

of copper prices. The situation is much more complicated today. Other than the physical demand for copper, there is also a financial demand for copper since raw materials are seen as an asset class by investors and even pension funds, which are known to be conservative, and they have been investing in copper and other commodities as a part of the asset diversification strategy. An investor can decide to increase his exposure to copper at any time if he thinks that the returns will be better than the returns on other asset classes. These types of financial demands are simply impossible to predict. The procurement professionals in transformer industry are directly exposed to the financial markets when they are managing purchases of raw material.

When is the right time for hedging?

The rule should be to hedge the copper requirements immediately once a trans-

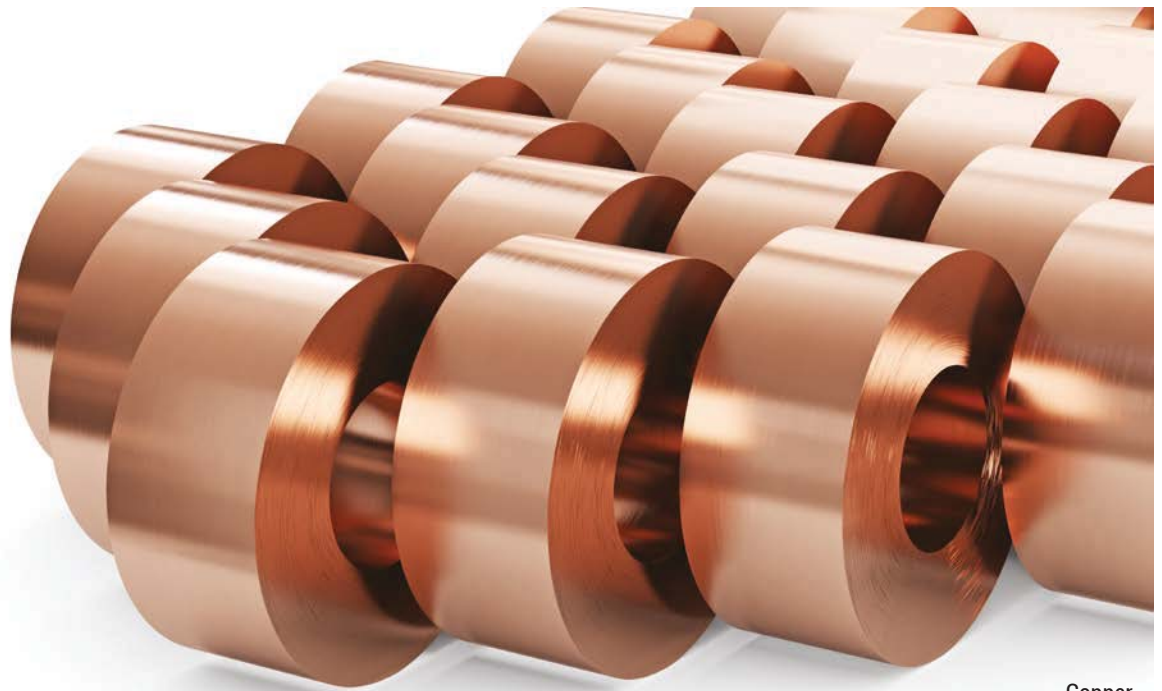
former sale contract is concluded. The management may decide to hedge even earlier based on a letter of intent or when they feel the order is firm. If a transformer is sold, it brings a liability to deliver a certain quantity of copper (inside the transformer), and if this quantity is not hedged, the seller will be exposed to the risk of market price fluctuation. The next question is the timing of the hedge. When should we hedge the copper requirements for a transformer project? One common mistake is to wait until the design is completed. The idea is to have the precise quantity of copper before it is hedged. This practice simply increases the risk. The longer you wait, the higher is the risk of price fluctuation. The risk of inaccuracy regarding the copper quantities is much lower in comparison. The suggested practice is to hedge the copper based on the quantity in cost estimation, which is the basis for the quoted price. A transformer producer

will always have several projects at the same time and positive and negative deviations from the estimated quantities will usually offset each other.

Different methods of hedging

There are several ways you can make the hedging in commodity exchange:

- Hedging a spot price: In this method, you should either have real time access to commodity exchange so that you can follow the spot prices (this is usually not the case) or you should communicate with your broker and ask him to inform you about the spot prices. If the spot price is acceptable to you, you may immediately ask the broker to book a certain quantity for you.
- Hedging based on the official settlement price on a future date: You may ask the broker to book a



Copper

certain quantity based on the official settlement price on a future date. In this method, you will be booking at an unknown price. The following day, the official settlement price will be published on LME website.

