Value in Use in an Index-priced world

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Is there a place for VIU?

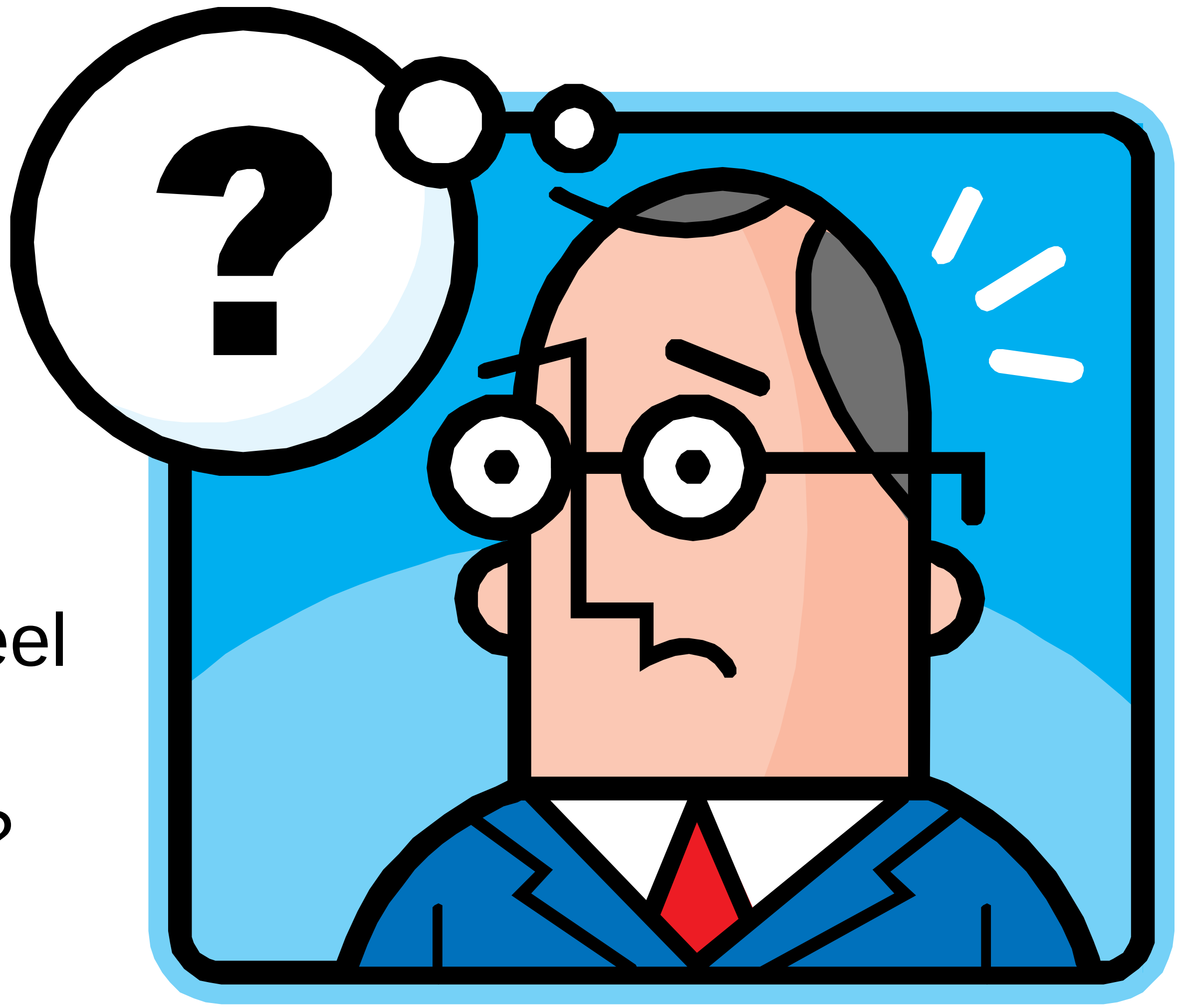
- Model types
- Calculation examples
- Negotiation strategies
- Y/N

Classic negotiation fundamentals

- Steel consumption per capita
- Iron ore demand
- Iron ore supply
- Quality price adjustments (VIU)

