Development of Sheikhoo Sugar Mills with regards to energy efficiency and diversificationresentation on Sheikhoo Sugar Mills

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Abstract:

Pakistan's Sugar Industry is passing through a difficult time of survival due to the high price of sugar cane, low sugar content in cane, low price of sugar, strict control of the government, and environmental regulations. This situation forced us to adopt new technology, to increase efficiency, reduce the cost of production, diversify into the allied industry using the advantage of core business and increase revenues.

The processing technology was changed using IPRO Germany design/recommendation and replaced evaporators with FFE technology. Fully automated based on DCS at raw & refinery pans reduced water consumption/steam saving, and bagasse saving. Improvement of quality of sugar, Eaton filters, and a new pharma-grade line were added. Replaced old technology with highest efficiency CMD gears at mills, use of VFDs to reduce KWH/TC. Replaced the old boilers and turbogenerators with the high-pressure system, and installed a downstream steel plant. High sucrose, high-yielding varieties were cultivated.

Introduction:

Roadmap of Sheikhoo Sugar Mills:

- Capacity enhancement from 6000-20,000 TCD
- Modern laboratory control
- Sugar yield & increase in recovery
- Sugar quality improvement
- Process steam optimization
- Power demand reduction
- Power export for the downstream industry
- Maintenance cost reduction

Cane Quality Issues:

- Sugar Cane had an abnormal quality of extraneous matter, trash, and tops as well as borer
- High cut to crush time (5-10 days)
- Infestation in cane
- Supply of non-quality/banned varieties that have low sugar content
- Above factors were causing low sugar recovery, increased milling, and processing losses, and ultimately increasing the cost of production

The trash in Cane coming to mills for crushing

Poor quality Cane with borers.

Roadmap to increase recovery & reduce the cost of Production:

- Supply of healthy seeds having high yield and sucrose content
- Soil analysis and soil mapping were done as shown in figure-4 to find the deficiencies of nutrients and organic matter. Soil amendment plans and advisory services to growers provided
- Training in integrated pest and disease management provided to growers to keep the crop safe from infestation
- Education and training provided to farmers for balanced use of fertilizer
- Implementation of sugar cane protection and production strategies in line with farmers
- Cane planning and procurement planning to reduce cut-to-crush time
- Monitoring and control measures for supply of clean cane

