

Shareholder Update – India Activity

Techno-Economic Feasibility Study – Public Release Document

Dear Shareholders,

We are pleased to provide to you the public release of the Techno-Economic Feasibility (TEF) study conducted on the proposed Coldry-Matmor Integrated Steel Plant.

ECT would like to formally acknowledge and thank our project partners, NLC and NMDC, together with TEF Study Working Group members Dastur and Thermax.

The TEF Study report contains detailed information regarding assessment of our technologies operating together, projected forwards to commercial scale. The intent of the report is to demonstrate not only the technical feasibility of our technologies, but also the comparative economic performance versus incumbent technology options. In demonstrating that strong relative performance, we underpin the business case to invest in the development stages ahead.

The report in its original form contains significant volumes of information of a confidential nature, the release of which could contravene our confidentiality obligations with our partners and may impact on our ability to deliver value from the commercialisation of our technologies. The report was also a time based document, which contained information current as of the issue date. Our discussions have continued with our partners since that time, and this report does not capture changes in status associated with those discussions now underway.

ECT is very encouraged by the results of the study, and by the response to the report received from our partners, NLC and NMDC and look forward to working though the development of project structuring and agreements and continuation of the detailed design program.

Sincerely,

Ashley Moore Managing Director

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About ECT

ECT is in the business of commercialising leading-edge coal and iron making technologies, which are capable of delivering financial and environmental benefits.

We are focused on advancing a portfolio of technologies, which have significant market potential globally.

ECT's business plan is to pragmatically commercialise these technologies and secure sustainable, profitable income streams through licencing and other commercial mechanisms.

About Coldry

When applied to lignite and some sub-bituminous coals, the relatively simple Coldry beneficiation process produces a black coal equivalent (BCE) in the form of pellets. Coldry pellets have equal or superior energy value to many black coals and produce lower CO2 emissions than raw lignite.

About MATMOR

The MATMOR process has the potential to revolutionise primary iron making.

MATMOR is a simple, low cost, low emission, production technology, utilising the patented MATMOR retort, which enables the use of cheaper feedstocks to produce primary iron.











Techno-Economic Feasibility study Coldry-Matmor Integrated Steel Plant

"Supporting India's growth and prosperity through

innovation."

30 June 2016

[Public Release Document]





India's openness to new ideas is manifest in the Rig Veda: आनो भद्राः क्रतवो यन्तु विश्वतः Let noble thoughts come to us from all sides.

Narendra Modi

TEF Study Working Group





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Executive Summary

The following report contains the results and discussion from the Techno – Economic Feasibility Study of a proposed integrated Coldry / Matmor Plant, for the production of steel billet, in Neyveli, India.

Led by MN Dastur, with significant support from ECT and Thermax and alongside Project Partners NLC and NMDC as part of the Tripartite working group, the study considers the technical and economic performance of a proposed plant and presents its findings in the context of the current global and Indian steel industry drivers.

The TEF Study Working Group are pleased to present this report outlining the study results and conclusions.

Based on the significant economic potential detailed in this report, ECT intends to proceed with the detailed design program in preparation for the funding and construction of an interim stage combined Matmor Pilot and Coldry Demonstration plant. Once complete, this interim stage plant will establish the conditions precedent to the ultimate objective of a full-scale commercial plant, proposed for construction in 2019.

	(BF - BOF)	DRI - EAF	C/M - EAF	C/M - EAF
	Blast Furnace - Basic Oxygen Furnace + Power Gen	Coal Based DRI - Electric Arc Furnace + Power Gen	Coldry / Matmor - Electric Arc Furnace (no power gen)	Coldry / Matmor - EAF + Power Generation
Case / Scenario	Base Case	Base Case	Base Case	Mid Case
	Cr.₹	Cr.₹	Cr.₹	Cr.₹
CAPEX	2,522	2,257	1,400	1,607
OPEX	969	1,187	1,085	1,002
SALES	1,264	1,372	1307	1,307
Gross Profit	295	185	222	305
IRR (Ungeared)	9.1%	5.0%	14.1%	17.2%

The following Table summarises the outcomes of the economic analysis provided by Dastur and ECT:

Table 1 Summary of Economic Potential for the Coldry-Matmor Integrated Steel Plant at commercial scale

Section 7 of this report outlines the path forward, including consideration of the proposed schedule of technical, financial and legal development activities.

The TEF study concludes that the development and subsequent commercial deployment of the Coldry / Matmor technology for steel making has significant potential to deliver technical and economic performance in excess of current steel industry benchmarks.

This result has been achieved despite the current market price for coking coal, thermal coal, and iron ore being at recent historical and cyclical lows, reducing the relative competitive advantage of using lower cost raw materials.

In continuing to support the project development process and timeline, NLC has the opportunity to drive a relatively low value, low-grade lignite resource up the value chain to a higher value metallurgical application - a significant additional value proposition for NLC's abundant lignite resources.

Similarly, continued engagement and support from NMDC will allow the liberation of stranded iron ore fines and slimes to drive increased value from its mining efforts.

Combined, the outcome of leveraging lower value and stranded resources will deliver a solution that has broader implications for both NLC and NMDC:

- Energy & Resource security;
 - Through the Coldry / Matmor innovation, lignite can be used instead of higher-cost coking coal. Soft iron ores, fines, and slimes can move up the value chain, as diversified sources of supply and displace the import of higher-cost lump ore.
 - This diversification of supply via the upgrading of lower-value and stranded domestic resources increases self-reliance, assisting India to decouple from the risks of heavy reliance on international suppliers of coking coal, and enabling the use of a broader range of domestic iron ore sources.
- Economic security;
 - Underpinned by energy and resource security, economic security drives growth and improvement in the standard of living.
 - Enhancement of economic security can be accomplished through the application of technology to achieve diversification of suppliers and markets, reducing a nation's vulnerability to changes in supply, price, and foreign manipulation.
 - The Coldry and Matmor technologies act as economic levers, upgrading lignite to enable higher value applications that can broaden supply options across thermal coal, gas, oil and fertiliser markets, mitigating reliance on imports.
 - Coldry increases the efficiency at which the lignite resource is used, extending its useful life or extracting greater value.
 - Matmor's potential lies in its ability to take 'waste' iron ore, combine it with low-cost lignite and turn it into a high-value product. It opens the door to alternative iron ore sources, diversifying supply and mitigating imports, resulting in an improved balance of payments, increases in GDP and contributes to affordable iron and steel supply in support of infrastructure growth.

- Sustainability;
 - Energy security underpins economic security, which in turn supports the cost of environmentally cleaner pathways.
 - At the broader national level, increased economic prosperity leads to better ability to invest in, and respond to key environmental outcomes.
 - The Coldry-Matmor process for steel making has lower emissions intensity than incumbent processes, helping mitigate environmental impact.