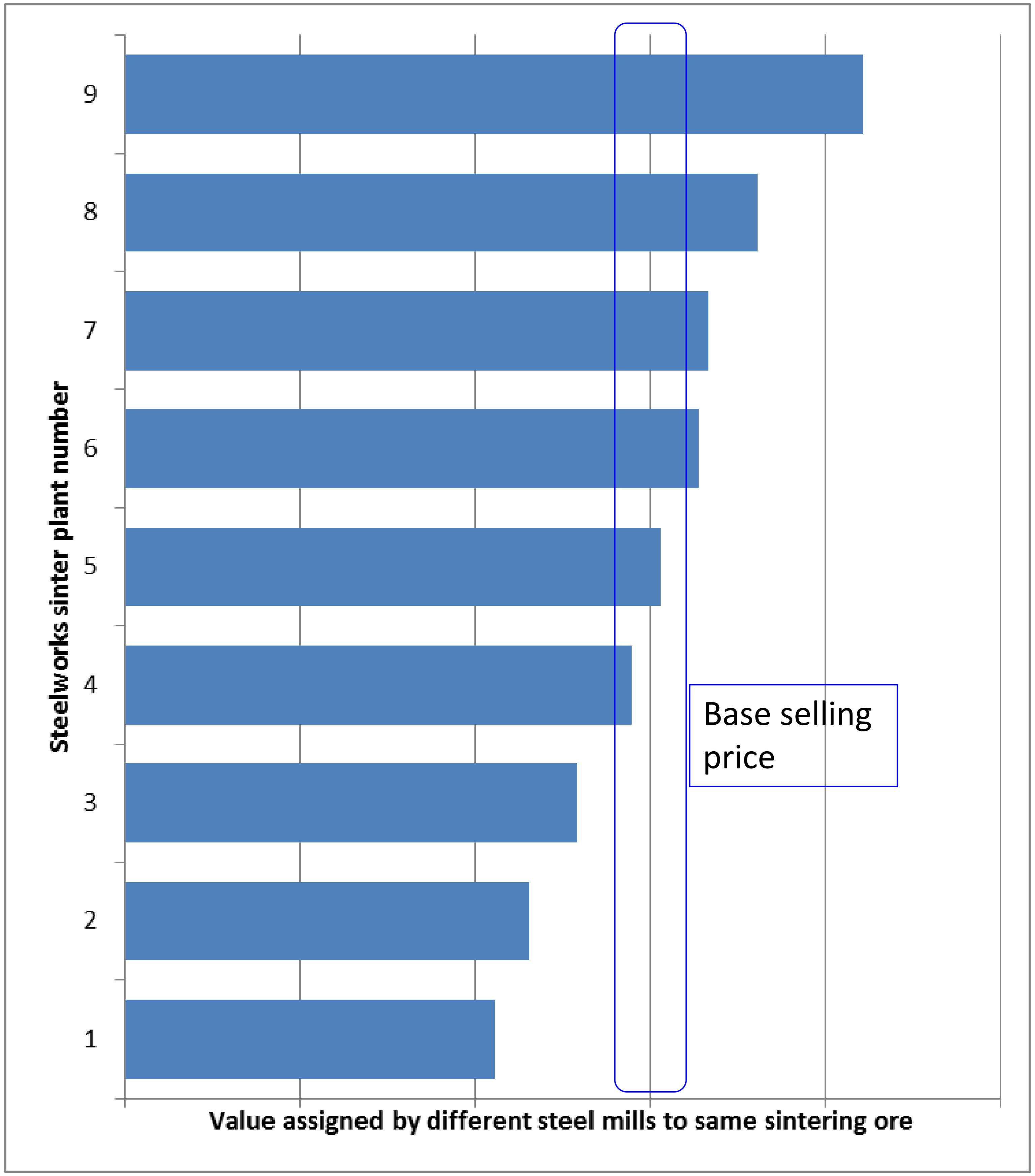
VIU Calculation methodologies

- Objective is to replicate the decision-making process of the end-user
- Simplistic to very complex
- Mass balances, energy balances and even rigorous process modelling
- Do you include or exclude the steel profit margin?
- Generic steel mill or mill-specific?



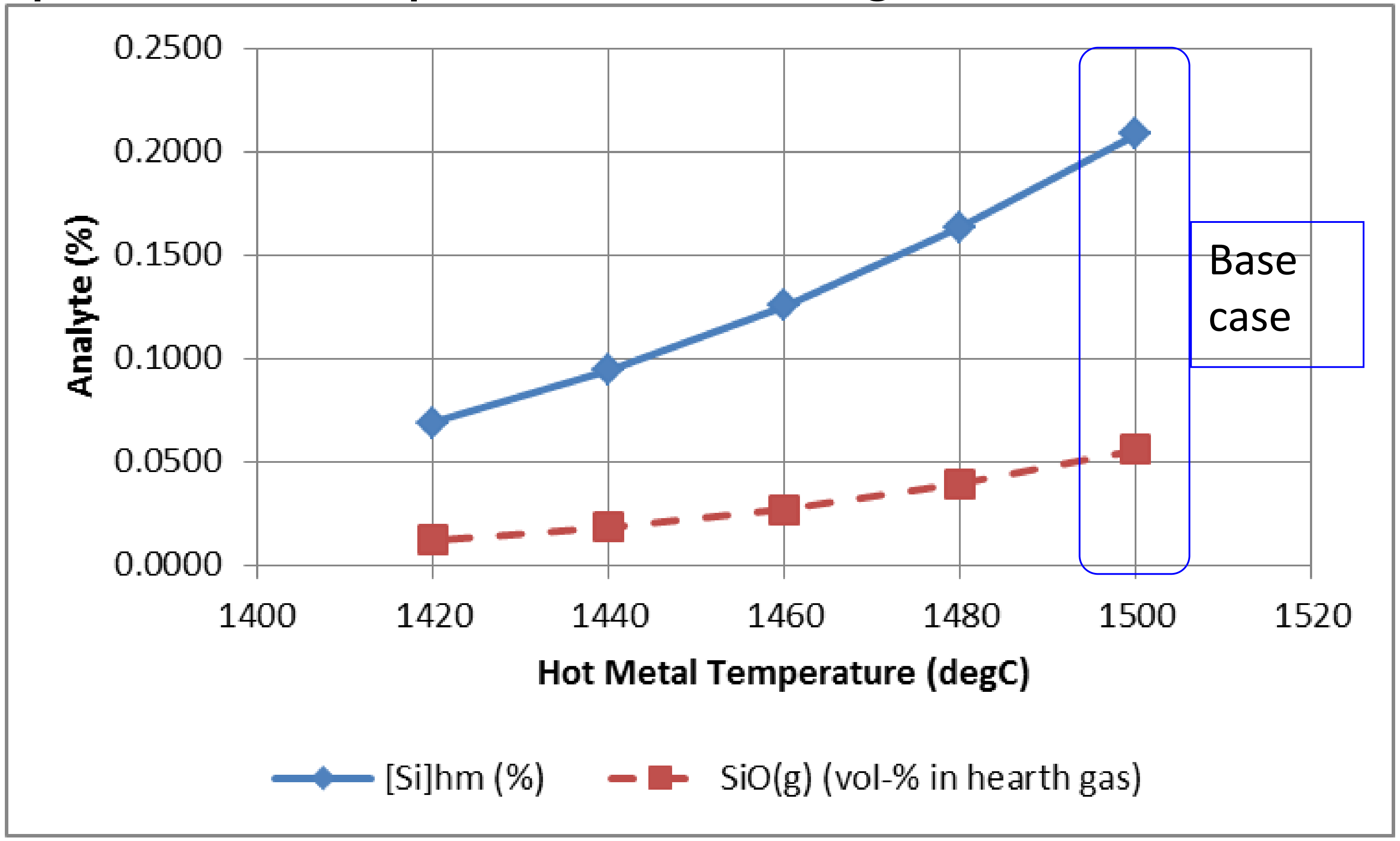
Generic steel mill?