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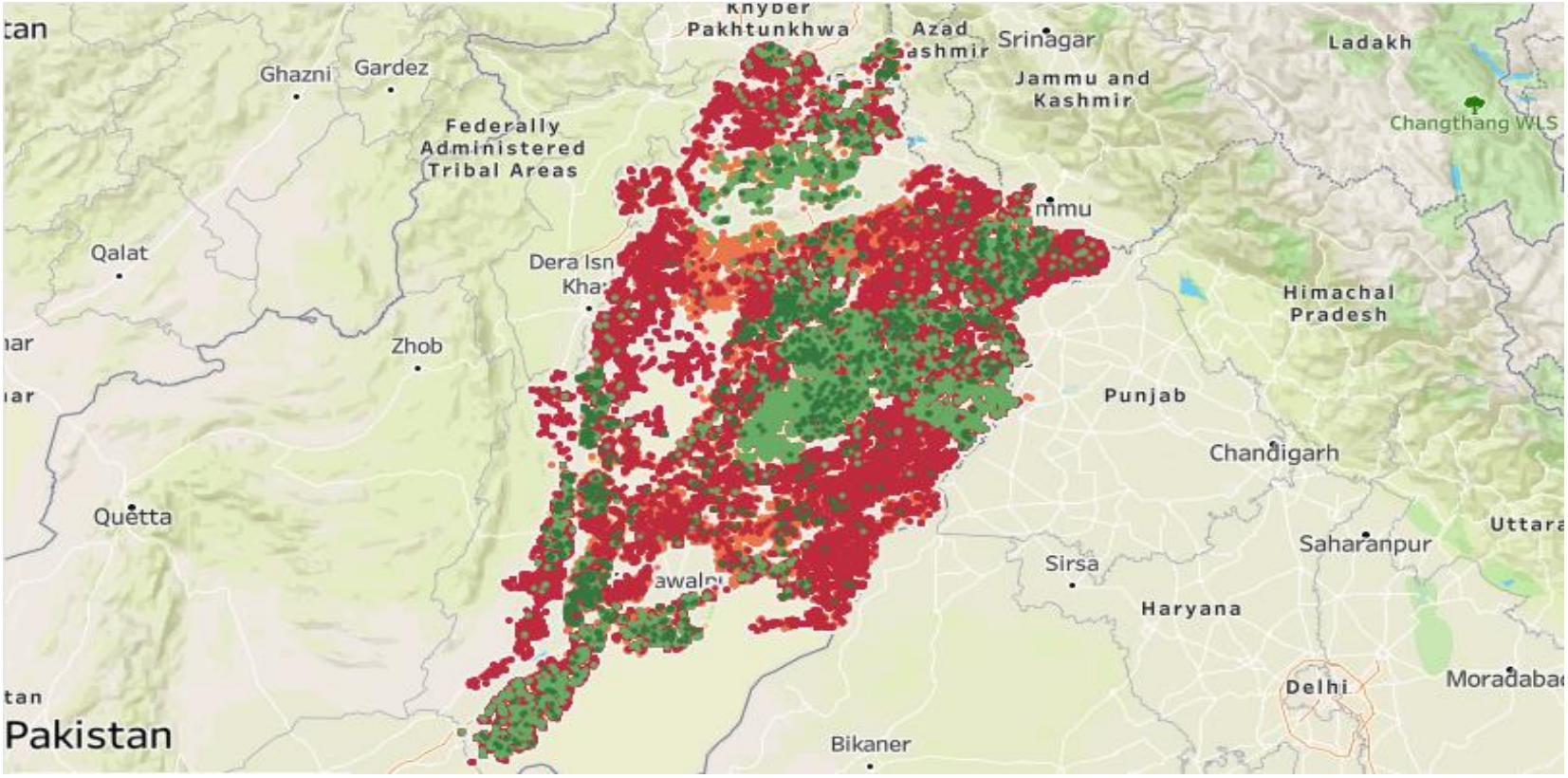
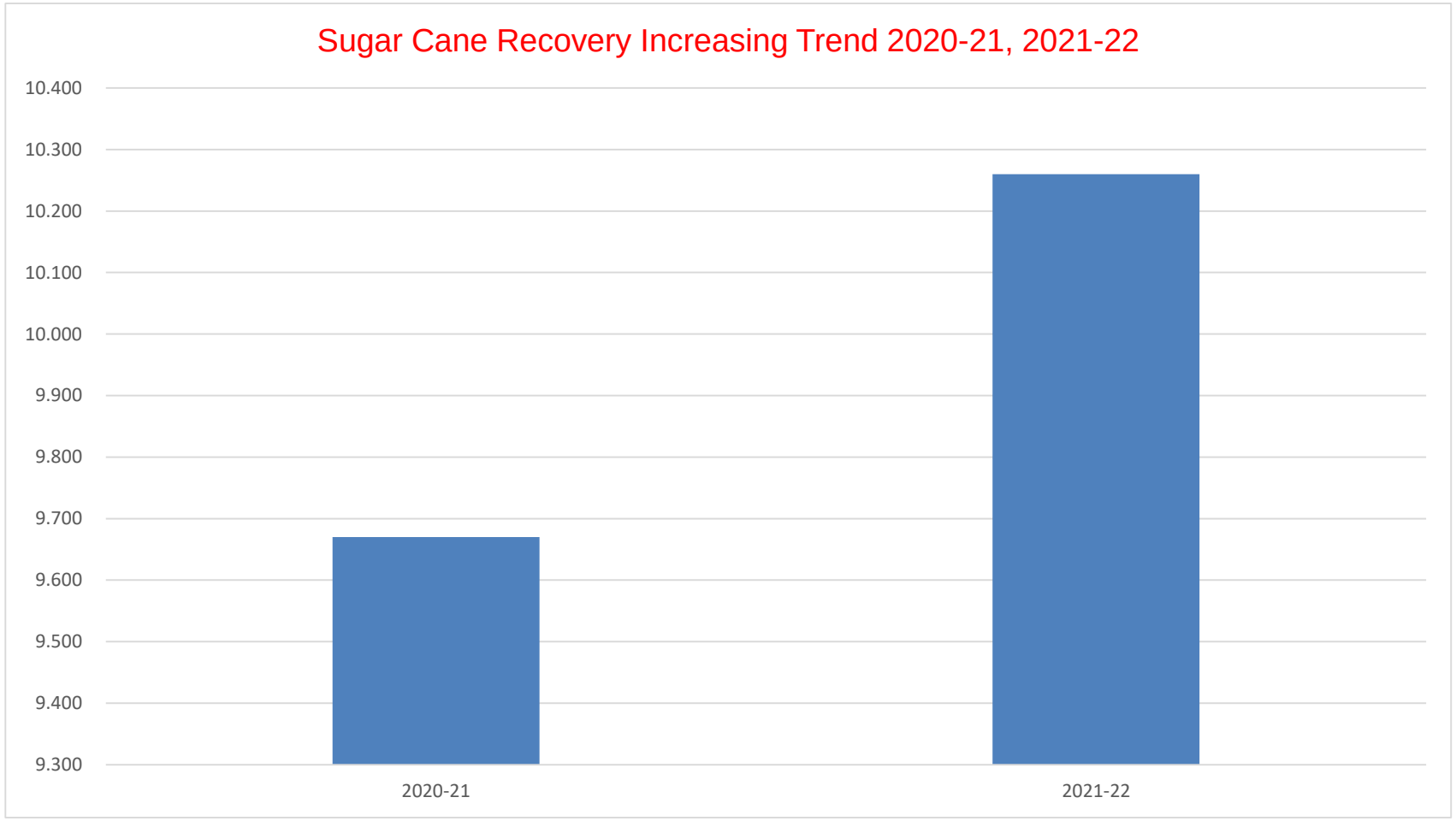
Soil Map of Punjab Province:





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Energy Conservation Initiatives Cont--:

- Energy conservation/saving by the installation of high-efficiency AC motors & VFDs at all mills, fans of boilers, pumps, carrier drives, cooling towers, and other drives
- Replacement of low-efficiency crown gears at mills with high-transmission efficiency CMD Gears as shown in Figure-8. This saved power for capacity increase instead of installing higher power motors. The power-saving from the high transmission efficiency of CMD gear is shown in table-2.
- Use of multi-misalignment couplings (Figure-7) to reduce power consumption and save on maintenance costs by replacing tail bar couplings, Fig-6. Transmission efficiency was increased. Estimated power savings was around 8%
- Processing technology was upgraded using IPRO Germany design & recommendation
- Crystallization with second Vapors & third vapors