- Hedging based on a monthly average: It is possible to hedge based on a monthly average. The rule is that you have to give the order to your broker before the month starts. The advantage of this method is avoiding the booking at the peak value.
- Hedging with a target price: this method is less known by transformer producers. You can give a target price to your broker with certain validity. If the copper price in LME hits your target price even for a minute, the broker will be able to book it. The important point is not to give an unrealistic target price. The typical practice is to give a target, which is 3-5 % below the current price. This method enables you to book the copper at a lower point of the fluctuation range. But you will be delaying your booking for the duration of the validity of the target price.

Physical vs. financial hedges

Copper hedging can be done in different ways. It could be done in the form of a physical contract where copper will be physically delivered to your copper manufacturer; or it could be done in the form of a financial transaction where the future contract will be sold on the date of

maturity at the prevailing market prices. Both methods serve the same purpose of risk mitigation. However, financial hedging gives more flexibility. In case of physical hedging, you have to decide on your copper manufacturer upfront and estimating the time of delivery is more critical. In case of re-scheduling, you have to make sure to change your future contract accordingly, in order to avoid production disturbances. Financial hedging is a parallel transaction to your physical copper purchase and it completely offsets the price movement on the market. If the copper prices have increased, you pay a higher price to your copper fabricator, but at the same time, you sell your copper contract with a profit and these two transactions balance each other at zero net result. It is important to synchronize these two transactions. If your copper fabricator is charging you the monthly average price of copper prior to delivery, you need to make sure that your future copper contract is based on the same month.

Hedging through suppliers

One popular practice is asking your copper fabricator to hedge for you. The advantage in doing so is moving the administration of the hedging process to the supplier instead of handling it yourself. However, then you are locked to the supplier, which decreases your flexibility. If your planning is inaccurate and if you want to postpone the delivery

time, the supplier may claim storage and financing cost from you. Another disadvantage might be the extra financing cost. Smaller copper fabricators, which do not have a credit line with the brokers, will need to deposit a certain percentage of the hedged value and they will typically ask you to pay this as an advance or will add a financing cost to the price. If you are asking your copper fabricator to hedge copper for you, you need to make sure that they are actually making the forward contracts. Some Asian fabricators do take risk on copper. They offer prices based on the current market rates and if there are no big price fluctuations, they can handle the situation. However, if there is a significant hike in copper prices, they could even default on their commitments. In spite of these disadvantages, hedging through fabricators is still a popular method, especially for smaller companies, which do not have the in-house experience and capability needed for hedging.

What is the cost of hedging?

Many people, who are not familiar with hedging, assume that there is a high cost of hedging and this comes on top of the copper cost. If you have a credit line with a broker, you will not need to deposit a certain percent of the hedge value and hedging will not cost you anything. Broker fees are typically minor. Most of the time, future copper prices are higher than current prices. This is called contango. Some people interpret this as an extra

Hedging is a common risk management tool; it can be either physical or financial, however, the financial hedging gives more flexibility

cost for hedging, but this is not correct. This comparison is not relevant. Instead of buying a one-year forward copper contract, if you wait 1 year and buy with spot copper prices, you don't know what you will be paying by that time. Besides, the differences between future and spot prices are relatively small. On the other hand, there are also periods when future copper prices are lower than current prices. This is called backwardation. (As of February, copper market is in backwardation.) Some people think that backwardation shows that market is predicting a price drop in the future, but this is wrong. Backwardation indicates a tight market situation for physical copper deliveries which means you have to pay a premium for immediate delivery.

Power vs. distribution transformers

In power transformer industry, copper hedging is usually done for each project separately. Most distribution transformer producers do not hedge copper assuming that the cycle times are short and risk of price exposure is

low. Considering that the cycle times in distribution transformers last typically 3-6 months, it is correct that the risks are lower compared to power transformer business. However, in a volatile market situation, the risks may still generate high amount of losses. It would be impossible to hedge the copper per project in distribution transformer business because of small quantities of copper needed per transformer and the large number of transformers (typically in the range of thousands per year). For distribution transformers, the recommended practice would be hedging a certain percentage of the forecasted copper demand. The management should decide on a certain hedging profile with higher percentage coverage for the shorter-term demand (for example next 1-2 quarters) and gradually decrease percentage coverage for the longer periods (for example 3-4 quarters starting from now). This reflects the decreasing visibility for the demand and it will create a natural averaging over time since the copper demand in a particular month will be hedged in several installments and

thus avoiding buying large quantities at peak values. The hedging profile should be dynamically updated based on the market conditions.