This report encompasses a study conducted in the second quarter of 2016 by MN Dastur, which considered the viability of a commercial scale Coldry-Matmor plant. The Dastur study was, in part, based on a comparison of the costs involved in the construction and operation of a process plant to produce 500,000 tonnes per annum of billet steel in India. Principally the study compares the capital and operating costs of Coldry and Matmor technology with established technologies for steel production, and their relative financial performance under a range of scenarios.

Capital and operating costs of traditional approaches to steel production (Blast Furnace & Basic Oxygen Furnace; Coal based Direct Reduced Iron & Electric Arc Furnace) are compared to a Coldry-Matmor plant integrated with an Electric Arc Furnace. The comparison is based on utilisation of the iron ore fines produced by NMDC to the greatest extent possible and, if compatible with the technology, utilising NLC's lignite resources to produce billet steel. This study reviews the production cost and the capital cost of each process option and quantifies the economic and strategic advantages of the Coldry-Matmor integrated steel plant as a means to validate the investment in innovation required to advance the technology to commercial production.

The Dastur study provides the technical and economic rationale to proceed to the detailed design phase, and from there to the funding and construction of a Pilot Matmor Demonstration Coldry Plant in Neyveli. Once completed, this provides the necessary conditions precedent to construction of a full commercial scale Coldry and Matmor plant in 2019, and realisation for both NLC and NMDC of the significant advantage this technology can deliver to India's future steel production industry via lower operating costs and lower cost volatility, lower capital cost, and reducing the dependence on imported raw materials.

1. Project stakeholders

Partners

India's national lignite authority, NLC India Ltd and India's largest iron ore miner, NMDC are the key project partners to the development of the proposed integrated Coldry-Matmor Plant in Neyveli, India. Together with ECT, the parties have executed an agreement to proceed with the Techno-Economic Feasibility (TEF) study, this report, as the first stage of the joint project.

This report has relied upon specialist advice and analysis provided from two global engineering firms, Thermax, and Dastur. This contribution sets the key design and economic parameters for progression to the Detailed Design phase, through to an agreement to build the demonstration plant facility as a condition precedent to a full-scale commercial plant.

Expertise and Resources

Each partner contributes key expertise and resources to the project development pathway as summarised below:

NLC

- Lignite supply
- Site & site services
- Water supply
- Power supply
- Project Funding
- Marketing & Selling Steel output

NLC India Ltd is a Government of India owned enterprise that controls more than 70% of India's Lignite and will provide the host site for the Project. NLC will be responsible for the supply of the raw Lignite, site allocation with the provision of waste energy, electricity and arranging required project approvals. It is envisaged that NLC will provide funding for the construction of the Demonstration Plant.

NMDC

- Iron Ore
- Project Funding
- Marketing & Selling Steel output

Incorporated in 1958, NMDC is under the administrative control of the Ministry of Steel. Since inception NMDC has been involved in the exploration of wide range of minerals including iron ore, copper, rock phosphate, limestone, dolomite, gypsum, bentonite, magnesite, diamond, tin, tungsten, graphite, beach sands, etc. NMDC is India's single largest iron ore producer, presently producing about 30 million tonnes of iron ore from 3 fully mechanised mines in Chhattisgarh State and Karnataka State. NMDC will be responsible for the supply of the iron ore and support of required project approvals. It is envisaged that NMDC will provide funding for the construction of the Demonstration Plant.

Environmental Clean Technologies Limited (ECT)

- Technology provider
- Training
- Commissioning
- Operations & Maintenance support
- Project Funding

ECT is the Australian Coldry and Matmor technology owner and will be responsible for ensuring the detailed design, construction engineering, and commissioning procedures meet the process specifications of the Coldry and Matmor technology. ECT has established 'ECT India' as a subsidiary for licencing of the Coldry and Matmor technology for projects in India. ECT will provide IP, OEM, and EPC capability through existing partnerships with Dastur, Thermax, and others. ECT will invest in the Project;

MN Dastur

- Engineering Design
- Route Process Evaluation
- Economic Analysis

Founded in 1955 by Dr. Minu Nariman Dastur, Dastur is today one of the largest independent consulting engineering organisations in the world, enjoying a global reputation built on trust. The organisation has a multidisciplinary team of professionals with an in-depth understanding of the latest trends, combining creativity with initiative. Dastur is headquartered in Kolkata with offices in Chennai, Mumbai, Bangalore, New Delhi, Bhubaneswar, and Hyderabad. International operations are based out of Düsseldorf in Germany, Tokyo in Japan, Abu Dhabi in UAE and New Jersey in the USA.

Thermax

- Project Management
- Engineering
- Procurement
- Construction

Thermax is a leading Indian based global engineering company that has been proposed as a credible and cost effective EPC partner. If selected, Thermax will be responsible for final integration and detail engineering, equipment fabrication and construction of the Project plant with suitable assurances on component functionality to ensure they meet engineering design and operational specifications. Thermax may also have an interest in the provision of ongoing O&M post commissioning.

YES Bank

• Project Advisory

YES BANK has been recognized amongst the Top and Fastest Growing Banks in various Indian Banking League Tables by prestigious media houses and Global Advisory Firms and has received several national and international honours for various Businesses including Corporate Investment Banking, Treasury, Transaction Banking, and Sustainable practices through Responsible Banking. YES Bank are the Indian based advisers for ECT to assist with the development of the Coldry / Matmor Project and future business development and project deployment in India.

2. India Strategy

Outline of the India Market Opportunity

In 2010–11 India was Australia's third largest export market for energy and non-energy mineral commodities, the principal export market for gold, the second-largest export market for metallurgical coal, and the third largest export market for non-energy minerals. In 2010–11, India was Australia's fourth largest resources and energy trading partner with resources and energy exports valued at around AUD\$14.6 billion.

The International Energy Agency (IEA) reports:

"A combination of rapidly increasing energy demand and fuel imports plus growing concern about economic and environmental consequences is generating growing calls for effective and thorough energy governance in India. Numerous policy reforms over the past 20 years have shifted the country's energy sector from a state-dominated system towards one that is based on market principles. However, with the reform process left unfinished, India now finds itself trapped halfway along the transition to an open and well-performing energy sector.

India suffered from the largest power outage ever in late July 2012, affecting nearly half of the population. While this incident highlights the importance of modern and smart energy systems, it indicates that the country is increasingly unable to deliver a secure supply of energy to its population, a quarter of which still lacks access to electricity."

In short, India today is a net energy importer, facing a broad range of issues and driven by the projected growth in energy demand as it aims to bring affordable electricity to that 25% of its population currently without access and its rapidly growing industrial base.