- **Energy Conservation Initiatives Cont**
- Falling film evaporators were installed (Figure-9) in place of Robert evaporators. FFE works with very low delta T, minimum juice residence time, and ultimately, low sucrose loss. A comparison of old and new evaporator stations
- Various changes in the processing scheme were made. These steps resulted in an increase in the efficiency of evaporators and water consumption at raw & refinery pans. Steam demands were reduced significantly and bagasse savings increased.
- Use of vapor heater for mix juice heating
- Use of continuous pans at A, B & C massecuite boiling for uniform crystal growth allow boiling with V-3 due to low massecuite boiling head
- Use of molasses conditioner for steam saving
- Use of Eaton filters with 10-micron cartridge for efficient filtration of liquor as well control on wash water for recycling and hence energy saving
- Use of MultiJet SEDL & IPRO design condensers with minimum water and energy requirement

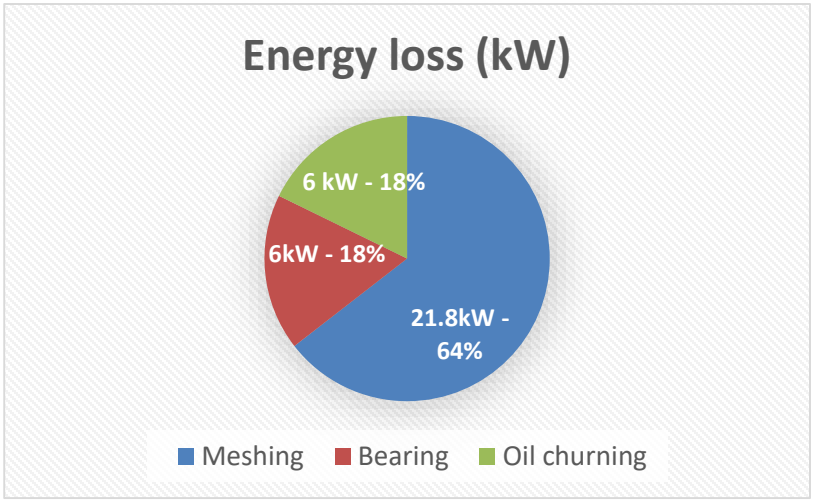
Tail bar coupling a conventional arrangement

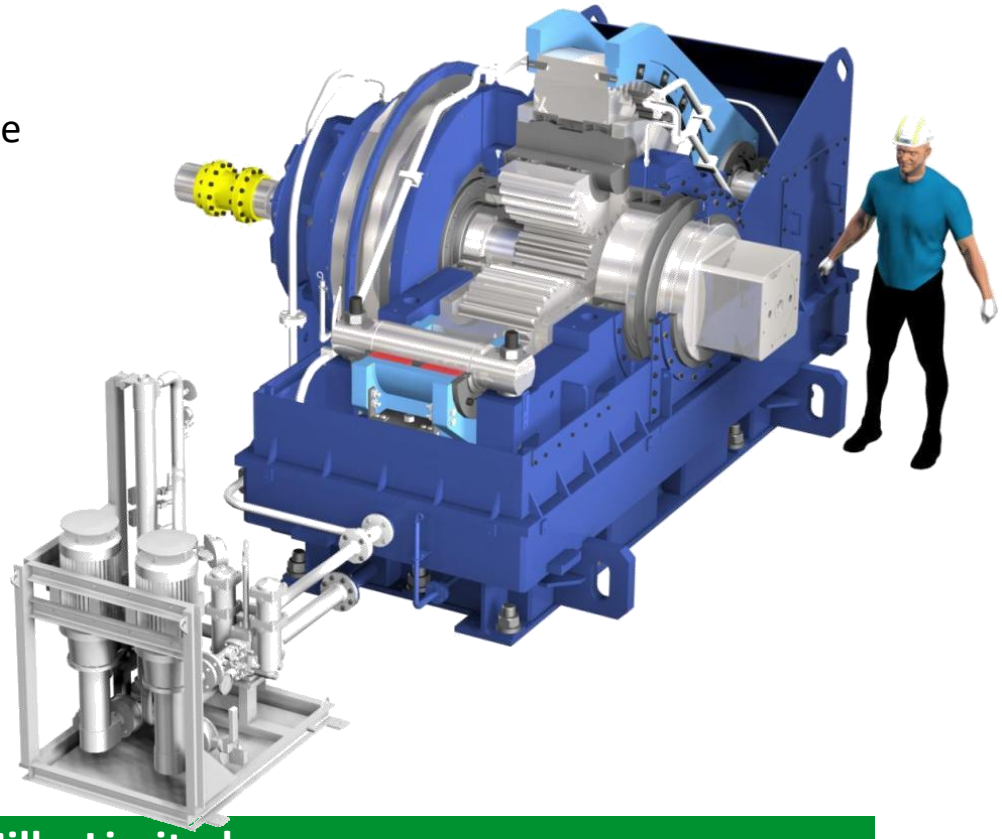
Multimisallignment coupling

Technological Development at SSML

Technological Improvement at Process

Example with a modern planetary gearbox
Calculations were done with Kiss soft software
Correlated with ISO standards and CMD experience





Total energy loss = 3,0%
Efficiency = 97,0%

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Power Saving & increase in transmission efficiency after CMD Gear

Generation	Absorbed Power by Mill KW	Transmission efficiency	Installed Power KW
4th	1140	93%	1226
3rd	1140	83%	1373
2nd	1140	81%	1407
Ist	1140	73%	1572

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Evaporator Station old & new Set Up

Sr No	Evaporators	Old Set Up	New Set-Up
1	Ist effect	4000+4000m^2 Robert Type	6000+6000m2 IPRO FFE
2	2nd Effect	2700+2500m^2 Robert Type	6000+6000m2 IPRO FFE
3	3rd Effect	2300+2300m^2 Robert Type	4000+4000m2 Robert Type
4	4th Effect	1800+1500m^2 Robert Type	1800+1700m2 Robert Type
5	5th Effect	1100+1100m^2 Robert Type	1350+1350m2 Robert Type

