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Forecasting Industrial Wood Pellet Prices – A new model for calculating future prices[1]

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FutureMetrics has developed a comprehensive model for estimating the cost of producing and transporting wood pellets from all major producing regions to the foreign ports of major industrial end users.

Our model provides valuable insight into the future costs and prices for industrial wood pellets and the potential cash flow risks associated with the uncertainty of those costs. It is important to analyze pellet supply chain cash flows and costs to better understand the price dynamics in long-term offtake agreements. FutureMetrics' model provides insight into the components of the total cost of industrial wood pellets delivered to a foreign port.

The analysis of the model's outputs offers information that is crucial to due diligence by pellet producers, buyers, traders, suppliers, and financial stakeholders in the wood pellet industry.

This white paper describes the model and some of the insights the analysis can offer.

Historical Prices for Delivered Pellets as a Baseline for Calibrating the Model

FutureMetrics has estimated the historical delivered (CIF) price of wood pellets from international trade data. In aggregate, data on the value and quantity of imported pellets gives insight into the actual prices that buyers are paying for pellet fuel. Because most of the international trade in pellets is under long-term contracts, rather than on a spot market, the prices we calculate reflect a competitive long-run market-clearing value.

Long-term offtake prices are based on mutually sustainable price agreements for the pellet fuel. Those prices are unaffected by short-term supply and demand imbalances. The spot price for industrial wood pellets, on the other hand, is strongly influenced by short-term supply and demand imbalances. If the market is in a state of excess supply, prices fall. If the market in a state of excess demand, prices rise. Because such a large proportion of the total market is under long-term contract, the limited volume available on the spot market is more volatile as it reflects most of the short-term supply and demand imbalances.

In our model, FutureMetrics has estimated CIF prices for several common destinations including ARA[2], the UK, South Korea, and Japan. The estimates for CIF Japan and UK are shown in the charts below. Note that the weighted average considers the market shares of the exporting countries.

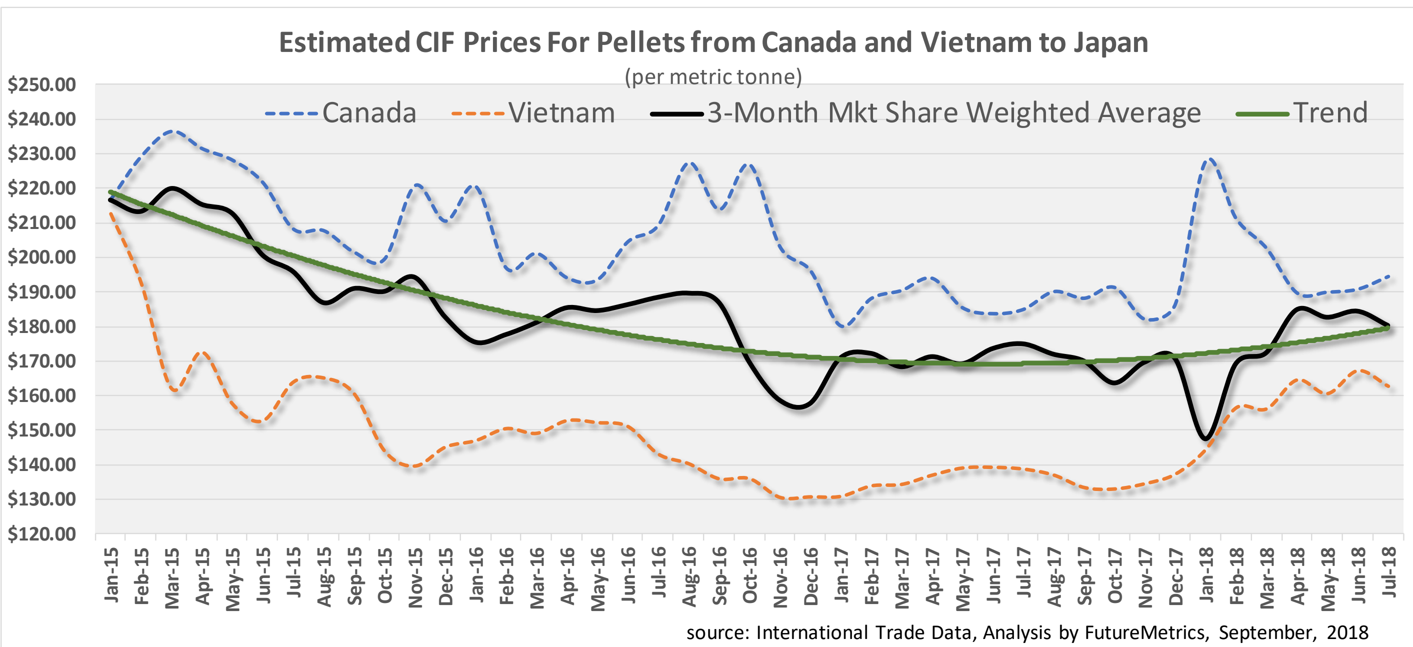
[1] A short version of this paper is in the Sept/Oct issue of Pellet Mill magazine.
[2] ARA is an acronym for Amsterdam, Rotterdam, and Antwerp. Those ports represent a major import hub in western Europe for wood pellets.

For Japanese pellet imports, Canada and Vietnam dominate the market. The most recent data through July 2018 shows that Canada's six-month moving average market share is about 70%.