India currently faces the following issues;

- Insufficient fuel supply
- Pricing distortions
- Infrastructure limitations
- Investment risk

Given the above factors and that power generation capacity is forecast to grow by almost 400% through to 2035, the impetus to upgrade and leverage existing domestic lignite resources has gained significant momentum.

In the context of ECT, it has a two-fold implication;

- 1) Thermal power generation black coal power stations
- 2) Value added applications;
 - Metals production via Matmor technology
 - Coal to liquid fuels

- Coal to gas
- Metallurgical coal substitute
- Fertilisers

Market Dynamics

Energy – As noted in the IEA's World Energy Outlook 2015 Factsheet India, "Energy use has almost doubled since 2000, and economic growth and targeted policy interventions have lifted millions out of extreme poverty; but energy consumption per capita is still only around onethird of the global average and some 240 million people have no access to electricity. Threequarters of Indian energy demand is met by fossil fuels, a share that has been rising as households gradually move away from the traditional use of solid biomass for cooking. Coal is the backbone of the Indian power sector, accounting for over 70% of generation, and is the most plentiful domestic fossil-fuel resource".

"Indian energy demand grows by more than any other country in the period to 2040, propelled by an economy that grows to more than five times its current size and by population growth that makes it the world's most populous country."

Chart 1 Estimated Energy Mix India 2030

"The sheer size of the increase in energy demand in India means that it mobilises its energy supply resources on all fronts. The increase in domestic energy production is far below India's consumption needs, and by 2040 more than 40% of primary energy supply is imported, up from 32% in 2013. Coal production increases to 930Mtce in 2040 (+4% per year), making India second only to China among global producers. India becomes the largest importer of coal in the current decade and imports rise to over 400Mtce by 2040."

"India requires a cumulative \$2.8 trillion in investment, an average of \$110 billion per year, to meet the supply projections in the New Policies Scenario, 75% of which is in the power sector, and an additional \$0.8 trillion to improve energy efficiency."

With significant domestic Lignite resources, enhanced efficiency utilisation of those resources is vital to ensuring India can meet its growth and GDP ambitions.

ECT's Coldry technology is the world's most effective drying technology for lignite, utilising waste energy to remove the entrained moisture. The dried lignite is then able to be utilised in a range of higher efficiency and higher value applications; Supercritical and USC generation; Metals production via ECT's Matmor technology; Synthetic natural gas, Chars, and Fertiliser production via Gasification and Pyrolysis technologies.

Iron & Steel – India is the world's third-largest steel producer and its most rapidly growing supply nation. Support for transport, infrastructure, and industrial growth, as well as power and energy production, are key drivers behind this growth. The World Steel Association in April 2016 projected India's domestic steel demand to grow by 5.4% to 83.8 million tonnes per year. It further projected growth to 88.3 mtpa in 2017 – a further 5 mtpa.

To meet the Government's ambitions as outlined by EY in Appendix 3, more than 200 mtpa capacity growth is required over the coming decades, which – with current technologies – would require import of significant quantities of high-quality reductant (coking coal) and other materials.

Through the application of ECT's Coldry and Matmor technology, signif icant capital cost savings for capacity addition is possible. Further, significant savings on the importation of high-cost, overseas sourced coking coals could be avoided, adding to the growth momentum within India's economy.

Chart 2 Steel Intensity Curve

The size of the bubbles in the above chart represents population. The orange trend line is representative of the typical steel intensity curve followed by nations as they develop their infrastructure and economy.

India: The place to be for Coldry

India is in a major growth phase:

- Energy demand is increasing, outstripping domestic primary energy source growth
- With over 4.5b tonnes of proved recoverable reserves in India, low-rank coal can play a major supporting role via application of ECT technologies
- India will be the fastest-growing major economy in 2016, with the IMF projecting GDP growth of 7.5 percent against China's 6.8 and a global rate of 3.8 percent.
- India's coal-based energy production is projected to double by 2030.

Chart 3 Electricity Use; India's per person electricity consumption is lower than advanced economies and many emerging economies.

India: The place to be for Matmor

India is in a major growth phase:

- Infrastructure development requiring substantial increases in iron & steel production
- Domestic coking coal reserves (effectively zero) making India heavily reliant on imports
- Low-value resources (low-rank coal & iron ore fines & slimes) able to play a major role in bridging this gap via application of ECT technologies
- World Steel Association projects India's steel consumption growth rate to remain the highest in the world at 7.3% p.a. for 2016
- India is currently the world's third largest producer of crude steel
- If India increase consumption to half of global average, this represents an increase of 85% or ~70Mt pa
- If Matmor can service just 5% of the growth, this represents 3.5M tpa.

3. Technology Overview

This report proposes the integration of the Coldry and Matmor technologies with existing steel melting and refining processes to present an integrated steel production solution.

When integrated with Matmor technology, Coldry enables the use of low-cost, low-risk feed materials for a high-value end product. ECT technology can significantly reduce the carbon intensity and water use of steel production in comparison to the process options evaluated in the Dastur Study

Additionally, in the production of direct reduced iron, Matmor is significantly less energy intensive compared to traditional DRI processes. Matmor and Coldry are scalable and modular allowing for ease and speed in scale up and simplicity of fabrication, construction, and operation.

Coldry: Description and Background

Coldry technology, developed in Australia and patented globally, is a cost effective and energy efficient method for dewatering lignite and low-quality coals, creating an upgraded product similar in material properties to black coal for local and export markets.

ECT have designed Coldry to work as a standalone technology that has applications in the power industry where it can be used to upgrade low-quality coal and reduce carbon intensity and increase the efficiency of coal-fired power plants. The Coldry process, when applied to making feed pellets for the Matmor retort, produces feed pellets that enable the unique process efficiencies of the Matmor DRI process.

Technology Overview

The Coldry technology process involves several process stages:

- 1. Mechanical Shearing: The majority of the physically trapped moisture is released via destruction of the porous structure of the coal, which is achieved via mechanical shearing, resulting in a coal slurry of suitable consistency for extrusion.
- 2. Extrusion: The slurry is extruded to produce pellets of optimal dimension for subsequent drying.
- 3. Drying: Waste energy from a co-located power station (or another low-grade 'waste' energy source) is utilised to cost-effectively evaporate the mobilised water within the pellets, delivering a finished product with less than 15% moisture.

The Coldry process has impressive benefits in comparison to the established technology, including;

- No direct gaseous emissions (including CO₂, NOx, and SOx);
- Significant energy uplift compared to the raw Lignite (200% increase in calorific value);
- Thermally stable finished product, with reduced spontaneous combustion tendencies;
- Where commercially desirable, there is also the option to harvest evaporated moisture.
- Flexibility for use in the upgrade of lower-quality coal for use in power generation and to create the feedstock for an integrated steel-producing DRI facility.

