AFGHANISTAN RESOURCE CORRIDOR DEVELOPMENT

regarding

ASSESSMENT OF DOWNSTREAM MINERALS MARKET

made for

THE WORLD BANK
Working for a World Free of Poverty

Report 2: First overview of mill potential

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# Table of Contents

1. Introduction .................................................................................................................. 3
2. Objective and methodology .......................................................................................... 4
3. Executive summary and conclusions ............................................................................. 5
4. Determination of scope .................................................................................................. 6
   4.1 Basic choice of technology ....................................................................................... 6
   4.2 Product mix .............................................................................................................. 7
   4.3 Plant Configuration (headlines) ............................................................................... 8
       4.3.1 Capacity, CAPEX and operational cost parameters ........................................ 9
5. Product costing .............................................................................................................. 11
   5.1 Raw material cost ..................................................................................................... 11
   5.2 By-products ............................................................................................................. 12
   5.3 Product costing ......................................................................................................... 12
       5.3.1 Pig iron .............................................................................................................. 12
       5.3.2 Billets ................................................................................................................. 13
       5.3.3 Rebar .................................................................................................................. 13
   5.4 Total cost per product ............................................................................................. 14
6. Market logistical cost .................................................................................................... 15
7. Confrontation with market prices ................................................................................. 17
   7.1 Reference market prices ......................................................................................... 17
   7.2 Cost price versus market price ............................................................................... 18
8. Economies of scale ....................................................................................................... 19
9. Assessment of steel mill potential ................................................................................. 20
10 Potential scenario’s for the phased construction of capacity ...................................... 21
11 Summary of annual volumes(main process) ................................................................. 22
1. Introduction

The World Bank is helping the Government of the Islamic Republic of Afghanistan to prepare a Resource Growth Corridor Strategy anchored to upcoming large mining investments.

The latest large scale mining tender in Afghanistan concerned the Hajigak iron ore deposit. In this tender three out of four blocks, containing some 1.5 – 1.8 billion tons of iron ore (grade 62 – 63%), were awarded to the AFISCO consortium. The proposal of the consortium included the commitment to build a 7 million ton per annum steel mill in Afghanistan. Within this commitment it is assumed that proximate coking coal deposits will be developed for utilization in the steel plant.

In order to further the assistance for the Resource Growth Corridor strategy development, and in particular to assess the viability and potential of these AFISCO consortium plans and to consider possible alternative scenario’s against the objectives of the strategy, an assessment of downstream mineral markets is to be made.

With reference to the “Inception report, dd 14 04 2012” a quantitative assessment of the steel market in the wider region is made. Taking these findings into account, this report will focus on the potential of the proposed steel mill project.

This report, “first overview of mill potential” presents:
- Estimation of the likely products profile and markets
- Initial cost analyses versus regional comparators
- Considerations with regard to economies of scale
- Potential scenario’s for the phased construction of capacity

The report is the second out of four reports.
- Inception report, issued 14 04 2012, addressed the market potential and raised issues to be addressed in this and later reports.
- The next report will finalize the evaluation of the steel mill potential, and especially provide a deeper analyses of raw material cost and the logistical issues.
- The fourth report will be the draft final report comprising: a) quantitative market evolution; b) evaluation of AFISCO proposed steel mill potential; c) evaluation of further potential steel making projects; d) alternative scenario’s.
2. Objective and methodology

Objective:

The objective of this report is to provide insight in key parameters that determine the feasibility of the proposed 7 million ton/a steel mill project.

Methodology:

a. Starting points

In this stage little to nothing is known with regard to the scope of the 7 million ton steel mill.

The starting point is the use of Hajigak iron ore and of Darrah-i-Soof coking coal.

Another starting point is the quantitative market evaluation as reflected in the Inception report.

b. Drafting a scope

Taking into account the quantitative market evolution, a scope will be drafted. This scope has the objective to provide insight in the mechanism’s that drive cost and income. It is important to note that the scope is not the outcome of a feasibility study or any form of advice to investors.

c. Cost analyses

Cost will be analyzed with reference to international markets and target markets. Specific cost in Afghanistan (including the cost of iron ore and coking coal) are not known to date. The analyses is to provide insight in the potential competitiveness of the steel mill based on market forces. For Coal and iron ore the opportunity cost versus international trade markets is taken into account.

d. Economy of scale

We will elaborate on economy of scale issues, and indicate potential cost impact of downsizing.

e. Phasing

Based upon the initial scope choices that have been included in the drafted scope, options for an alternative phasing strategy will be discussed.
3. Executive summary and conclusions

The opportunity cost of Afghanistan iron ore and coal is, assuming a rail connection to a suited sea port, $35/ton lower than market price references. Without a rail connection the opportunity cost will decrease further, in favor of the steel mill.