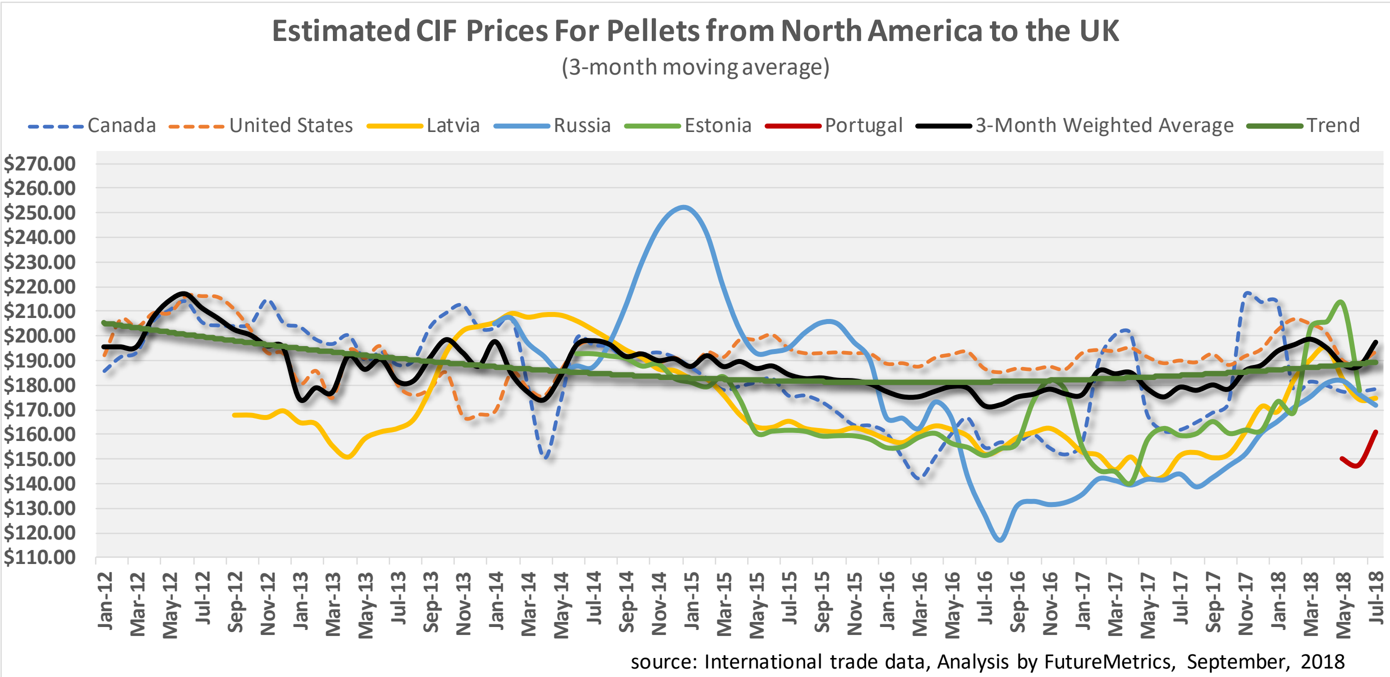
For the UKs pellet imports, the US, Canada, and the Baltic states dominate. The six-month moving average market share for US is 61.5%, for Canada is 20.8%, and for the Baltic states is about 11%, with remainders from Russia, Portugal, and more recently, Brazil.

Since the trade data includes pellets imported at spot prices, lower volume exporters such as Russia, which has traded almost entirely on spot, will exhibit higher price volatility. The three-month moving average and the trend smooth out most of that volatility.

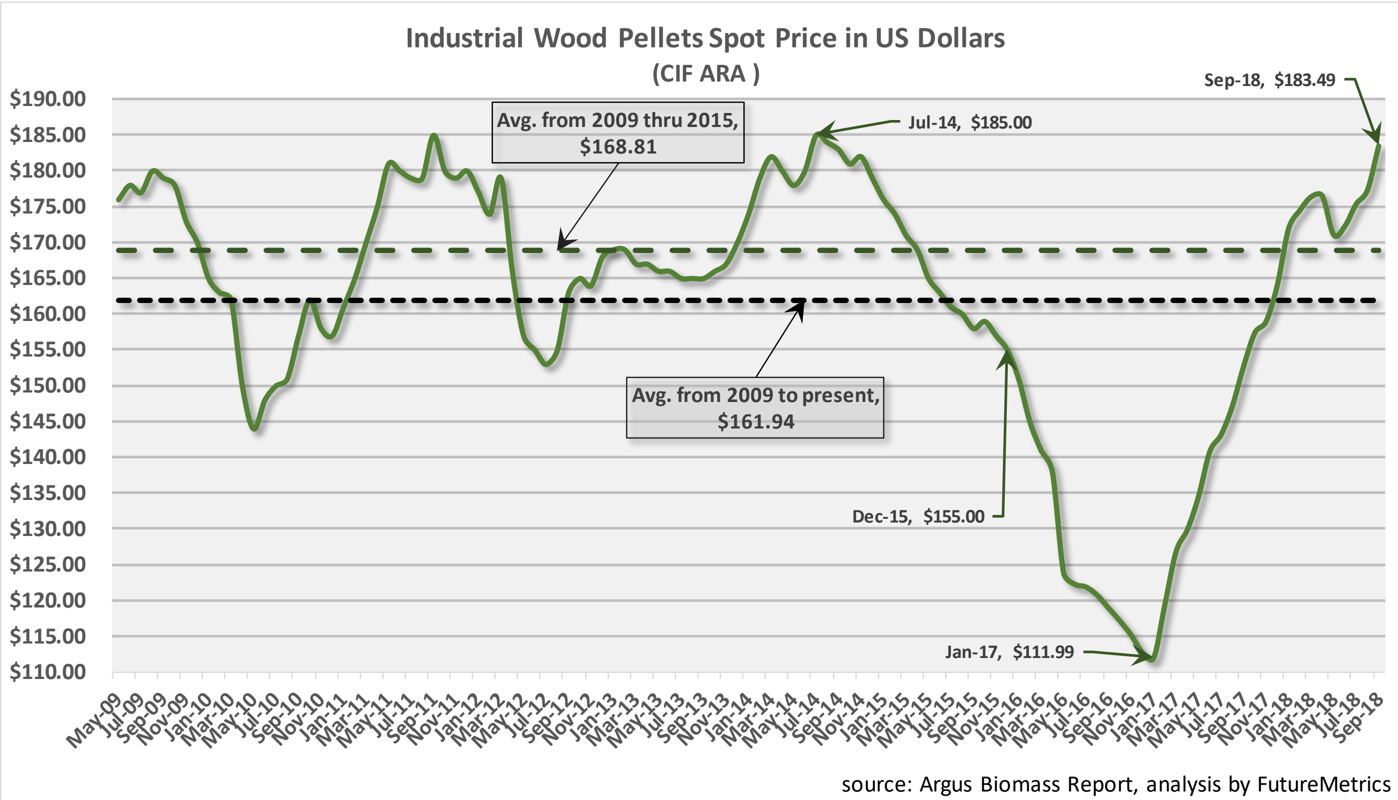
Over the past several years, based in this analysis, the average long-term offtake price delivered to the Japan has been between $170 and $180 with the trend moving up as Vietnam pellet prices have trended upward[3]. The second chart on the next page shows that pellets imported into the UK have been between $180 and $190 per metric tonne.



[3] See a recent FutureMetrics white paper on the Vietnam pellet export sector. Available at www.FutureMetrics.com.



If we compare the prices in the charts above, primarily based on long-term contracts, to the spot prices from the Argus Biomass Markets report CIF index (shown in the chart on the next page), we can see the increased volatility, as noted above, because the spot price is influenced by short-term imbalances in supply and demand. From 2015 through most of 2017, the spot market was in a condition of excess supply. However, in 2018 demand for pellets has caught up to the supply, closing the gap between long-term off-take prices and spot prices.