- A generic steel mill does not exist. Every mill has contractual and operational differences.
- This leads to different value ascribed to the same raw material.
- Need detailed operating data to model a specific steel mill.



Calc example 1: hot metal silicon

- A steel mill requested advice on how to lower their hot metal silicon to achieve operational goals.
- A change in raw material selection was offered as a prize.
- A model was developed for their blast furnace bottom and operational changes recommended.
- VIU and operational experience offering added customer value.



VIU models in everyday use

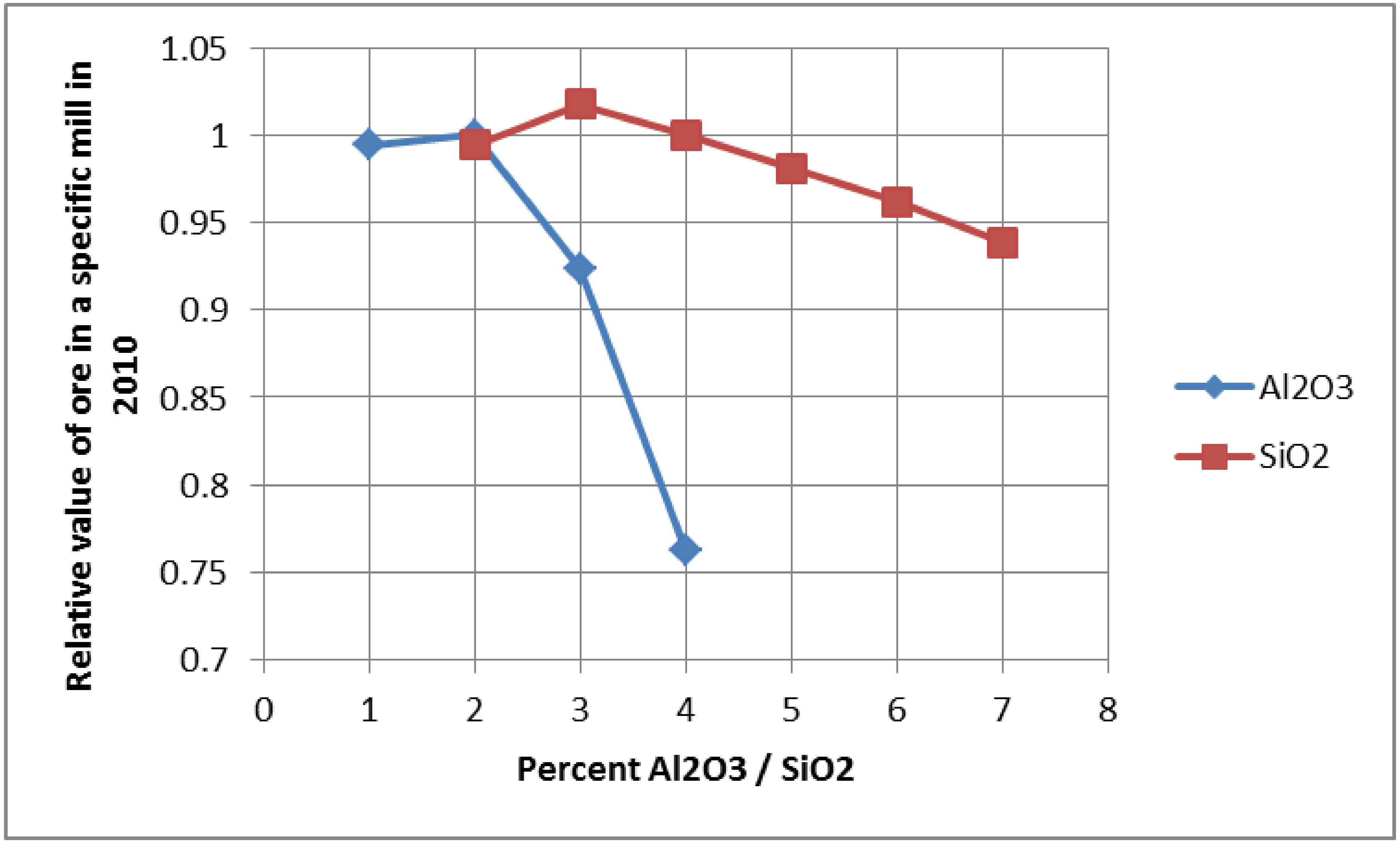
- Platts 62, Platts 58.
- TSI 62, TSI 58.
- These models attempt to normalise different grades to a standard grade based on delivered raw material costs.
- Normalisation factors used reflect reality fairly well.
- Can be used to negotiate lower prices for clearly superior products.
  - 58%Fe high LOI ore vs. 58% Fe high Al2O3 ore.
- Assumes a generic steel mill. Answer is generic.

Customer knowledge

- Credit rating and other commercial aspects
- Technical operating data
- Better customer selection
- More value for both parties.
- Steel mills will naturally try to achieve this pending level of sophistication/modelling capability.