Status of development

The research and development of the Coldry technology have followed a methodical, stepwise process involving scale-up, validation and optimisation from lab scale to pilot scale to inform the current Coldry plant modular design.

Matmor: Description and Background

Matmor is a novel iron processing technology that facilitates the efficient production of high quality direct reduced iron from inexpensive materials that have been traditionally thought of as poor or sub-economic quality such as mill scale, nickel tailings, high or low-grade iron ore and iron ore fines and lignite and other low-quality coals. Matmor, integrated with Coldry, can utilise these low-cost feed materials which are traditionally regarded as sub-economic and low quality due to their incompatibility with traditional iron production techniques. Utilisation of NLC Lignite and NMDC ore fines gives the Coldry-Matmor plant a unique competitive advantage in the Indian context.

The Matmor retort processes Coldry pellets specifically blended according to the makeup of the feed materials and can efficiently reduce Iron oxide at relatively low temperature. The Matmor retort's unique combination of a highly reactive atmosphere, coupled with the pelleted compounding of reductant and ore enable a uniquely efficient metal production.

Technology Overview

Matmor is a vertical DRI retort developed and owned by ECT. It is fed in a semi-continuous method with Coldry pellets and efficiently reduces iron oxide at relatively low temperatures. The product of Matmor is comparable to a high-quality DRI pellet (depending on feed material) and can be used as feedstock to traditional steel making processes.

The Matmor process results in benefits including:

- Ability to utilise feed materials that are sub-economic in traditional steel making processes resulting in low material input costs
- Relatively low operation temperatures reduce material capital cost of plant
- Smaller equipment sizes, when compared to existing steel production processes, results in reduced land area requirements
- Efficient reaction kinetics result in lower reductant requirements when compared to DRI technologies
- Simple equipment design facilitates low maintenance requirements, high asset availability and long production lifetime.
- Simple process flowsheet and high levels of process automation allow for low operational staffing requirements
- Very low water consumption compared with other DRI technologies

Status of development

The research and development of the Matmor technology have following a methodical, stepwise process involving scale-up, validation, and optimisation from lab scale to test plant and to pilot scale.

Current plans to upgrade the Matmor test facility will enable the acceleration of the development program and increase the confidence in the process and scale-up design.

The planned upgrades will result in the facility's ability to process higher volumes of material on a continuous production basis. Continuous operation enables the collection of steady state operation data and inform future engineering design decisions.

Further details regarding the development and status of the Coldry and Matmor technologies are set out in Appendix 1 to this report.

4. Industry Drivers

The global steel industry is integrated – across borders for both raw materials, as well as for finished products. Steel and its range of products are required for nation building infrastructure, and the industry represents a core for all industrialised nations. The industry is subject to a range of critical drivers, some of which are presented below as they apply to India.

Capacity

The global steel industry, estimated in 2014 at 1,665 million tonnes per annum of crude steel¹, is an industry in transition. Current overcapacity on international markets is contributing to pricing pressure, where steel prices are picking up from recent historic lows.

World Export Price - \$414 per metric tonne, FOB the port of export – down \$13 from \$427 three weeks ago, up \$142 per tonne from the recent low of \$272 on Feb. 8, 2016 and down \$82 from the low of \$496 per tonne on Nov. 9, 2009. It is down \$359 per tonne from the recent high of \$773 on Feb. 14, 2011, and down \$699 (62.8%) from the record peak of \$1,113 per tonne on July 28, 2008.²

This Steel market pricing pressure, added to recent significant expansions in iron ore capacity, are also contributing to recent lows in prices of key raw material inputs for steel production³

¹ World Steel in figures 2015 (World Steel Association, 2015

² Steelbenchmarker.com; World export pricing history (13 June 2016)

³ Global Steel 2015-2016; Globalize or Customize: finding the right balance (EY, 2015)

Chart 4 Iron ore and coking coal prices⁴

However, economic growth in key markets such as India is leading to moderate growth prospects, supported by Government policy, though challenged by the same dynamics impacting the rest of the global industry.

Industry Commentary

"The outlook for the global economy is mostly positive with growth picking up in the US, India, and Southeast Asia, while several emerging markets are experiencing a deceleration in growth."⁵

"The Indian steel industry is expected to grow moderately in the near future as enduser demand starts to pick up. Domestic steel capacity is expected to correspondingly mirror the growth of end-user industries. The Government plans to unveil a policy that targets 300mtpa in a decade from now."⁶

Raw Materials

India has historically enjoyed some insulation against the global Steel market. That, in addition to secure access to local raw materials, have been a critical success factor for the Indian domestic steel manufacturers. That, however, is changing. The increasingly global nature and steel trade,

⁴ Global Steel 2015-2016; Globalize or Customize: finding the right balance (EY, 2015)

⁵ ibid

⁶ Indian Steel; Strategy to Ambition (EY, 2014)

along with diminishing suitable local resources – especially true for coking coal – is driving India's steel growth to look progressively to imports for supply. This is evidenced in the M.N. Dastur report which cites all coking and non-coking coal sources to be from imports. The driver for this selection is suitable quality for steel industry application, in particular, Ash and sulphur levels in domestic Indian coal supplies.

Matmor technology promises to build upon and extend India's competitive advantage through utilising domestic resources as critical inputs for steel manufacturing, especially those of lower grade.

Further, the risks associated with raw material pricing at current levels are more pronounced in the upward direction. While increased demand is likely to see an increase in pricing on hard coking coal, and to a lesser extent on high-grade lump iron ore, prices of lower grade raw materials – those used by the Matmor technology – are less likely to increase, and if so, increase to a lesser extent. In other words, with additional growth in the steel market and its flow through impact on raw material pricing, the competitive advantage of the Matmor technology is projected to extend further.

Industry Commentary

"However, the benefits accrued have varied across steelmakers depending on the quality of raw material used, production process and plant location. Low-quality raw material witnessed a steeper decline in prices, which benefitted those companies that operate blast furnaces with a higher mix of low-grade ores. On the contrary, scrap prices were comparatively resilient keeping costs up for Electric Arc Furnace (EAF) steel producers."⁷

"Continued oversupply in the iron ore market, due to significant production expansion in Brazil and Australia, is expected to keep iron ore prices subdued in 2015/16. However, hard coking prices stabilized in the second half of 2014 as high-cost mines have closed. If this trend continues, the supply of coking coal might begin to tighten up in 2016 with increasing demand coming from India and other growing steel-producing nations."⁸

Capital

With the Indian Government and its Ministries clearly supporting growth via domestic steel manufacturing policy, as earlier noted, it recognises the capital intensity of such a challenge, as well as the requirement to secure suitable raw materials to provide for that sector.