This advantage plays out in the regional “home market”, in which an Afghanistan steel mill can profitably market pig iron and rebar/wire rod.

The advantage is offset with additional transportation cost of products that are to be shipped to “out of the region” export markets. In addition these export markets maintain more competitive (lower) prices.

Therewith, the status and development of infrastructure (road – rail) will have substantial impact on both, mining and steel making.

Under current market circumstances and subject to financing of the investments, and assuming rail connection to the sea, the investment in a 7 million ton steel mill might be viable.

Driving argument to invest in this scale, is to be the exploration of ore and coal.

The plant economical optimum for a steel mill design seems a smaller scale, meeting regional demand for pig iron and construction steel. Such scale would be 2 – 3 million ton. This scale is also viable without rail sea connection (of course at cost of mining proceeds).

Diseconomies of scale with downsizing are limited, subject to site and infrastructure investments. Such investments might either be subsidized (quite common) and / or depend on site selection.

A down sized steel plant could be the first phase of a growth strategy towards 7 million ton further down the road when market developments permit such.

Characteristics of a 7 million ton steel plant could be:

- Total investment $6 billion
- Saleable products:
  - 2.5 million ton pig iron
  - 3.0 million ton billets
  - 1.0 million ton rebar/wire rod

## Product/market

<table>
<thead>
<tr>
<th>Product/market</th>
<th>Price to market</th>
<th>Market price</th>
<th>difference</th>
<th>appreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron home region rail</td>
<td>$506</td>
<td>$550</td>
<td>$44</td>
<td>Green</td>
</tr>
<tr>
<td>Pig iron home region truck</td>
<td>$531</td>
<td>$550</td>
<td>$19</td>
<td>Orange</td>
</tr>
<tr>
<td>Pig iron Iran rail</td>
<td>$521</td>
<td>$550</td>
<td>-$1</td>
<td>Red</td>
</tr>
<tr>
<td>Pig iron Iran truck</td>
<td>$556</td>
<td>$520</td>
<td>-$36</td>
<td>Red</td>
</tr>
<tr>
<td>Billets India (rail – ship)</td>
<td>$657</td>
<td>$650</td>
<td>-$7</td>
<td>Orange</td>
</tr>
<tr>
<td>Billets India (truck – ship)</td>
<td>$702</td>
<td>$650</td>
<td>-$48</td>
<td>Red</td>
</tr>
<tr>
<td>Rebar home region</td>
<td>$722</td>
<td>$750</td>
<td>$28</td>
<td>Orange</td>
</tr>
</tbody>
</table>

Green is profitable; Orange is just lower than industry standard ROI; Red is not viable.
4. Determination of scope

4.1 Basic choice of technology

Today there are three main routes for producing steel. Hereunder we provide a schematic overview of these three routes.

The Afghanistan situation is, from a raw materials and infrastructural point of view best suited for the primary steel route [The nation is short in Scrap, short in Gas supply, short in power].

Little is known of the iron ore qualities. A brochure of the Ministry of mines shows a Russian qualification from the 60ies which might indicate certain volumes of lump ore. This would reduce the investment in ore preparation (Sinter plant and/or pellet plant). We assume a fully fledged sinter plant to be required and no pellet plant.

Rule of thumb investment (CAPEX) requirement up to (and including) the casted steel phase, per capacity ton crude steel is:

- Primary steel route: \$ 1.000 / ton
- Secondary steel route: \$ 250 / ton
- DRI route: \$ 1.100 / ton

In addition to these three, there is a new development led by Brazilian Vale. The technology, called Tecnored, may help to extend the lifespan of Vale’s mines and reduce their environmental impact, as it enables pig iron to be produced from iron ore of different grades and quality, and even ultrafine iron ore, which is currently deposited in tailings ponds. By using iron ore fines, it is possible to reduce the need to open up new areas for tailings ponds, which require environmental licenses to be created. The technology produces 25% less CO2, and it claims substantial cost reduction. Tecnored is proprietary Vale, and just in the scale-up phase. In this stage this technology is not to consider.