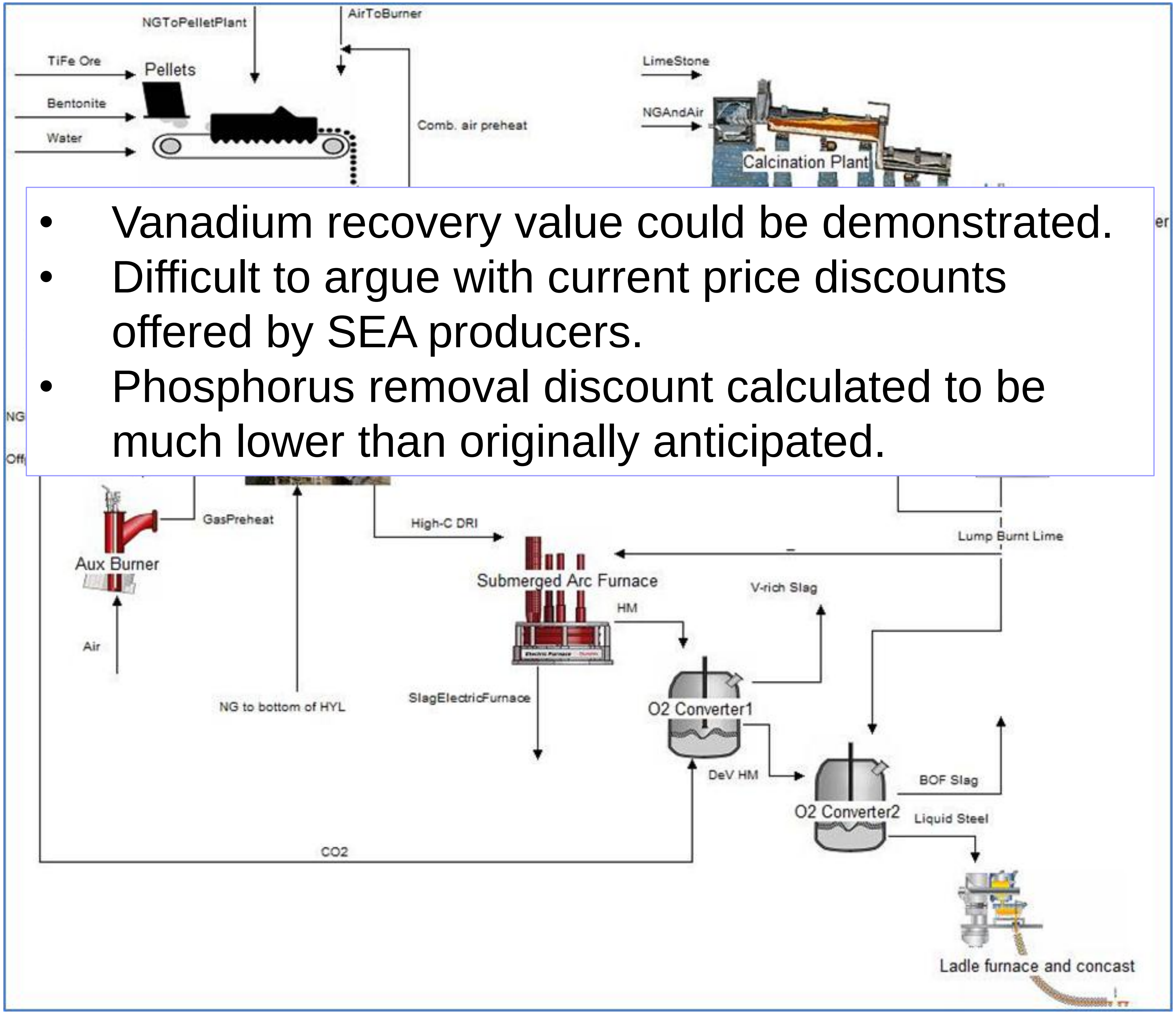
Calc 2: Impact of silica and alumina

- Some public contracts specify Total gangue (SiO_2 +Al_2O_3).
- The two are very different.



- Both are required in suitable quantities to ensure stable operation of sinter plant and blast furnace.