This is evidenced by multiple Ministry and PSU strategic projects which support these objectives. Policy-driven growth objectives, which partially meet the Indian economy's growth ambitions,

⁸ ibid

⁷ Global Steel 2015-2016; Globalize or Customize: finding the right balance (EY, 2015)

require the installation of more than 200 million tpa of new steel capacity^{9 10}. Using existing steel production technologies that would require more than 200 billion USD in investment in steel plant and upgraded importation logistics facilities (port and rail).

Further, this capacity would require the importing of more than 20 billion USD per year for reductant (coking coal, PCI) – considering that pricing remains at current levels, which are at historically low points – reducing India's GDP by that figure and more.

Competitiveness for expansion capital is increasing as the global investment market becomes more wary of risk. Therefore, a decreased demand on capital resources to provide equivalent capacity, even at similar economics, provides significant improvements in project returns and return timetables.

Industry Commentary

"Increased volatility in financial markets over the last few years has made investors risk averse. Shareholders are looking for early returns on short-term investments. India's steel capacity expansion from here on will require long-term investments in steel infrastructure and new steelmaking technologies."¹¹

Environment

Growing pressure to reduce the carbon footprint of all manufacturing operations is a reality. The financial impact is a question of timing. In Europe today, there is a ≤ 40 per tonne of CO₂ emission penalty – definitely an incentive for improvement when steel production includes a nominal CO₂ emissions intensity of between 3.1 - 3.8 t CO₂ per tonne of steel, as is the case for India and China¹².

The CO₂ footprint associated with the Matmor technology's unique chemical pathway is substantially lower than conventional Blast Furnace and Coal based Direct Reduced Iron pathways. ECT calculations using flowsheets developed by M.N. Dastur show a 35% reduction versus Blast Furnace and a 65% reduction versus Coal based DRI. This assessment includes CO₂ generated via direct raw materials, as well as including an allowance for electricity purchased. Such improvements will drive competitive advantage, both regarding compliance, as well as alignment with Government policy objectives.

⁹ ibid

¹⁰ World Steel in figures 2015 (World Steel Association, 2015)

¹¹ Indian Steel; Strategy to Ambition (EY, 2014)

¹² Climate Change 2007; IPCC Working Group publication, Ch7, Pg461

Industry Commentary

"The steel industry is coming under increasing scrutiny from environmental regulators to limit its carbon footprint and reduce emissions. Carbon-related costs imposed in the EU and elsewhere have negatively affected their local steel industry margins to the advantage of regions where such regulations are not yet in place. Plants in developing countries have typically been slow in adopting the latest technology to adapt to new environmental regulations. Complying with these new environmental standards will not only lead to increased capital costs but also result in an ongoing increase in operating costs, as is being seen in China. This may be both a risk and relative opportunity for steelmaking in India."¹³

¹³ Indian Steel; Strategy to Ambition (EY, 2014)

5. Dastur – Process Route Evaluation Summary

Basis of Comparison

MN Dastur has conducted a thorough technical and economic evaluation of the Coldry and Matmor technology based on a proposed commercial-scale integrated plant in Neyveli, India. The Dastur study uses an assessment process based on a comparison of the integrated Coldry-Matmor plant with traditional steel production technologies and uses domestic Indian resources as process inputs, namely, NMDC ore fines and NLC Lignite where possible to support the output of steel billet.

Through this study, Dastur has developed and assessed capital and operating cost estimates for the Coldry-Matmor plant and compared them to capital and operating cost estimates for a blast furnace facility and a coal-based direct reduced iron (DRI) plant. Dastur has used their vast industry experience, tapped their industry performance and cost databases, and applied their engineering skill and judgement to develop the study results. They developed a robust and conservative comparison framework, and as such, we have confidence in their results.

A simple billet steel end product has been selected as the basis for comparing plant estimates as this represents a common endpoint and gateway to a wide range of further value-added steel products.

Iron ore was specified as NMDC ore fines, with 59% Fe by weight to be used to the greatest extent possible. Lignite is to be used as the reductant in the Coldry-Matmor Plant. The plant, equipment, operational modes and associated processes were then scaled to provide for 500ktpa of suitable quality, medium grade billet steel product.

The process trains for the three comparative steel production routes are shown in Figures 1 - 3 over the following pages.

Process Flow: DRI-EAF Steel Plant

TEF Study Report

Process Flow: Blast Furnace-Basic Oxygen Furnace Steel Plant

Figure 2 CONCEPTUAL PROCESS FLOW DIAGRAM FOR BF-BOF ROUTE

Process Flow: Coldry-Matmor Integrated Steel Plant

Figure 3- CONCEPTUAL PROCESS FLOW DIAGRAM FOR MATMOR-EAF ROUTE

Details of each plant configuration, operating costs and capital estimates are provided in Appendix 2 of this report (removed for public release).

Iron Ore and Lignite Supply

The ability to process NMDC ore fines affects the selection of process equipment in two key ways. With 59% Fe content, these low-grade fines contain higher gangue levels than premium grade iron ore lump which require that each of the selected process options consider all necessary design and operational adjustments to enable stable and feasible operations. As such the fine nature of the iron ore requires additional unit operations to sinter and pelletise feed materials to enable utilisation by Coal Based DRI and Blast furnace processes.

Specifically, the BF-BOF route required a large sinter plant, and higher Blast Furnace volume to handle the larger slag volumes associated with lower grade ores. Additionally, even with the sintered feed, the BF / BOF route required 20% of the incoming feed to be premium grade lump ore to allow for sufficient porosity within the Blast Furnace.

The DRI-EAF route requires that the ore feed is pelletised. Additionally, the Electric Arc Furnace was required to be a larger size to cope with the higher slag volumes associated with the ore selection.

The choice of NLC lignite as a reductant has several implications for the Coldry-Matmor plant. NLC Lignite contains higher sulphur than other materials, which requires specific process adjustment to remove that sulphur from the processed product.

NLC Lignite is a significant contributor to the operating costs of the Coldry-Matmor plant, and there are opportunities to reduce these associated costs. NLC Lignite has the advantage of being mined on-site so that the project can take advantage of low transportation and logistics costs. Overall, the adaptions required of the Coldry-Matmor Plant are not significant, but the adaptions required to the steel EAF are as follows:

- Coldry plant no adaptions needed. Fine sized ore can be easily (& preferably) processed.
- Matmor plant no adaptions needed.
- Electric Arc Furnace Higher furnace volume was required to cope with the higher slag volumes resulting from the lower Fe concentrations in the ore. 'Double slagging' was required in the EAF operations to allow for effective sulphur removal, which marginally increases the tap to tap time for furnace operations.

Operating Costs Estimate – Commercial-scale

The operation cost estimates provided by Dastur have been built up from input quantities taken from mass balance models developed by Dastur. Unit prices and costs were derived from a combination of Dastur internal database and market-based pricing references.