Another development is ULCOS (Ultra Low CO2 Steelmaking). ULCOS is a research foundation of the industry aiming for at least 50% CO2 reduction. One of the options is using Hydrogen instead of Carbon in the process. These technologies are not relevant within at least the next 20 years.
4.2 Product mix

In the quantitative market assessment we defined the Stan Countries, excluding Pakistan, as home market. We take the middle market estimate of 5 mio ton in 2025 as a starting point. [than there is a down side on 5 mio ton, and an upside on 16 mio ton]

The nearest competitor being Kazakhstan’s Temirtau mill of Acelor Mittal, specialized in flat steel and ready to expand in long products.

Next to that there is Uzmetkombinat in Uzbekistan and Turkmenistan Iron Steel Plant, and a small number of quite small anonymous plants. These all have in common that they are based on scars scrap, and depend on electrical power which is in short supply. These companies are potential customers for pig iron (granulate) which sells at a premium over scrap, improves their quality which is good for the market development, and maintains a competitive market on the product level which is preemptive towards Temirtau.

Against that background a reasonable scenario for the home market region could look like:

Steel demand x mio ton by supplier

Long products being rebar and/or light sections

So for the remaining volume Afghan Steel will depend on export markets. For these markets we assume:
- 1.5 mio ton pig iron to the Iran mini mills (which are remote, and scars of scrap)
- 3 mio tons of billets to India

In summary the product mix 2025:

<table>
<thead>
<tr>
<th>Product</th>
<th>Volume</th>
<th>market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron</td>
<td>1.0 million ton</td>
<td>Home region</td>
</tr>
<tr>
<td>Pig iron</td>
<td>1.5 million ton</td>
<td>Export Iran</td>
</tr>
<tr>
<td>Rebar (or wire rod)</td>
<td>1.0 million ton</td>
<td>Home region</td>
</tr>
<tr>
<td>Billets</td>
<td>3.0 million ton</td>
<td>Export India¹ (or e.g. Iraq)</td>
</tr>
</tbody>
</table>

The plant potential is therewith roughly 7 mio ton crude, subject to downstream investments.

¹ Ref. the Inception Report dd 14 04 2012, the market of India might turn to self sufficient or net exporting.
4.3 Plant Configuration (headlines)

- Coking plant
- Limestone
- Sinter plant
- PCI coal
- Blast Furnace 1
- Blast Furnace 2
- Basic Oxygen Furnace (2 converters, option on third)
- Billet caster 1
- Billet caster 2
- Rebar rolling mill
- Tar to chemical plant and/or road construct
- To power plant and/or fertilizer plant
- To cement plant and/or road construct

Report 2: First overview of steel mill potential
4.3.1 Capacity, CAPEX and operational cost parameters

The foregoing is a simplified illustration of the main processing plants at the integrated steel works.

The plant will require a complete infrastructure, with all kind of auxiliaries like an Oxygen plant, power station, water treatment (quite a bit of water is required anyway), internal (rail) transport facilities, maintenance shops etc.

By-products have a market value, but if such market is not there, the processing of these products to trading goods requires investments in, e.g. a power plant (to convert of gas into electric power); a fertilizer plant (to convert of gas into fertilizer); a cement plant (to convert slag into cement) and possibly a chemical plant (to convert tar in chemical products).

And site preparation, including access road & rail (in this case a port is not an option), power lines, to connect to the national infrastructure, is required.

Elaboration on all these potentially substantial investments is not within the scope of this report. We will look at the main facilities only, assume all other investments are done appropriately, and take their inputs / outputs into account if we analyze the costing.