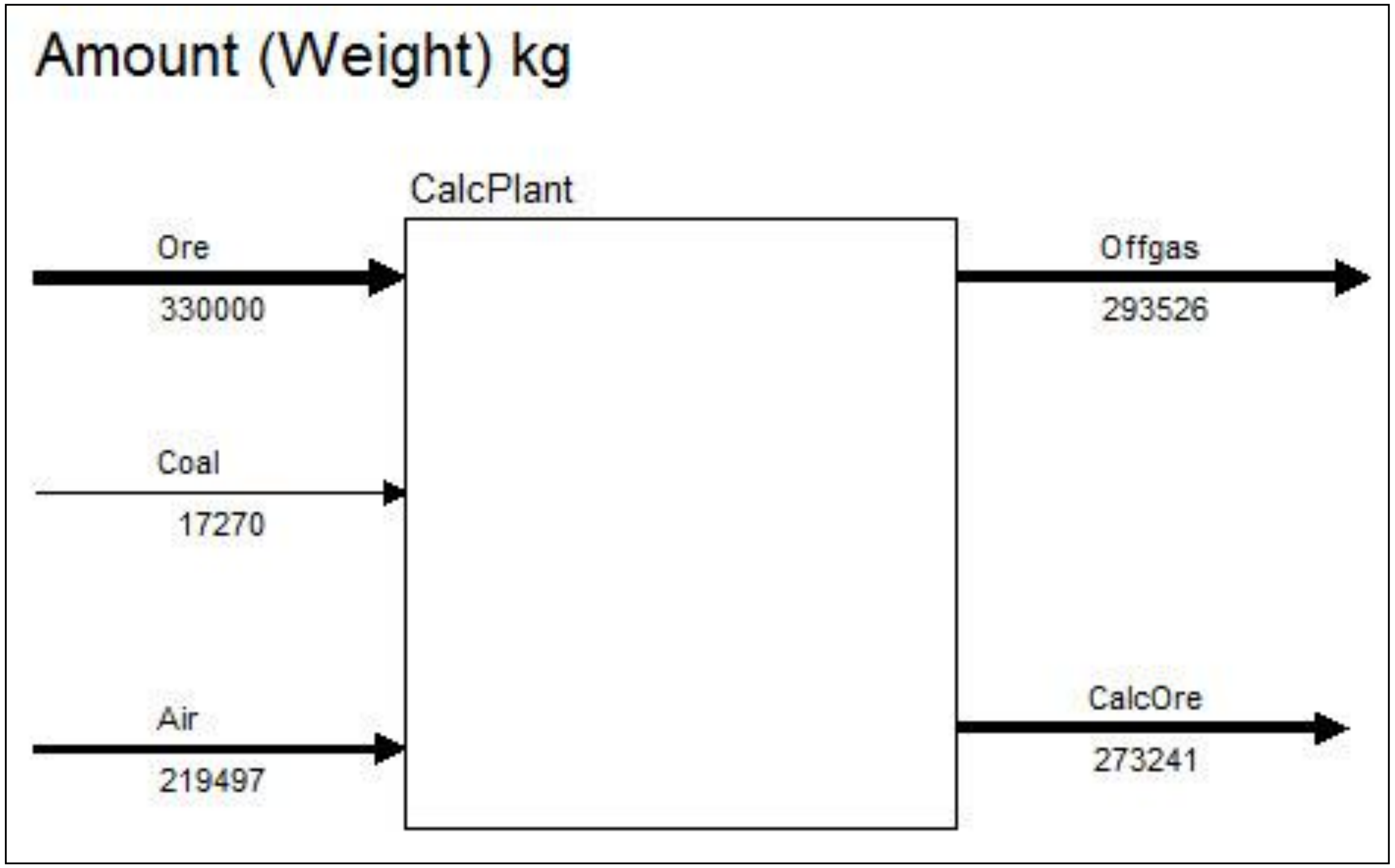
Calc 3: Recovery of by-products



- Vanadium recovery value could be demonstrated.
- Difficult to argue with current price discounts offered by SEA producers.
- Phosphorus removal discount calculated to be much lower than originally anticipated.

Calc 4: Value-adding before shipping

- Lower Fe, high LOI ore.
- Modified cement kiln modeled to remove free moisture and decompose goethite.
- Result was marginal but economic due to cheap low quality thermal coal available.



Negotiating strategies

- Transparency
  - Vale published a reduced quarterly silica penalty based on delivered raw material prices (coal, iron ore and fluxes).
- Different pricing strategies
- Customer assistance
- Customer selection - requires data

Is there a place for VIU?

- Useful tool to aid commercial decision making
- Only an extra tool, not the final answer.
- Steel mills, Index providers, service providers think there is value.
- Understand your customer, price correctly.

Value in Use in an Index-based pricing world

Paul Vermeulen[1]

1. Introduction

The move to Index-based pricing has presented interesting challenges to the field of raw material value calculations. Value has always been calculated as a relative factor based on other delivered raw material and steel prices. In the world of yearly pricing a steady state of raw material and steel prices could easily be simulated and availed the VIU service provider with valuable analysis time. Is there still a place for VIU in the current fast-changing price world based on supply-demand? This paper documents the development of a view using calculation methodologies, examples and negotiating strategies.

2. The traditional negotiation

In the world of yearly pricing the following topics were discussed before a new price was negotiated:

- Demand - Based on steel intensity per capita, population growth, urbanisation and scrap recycling the blast furnace/basic oxygen furnace steel production can be calculated per country or region, leading to a global total iron ore demand estimate for the next year. This can be further refined to estimates for fines, lump and pellet requirements based on published purchasing habits and quality requirements.
- Supply - Similarly, iron ore production from seaborne trade and domestic supply, together with expansion plans by the few iron ore producers at the time gives a good iron ore supply estimate. This can be refined further into lump, pellet and fine ore supply. Refinements include classification of projects into committed, probable and unlikely, since many announced projects failed to materialise.
- Quality - apart from the broad principles above, other factors also play a role. Quality of different iron ores vary greatly and this may impact total demand as well as iron ore pricing. Though yearly tonnages and pricing are up for review, quality penalties/bonuses were left largely unchanged for many years due to a lack of technical input around the negotiation table. But processing costs continued to rise and value calculations started playing a more prominent role. VIU calculations were used as part of negotiation strategies to realise price relativity adjustments in the 2000s.

3. VIU Calculation methodologies

Various methodologies ranging from simplistic to very complex have been developed by many authors[i],[ii],[iii],[iv],[v], trying to replicate the operational and purchasing decision-making process of a steel maker. A typical model should account for the profit margin an end-user can make from steel sales as well as all the intricate nuances of their specific operation. Many authors offer a generic Chinese Coastal steel mill and an Inland Chinese steel mill as

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base cases. The reality is that these generic mills do not exist in real life, as each mill is different. A recent calculation example for mot metal chemistry control is shown below. The specific steel mill wanted to reduce hot metal silicon ($[Si]_{hm}$) even further from the low 0.2%, and modelling of casting practice, blast furnace operational parameters and their envisaged blast furnace rebuild showed that a lower hot metal temperature together with modified slag chemistry would yield an effective improvement to be able to operate at 0.1% $[Si]_{hm}$.

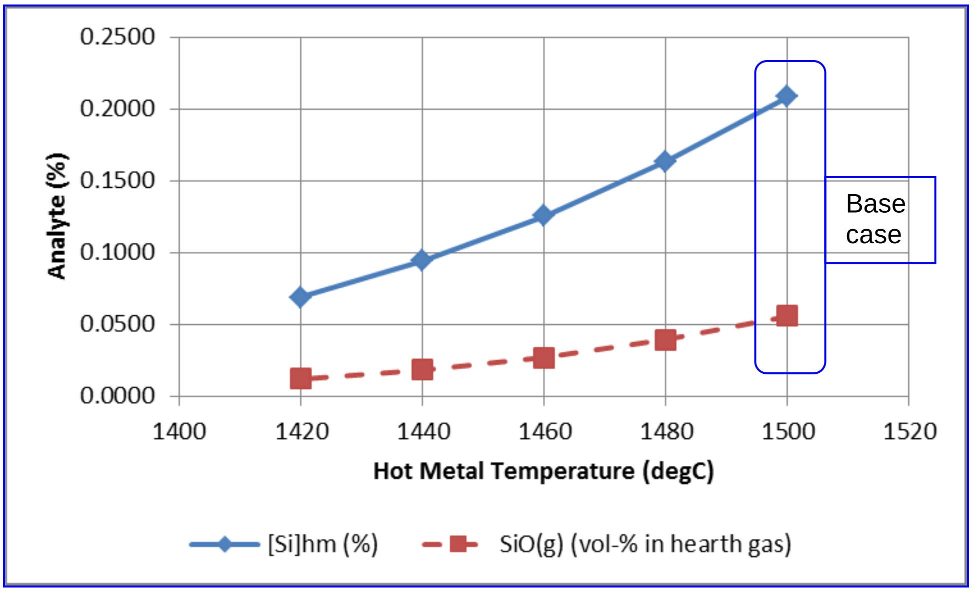

Figure 1: Impact of hot metal temperature on [Si]hm.