The comparative manufacturing costs of steel production from Matmor DRI are within 10% of the annual manufacturing costs of steel from the blast furnace. This is a significant result considering the traditionally higher relative operating costs of a typical DRI plant.

Dastur has estimated that the per ton cost of DRI produced via Matmor would be approximately 40% lower than the cost of production using the comparative coal based DRI process.

The annual manufacturing costs are summarised in Table 2. The full breakdown of the operation costs can be seen in the Dastur report attached in Appendix 2 (removed from public).

Item	BF-BOF + Power Gen	DR-EAF + Power Gen	MATMOR-EAF No Power Gen	MATMOR-EAF + Power Gen	
Raw material cost	669	800	641	641	
Utilities and services	88	146	234		
Consumables and refractories	67	116	98	270	
Manpower	20	15	13	279	
Repair and Maintenance	33	23	18		
Sub Total	877	1100	1004	921	
Administrative and works overheads	92	87	81	81	
Annual production costs (Crores, ₹)	969	1187	1085	1002	
Annual sales realisation (Crores, ₹)	1264	1372	1307	1307	

Table 2 Annual manufacturing costs and sales estimate

The most significant cost in the operation of the Coldry-Matmor integrated steel plant, after the cost of raw materials, is the cost associated with the operation of the electric arc furnace. The furnace running costs are reduced via the efficiency gain made with the charging of hot DRI from the Matmor retort directly into the EAF. This is somewhat offset due to the need for additional process inputs, namely ferrosilicon and additional limestone to manage the high levels of sulphur that are likely present due to the use of NLC lignite as a feedstock.

The design of the Matmor plant is relatively simple, compact and modular. As the retort itself has no moving parts, this lends itself to high equipment utilisation and low maintenance downtime reducing operating, maintenance and labour costs.

Matmor DRI does not require cooling before being fed into the EAF via a hot transport conveyor, representing a major saving in water consumption compared to a traditional DRI operation.

There are several options available to the project that could reduce the operation costs of the Coldry-Matmor Integrated Steel Plant. A major operating cost improvement would be the construction of a power generation facility. This would offset the significant costs of buying power to run the EAF but would require an increase in capital investment to be realised. The impact is positive, in that it provides increased ROI and IRR outcomes.

The utilisation of Matmor technology can reduce exposure to global market volatility through the optimal use of India's abundant domestically available resources such as lignite and stockpiles of low-quality iron ore fines. This is an advantage when prices are high on international markets and could insulate a Coldry-Matmor integrated steel plant from international price volatility. In the inverse situation, however, when international prices are significantly depressed, as is currently the case, the Coldry-Matmor integrated steel plant would be in a position to take advantage of the lowest price material available.

Capital Cost Estimate – Commercial-scale

Capital costs estimates for each of the comparison processes have been compiled by Dastur and ECT and are summarised in the table below. For a detailed breakdown of the capital costs refer to Appendix 2 – Dastur capital cost estimates (removed for public version).

lte	m	BF-BOF + Power Gen	DR-EAF + Power Gen	Matmor-EAF No Power Gen	Matmor-EAF + Power Gen
a)	CAPEX (Crores, ₹)	2,522	2,257	1,400	1,607
b)	Annual manufacturing expenses (Crores, ₹)	969	1,187	1,085	1,002
c)	Annual sales realization (Crores, ₹)	1,264	1,372	1,307	1,307
d)	EBITDA; (c-b) (Crores, ₹)	295	185	222	305
e)	EBITDA margin (Crores, ₹)	23%	13%	17%	23%
f)	Return on investment (ROI) (d/a), %	12%	8%	16%	19%

Table 3 - CAPEX Summary

The capital estimates considered above are based on an analysis by Dastur and reference data derived from previous Dastur projects which provide a basis for the relatively low contingency factors of 5% that have been applied to the majority of the unit operations in the capital estimate.

The Matmor equipment costs have been derived from preliminary engineering designs, and civil and structural quantity estimates. To reflect the more preliminary nature of the engineering design, the capital estimate for Matmor has had a higher contingency of 20% applied. The capital cost estimate for Coldry has been derived from the Thermax engineering design and as such reflects the higher level of design maturity to which a lower contingency factor of 10% has been applied.

The relatively low capital required for the Coldry-Matmor Integrated Steel Plant is a significant advantage for the development of the new technology and represents a unique opportunity to build significant steel production capacity.

6. Additional Financial Analysis

Extending from the economic analysis conducted by Dastur, section 6 of this report provides an expanded scope of financial analysis. This additional review considers the impact of gearing (debt) to fund capital costs, the sensitivity of the different technology financial models to key variables such as costs and prices, and a range of financial scenarios that measure the forecast impact on the performance of the Coldry / Matmor technology.

Impact of Debt Funding on Project Performance

Base Case	OPTION # I BF — BOF + Power Gen	OPTION # II DRI — EAF + Power Gen	OPTION # III Coldry-Matmor – EAF No Power Gen
Raw Material	669	800	641
Cost above material	208	300	363
Overhead	92	87	81
Total (Annual manufacturing cost)	969	1,187	1,085
Сарех	2,522	2,257	1,400
ANNUAL SALES REALISATION	1,264	1,372	1,307
Gross Profit	295	185	222
ROI	12%	8%	16%
IRR (Ungeared)	9.1%	5.0%	14.1%

Table 4 Project performance, no debt funding

Gearing	OPTION # I BF — BOF + Power Gen	OPTION # II DRI – EAF + Power Gen	OPTION # III Coldry-Matmor – EAF No Power Gen
Interest Rate	11.25%	11.25%	11.25%
Repayment structure	Principal & Interest	Principal & Interest	Principal & Interest
Loan term (period)	22 years	22 years	22 years
IRR (Geared) @ 30%	7.7 %	1.4 %	14.3 %
IRR (Geared) @ 50%	5.9 %	-3.8 %	14.6 %
IRR (Geared) @ 70%	2.4 %	N/A	15.0 %

Table 5 Impact of gearing on project performance

Large Infrastructure and manufacturing assets typically generate cash flows well suited to the payment of regular interest bills and as such debt funding is a common financing strategy adopted globally. The available interest rates on commercial finance are influenced by a range of factors including the relative risk and opportunity costs of alternate investments. Similarly, the ratio of debt

to asset value will also be affected by a variety of complex factors, including the ability for the business to make repayments from forecast earnings over the loan term.

For this analysis, Dastur has provided an input measure of 70% debt to asset value ratio and a corresponding interest rate of 11.25%. These levels of gearing are much higher, and at a higher cost than likely in the majority of other countries globally. As demonstrated in the previous table, the impact of gearing on Blast Furnace and Coal based DRI would suggest this is not an efficient finance strategy for these prospective plant configurations. Debt funding remains a viable option for the proposed Coldry-Matmor plant.