Risks during tender/ quotation stage

So far it has been mentioned several times that, as soon as a transformer order is received, copper price risk should be mitigated by hedging.

The next question to discuss is the risks involved during quotation/tender stage. Typically, transformer customers open a tender or ask for a quotation from several producers and they demand a certain validity period for the quotations. These periods can last from a couple of months to even 1 year depending on the procedures of the customer. This practice imposes a significant risk to transformer producers. During the quotation validity, the quoted price is legally binding for the producer and the customer has the right to place an order at the quoted price, but they have no obligation towards the producer to purchase. In the commodity market terminology, this is called an "option". If you want to buy copper option on the LME, you have to pay for it. Options in commodity markets are never free of charge. A copper option on the LME gives you the right to buy a certain quantity of copper at a certain time at a





Transformer oil

Transformer quotations are similar in nature to share options with the only difference being that transformer quotations are given free of charge

certain price, but there is no obligation. A customer will exercise the option only when the option price is better than the market price. It is exactly the same as the share option. Transformer quotations are also similar in nature, with the only difference being they are given free of charge. Since producers do not know whether they will get the order or not, it is not possible for them to hedge the copper. Any price increase of copper during the quotation validity will decrease the calculated margin of the producer and it is a significant risk. The longer the quotation validity lasts, the higher the risk. Logical recommendation would be to restrict the quotation validity as short as possible, however, that is not possible in most cases since customers usually dictate this. What is the best way to cover this risk? Some producers create a copper hedge pool for tenders and use the actual price of the copper in this pool for tender cost calculations. This is a dynamic process and it is a challenge to manage such a process properly. Another way is

to quantify the risk based on the current price volatility on the market and to add a risk premium (firming factor) in the cost estimations. Quantified risk should be directly proportional to the duration of the offer validity. Quite a large number of producers ignore this risk and simply wish that pluses and minuses will offset each other and hope they will not face a loss.

Aluminum

Aluminum conductors are very rarely used in power transformers, but they are widely used in distribution transformer windings. The trend is biased regionally: In the US, distribution transformers mostly use aluminum; in Asia the conductors are dominantly copper, and in Europe there is a mix of copper and aluminum. The nature of the risk due to price fluctuation of aluminum is very similar to copper, except that aluminum has lower volatility in comparison to copper and the commodity market

characteristics are different. Aluminum is also traded dominantly on the LME and the risk management principles are exactly the same as with copper. What has been mentioned so far about copper can be applied to aluminum.

Transformer oil

Transformer oil is refined from crude oil and crude oil is a market-traded commodity. One major difference between metals such as copper and aluminum and crude oil is that crude oil is a highly politicized commodity. Other than supply and demand balance and financial investors' interest, political factors also play a very significant role in pricing. This increases the volatility further and longer-term price predictability is very poor. When transformer producers buy insulating oil, roughly half of the cost is crude oil and this could amount to 2-3 % of the transformer cost, which is not negligible. Like other market-traded commodities, crude oil can be hedged and same principles as with the copper hedging are applicable. The difference is that there is no single crude index and it is important to agree on a pricing formula with the oil supplier based on a popular crude oil index, which is easy to hedge.

Grain-Oriented Electrical Steel (GOES, GOS or CRGO)

Along with copper, GOES is one of the two highest cost contributors in transformer manufacturing. It is a high value-added, niche product within the wide spectrum of steel industry. There are only a handful of mills in the world that can produce this product and the market for the product is worldwide. The product dominantly (> 95 %) goes to transformers. The prices can fluctuate significantly based on the supply and demand dynamics. Typical contracts on the market are made either on quarterly or semi-annual bases, which is much shorter than the cycle times of transformer business. This exposes the transformer producers to a high risk of cost increases and margin deterioration on existing projects. It is not possible to hedge GOES. Building up stock would be a costly solution. With good knowledge of the market and with a good follow-up, it would be possible to make some predictions about the price trend. There are no financial investors in GOES market and the capacities are not shared by other industries, which make it possible to forecast demand and supply. However, there are still unexpected events, like trade conflicts and regulations or major production disruptions in a mill, which may create deviations from expected trends. Obviously, this is a challenging

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item for risk management. The best you can do is to quantify some risk premiums based on the market outlook and account for them in the cost estimations. Another alternative might be using escalation clauses, which will be covered later.