This is a good example of a specific nuance that could not be solved by raw material choice but by an operational adjustment.

Public information lists linear optimisation models, non-linear models in Excel, partial and full thermodynamic models and even as far as a comprehensive two-stage mass and energy balance over a blast furnace. Each of these model development routes have merit, from speed of calculation to being able to assist customers with their steel plant operation. An effective negotiating strategy might be to offer this kind of technical assistance to end-users to enable higher percentages of a specific ore to be used more effectively, or to extract a higher sales price for a specific ore with a profit share scheme.

An innovative approach in a model once used by the author was to assign a fixed energy penalty to keep one ton of blast furnace slag molten. This negated the need for a full energy balance on the blast furnace, speeding up calculation time dramatically.

A model once encountered used penalty specifications to empirically calculate the value of a raw material. As will be shown below, this is of zero value and the end-product was just a very expensive consulting bill.

In use every day are the VIU models developed by The Steel Index, Platts Iron Ore Index and the like. These models were developed to normalise different iron ore chemistries to the TI and Platts indices published daily. Based on the delivered costs of iron ore, fluxes and fuel these indices attempt to equalise the variances in Fe, SiO2, Al2O3 and LOI to a representative value. Not an easy task, but not impossible. Calculations can show that the normalising factors used reflect reality quite well.

The value of a complex, all-encompassing, full blown model is doubted because of the data requirements that are associated with such a model. Without good detailed operational data the model cannot be calibrated to sufficient detail, and thus may spit out incorrect answers. In the case of providing operational assistance to customers this type of model is more akin to what they would use, so is thus more useful.

Whatever complexity model is being used, the real value is in good end-user operating data and understanding the purchasing behaviour of the end-user.

What factors are considered more valuable by the end-user? Lump Reduction Degradation Index (RDI) or Reducibility Index (RI)? High silica content or low silica content? Is low phosphorus really necessary or is there enough space in the burden for extra phosphorus? Ditto for alumina input. Without these answers only a generic value answer can be calculated, and some value may be left on the table.

4. Customer selection

With intimate customer knowledge the most suitable customer base can be chosen for a specific ore quality that will maximise value for both the raw material supplier and the end-user. But this is not really the question. The question is whether there is still a place for these calculations at the negotiating table.

5. Calculation examples

5.1 The impact of silica and alumina on customer operations

In an ideal world the steel maker has access to a wide range or raw material qualities at reasonable prices and can thus choose a blend that results in high productivity, low production cost. The main gangue components in both iron ore and coal are silica (SiO_2) and alumina (Al_2O_3) and they have to be fluxed into a liquid slag by the addition of limestone and dolomite. For every one part alumina in the slag the steelmaker will require two parts silica, 2.2 parts lime and 0.7 parts MgO from dolomite. Furthermore there is the energy requirement to melt and keep liquid each ton of slag at typically 100-250kg of coke per ton of slag - the large range based on different steel maker operational efficiencies. Here it should be noted that a thermodynamical calculation will calculate 250 kg of coke, yet steel makers can achieve much better operational efficiencies.

The perception is that silica and alumina are both bad, yet a certain amount of slag is required to remove sulphur and alkali metals, and the silica plays a significant part in diluting the alumina input to acceptable levels. For the metallurgically-minded, bonds between silica molecules are very viscous and lime, MgO and alumina help to break these bonds to make slag more fluid.

So is silica or alumina the most valuable in an iron ore? In the study results shown in Figure 2 the costs incurred by a steel maker is shown for various levels of silica and alumina replacing Fe OR LOI. Note that it does make a difference whether Fe or LOI is replaced and that in general silica deserves very little penalty relative to alumina.

Like all aspects of raw materials, too little or too much of a good thing generally should be avoided. But there is a place for silica and alumina in a raw material burden.

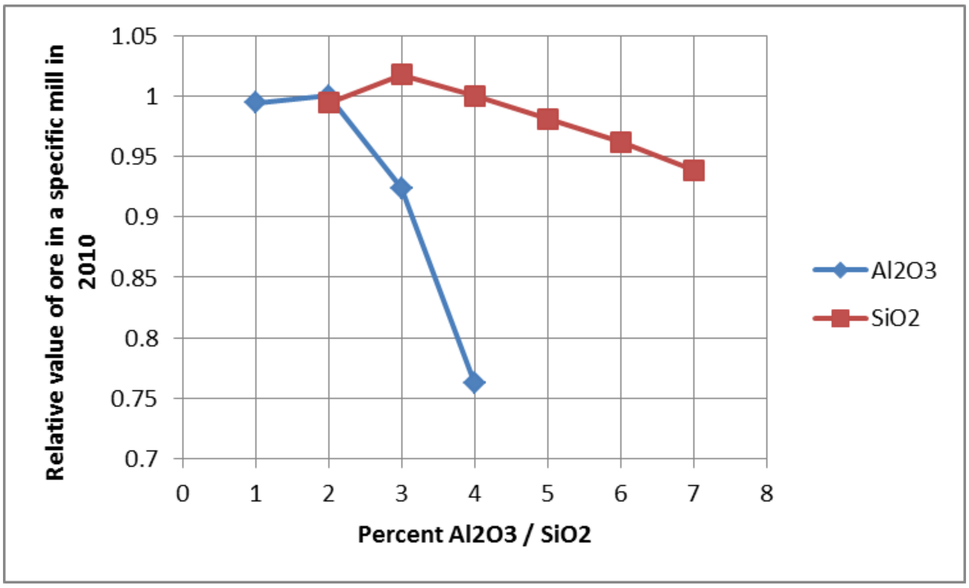

Figure 2: Impact of additional alumina or silica on ore value.