The Model

The goal of the model is to replicate the estimated delivered price of pellets and then, based on commonly forecasted macroeconomic parameters, forecast future prices.

One of the significant drivers of the forecast estimates is the cost of diesel fuel used in the harvest and transport of forest products to the pellet factories, and the transport of pellets to port terminals. Bunker fuel costs for shipping also have an influence, but the impact is significantly lower than that of fuel price changes to harvest and inland transport costs. Using forecasts for petroleum prices[4] and known or expected values for other components of the supply chain for pellets, the model estimates the future costs to produce and deliver pellets.

The analysis assumes that that market is not in a condition of excess supply or demand. In the short-run, there may be an imbalance between supply and demand that will impact spot prices. However, the intrinsic costs of producing and delivering pellets, including typical profit margins, will set the market prices for long-term contracts for supply.

[4] The analysis that follows uses the EIA forecast for oil prices to 2030. All oil price forecasts, including the EIA's, have a history of being wrong! FutureMetrics takes the forecast and adds a stochastic element that progressively increases the uncertainty of the mean price for more distant price forecasts. FutureMetrics can apply a different data source (other than the EIA) for the future oil price time series if requested.

The methodology involves developing several sub-models for each of the main components of pellet costs:

- Wood costs delivered to the pellet mill,
- Pellet mill conversion costs (excluding wood costs) plus margin (measured as EBITDA[5] per tonne),
- Inland transportation from the mill to the port and port storage and loading costs,
- Shipping.

The wood cost model begins with stumpage cost and then accounts for equipment, labor and trucking for harvest and delivery. The harvest module considers the type of equipment and labor used in-woods for harvest and extraction. Within the delivery module are inputs for fuel efficiency and for the distance traveled on four classes of roads from in-woods to highway. The use and cost of diesel fuel is a large component of the total cost of harvested and delivered wood. If the pellet mill uses only sawmill residuals, the model accounts for the fact that the sawmill has absorbed most of the harvest and roundwood delivery costs.

Conversion costs are the costs to take incoming fiber and convert it into wood pellets. This includes electricity, labor, and other ongoing operating costs such as the maintenance and repair of equipment. Conversion costs vary based on economies of scale, region, design and equipment. Optimizing conversion costs is within the control of the pellet producer. Well run plants with good equipment and good design will have fewer kilowatt-hours used per tonne of pellets produced, fewer man-hours per tonne, and lower repair and maintenance costs per tonne. Pellet mills using a high proportion of sawmill residuals versus mills that debark and chip roundwood will also have lower conversion costs.

The margin is based on historic values for EBITDA/tonne. EBITDA/tonne will vary with costs and prices but in general it should be above about $20/tonne or there is risk of cash flows being insufficient to sustain operation. The profit margins of the pellet producers and their customers, the power producers, are linked inversely. If the costs of the production and delivery of pellets goes up, either the pellet producers' margins must fall or, if prices go up in response in higher costs, the margins of the power producer will fall. Both parties hope to engage in long-term agreements that support their margins.

For inland transportation from the mill to the port, costs per tonne-kilometer are calculated based on several inputs. The inland transportation module can estimate costs for rail, truck, or barge (or combinations of those). Other factors include the quality of roads and highways for trucking.

Port storage and loading costs are based on typical stevedoring rates and the amortized cost of the storage and ship loading infrastructure. The higher the volume passing through the port and the better the efficiency of the ship loading systems, the lower the cost per tonne.

To estimate shipping costs, FutureMetrics used many years of pellet freight rates from five different routes and two vessel sizes from the Argus Biomass Market Report and performed a regression analysis based on oil prices, distances traveled, vessel sizes, transit time, loading/unloading time, and a few other parameters.