Structural steel

Structural steel is used in transformer tanks, radiators, core clamps, etc. Most transformer producers do not buy raw steel; they buy it in fabricated forms. However, they will be affected by cost increases anyway. Steel is a mass commodity used by many industries. So far, there are no visible financial investors on this market. Although there are a few companies offering steel hedging, there is no well-established forward market for steel. The LME has included steel rebar and steel scrap with a trading window of 15 months, but this is not very helpful for transformer industry. The best option to cover the steel price risk is to quantify the risk factor based on the market outlook or include it in an escalation formula.

Other transformer components

Fabricated products and components can usually be covered by annual contracts or sometimes even multi-year supply contracts. And, typically, price fluctuations are much lower compared to raw materials. If your supply contracts do not cover the pricing needed for some projects, you can ask your suppliers to provide a project-based firm price. Or you may also apply a risk premium in cost calculations.

Escalation clauses in sales contracts

One of the practices used for mitigating the commodity risk is using a price escalation formula in the sales contract. In this case, the transformer will not have a fixed price, but the invoiced price will be calculated based on a formula, which covers the basic cost components. The reference values of the cost components will be defined either on the date of quotation or on the date of the contract and they will be re-calculated prior to the delivery of the transformer. So,



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if the costs have increased, the transformer will be invoiced at a price higher than the initial price. But, if the costs have decreased, the transformer price will be reduced according to the formula.

If it is done properly, this method mitigates the risk for the producer. But then the customer bears the risk of price fluctuation. Most customers do not like the idea of taking the risk for price increase; besides, it also creates some administrative issues to deal with a fluctuating price contract, such as how the budget will be approved, who needs to approve it based on “Table of Authority” in the company, etc. As a result, this application is rather limited to some countries, like Germany, some Central European countries, India, and the USA.

One common mistake is to assume that the risks are fully mitigated if there is an escalation clause in the contract. It is important to match the weightings defined in the escalation formula with the actual cost structure. Some customers dictate a certain escalation formula in order to make it comparable among the bidders and this creates a challenge. For example, if the escalation formula assigns 7 % weighting to copper and if the real cost share of copper is 10 %, the risk on copper is not mitigated. This additional quantity needs to be hedged.

Another critical point is to select the right indices for each commodity included in the escalation formula. This is easy for copper or aluminum where the logical choice is the LME. For crude oil, you should try to include the right index, which you are using for your oil purchases.

For GOES steel there is no globally accepted index. There are some indices available, but they are usually local or regional and the acceptance level is not high. In India, IEEMA publishes GOES Index, which is well accepted in India, but it is a market average and it may not reflect the actual cost trend for each and every producer. There is no easy solution to representing the cost trend of GOES.

The specific conditions of a project should be studied and a solution needs to be developed case by case.

For structural steel, there are a number of websites publishing local and regional steel prices. There are also country-specific websites. In general, it is easier to find a steel index, which represents cost trends reasonably well.

Another important thing is to synchronize the timing of the calculation of escalation formula with your actual purchase cycles. For example, if you are buying the copper 3 months prior to transformer delivery, the escalation formula should also be calculated for the same month.

If the escalation formula is fully mitigating your risk for a specific commodity, then that commodity must not be hedged. If you do this, you will re-establish the mitigated risk.

Frame contracts

One specific type of sales contract is “frame contract”, where a large customer group with multiple entities/locations signs with a transformer producer in order to fix the prices and commercial conditions, but quantity of transformers to be purchased are not fixed. They are to be ordered by each entity based on actual demand. In most cases, there are no guaranteed quantities for transformer

purchases. Although sales people like this type of business with the expectation of large business volume, from risk management’s point of view, this is a very high-risk business. Since there is no guaranteed volume for transformers to be purchased, it is not possible to hedge copper and oil or to use any of the risk management techniques covered here. The producer is completely exposed to the risk. If a proper price escalation formula is included in the frame contract, then the risk is eliminated. But unfortunately, most frame contracts are based on fixed prices. It is recommended to avoid such contracts unless the margins are high enough to justify the high risk.

Conclusion

As can be seen from these explanations, developing a corporate know-how for commodity risk management is an important element of operating a successful transformer business. There are many different factors which need to be evaluated in order to make a good risk mitigation plan for a transformer project. Sales contracts are the starting point of the process and the companies should develop clear rules and principles of acceptable practices regarding the commodity risks in sales contracts. Procurement function should understand the implications of the sales contract and employ the proper risk management techniques for the project. Treasury/finance function should support the hedging transactions. The ownership and governance of the processes should also be clearly defined. Strict adherence to these principles will minimize losses realized through commodity risks and help to sustain profitable business.

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