Hereafter we review the main production line and give reference figures:

**Rebar rolling mill:**
- **Output:** 1,000 kton rebar / wire rod [to market]
  - 50 kton scrap
- **Input billets:** 1,050 kton billet
- **Conversion cost:** $50 / ton rebar
- **CAPEX:** $250 / ton annual capacity

**Continuous Casters:**
- **Output:** 4,050 kton billets [ of which 3 mio to market]
  - 120 kton scrap
- **Input:** 4,200 kton liquid steel (Crude steel)
- **Conversion cost:** $13 / ton billet
- **CAPEX:** $100 / ton annual capacity

**Basic Oxygen Furnace:**
- **Output:** 4,200 kton liquid steel
  - 500 kton slag
- **Input:** 4,025 kton hot metal (iron)
  - 450 kton scrap
  - 34 kton alloy
  - 275 kton fluxes
- **Conversion cost:** $42 / ton steel
- **CAPEX:** $90 / ton annual capacity
Desulphurization:

Output: 4,025 kton hot metal
Input: 4,065 kt hot metal
Conversion cost $ 2 / ton hot metal

Blast Furnace:

Output: 6,565 kt hot metal (of what 2.5 mio ton to market)
41,360,000 Gj Gas
1,970 kt slag
Input: 10,500 kt sinter
2,400 kt Coke dry
1,310 kt PCI coal
Conversion cost: $ 59 / ton hot metal
CAPEX: $ 225 / ton annual capacity

Sinter Plant:

Output: 10,500 kt sinter
Input: 8,400 kt standard sinter fines
1,575 kt limestone (fluxes)
685 kt coke (breeze)
Conversion cost $ 12 / ton sinter
CAPEX: $ 50 / ton annual capacity

Coke Plant:

Output: 2,970 kton Coke
115 kton Coke breeze
18,720,000 Gj Gas
105 kton Tar
Input: 4,190 kton Hard Coking Coal
Conversion cost: $ 60 / ton Coke
CAPEX: $ 350 / ton annual capacity

In summary, this analyses leads to the following:

<table>
<thead>
<tr>
<th>Plant</th>
<th>capacity</th>
<th>CAPEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolling mill</td>
<td>1.0 million ton</td>
<td>$ 250 million</td>
</tr>
<tr>
<td>Continuous Casters</td>
<td>4.1 million ton</td>
<td>$ 410 million</td>
</tr>
<tr>
<td>BOF steel making</td>
<td>4.2 million ton</td>
<td>$ 380 million</td>
</tr>
<tr>
<td>Blast Furnace</td>
<td>6.6 million ton</td>
<td>$ 1,490 million</td>
</tr>
<tr>
<td>Sinter plant</td>
<td>10.5 million ton</td>
<td>$ 520 million</td>
</tr>
<tr>
<td>Coke plant</td>
<td>3 million ton</td>
<td>$ 1,050 million</td>
</tr>
<tr>
<td>Auxiliaries &amp; infra and site</td>
<td>guesstimate</td>
<td>$ 1,900 million</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$ 6,000 million</td>
</tr>
</tbody>
</table>
5. Product costing

The parameters set in section 4.3.1, in combination with market price assumptions allows for determination of the cost price for the three products we defined in section 4.2:

- Pig iron
- Billets
- Rebar

Issues that are to be addressed in the costing are the unit cost for raw materials and the unit value or market price for by-products.

The conversion cost stated in section 4.3.1 are based on common (current) industry cost. For the Afghanistan situation these might turn out slightly different, but the impact is minor to that of the raw materials.

In addition thereto we have to consider capital cost (interest, depreciation and ROI), and general overhead (sales, admin, etc.).

5.1 Raw material cost

For purpose of this analyses we take rough estimates for prices, delivered at South Asian ports.

Iron ore, sinter fines, 63% Fe: $150 / ton (Indian West coast)

Hard Coking Coal: $250 / ton

PCI Coal: $200 / ton dry

Fluxes: $20 / ton

Scrap: $450 / ton

Alloy's: $1,000 / kg

For Coal and iron ore, and with reference to the report “Afghanistan Railway Development Plan” dd April 13th, of Harral.Winner.Thompson.Sharp.Klein , the opportunity cost of the Afghanistan mines can be estimated $20 – 25 / ton lower, for the additional\(^2\) cost of transport to the nearest port, and $10 - 15 / ton lower for seaborne transport to e.g. Indian port.

Iron ore, sinter fines, 63% Fe: $115 / ton ($182 / dmtu)

Hard Coking Coal: $215 / ton

PCI Coal: $165 / ton dry

\(^2\) Additional above estimated transport cost of mines to plant = Total cost 1.7 ct/t/km x 1800 km minus local transport from mine to plant.
Please keep in mind that these prices used have a snapshot character, which is not sufficient to use for purpose of investment feasibility analyses. Over the last years raw material prices have moved substantially and correlate with the growth of the Chinese steel demand. The graph of India export price is illustrative. In the next report we will elaborate on these price aspects.