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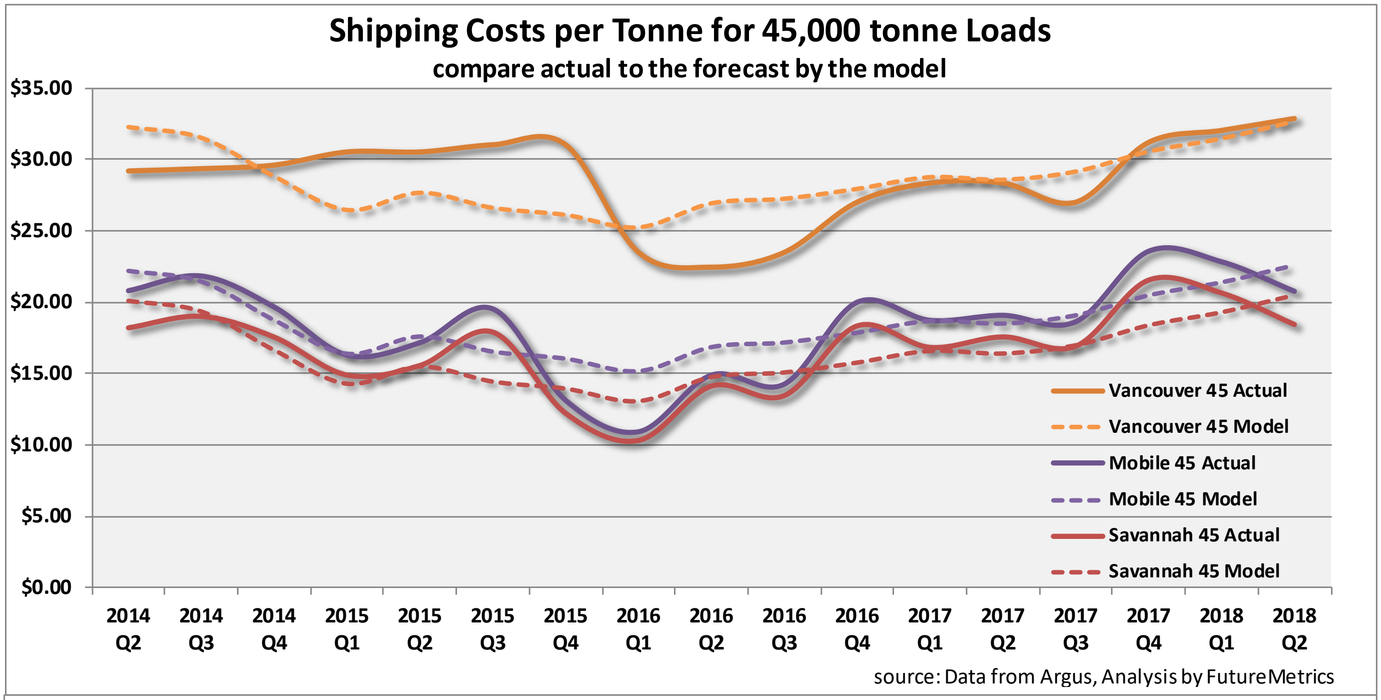
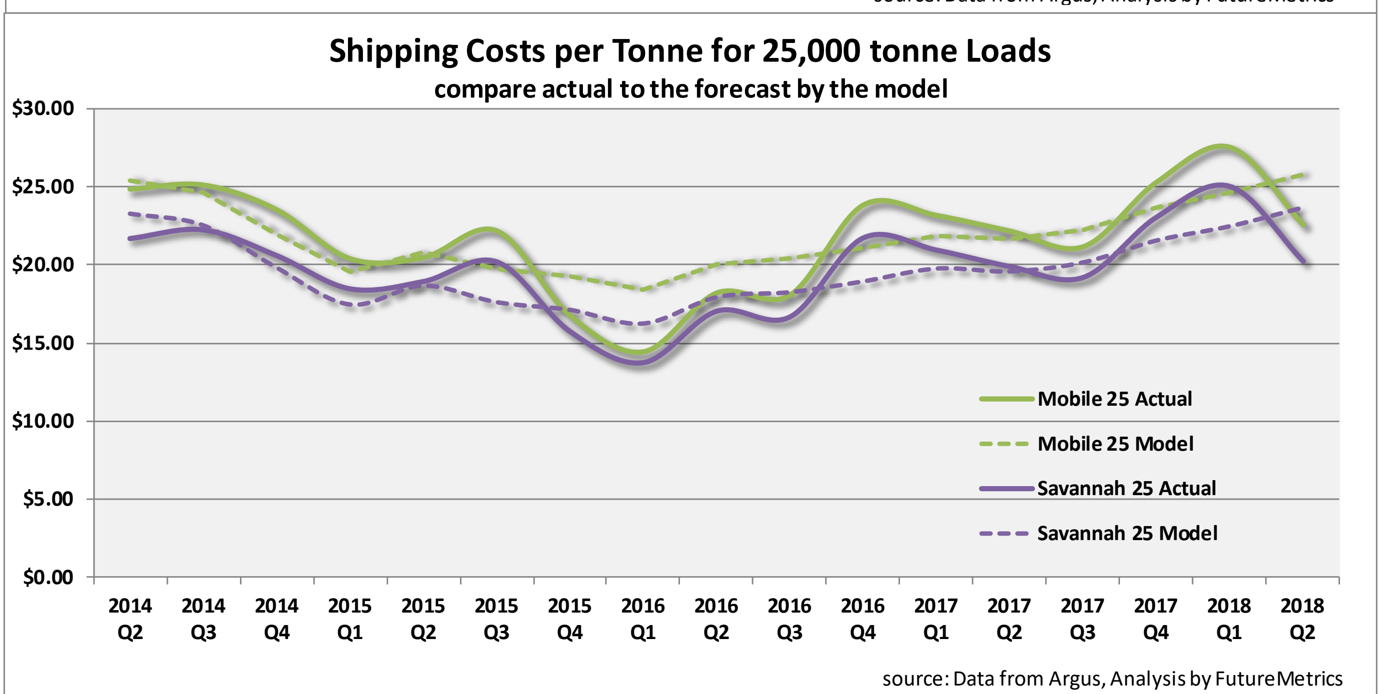
[5] EBITDA is an acronym for earnings before interest, taxes, depreciation, and amortizations. It is a common measure of free cash flow.

The regression output provides a robust set of coefficients for estimating long-term shipping costs and the uncertainty of those forecasts. The charts below show the actual shipping costs from various origination ports to ARA, and the model's estimate of the shipping costs based on the independent variables in the regression analysis.





FutureMetrics has added an adjustment to the per tonne shipping rates based on the January 1, 2020 implementation of the International Maritime Organization (IMO) sulfur cap on emissions from shipping, which will increase the cost of fuel and/or the cost of operating the ship if scrubbers are installed. The adjustment is based on distance traveled and thus the increased cost per tonne for compliance increases with longer distances[6].

Shipping costs fluctuate over time based on the supply of ships versus the demand for ships. Due to the long lead time to build new shipping capacity and the tendency for excess capacity to remain in service, shipping rates under and overshoot the long-run market clearing price as economic growth rates vary. The model assumes that shipping rates trend toward the long-run average daily charter price for each type of vessel. It is likely that shipping rates will be above or below the long-run average price. That uncertainty is captured in the probabilistic function used in the simulation described in more detail below.

For origins other then the US, the currency exchange rate for converting to US dollar values matters. Rather than attempt to forecast exchange rates, this analysis assumes that exchange rates trend to purchasing power parity[7] (PPP) over the next 5 years. The base rate in the first quarter of the forecast is the current exchange rate. Exchange rates are allowed to vary around PPP in the simulation.

There are several other inputs including general cost inflation rates.

FutureMetrics has measured the actual and estimated potential variability of the inputs to the model and has developed probability distributions for those inputs. That allows for a series of Monte Carlo simulations[8]. The simulations yield ranges for the price forecasts that are shown in the example below[9]. Monte Carlo simulation provides a basis for understanding the risks associated with producing and delivering pellets. As is shown below, key areas in the supply chain that have a strong influence on the cost of delivered pellets can be identified and, in many cases, controlled and improved to mitigate overall risk.

Results of the Analysis for this Hypothetical Producer

The results of the hypothetical model for the expected price of pellets produced in the southeast US and shipped from Savannah, Georgia to the port of Immingham, UK are shown in the chart below. Later in this white paper the results of the simulation are shown and discussed.

