming from the emulsion process makes it easier to switch from a supplier to the other, without any re-configuration of the processing machines and procedures. So one of the main efforts of the S-SBR producers has been the search for a better processability, which is obtained by modifying the polymer macrostructure (ie MWD and LCB). In this sense, the use of coupling agents like $SiCl_4$ and $SnCl_4$ in the batch anionic synthesis provided a way to broaden the MWD adding a star-shaped structure at the same time.

In order to maximize market share, automotive companies have continuously developed vehicles with superior performance and durability (increased mileage). This has resulted in increasingly stringent tire performance specifications. These have been partly met by redesigning the structure components (ie tread patterns and reformulating compounds). In spite of their resistance, tire producers have found no alternative to S-SBR grades for highly specified tire components for high performance tires. The need for reducing fuel consumption led to the definition of specifications also for the rolling resistance of the tread material: in the U.S. the CAFE (Corporate Average Fuel Economy) regulations are gradually pushing in this direction. The market is getting more and more demanding in the aforesaid specifications, and such performances improvements cannot be achieved with E-SBR, making a gradual trend toward the use of S-SBR inevitable.

PLANT SCHEMES

The production of emulsion and solution SBR can be carried out by means of two fundamental process configurations: the batch process and the continuous process.

Typically, the E-SBR process is continuous, while S-SBR facilities are both continuous and batch.

The batch process allows a better and easier "fine tuning" of the reaction conditions and, therefore, of the polymer characteristics

Solution SBR is made by termination-free, anionic "living" polymerization initiated by alkyl lithium compounds, usually n-butyl lithium (NBL). The use of alkyl lithium compounds is due the solubility of this class of organometallics in the hydrocarbon solvents (n-hexane and cyclohexane) used in this process.

Thanks to the characteristics of "living" anionic solution polymerization, the final practical conversion of the reaction is 100 %, so there is no need for a residual monomer recovery step, as it is the case in the emulsion radical process (~ 70 % end conversion for oil extended grades).

Due to the broad range of possible micro and macrostructures, it is difficult to define a typical recipe for a S-SBR: the following table represents a general scheme, showing some of the most important features of the recipe for a 25% styrene S-SBR (the styrene content of the commercial products varies typically from 10 to 40%).

D

East West Copolymer L.L.C. (March 2016)

"The restart began after Lion Copolymer Holdings L.L.C. stopped production at the ESBR factory in Baton Rouge in December 2013."

"The facility restarted with two masterbatch and two clear lines by the end of the first quarter of 2014."

3/1/2016 UPDATED 3/1/2016

SR plant thrives, two years after rebirth

By EDWARD NOGA

Photo by Bruce MeyerGreg Nelson (right), president and CEO of East West Copolymer, along with the firm's Larry Harris at the ACS Rubber Division's 2014 Rubber Expo in Nashville, Tenn. Nelson said the revival of the Baton Rouge, La., SBR firm is going well.

BATON ROUGE, La.—The revival of the oldest synthetic rubber plant in North America, if not the world, has moved beyond the difficult startup phase two years after being reborn as East West Copolymer L.L.C.

The company has improved its operations, regained its customer base, fashioned a new union contract and brought on a major investor in its quest to remain one of only two domestic emulsion styrene-butadiene rubber producers in the U.S.

"Our customers wanted us back," said Greg Nelson, president and CEO of the Baton Rouge operation who spearheaded the company's rebirth. However, getting contract commitments required proof that East West Copolymer is a viable business—a status its clients now accept as reality, he said.

I. Back in action

The restart began after Lion Copolymer Holdings L.L.C. stopped production at the ESBR factory in Baton Rouge in December 2013. The facility was one of the original plants opened during World War II in the national effort to create a synthetic rubber industry to counter the loss of Southeast Asian natural rubber plantations to Japanese forces.

Over the years the factory was owned by a laundry list of companies—ranging from Sears, Roebuck and Co., Gates Rubber and Armstrong Rubber to Armtek, DSM and Lion Copolymer and its eventual owner, Goradia Capital L.L.C. Lion pointed to poor market conditions in some of the plant's customer segments and a reluctance to reinvest in the operation as reasons for the shutdown.

Nelson, with several employees and some investors, bought the facility and began putting it back in action as East West Copolymer.

"We spent a bit of that time (2014) and a little bit of 2015 proving ourselves, working to get all our customers back," Nelson said. The facility restarted with two masterbatch and two clear lines by the end of the first quarter of 2014.

"We were able for the most part to get back what we had before the shutdown," Nelson said. "For 2016 we have contracts with pretty much all the customers we had before we shut down. We have a contract level a little above what we had in 2015, which is great. We're positioned for success in 2016."

The firm brought customers in to see how the plant had been improved and automated, "is in good shape and running, the product quality good, in some cases better than it was before."

Restoring its customer base was a big vote of confidence for the business, Nelson said.

"These are our traditional customers, who we worked with the last 20, 30 years, so they know us. The key thing for them was are we going to be around, be a credible organization. We demonstrated that."

One of East West Copolymers' goals is to be the low-cost producer of ESBR. The facility traditionally had a production volume of about 80 million pounds, but it today is "right-sized" and not geared for that level, Nelson said.

"As we increase volume, as we are doing this year, we are getting closer to that goal (of being the low-cost producer), because we were able to take out a lot of cost at the plant and run it more efficiently," he said. The factory has plenty of room to add capacity if needed.

East West Copolymer also secured supply agreements, among them with Exxon, which operates a huge complex next door to the rubber company. The revived SR producer had plans to buy utilities from its petrochemical neighbors to decrease costs, and while it hasn't been able to do that yet, Nelson said the idea still is on the drawing board.