5.2 By-products

In the steel industry the common way of cost price calculation deducts the value of by-products from the cost incurred in that specific production phase. Such includes scrap that, thereafter against market prices is input with the steelmaking.

Gas: $ 9 / Gj
Slag: $ 5 / ton
Tar: $ 200 / ton

5.3 Product costing

In the next analyses we consider direct cost, leaving out of the equation capital cost and general overhead.

5.3.1 Pig iron

Taking into account the recalculated local cost for iron ore and coal (both coking coal and PCI coal), the cost price for hot metal is:

Direct cost Hot Metal: $ 346 / ton. (with undiscounted international market prices for raw materials this would have been $ 417 / ton).

The cost for granulation and metal losses will be another $ 4. In conclusion we calculate the cost price for

Granulated pig iron: $ 350 / ton, FOB steel mill
5.3.2 Billets

With the iron cost included, the cost of steelmaking in the Basic Oxygen Furnace and the Casting of billets, we calculate, including $3 for handling and stocking, the cost price for

Billets: $450/ton, FOB steel mill

5.3.3 Rebar

Including the forgoing in the rolling and finishing the product to rebar or wire rod will result in a direct cost price for:

Rebar: $520/ton, FOB steel mill
5.4 Total cost per product

A WACC of 9% and depreciation (20 year) is allocated for the identified investments and linked to the specific products at a per ton basis [direct capital]. For the indirect or undefined facilities we divide the cost evenly on a per ton product basis [ plant general capital]. **Therewith** a profit margin (subject to leverage) is included in the cost prices below.

Overhead, including all other indirect cost, is estimated at $ 25 / ton (a common reference in the industry).

<table>
<thead>
<tr>
<th></th>
<th>Cost price $ / ton</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pig iron</td>
</tr>
<tr>
<td>direct cost</td>
<td>$350</td>
</tr>
<tr>
<td>direct capital + depr</td>
<td>$65</td>
</tr>
<tr>
<td>plant general capital +</td>
<td>$41</td>
</tr>
<tr>
<td>overhead</td>
<td>$25</td>
</tr>
<tr>
<td><strong>--------</strong></td>
<td><strong>--------</strong></td>
</tr>
<tr>
<td><strong>$481</strong></td>
<td><strong>$612</strong></td>
</tr>
</tbody>
</table>

In graphical format:

![Total cost breakdown per product](source: SteelConsult International, Cordellt Analyses, and various data sources.)
6. Market logistical cost

In section 5.1 we elaborated on the extra transport cost that is to be incurred for Afghanistan iron ore and coal before it can compete at par on the international market. It must be noted that the estimate of extra cost assumes a rail infrastructure, connecting Hajigak with a sea port, will materialize beforehand. If not, the discount for iron ore and coal in comparison to international market prices might be larger.

[In the region there is no other demand for these raw materials, except possibly for DRI quality iron ore in East Iran.]

For scrap, another basic raw material, it works the other way around. The area is scars of scrap. And the scrap is on average of bad quality. (this, in combination with lack of power, prohibits the few mini mills in the entire Nordic Stan region and North Pakistan to expand production). Sourcing scrap from the international market, as is done so successfully by the Turkish steel industry, faces high cost because of the additional transport. We estimate the additional cost, on top of the international "delivered" price at $ 30 / ton.

Considering the saleable products:

Pig iron:
The target market, the Nordic Stan countries and the North of Pakistan are within trucking distance. Current imports of rebar from Uzbekistan incur a trucking cost of $ 50 /ton\(^3\). Within a radius of 1,000 km the entire target market can be reached. With rail connection (target customers are steel works, and most have likely rail access) the cost may go down to $ 25 / ton. We estimate the trucking cost within a radius of 300 km to be $ 25. If rail connection is made, than for short distance still trucking will be advantageous (flexibility & transfers).

The target market of Iran is between 1,000 – 1,500 km. Though multi modal transport (truck to rail (Khaf) might be an option, it might not be cheaper than the more flexible trucking We estimate trucking cost at $ 75 / ton, If rail connection is made, this cost can go down to $ 30 / ton.