In the next example it is shown that various plants will assign vastly differing value to a specific raw material based around their own specific constraints (Figure 4). These constraints may include raw material contractual purchasing limits, raw material availability and operational constraints. Customer selection comes back into play here if the seller wants to maximise price.

5.2 Recovery of by-product credits

A classic iron ore example if the use of high-vanadium, high titanium ores by steel makers, whether in moderate quantities for blast furnace hearth protection or in high proportions to enable recovery of vanadium. It is easy to calculate the costs and economic benefit of vanadium recovery in the plants that are equipped to do so (See Figure 5 for a domestic natural gas-based TiFe mill), but it is more difficult to obtain a higher selling price than the market price set by Indonesian and Filipino producers.

Of interest in this model was the development of a calcining kiln for limestone which reduced the phosphorus removal cost dramatically due to the reduced burnt lime cost.

5.3 Value-adding before shipping

A model was developed recently for a Malaysian high LOI ore with access to cheap domestic thermal coal. A calcination kiln was used to theoretically decompose all the LOI, remove all the free moisture and thus reduce transport costs and increase value.

Though the little box in Figure 3 does not look like much, the thermodynamics and cost calculations behind the whole value chain made it economical to consider as an option.

So was this an engineering study or a value in use study? Both, perhaps?

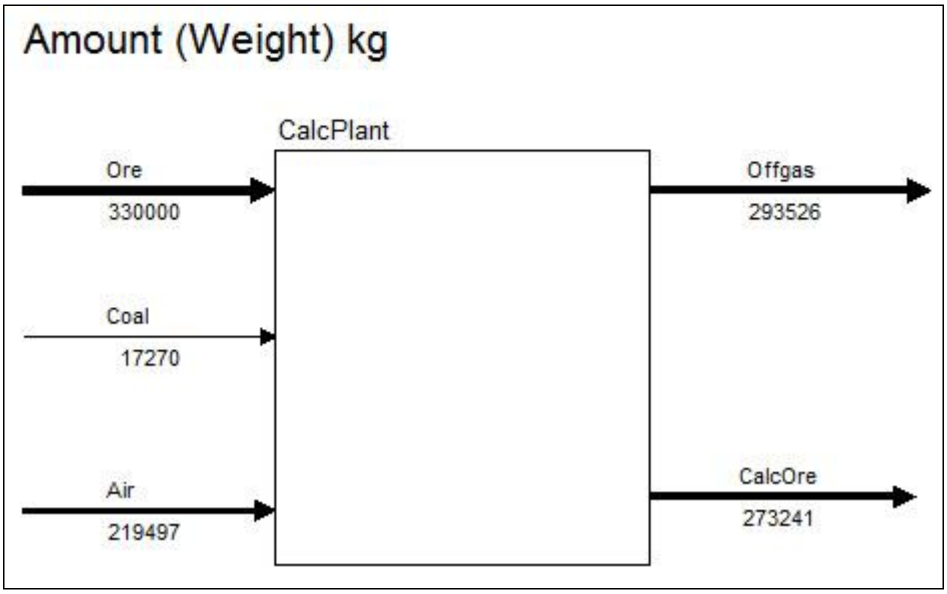

Figure 3: Calcination model for goethite decomposition.

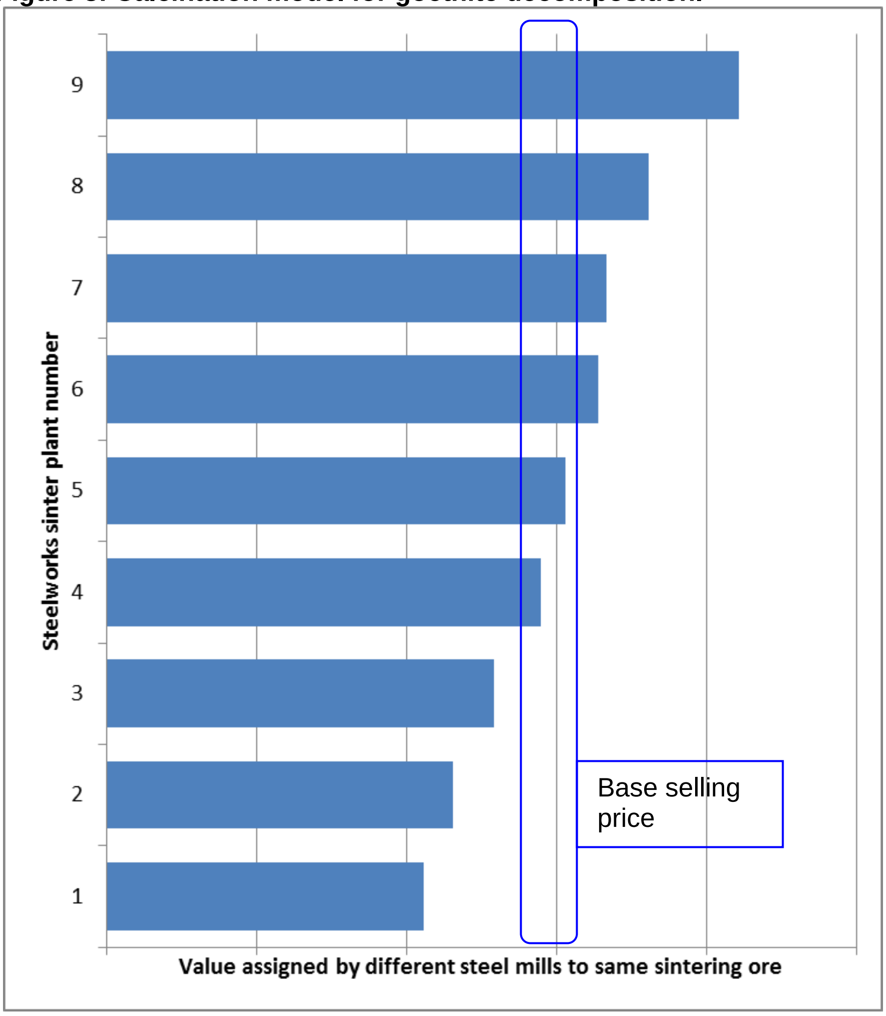

Figure 4: Differing raw material value assignments by different mills.