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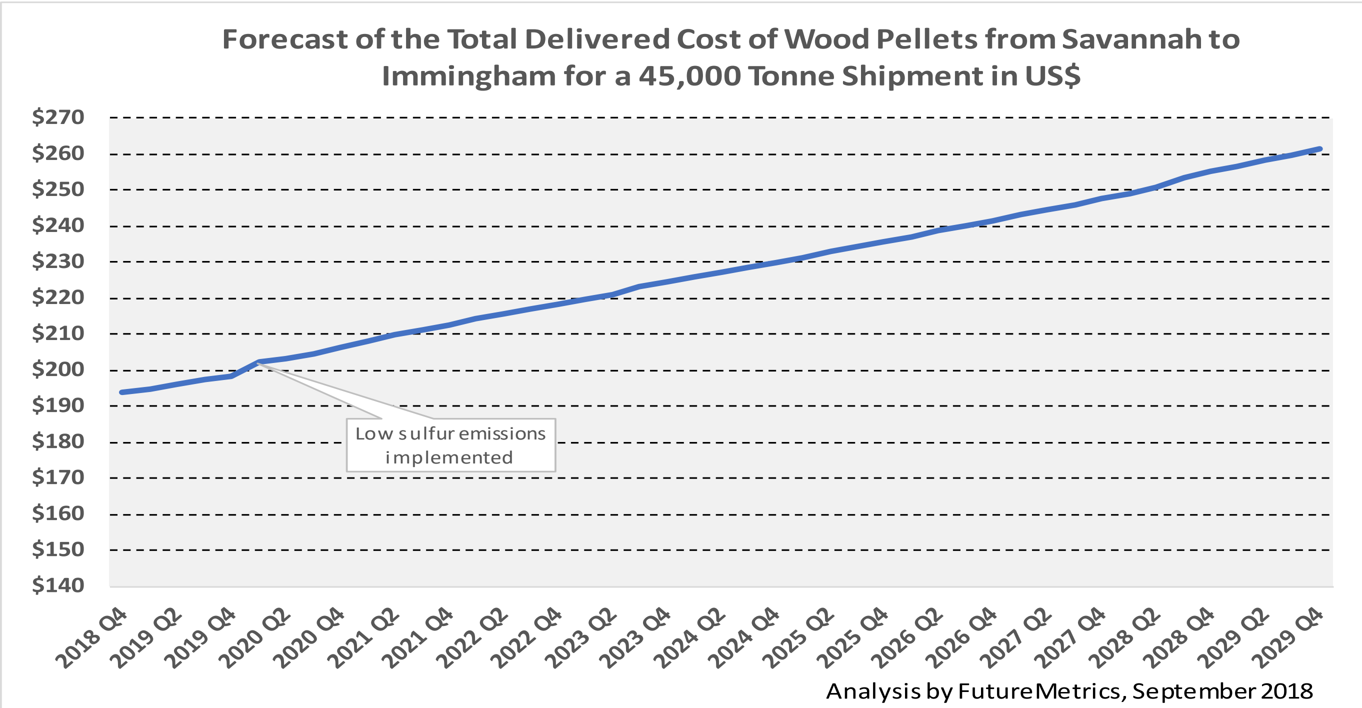
[6] The algorithm for calculating the increased cost is based on an analysis of the expected increase in fuel costs and the increase in operating costs from scrubbers. The analysis was enhanced by guidance from two major shipping companies.

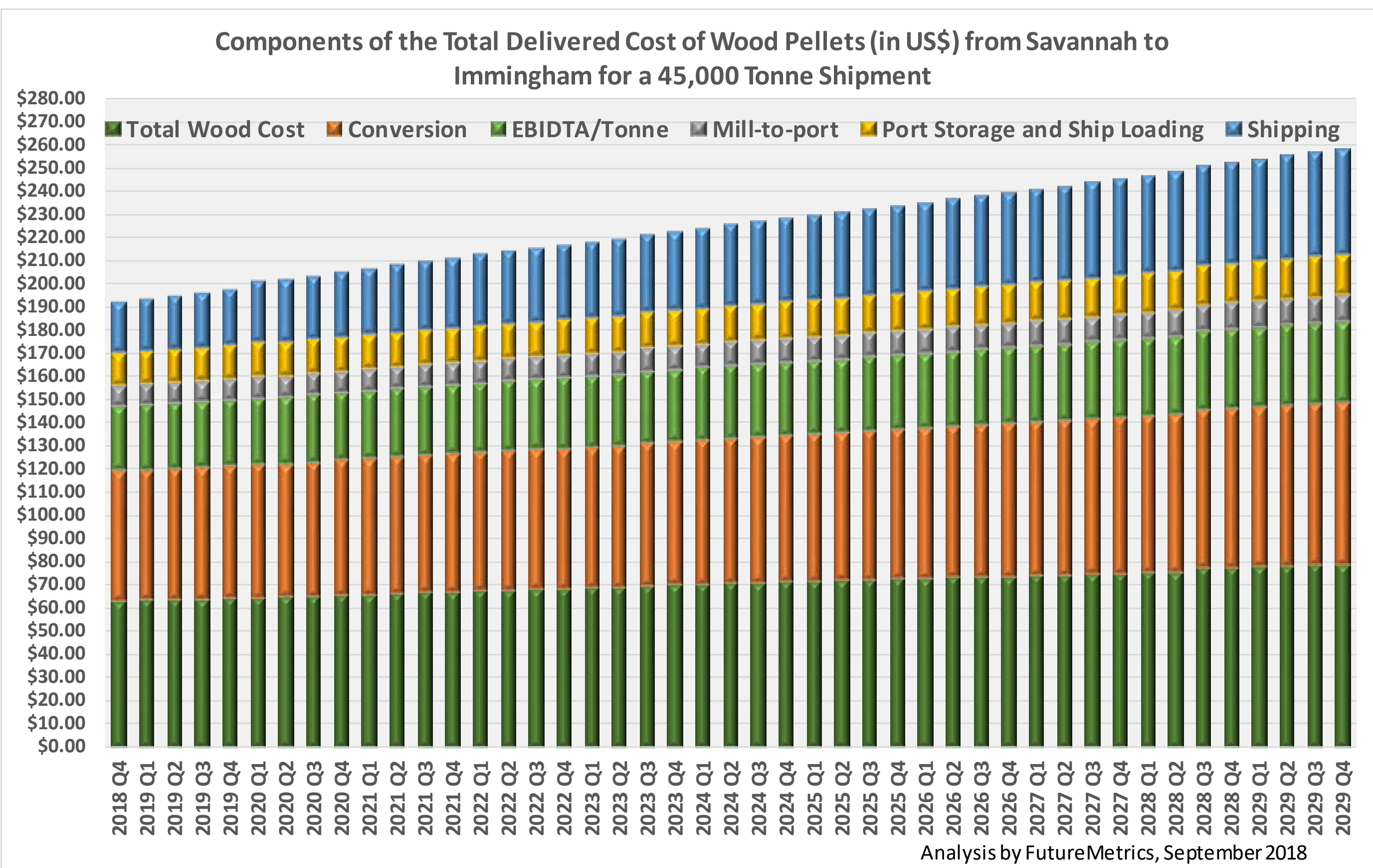
[7] Purchasing power parity theory states that the exchange rate between two countries is equal to the ratio of the currencies' respective purchasing power. The assumption is that in the long-run it will cost exactly the same number of, for example, US dollars to buy euros and then buy a market basket of goods as it would cost to directly purchase the market basket of goods with dollars. (from Wikipedia)

[8] Monte Carlo simulation performs risk analysis by substituting a range of values—a probability distribution—for any input factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. Monte Carlo simulation produces distributions of possible outcome values. (source: http://www.palisade.com/risk/monte_carlo_simulation.asp). FutureMetrics uses Palisade's DecisionTools Suite.