Since Temirtau in Kazakhstan is fully downstream integrated, this is not a likely competitor with pig iron. The only alternative would be exporters from oversea. This is very unlikely, but anyway the best positioned would be Brazil or Australia\(^4\) who face EXTRA cost of $ 20 / ton sea born + $ 30 / ton rail cost + $ 5 / ton for transfer, with thereafter the same distribution challenge.

Billets:
Target market is west coast India. If no rail connection exist the cost are to be estimated at $ 90 / ton for trucking + $ 10 / ton for shipping + $ 5 for transfer = $ 105 / ton.

With rail connection this goes down to $ 30 / ton for rail + $ 10 for shipping + $ 5 for transfer = $ 45 / ton.

\(^3\) Source: Altai consulting. Reference check with report “Initial Assessment of Key road Sector Issues with Recommendations”, Terje Wolden, 18 April 2012 suggest slightly higher cost (7Scf / t / km). We estimate averages / range and take into account major volumes at stake.

\(^4\) At current Australia is not exporting pig iron. But it is well positioned to do so if markets become accessible.
Rebar:
Target market is home region (Nordic Stan countries (+ North Pakistan)) within a radius of 800 km. Customers are NOT likely rail connected. Trucking is the best option at $ 50 / ton.

Competitors are the local scrap (and Afghan pig iron) based mini mills, Temirtau from Kazakhstan, and imports from overseas (Turkey).

Since the local competitors are limited in capacity (for many reasons, amongst others power and scrap), en Temirtau has focus on flat products, the price determining relevant competitors are overseas.

Turkey, as relevant overseas competitor with rebar has an additional transport cost of $ 20 for shipping + $ 30 for rail + $ 5 for transfer = $ 55 / ton.

Although the Afghan truck transport sector is currently “tariff regulated”, it is unlikely to maintain (other than for tax basis applications), the rigid system of a fixed price /t/km regardless the real cost. Comparing our estimates used in the above with the current tariff system suggests our estimates are high for the short range and low for the long range, but the differences are not significant enough to change conclusions.

<table>
<thead>
<tr>
<th>product</th>
<th>destination</th>
<th>radius</th>
<th>cost estimate</th>
<th>average road distance</th>
<th>controlled tariff reference</th>
<th>calc cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron</td>
<td>region</td>
<td>300 km</td>
<td>$ 25</td>
<td>300</td>
<td>$ 0,07</td>
<td>$ 21,00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 km</td>
<td>$ 50</td>
<td>900</td>
<td>$ 0,07</td>
<td>$ 63,00</td>
</tr>
<tr>
<td></td>
<td>iran</td>
<td>1250 km</td>
<td>$ 75</td>
<td>1400</td>
<td>$ 0,07</td>
<td>$ 98,00</td>
</tr>
<tr>
<td>Billets</td>
<td>sea port</td>
<td>1235 km</td>
<td>$ 90</td>
<td>1700</td>
<td>$ 0,07</td>
<td>$ 119,00</td>
</tr>
<tr>
<td>Rebar</td>
<td>region</td>
<td>0 km</td>
<td>$ -</td>
<td>0</td>
<td>$ 0,07</td>
<td>$ -</td>
</tr>
</tbody>
</table>
7. Confrontation with market prices

7.1 Reference market prices

**Pig iron:**
The reference market price for pig iron is scrap. Our international market price reference for scrap delivered is $450 / ton.

For scrap based mini mills, the input of pig iron has two major advantages:
- The re-melting cost is lower than of scrap (less energy required, less yield loss), and
- The pure metal helps to control the quality better

This rates the market price of pig iron at > 15% over scrap.

For Central Asia, the home region (the Nordic Stan countries and North Pakistan), which is an area short in scrap, there is likely a premium to account for the additional transport of $30 / ton on top of the “international delivered price”.

Conclusions:

Price reference “home region”: $450 x 1,15 + $30 = $550 / ton delivered

Price reference Iran: $450 x 1,15 = $520 / ton delivered

**Billets:**
The reference international market price we use for billets is $630 FOB Turkish port. Adding $20 / ton for transport to India West coast, The FOB cost Indian Port is $650 / ton.

Indian prices quoted by “Steelmint”: $630 Raipur; $650 Hyderabad and $720 Durgapur, all inland destinations (that might be delivered from inland steelworks) support the estimate.

Conclusion:


**Rebar:**
As it is the main exporter to the (wider) region, the reference international market price for rebar is $700 FOB Turkish port.