Sensitivity Analysis

A basic sensitivity analysis has been performed to test the robustness (measured by the internal rate of return) of each comparative technology to changes in key production and financial model variables, as listed below. The range over which each variable was tested was set at a nominal +/- 20%. This nominal range is not based on a particular view of risk or variability in each parameter; it simply provides a common integer to display the impact of changes to each variable independent of the other.

CAPEX

The capital cost of constructing a 500,000 tpa plant (based on each of the three technologies) has a significant impact on the overall financial performance of each plant, independent of the plant performance itself, the cost of input materials and labour, or the sales price of the manufactured product. As a result, capital cost is a key variable in the sensitivity analysis.

Steel price index

For testing the comparative models for their sensitivity to changing steel prices, it was first recognised that steel prices (output) are unlikely to change in isolation to key prices such as iron ore and coking coal (inputs). As such, this analysis includes a basic stochastic model that responds to this dynamic relationship. Changes in this one index show the relative movement in net performance as both input and output prices increase and decrease together, albeit at different relative rates as set out in the table (right).

Steel	1.0
DRI	1.0
Lump	1.0
Fines	0.5
Coking coal	1.0
PCI coal	1.0
Non-coking coal	1.0
Lignite	0.0

Table 6 Steel Price Index

Lignite price index

As set out the Dastur study, the choice to use NLC lignite as a reductant has several implications for the Coldry-Matmor integrated steel plant and is a significant contributor to its operating costs. While opportunities to reduce these associated costs will be considered in the scenario analysis to come, the sensitivity analysis is conducted here on the base case parameters.

Cost Above Raw Materials

The costs that are segmented from raw material input costs are all those which are associated with the running our auxiliary systems and the manual labour involved in management and operation of the plant. These include:

- Wages & Salaries
- Water
- Propane
- Power
- Argon

- Nitrogen
- Oxygen
- Refractory
- Consumables
- Repair & maintenance

Overheads

Overhead costs include all fixed costs associated with administration and operation of the corporate entity which owns and operates the plant and the land or lease costs for the project site itself. In the project model, these include:

- Admin Salary
- Works overhead
- Insurance
- Sales expense & Office expenses
- Land lease rent

BF / BOF + Power Gen	-20%	-10%	0	10%	20%
CAPEX	12.1%	10.5%	9.1%	8.0%	7.0%
Costs Above Raw Materials	10.9%	10.0%	9.1%	8.2%	7.3%
Overheads	9.9%	9.5%	9.1%	8.8%	8.3%
Steel price index	1.6%	5.7%	9.1%	12.2%	14.9%

Table 7 Overheads; Blast furnace, basic oxygen furnace plus power generation

CDRI / EAF + Power Gen	-20%	-10%	0	10%	20%
CAPEX	7.5%	6.1%	5.0%	4.0%	3.1%
Costs Above Raw Materials	8.2%	6.6%	5.0%	3.1%	1.1%
Overheads	5.9%	5.5%	5.0%	4.5%	3.9%
Steel price index	- 8.4	0.0	5.0%	8.9%	12.3%

Table 8 Overheads; Coal-based DRI, electric arc furnace plus power generation

Coldry / Matmor EAF No Power Gen	-20%	-10%	0	10%	20%
CAPEX	18.0%	15.9%	14.1%	12.6%	11.4%
Lignite price index	16.2%	15.2%	14.1%	13.1%	12.0%
Costs Above Raw Materials	19.1%	16.7%	14.1%	11.4%	8.5%
Overheads	15.3%	14.7%	14.1%	13.5%	12.9%
Steel price index	- 7.5	6.2%	14.1%	20.8%	27.0%

Table 9 Overheads; Coldry/Matmor, electric arc, no internal power generation

Break-Even Analysis

A Breakeven Analysis is an assessment of conditions that would cause the financial model of each technology case to return a zero internal rate of return. At this level, the financial returns of the proposed plant would only cover the operating costs and repayment of invested capital. Given the different plant configurations, the break-even analysis has been prepared on the basis of CAPEX and Steel prices, with no gearing. This recognises that while lignite and power input costs are significant to Coldry / Matmor plant, they are less relevant to the comparative technologies.

Breakeven Analysis	OPTION 1 BF – BOF + Power Gen	OPTION 2 DRI – EAF + Power Gen	OPTION 3 MATMOR – EAF No Power Gen
CAPEX	个 144%	个 68%	个 238%
IRR	0%	0%	0%
Steel Price Index	↓ 23%	\downarrow 10%	\downarrow 16%
IRR	0%	0%	0%
Combined			
CAPEX	个 20%	个 9%	个 15%
Steel Price Index	↓ 20%	↓ 9%	↓ 15%
IRR	0%	0%	0%

Table 10 Breakeven analysis

Scenario Analysis

The scenario analysis undertaken as part of this TEF study is informed by the results of the sensitivity analysis and as such uses the compound effect of multiple variables to test the underlying operational and financial performance of the prospective Coldry-Matmor plant set out in the Dastur report.

The purpose is to evaluate the impact of operating conditions that are broadly classified as 'negative' (being high costs, low prices, and poor efficiency) and 'positive' (being the counterpoint of lower costs, higher prices, and efficient production). The changes in each variable are relative to the likely and observed market conditions (and inherent volatility) in addition to the expected relationships between these variables. No modelling system which operates on multi-variables can

be entirely accurate. However, the intention is to produce indicative model results that provide a relative 'range' of performance that more closely resembles expected performance under 'real world' conditions.

Analysis Variables

In addition to CAPEX, Steel price Index and Lignite price index outlined in section 7.2 above, the scenario analysis considers the impact of additional power generation (and associated capital costs) as compared to purchased power from local power producers.

In regards to Lignite pricing, stable pricing indicates that Lignite is supplied from NLC. Reduced Lignite pricing reflects a lower pricing scenario.