[9] The example in this white paper use several assumptions for inputs. The inputs for each pellet factory location will be different and unique. Delivered wood costs will vary greatly depending on type of feedstock and the characteristics of the wood basket. Mill-to-port and port storage and loading costs will vary as well.

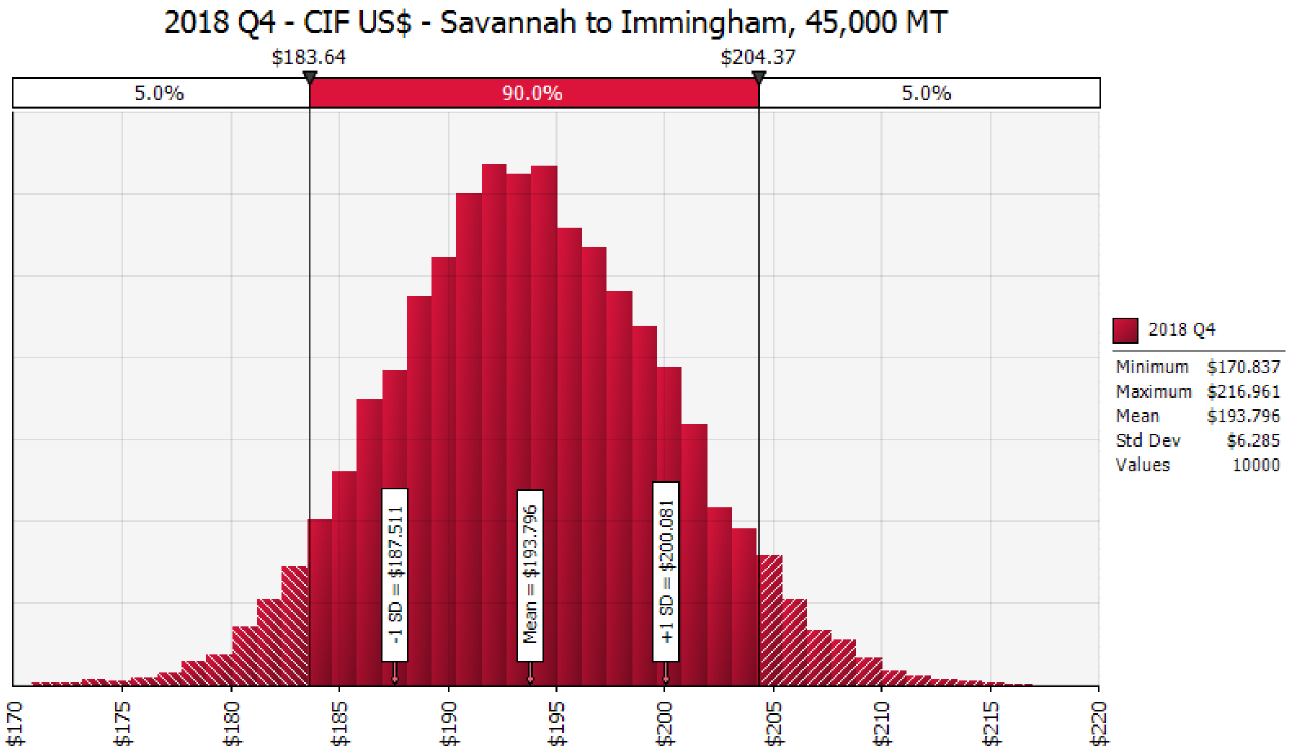


The buildup to the expected delivered price is shown in the next chart.



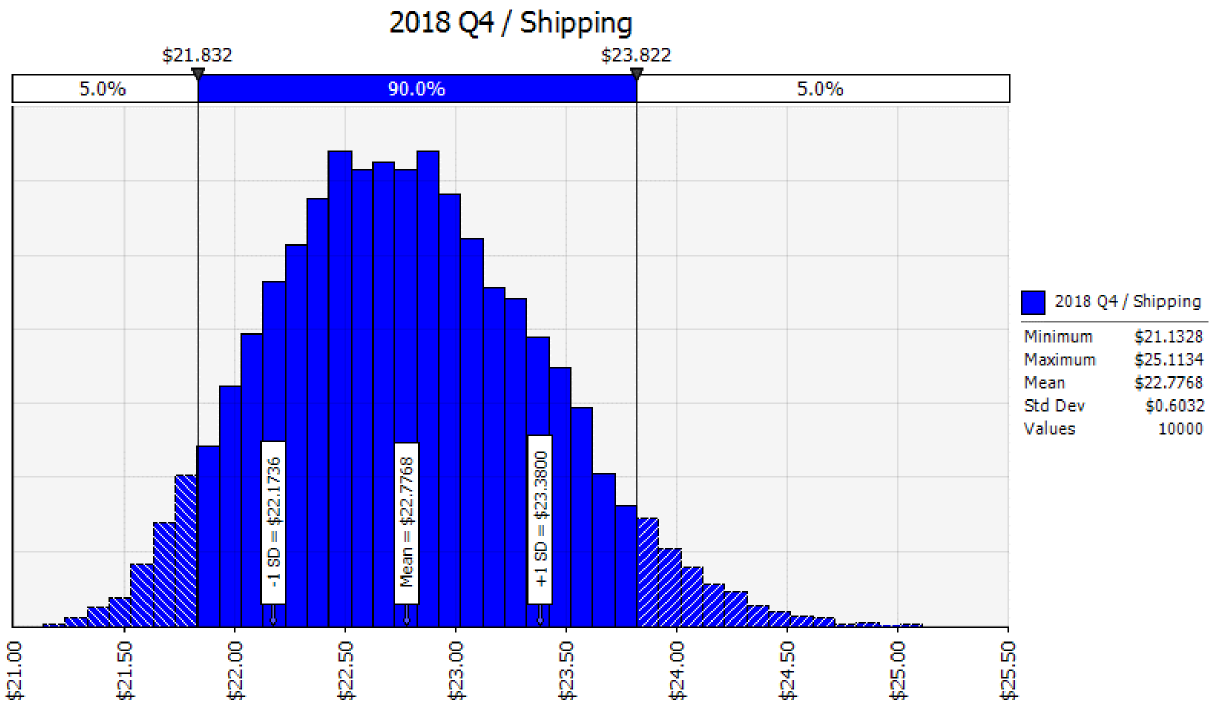
Each component in the total cost build up in the chart above has a probabilistic foundation based on the historic actual and estimated future variability in the costs. The costs for each quarter shown in the two charts above is the mean of a probability distribution of potential costs.