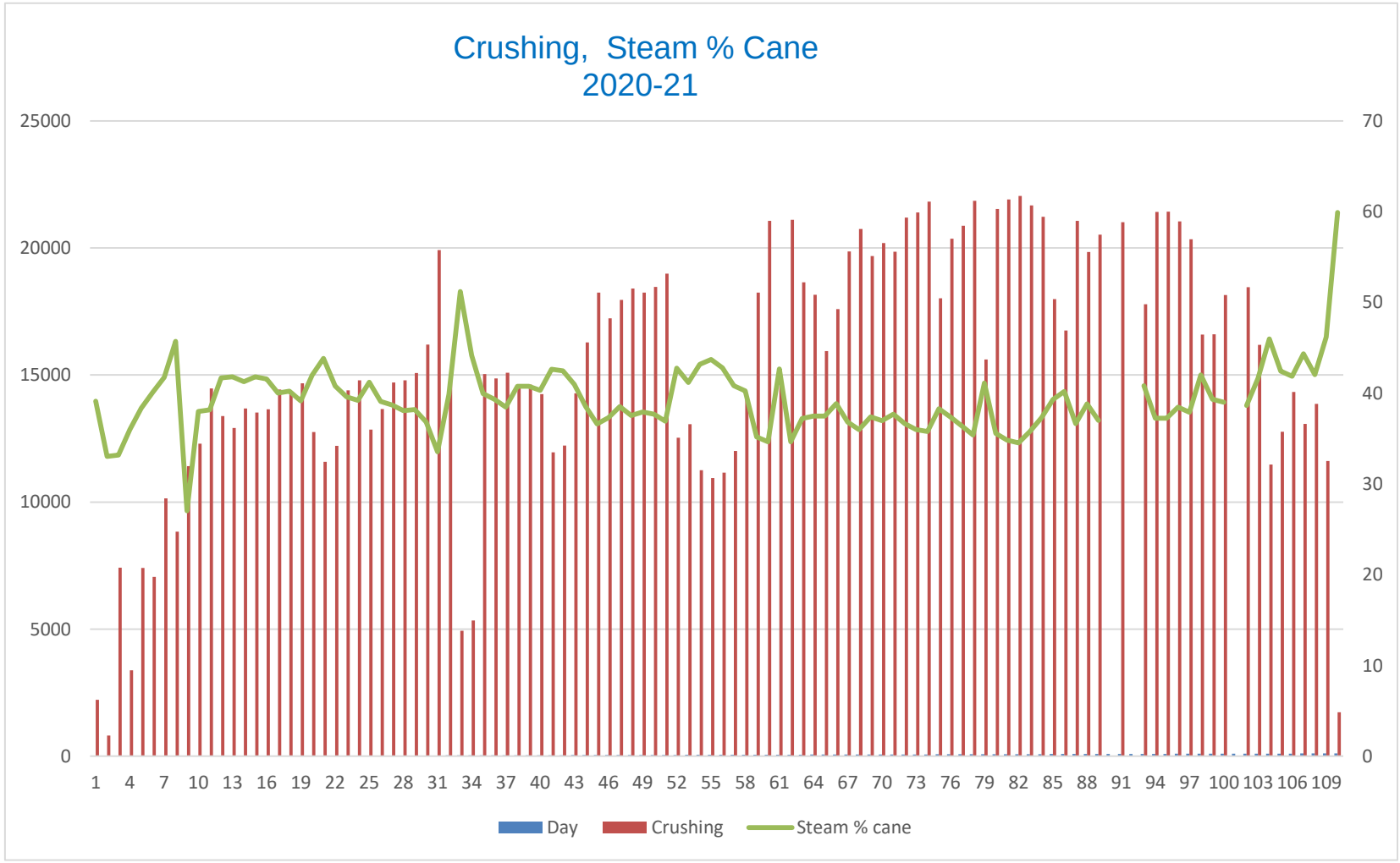
Falling film evaporators at Sheikhoo Sugar Mills.

Role of automation in Energy Conservation:

- Raw and refinery pans were put on the auto mode through DCS control and resulted in,
- Consistent and increased brix
- Increased crystal contents
- Reduction in dilution of water
- Improved CV of sugar
- Impact of improved energy efficiency was reflected in terms of steam economy
- Configuration of Sheikhoo Sugar, initial stage vs present status

Configuration of operation at Sheikhoo Sugar Mills

Sr No	Parameters of Operation	Target figures
1	Initial crushing capacity	4000-5000 TCD
2	Improved crushing capacity	23,000 TCD
3	Finished product	White refined sugar
	70%	Below 25 ICUMSA
	25%	Above 25 ICUMSA
4	Cogeneration (Initial stage)	No
5	Cogeneration (Now)	Yes
6	Evaporator station Initial	Quadruple Roberts
7	Evaporator station Initial	Quintuple FFE + Roberts
8	Initial Steam % Cane	53%
9	Steam % Cane Now	36-37%