II. A labor deal

A permanent labor pact with the Operating Engineers Local 216 was another priority.

"They canceled the contract with Lion, and had a temporary contract with us," Nelson said. For the past year the union and East West Copolymer worked at

negotiating a permanent agreement, and recently succeeded in getting a two-year deal.

"That puts us in pretty good stead. The union has done a really good job of working with us," Nelson said. The facility employs about half of the 310 staff it had when the shutdown occurred.

Next up on the "to-do" list was getting more investors to ensure the company's growth plans succeed. Originally, the investors were "myself, the employees and one other investor, a friend of mine," the president said. The company was able to attract some other investors, including Main Street Capital Corp., which provided $12 million.

Just after Christmas, East West Copolymer closed a deal with TerraMar Capital L.L.C., a Los Angeles-based private equity company. "They brought in additional capital to help us grow. The firm is in good shape now for several years to come," he said.

The investors recognized that East West Copolymer, operating as a viable business, is in a good position as one of only two independent SBR businesses in North America, Nelson said.

Lion Copolymer, after closing and selling the Baton Rouge operation, re-entered the ESBR business in late 2014 when it bought Ashland Inc.'s International Specialty Products' SBR business. Ashland had obtained the operation when it acquired ISP, which itself purchased the onetime Ameripol Synpol unit out of bankruptcy in 2003.

Ashland had been shopping the rubber business for awhile, and Nelson admitted East West Copolymer contemplated making a bid for it. "The timing wasn't right," Nelson said, as his company had its hands full re-establishing itself.

The return of Lion Copolymer as a competitor now has no particular impact on East West Copolymer, Nelson said—same operation, just a different owner.

III. Other accomplishments

Among other activities East West Copolymer accomplished since its startup was securing a $16 million revolving credit facility with NewStar Financial Inc. last September, and signing on T.L. Squire & Co. Inc. to handle sales and marketing of SBR to non-tire rubber product makers in North America.

T.L. Squire essentially fills a role formerly held by Harwick Standard Distribution, which moved on from the Baton Rouge operation when Lion shut it down. Nelson said the T.L. Squire arrangement started off a little slow, but

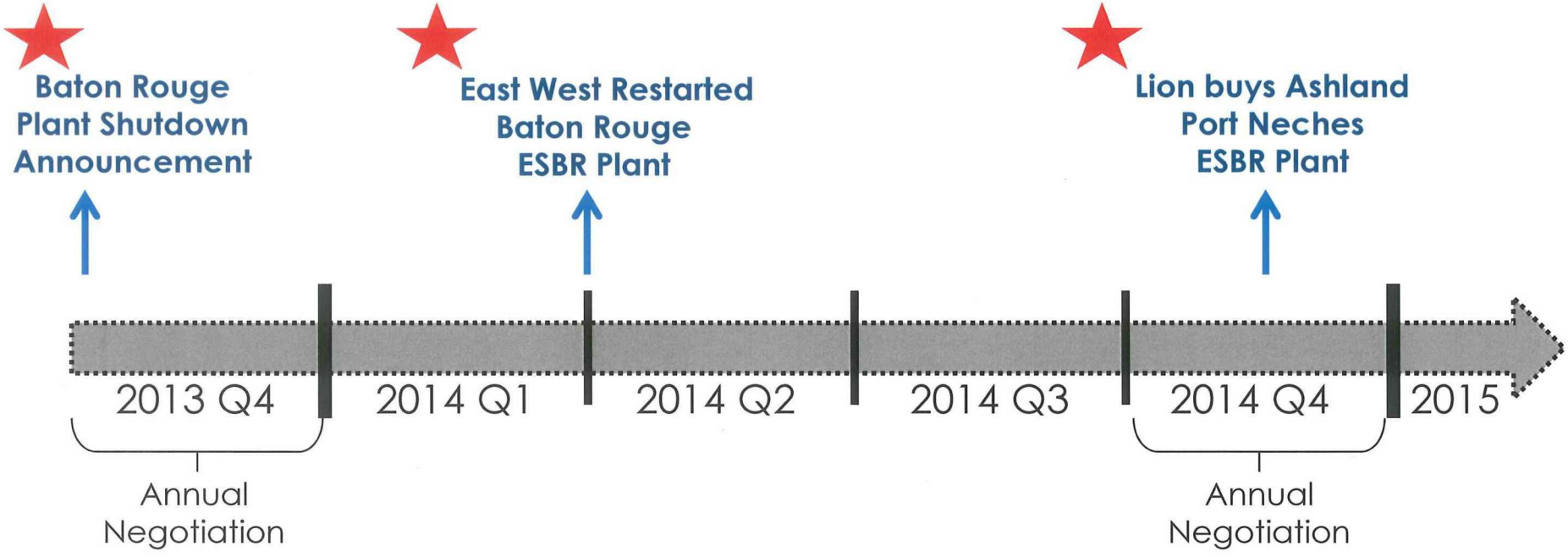
“ramped up last year, and we expect a big year from them. They have been great. They have been in the market a long time, have lots of customers and are well-respected,” he said.

While the overall prospects are good, Nelson said East West Copolymer does have to deal with some global issues in the SBR market, specifically the economic slowdown in China.

“The spot market is still a challenge,” he said. “A lot of volume that historically has gone to China is finding its way into North America, and we have to compete with that.”

In contrast, the huge decline in oil prices has resulted in some lower raw material costs, particularly for butadiene, he said.

E


Baton Rouge
Plant Shutdown
Announcement
East West Restarted
Baton Rouge
ESBR Plant
Lion buys Ashland
Port Neches
ESBR Plant
2013 Q4
2014 Q1
2014 Q2
2014 Q3
2014 Q4
2015
Annual
Negotiation
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