For example, for 2018 Q4 for pellets shipped from the southeast US to Immingham, UK on a 45,000 tonne vessel, the distribution of possible CIF prices from 10,000 iterations of the simulation is shown below.



The chart shows that there is a 90% likelihood that the actual delivered cost will fall between $184 and $204 per tonne.

The shipping cost component in the 2018 Q4 estimate is shown in the next chart. The reported shipping cost per tonne from Savannah to ARA (not Immingham, but close) in the September 26, 2008 Argus Biomass Markets report is $23.30. The model predicts $22.78/tonne with a 90% probability of the actual value being between $21.83 and $23.82.



The one variable in the total cost build up model that can adjust in real-time is EBITDA/tonne. While pellet producers have a target EBITDA/tonne, changes in costs that are outside of the control of the producer, given a relatively fixed price per tonne being paid at the foreign port, will be buffered by increases or decreases in the cash flow margin.

To capture this uncertainty, the output of the model is based on expected EDBITA/tonne generated by a simple triangular probability distribution as shown in the next chart. The EBIDTA/tonne output for each quarter is adjusted by the assumed annual price inflation rate.

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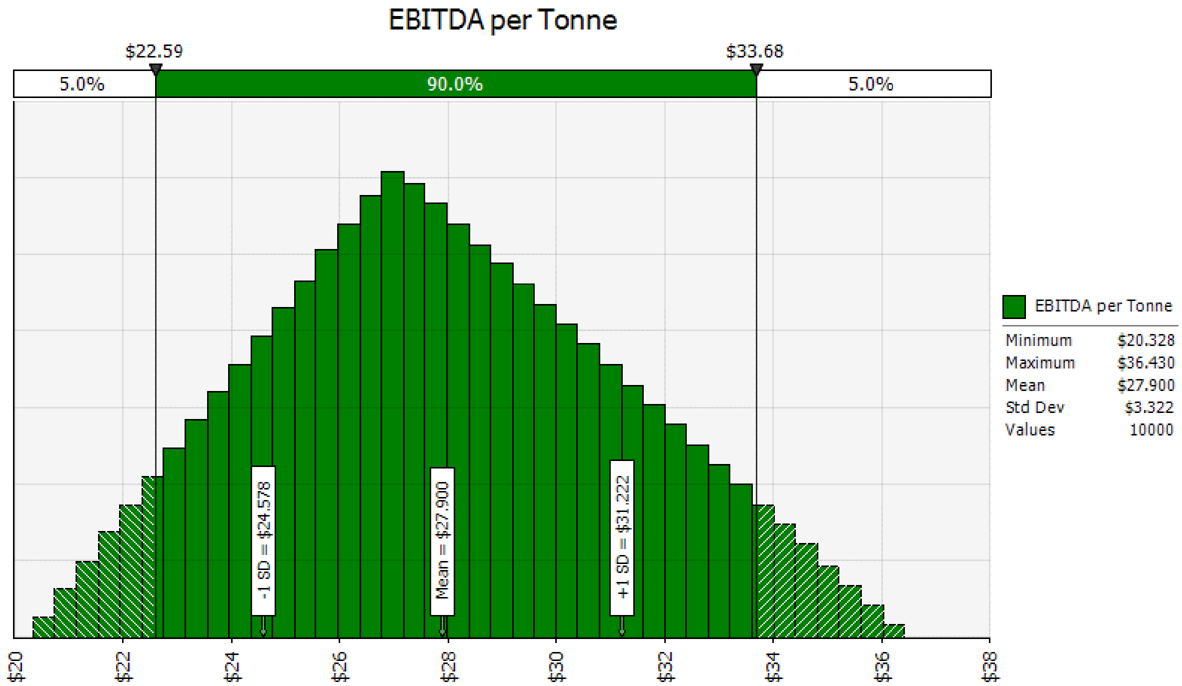
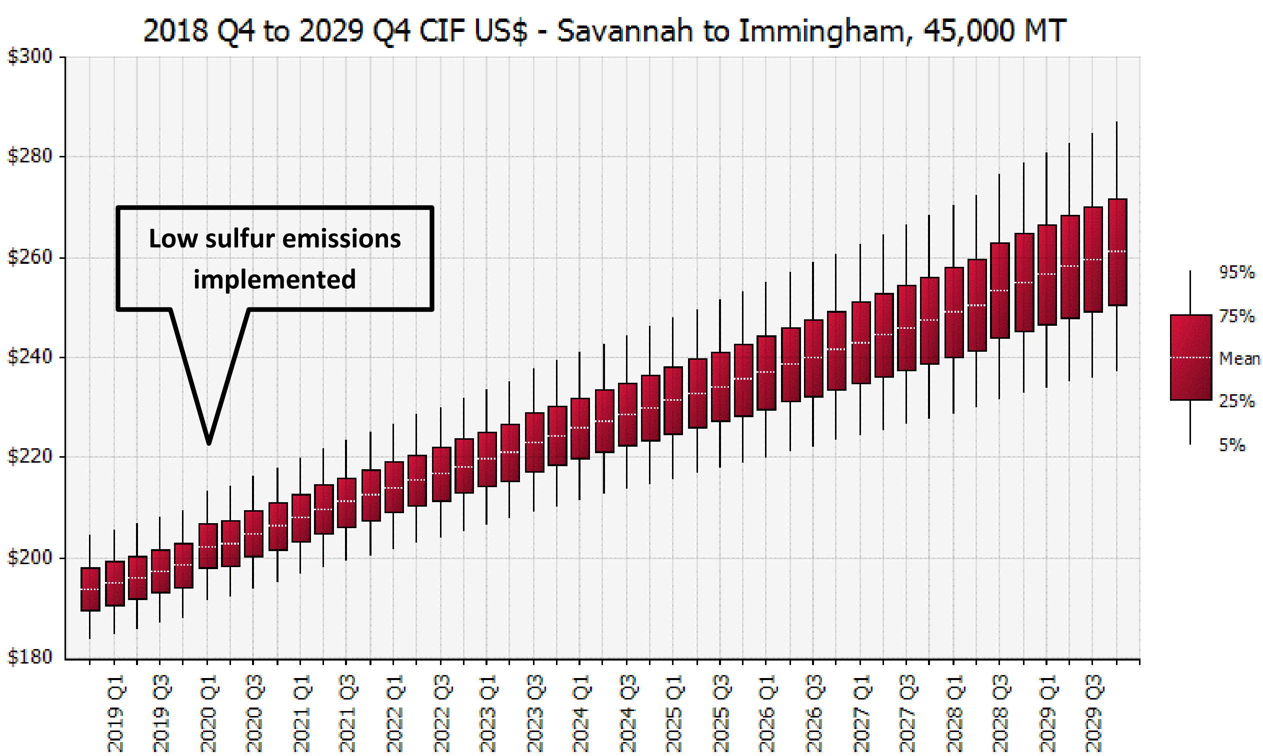
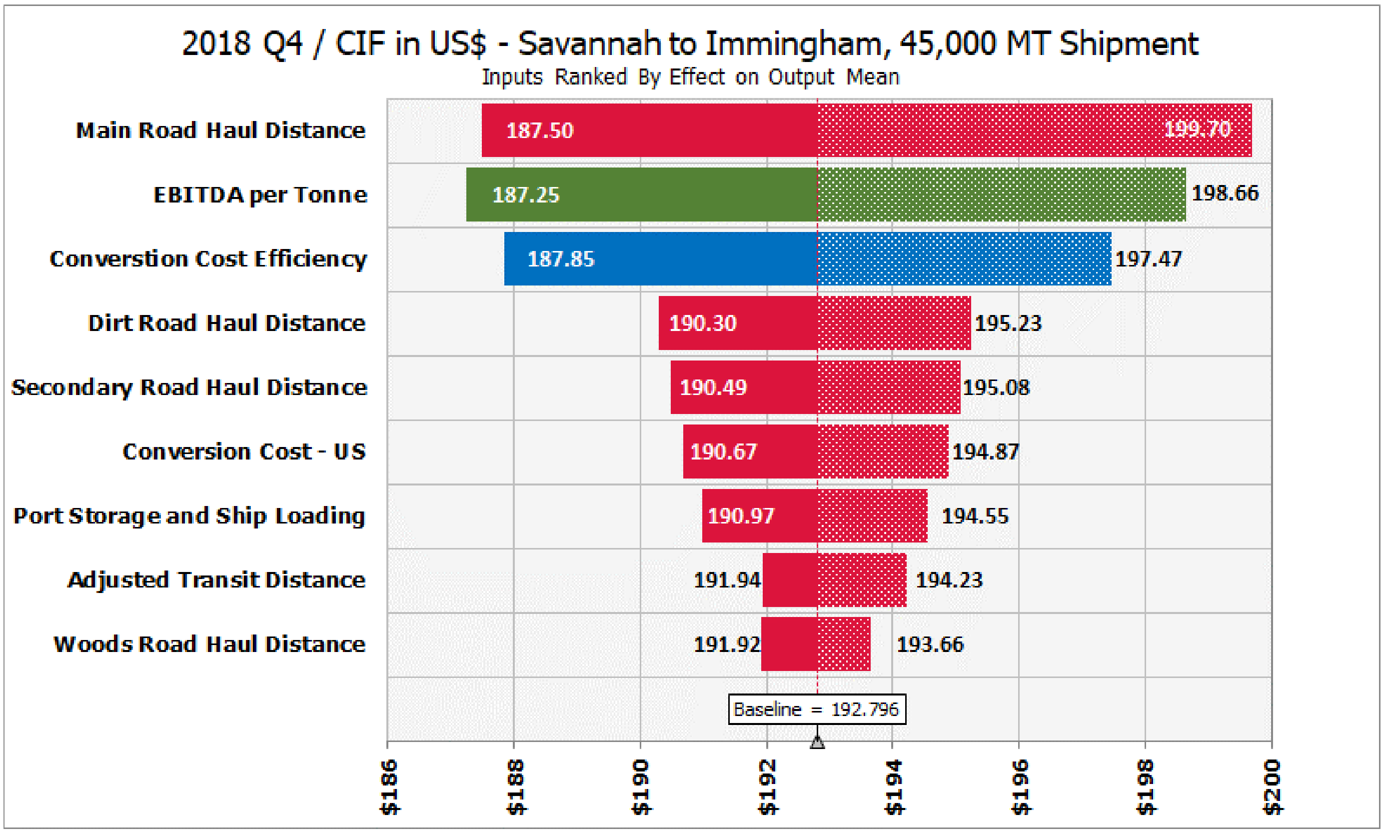