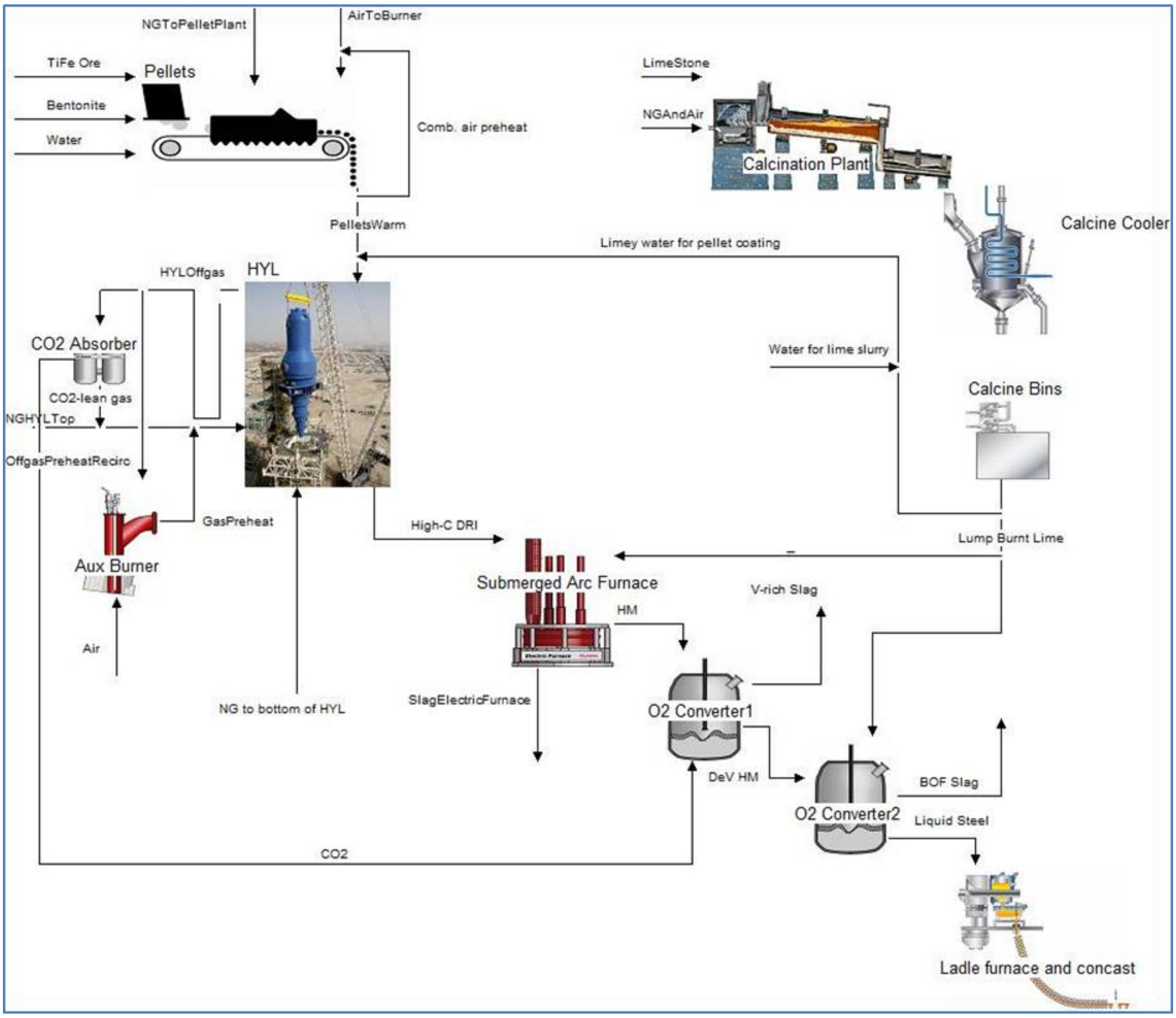

Figure 5: Modelling of ENERGIRON with limestone calcination and by-product recovery.

6. Negotiating strategies

How can VIU be leveraged in today's world? At best it can add a lot of value, worst case it can prove that your ore really deserved much more of a discount.

6.1 Transparency

Recently publicised is the reduction of silica penalties from USD2.50/1% SiO_2 to USD1.50/1% SiO_2 for the following quarter for Vale products. This is a sensible reduction and is based on the actual cost of production from coking coal and iron ore on a delivered basis.

Metal Bulletin also sees some merit and have advertised a VIU iron ore index with a range of product qualities converted back to 62% Fe. But is this realistic? Are all steel mills the same? Do all ascribe the same value to raw materials? Of course the answer is no. The best possible outcome is to model the value of a raw material in multiple end-user locations, knowing all their operating constraints and nuances.

6.2 Data requirements

But this requires a wealth of data. From blast furnace top gas analysis to balance the two-stage blast furnace mass and energy balance to percentage of each major steel type produced to model the effect of phosphorus properly.

There is thus a strong driver to simplify but the answer then becomes simplistic as well. Not worse or better, just simplistic.

6.3 Technical assistance

An experienced VIU operator can add value to customer operations in assisting to optimise blends, perhaps even reducing the ore percentage in question to negate any negative effects of the specific ore.

7. Conclusion

VIU can form part of a good negotiating strategy as it can add value to both parties across the table. At best it is a tool that can add value to the commercial discussion, but only a tool.

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[i] OREX – Promet Engineers
[ii] MARX – CPI Consultants
[iii] Burger, Bessinger and Moodley – Technical considerations and viability of higher titania slag feedstock for the chloride process. SAIMM, 2009
[iv] Pielet, Tsvik and Addes - Value-in-use model from iron ore through direct-reduced iron and electric arc furnace.
[v] Lares - Value in Use of HBI for EAF, Turkey, 2008