Sea born transport of $20 / ton, and inland transport to the region [e.g. Bandar – Kahf] of $30 / ton is to be added to bring this price at par with Afghanistan FOB price.

Conclusion:

Price reference home region: $750, FOB Afghanistan mill:

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5 Source: SBB; UN trade statistics; Cordellt database
7.2 Cost price versus market price

Combining the cost price analyses of section 5, the market logistical cost of section 6 and the market price references of section 7.1, we arrive at the following table:

<table>
<thead>
<tr>
<th>Product/market</th>
<th>Cost price FOB mill</th>
<th>Market</th>
<th>Logistical cost</th>
<th>Price to market</th>
<th>Market price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron home region rail</td>
<td>$481</td>
<td>Delivered</td>
<td>$25</td>
<td>$506</td>
<td>$550</td>
</tr>
<tr>
<td>Pig iron home region truck</td>
<td>$481</td>
<td>Delivered</td>
<td>$50</td>
<td>$531</td>
<td>$550</td>
</tr>
<tr>
<td>Pig iron Iran rail</td>
<td>$481</td>
<td>Delivered</td>
<td>$30</td>
<td>$521</td>
<td>$520</td>
</tr>
<tr>
<td>Pig iron Iran truck</td>
<td>$481</td>
<td>Delivered</td>
<td>$75</td>
<td>$556</td>
<td>$520</td>
</tr>
<tr>
<td>Billets India (rail – ship)</td>
<td>$612</td>
<td>FOB Indian port</td>
<td>$45</td>
<td>$657</td>
<td>$650</td>
</tr>
<tr>
<td>Billets India (truck – ship)</td>
<td>$612</td>
<td>FOB Indian port</td>
<td>$105</td>
<td>$717</td>
<td>$650</td>
</tr>
<tr>
<td>Rebar home region</td>
<td>$722</td>
<td>FOB mill</td>
<td>$0</td>
<td>$722</td>
<td>$750</td>
</tr>
</tbody>
</table>
8. Economies of scale

In section 4.3.1 we detailed the scope of the key production facilities, and expressed the CAPEX involved on a “per ton capacity” basis. This can be done, because for these facilities the technology has evolved in such a way that the investments are 1:1 scalable.

Given the prerequisite of a 7 million ton steel plant, we took 2 large blast furnaces into account. But today, newly designed mini blast furnaces exist with a capacity of even less than 200 kt against almost the same investment cost on a per ton basis. This is just an illustration because a smaller scale plant would, subject to the product mix, consider alternative technologies.

Economies of scale relate mainly to site and infrastructure, and to a minor extent to organizational and commercial aspects. At this moment no decision has been taken on where the steel plan will be build.

With determining the site for the project consideration made for:
- Available infrastructure (in the proximity of) vs complete self sufficient
- Site preparation cost
- Logistics of raw materials (consider a mine)
- Logistics to market (consider an “industrial” area / infrastructure access)
- Labor
- Etc.

The outcome of such considerations and the decision for a site location have impact on the sensitivity for economies of scale.

As a rule of thumb, for general Greenfield situation, one can consider:
- Investments in main facilities: no economies of scale
- Investments in Auxiliaries, infra, site and project cost: 30% is not scalable [if the scope remains a fully integrate steel works]
- Operational cost: economies of scale are within a 0 - 5% of operational cost range (plant of 500 kt, a maximum of 5% higher cost / ton than a 7,000 kt plant). Often such gets compensated with higher flexibility and lower market logistical cost, which offsets such in sales prices.
9. Assessment of steel mill potential

A steel mill of 7 million ton capacity in Afghanistan can, with the current market projections, not survive on regional sales. The market is too small. This might change longer term (2030 – 2040) or with more aggressive growth scenarios. Based on the current outlook, international export (outside the region) is required to run the mill at capacity.

Down side scenario’s impose more pressure on international export

With a free hand we designed the plant for an optimal market strategy, given the prerequisite of total size.