Placing each quarter's distribution for the total delivered cost into a chart yields the following.



The simulation analysis allows an inspection of how the various input variables effect the variability of the total delivered cost estimate. **Those inputs that impart high variability to the total delivered cost can be interpreted as adding risk to the actual value of EBITDA/tonne**.

The inputs that have the strongest impact on the outcome of the distribution are displayed in the "tornado" graph below. The horizontal bars show the impact on the mean price from changes in the critical inputs as they move from their lowest to highest values.



Transport distances for the pellet feedstock have a strong impact on the delivered cost of wood to a pellet mill that uses roundwood and/or in-woods chips. The delivered cost of wood is the most influential factor in the total cost of producing pellets. Optimizing the costs of provisioning the pellet plant with wood fiber is a critical part of having and maintaining a competitive cost structure.

The green bar gives some indication of the ability of the producer to buffer external cost changes with a lower or higher operating cash flow margin. A lower EBITDA/tonne may not be a voluntary choice for the producer (unless they are purposefully offering lower prices to gain market share), but it does have the effect of stabilizing the total delivered cost if other inputs move to the right side of the tornado graph. The impact of diesel fuel costs on delivered wood fiber costs is clearly an external effect that pellet producers have no control over.

But the pellet producers do have control over the blue bar. The blue bar shows how, if the producer can improve plant efficiency (for example, more consistent operation and output), then they can stabilize the impacts of other cost increases that are outside of their control. Or, with improved conversion costs, if other input costs remain stable, they can lower the price of their pellets and maintain their margin. The efficiency of the conversion from fiber feedstock to pellets affects a conversion costs baseline that varies by location. For each major producing country/region, labor costs, feedstock costs and characteristics, power costs, and environmental compliance costs will be different. In this example, US southeast costs are the baseline.

Conclusion

Insight into the components of the total cost of industrial wood pellets delivered to a foreign port is critical to due diligence on the parts of pellet producers, pellet buyers, and entities with a stake in the financial well-being of a pellet production or consumption project.

The model described in this white paper provides those insights.

As noted above, every project will have unique characteristics that drive costs. For this example, unless oil prices do not follow the upward trajectory that is forecast by the EIA and general cost inflation rates are below the assumption in this example (2.0% per year), and if producers cannot lower fiber costs and/or improve conversion costs, then the delivered cost of industrial wood pellets is likely to be above $250 per tonne by 2030.

To engage in communication with FutureMetrics about how this model may benefit you, send an email to info@FutureMetrics.com.