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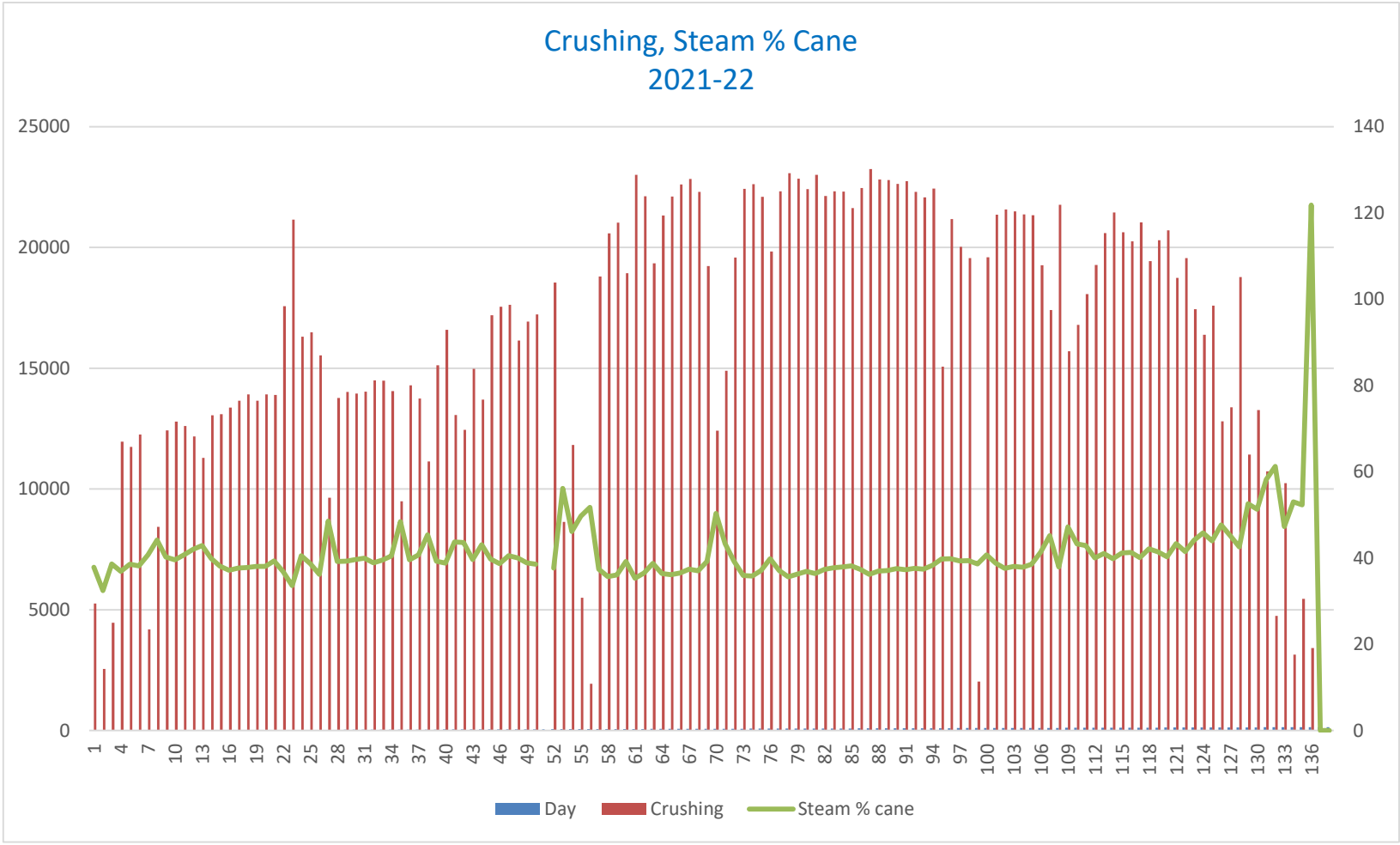

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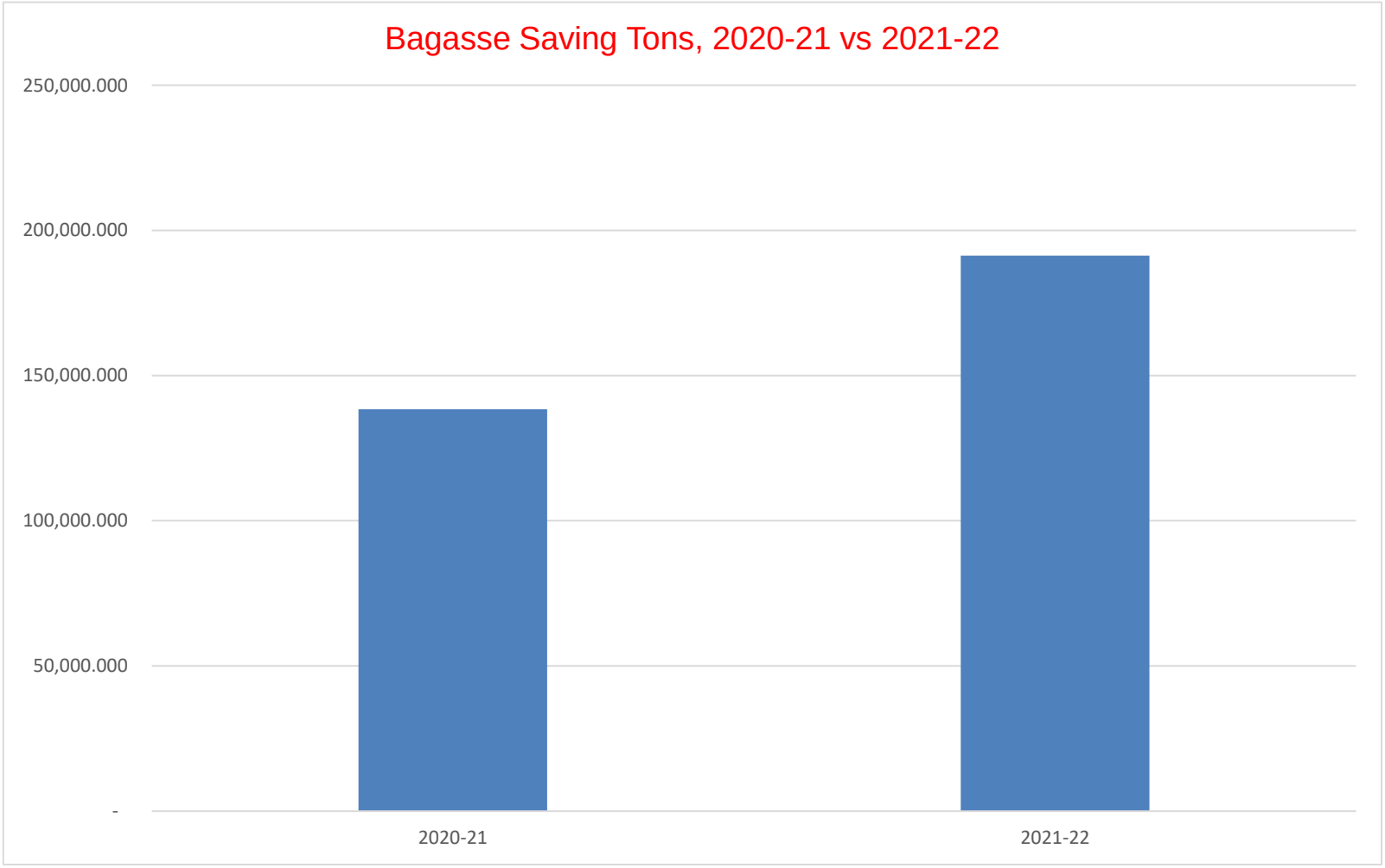
Technique Used for bagasse saving:

- Improvement in milling performance and reduction of bagasse moisture at 50%. This was fundamental support in an increase in boiler efficiency
- Replacement of Robert-type evaporators with FFE, using high heat transfer efficiency
- Efficient vapor bleeding, use of Vapor-1,2,3,4 and conserving steam use was a game-changer in energy efficiency and bagasse saving
- Control of the use of water at raw and refinery pans to save steam and bagasse
- Control of recirculation of sugar by installing an air jet system at refined centrifugal machines
- Energy audit of plant with special focus on improvement in the insulation of steam/vapors pipelines and control of steam leakages
- Installation of economizers at medium pressure boilers. Feed water temperature was increased from 100-125 C through waste heat recovery. There was a significant saving of fuel/bagasse through an increase in efficien


Bagasse Saving Tons, 2020-21 vs 2021-22
250,000.000
200,000.000
150,000.000
100,000.000
50,000.000
-
2020-21
2021-22

The co-Generation route adopted by Sheikhoo Sugar Mills:

Co-Generation is through the installation of high-pressure boilers and turbines to produce extra power from the same fuel. Surplus power can be sold to:

- National grid or
- In-house consumption for diversification into the downstream industry.

Sheikhoo Sugar Mills adopted the second option. Existing medium-pressure boilers and turbines were replaced with high-pressure pressure boilers and turbines. The scenario of power generation with medium pressure technology and with high-pressure technology

The scenario of Power Generation Medium Pressure Technology

Sr No	Operational Parameters	
1	Crushing TCD	23,000
2	Steam demand % Cane	36%
3	Steam demand TPH	345
4	Power requirement	26 MWH
5	Steam consumption in Power House TPH	275
6	Steam demand for shredder TPH	50
7	Miscellaneous steam consumption for makeup etc TPH	20

The scenario of Power Generation with High-Pressure Technology:

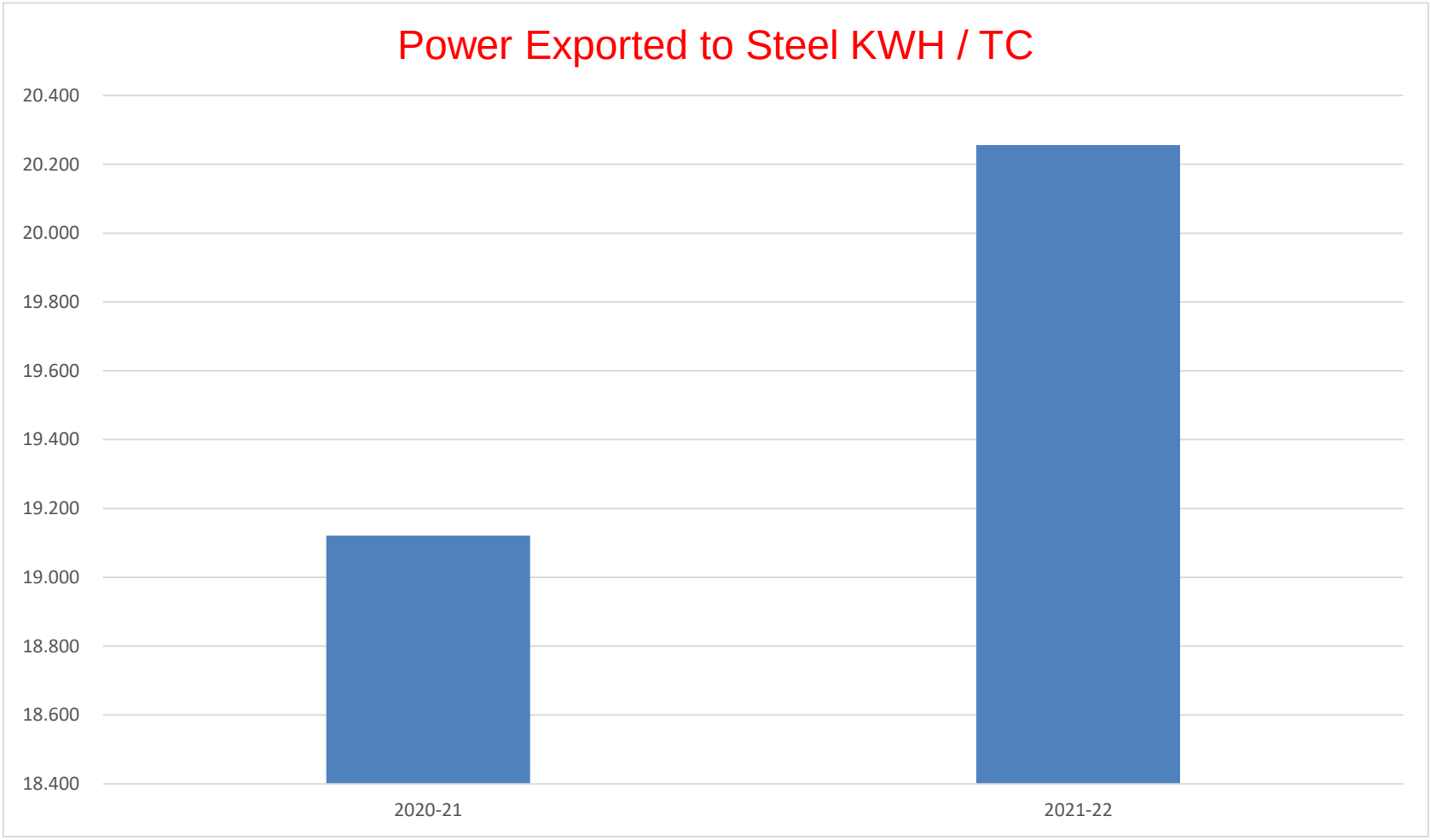
Sr No	Operational Parameters	
1	Crushing TCD	23,000
2	Steam demand % Cane	36%
3	Steam demand TPH	345
4	Power Generation MWH	47
	Power for Sugar Plant MWH	26
	Power for Steel Plant MWH	21
5	Steam consumption in Power House TPH	275
6	Steam demand for shredder TPH	50
7	Miscellaneous steam consumption for makeup	20

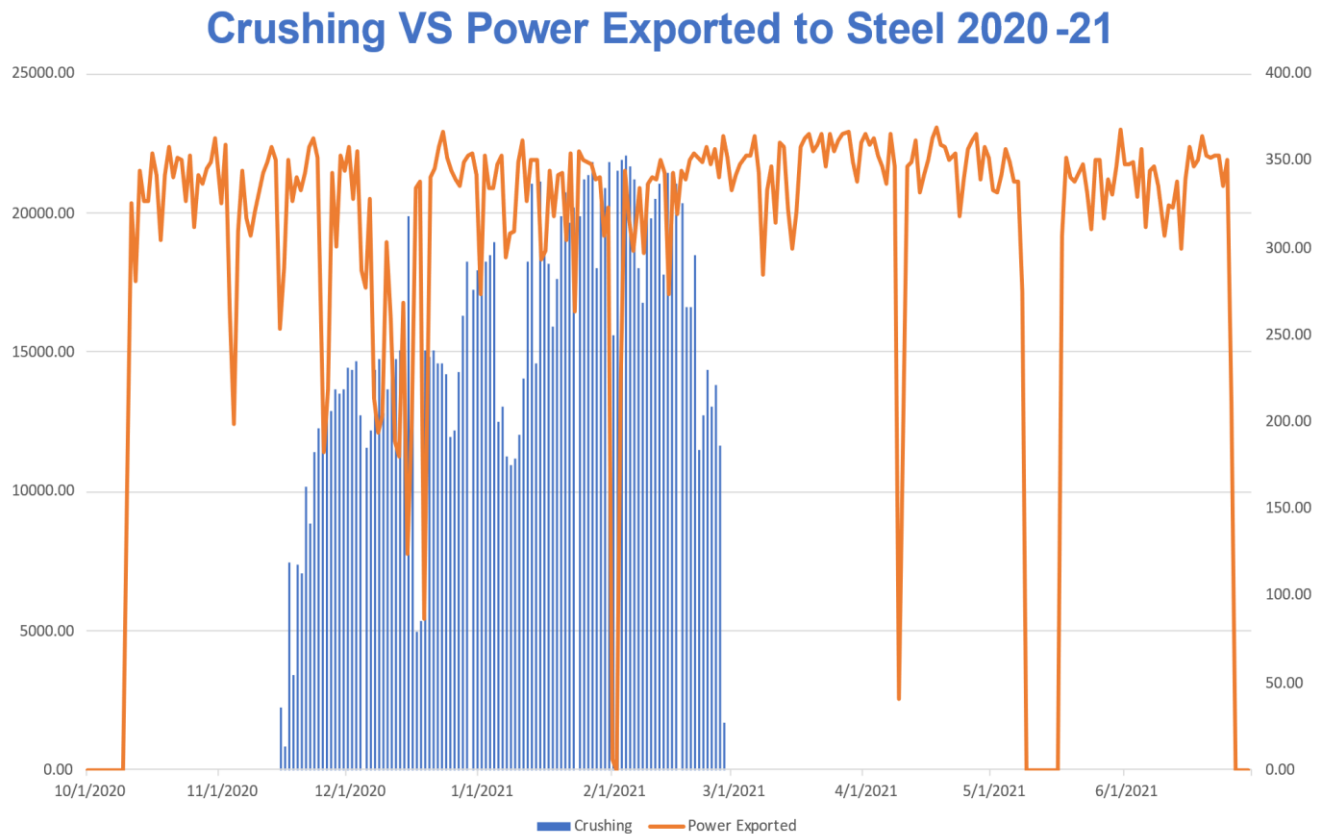
Diversification in Steel Rebar Production:

A downward steel billet and rebar production plant having a capacity of 150,000 tons/year was installed. A 50 MW power plant was installed with a sugar unit. This plant was supplying power to both sugar and steel plants with the same bagasse and it was consuming earlier with medium pressure set up. Surplus power exported to steel plant

Advantages to adopting in house power consumption philosophy:

- Reduction in transmission losses over the useful life of the project
- Increase in profitability/viability of business and competitiveness against competitors
- Reduction in administrative expenses
- Increase in employment in the local area
- Dependence on fossil fuels was reduced
- Biomass-based power is always environment friendly
- Power exported to steel per mega wat of melting is necessary


Power Exported to Steel KWH / TC
20.400
20.200
20.000
19.800
19.600
19.400
19.200
19.000
18.800
18.600
18.400
2020-21
2021-22



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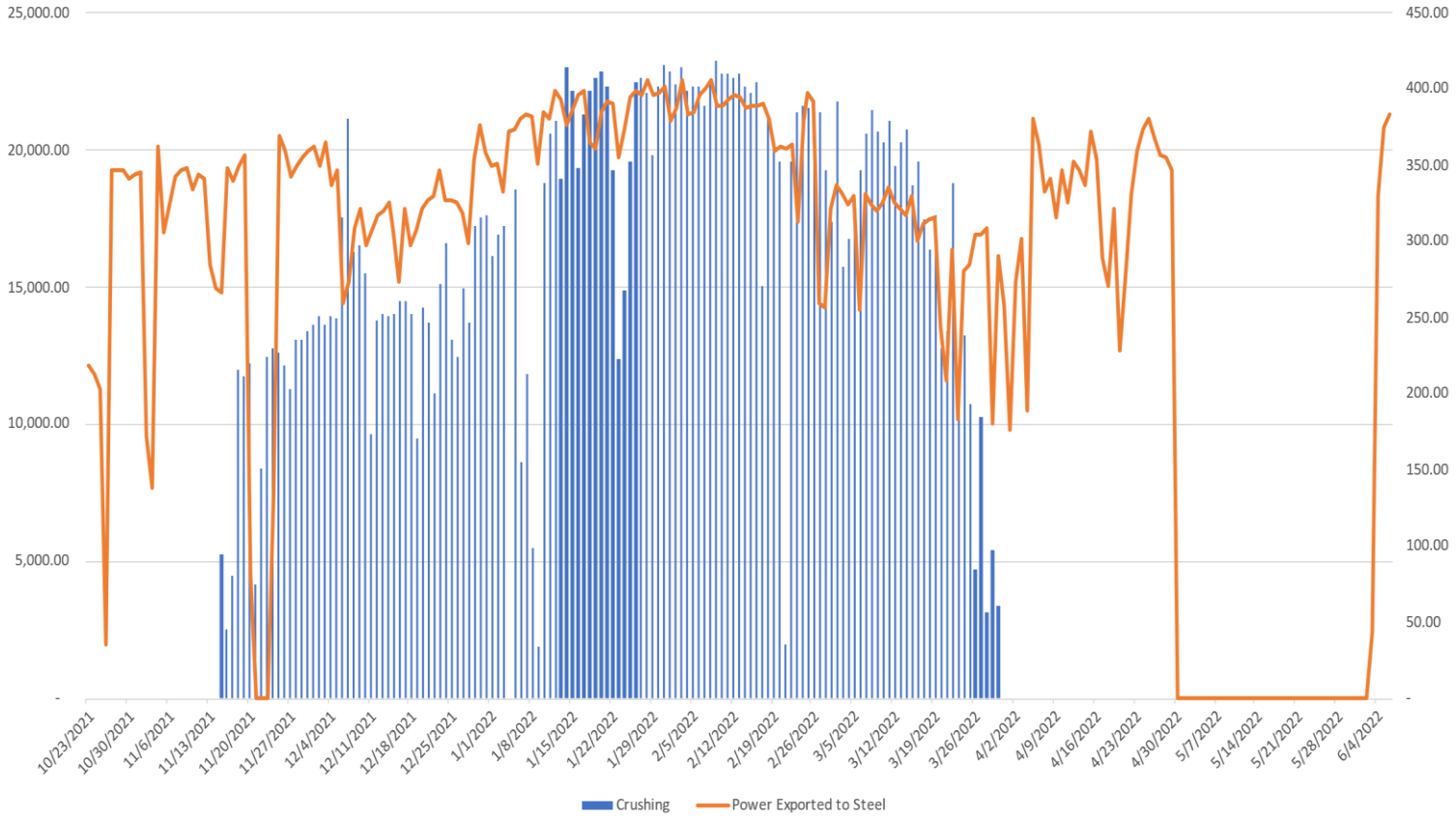
Crushing vs Power Exported to Steel 2021-22



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Conclusion:

Sheikhoo Sugar Mills has now achieved a level of one of the lowest cost, best efficiency, producer of best quality sugar, and fully diversified sustainable business leader in Pakistan. The downstream industry is a highly cost-effective and stronghold in the market due to its cost and quality competencies. The journey of improvement has not stopped and still moving to new milestones of further diversification into the new business of value addition of by-products.

The success story of Sheikhoo Sugar is food for thought and guidelines for others to make business sustainable through the adoption of technology and innovation.

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Thank you