This strategy results in the following:

<table>
<thead>
<tr>
<th>Product/market</th>
<th>Price to market</th>
<th>Market price</th>
<th>difference</th>
<th>appreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron home region rail</td>
<td>$506</td>
<td>$550</td>
<td>$44</td>
<td></td>
</tr>
<tr>
<td>Pig iron home region truck</td>
<td>$531</td>
<td>$550</td>
<td>$19</td>
<td></td>
</tr>
<tr>
<td>Pig iron Iran rail</td>
<td>$521</td>
<td>$520</td>
<td>-$1</td>
<td></td>
</tr>
<tr>
<td>Pig iron Iran truck</td>
<td>$556</td>
<td>$520</td>
<td>-$36</td>
<td></td>
</tr>
<tr>
<td>Billets India (rail – ship)</td>
<td>$657</td>
<td>$650</td>
<td>-$7</td>
<td></td>
</tr>
<tr>
<td>Billets India (truck – ship)</td>
<td>$717</td>
<td>$650</td>
<td>-$63</td>
<td></td>
</tr>
<tr>
<td>Rebar home region</td>
<td>$722</td>
<td>$750</td>
<td>$28</td>
<td></td>
</tr>
</tbody>
</table>

This table does not conclude that export products are loss making. It only tells that the contribution to profit is less.

Whether or not there is a net loss on the red marked product market combinations is subject to financing and leveraging. In section 5 we assumed a WACC of 9% and a depreciation of 20 years.

There is a clear sensitivity for the transportation. It must be noted though that the discount on ore and coal prices is based on the opportunity cost with rail transport. In case rail is no option, the discount might be higher until a level the mine stops operating. With that in mind, the overall conclusion is that the plant is profitable under the current market conditions.

Questions:

- Long term market conditions
- Verification transportation cost assumptions
- Financing
10. Potential scenario’s for the phased construction of capacity

The development of the steel mill is to be considered in perspective of:

- The development of the iron ore and the Coal mine
- The development of national infrastructure, especially rail connection with a sea port
- The market

We have made an initial assessment of the market, the other 2 issues are unknown.

Potential scenario’s to phase the investment are guess work if the first two points of consideration are unknown.

Taking as a starting point that the end situation is a 7 mio ton steel plant as described in this report phasing could consider:

Scenario 1:

Building a part of the Coking plant, a small sinter plant and a small, up to 1,5 mio ton sized Blast furnace, as a first step. Develop the market for pig iron.

A second step could be the investment in a rebar Rolling mill, based on imported billets, in order to build up market share [a barter arrangement with Uzmetkombinat is thinkable].

Next step could close the chain with the building of a second, large, Blast Furnace and the Steel plant with one converter.

Scenario 2:

Start with a Rolling mill, based on imported billets, as a first step.

A second step could be the building of a Sinter plant, Coking plant and large Blast Furnace and the Steel plant.

Scenario 3:

Start with one Sinter plant, Coking plant and a large Blast Furnace (3 mio ton), the Oxygen Steel mill and the rolling mill first. Al geared at the regional market.

Next step, expanding with a second Blast Furnace and expanding the Steel plant, should be subject to rail connection with a sea port, or further growth of the regional market.

Remark:

These scenarios are just creative thinking, and fail the tie in with overall strategic objectives. From a investors and steel plant only perspective scenario 1 aims at low risk, high return, but the feasibility is subject to site and infrastructure conditions.
11. Summary of annual volumes (main process only)

**Input:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron ore sinter fines</td>
<td>8.4 million ton</td>
</tr>
<tr>
<td>Hard Coking Coal</td>
<td>4.2 million ton</td>
</tr>
<tr>
<td>PCI Coal</td>
<td>1.3 million ton</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.9 million ton</td>
</tr>
<tr>
<td>Gas</td>
<td>2,400 Gj</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.6 billion Kwh</td>
</tr>
<tr>
<td>Oxygen</td>
<td>735 million Nm3</td>
</tr>
<tr>
<td>Inert gases</td>
<td>30 million Nm3</td>
</tr>
</tbody>
</table>

**Output (saleable):**

<table>
<thead>
<tr>
<th>Material</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron</td>
<td>2.5 million ton</td>
</tr>
<tr>
<td>Billets</td>
<td>3.0 million ton</td>
</tr>
<tr>
<td>Rebar</td>
<td>1.0 million ton</td>
</tr>
<tr>
<td>Gas</td>
<td>60,100 Gj</td>
</tr>
<tr>
<td>Slag</td>
<td>2.5 million ton</td>
</tr>
<tr>
<td>Tar</td>
<td>0.1 million ton</td>
</tr>
</tbody>
</table>