The resultant range of variables includes the follow parameters:

•	Base Lignite	Base Price ¹⁴ (₹/tonne)
•	New Lignite	Lower Price (₹/tonne)
•	Additional Capex (Power plant)	201 (crore, ₹)
•	Additional Capex (Water)	13 (crore, ₹)
•	Reduction in Opex (Power)	188 (crore, ₹)
•	Reduction in Opex (Lignite savings)	21 (crore, ₹)
•	Additional Opex (Water)	3 (crore, ₹)
•	Additional Opex (Lignite for Power)	84 (crore <i>,</i> ₹)
•	Additional Opex (O&M)	6 (crore <i>,</i> ₹)

¹⁴ Confidential information removed from public document

Sensitivity Analysis

Scenario handle	Low Case	Base Case	Mid Case	High Case	High Case 2	Breakeven
Steel market	\downarrow 10%	Stable	Stable	个 25%	个 25%	↓ 15%
Power Gen	No	No	Yes	No	Yes	No
Lignite Cost per tonne	Base cost	Base cost	Base cost	Lower cost	Lower cost	Base cost
Сарех	个 10%	Stable	Stable	Stable	Stable	个 15%
Electricity	Stable	Stable	n/a	Stable	n/a	stable
Coldry-Matmor-EAF Integrated Steel Plant (No Power Gen)						
Raw Material	610	641	641	700	700	594
Cost above material	363	363	279	363	265	363
Overhead	81	81	81	81	81	81
Total (Annual manufacturing Cost)	1,053	1,085	1,002	1,144	1,046	1,038
Сарех	1,540	1,400	1,607	1,400	1,607	1,610
ANNUAL SALES REALISATION	1,176	1,307	1,307	1,634	1,634	1,111
Gross Profit	123	222	305	490	587	73
ROI	8.0%	15.9%	19.0%	35.0%	36.6%	4.6%
IRR	5.1%	14.1%	17.2%	31.2%	32.5%	0.0%

Table 11 Sensitivity Analysis

7. Project Development and Funding

Project Schedule

The development of the Coldry-Matmor Integrated Steel Plant is currently at the concluding stages of Phase 1 with the Techno-Economic Feasibility assessment (this report) to be submitted and reviewed in coming weeks.

As a core engineering process, the detailed design program for the Coldry-Matmor plant will develop the concept design, preliminary process architecture, design specifications, and technical requirements into a final, fully costed design, and documentation platform for implementation. This is the primary prerequisite to the construction of the Matmor pilot / Coldry demonstration facility and, importantly, will also resolve several critical engineering parameters of the commercial scale plant design.

Beyond the detailed design phase, project partners will need to establish a project development pathway and agreement to proceed with the funding and construction of the Pilot/Demonstration facility in Neyveli.

The high-level Project Schedule / timeline is as follows:

High-Level Timeline

Detailed Design

The detailed design phase of the Matmor pilot scale and Coldry demonstration plant will follow a logical project development pathway that has been proposed as part of ECT's technology development plan and is outlined below.

Specialist Engineering - Matmor Test Plant (Australia)

This entails the preparatory engineering works to support the required process control systems, instrumentation, materials handling and safety system upgrades.

Upgrades & Testing - Matmor Test Plant (Australia)

The first stage of development for the scaled-up pilot plant is to establish a solid base of operational data for scaling up of the novel process equipment. This will be achieved by upgrading the existing test facility so that it is analogous to a full-scale plant and able to be operated on a continuous basis. The process of upgrading the test facility has begun with the conceptual designs being developed currently. The detailed design will be undertaken and implemented by Dastur and ECT with the upgrades being carried out on the existing test facility in Bacchus Marsh in Australia in the third quarter of 2016.

Once completed the upgrades to this test plant will enable the continuous operation of the Matmor process, which will enable the validation of process data and assumptions that have been made for scaling up of the design. Once established this data would give the design team a high level of confidence in the engineering of the pilot scale facility.

Specialist Engineering Matmor - Pilot Plant (India)

The next stage of development required for the commercial scale Coldry-Matmor Integrated Steel Plant is to establish a solid foundation of operational data by the development of a pilot-scale facility for the Matmor technology.

Once the upgrade development and operation of the test facility has been completed, the detailed design of the pilot scale Matmor plant will begin.

The Matmor plant utilises equipment that is novel and is yet to be designed or built at a commercial scale; this means that until detailed engineering design is completed, planning estimates have to be prepared using indirect means.

The Capex for the combined pilot/demonstration facility can be approximated by factoring of the costs of the commercial plant. This planning estimate is Crore Rs 120-150.

Coldry

Coldry is at a more mature stage of engineering design development, and so the pathway to constructing it as part of an integrated pilot plant is more straight forward. Thermax completed initial engineering design of a commercial scale standalone Coldry plant in 2015. Incorporation of the standalone plant design into the integrated ECT pilot plant should be relatively straight forward.

The existing design is of an appropriate scale and would only require material handling and operational changes to enable its incorporation into the integrated ECT pilot plant.

Specialist Engineering – COLDRY

Incorporate existing detailed design into specific NLC site context, including integration with the Matmor process.

Vendor Development

- Original Engineering Manufacturing (OEM) Vendor Development
- Engineering, Procurement and Construction (EPC) Vendor Development

Detailed engineering designs for the Matmor pilot / Coldry demonstration plant will be developed by Thermax and Dastur (as appropriate) in collaboration with ECT. These designs will be supplied to a selected local fabricator and be constructed under the close supervision of ECT and Thermax or Dastur.

Project Development Structure & Agreements

The current Tripartite Agreement established between NLC, NMDC and ECT provides the high-level intent, roles, responsibilities and confidentiality between the parties. Pending a positive review and approval of the TEF Study (and Report), the parties have the ability to proceed with an agreement to invest in the construction of an integrated demonstration scale Coldry, and Pilot Scale Matmor plant.

Before a Project Development Agreement process commences, it will be necessary to develop, review and agree on a proposed structure; this will determine the essential legal and corporate fundamentals on which the agreements are based.

Appendix 1: Coldry & Matmor Technology Overview

ECT Technology Overview

Technology Highlights

Innovative resource upgrading technologies

ECT is developing unique minerals processing technologies focused on transforming low-value resource streams into higher grade, valuable products delivering positive economic, energy, resource and environmental security outcomes.

Coldry

Unique low rank coal

drying technology

- Intellectual Property owned 100% by ECT
- World's most efficient pre-drying process for high moisture content coals
- Enables low-rank coal use in downstream conversion process for high value products
- Outstanding environmental credentials including a zero net CO₂ footprint from the process
- Construction-ready designs for first commercial scale plant ready to go

Matmor

Primary iron processing

technology

- Intellectual property owned 100% by ECT
- Integrates with Coldry which acts as the feedstock preparation stage
- Reduces feedstock costs by 40-60% through use of low cost, abundant raw materials
- Reduces energy costs by up to 50% through innovative thermo-chemical pathway
- Lower CO₂ intensity compared to the traditional blast furnace process
- Ready to progress to pilot scale

Coldry Value Proposition

- Opens new markets to lignite resource owners
- Establishes new revenue streams
- Diversifies energy and resource options
- Upward revaluation of stranded or lower value, low rank coal assets
- Enhanced efficiencies
- Mitigate CO, emissions

Conventional utilisation of low rank coal (brown coal or lignite) is via combustion in a conventional, and typically low efficiency, thermal power station. The finished product is electricity, which enters the wholesale market, and generates a certain value for the owners.

Generating higher value with conventionally available technologies is not possible. The Coldry technology changes that paradigm, and eliminates emissions intensive trade-offs.

The Coldry technology, applied to low cost lignite, generates a low moisture, high energy value fuel. This can be used in a wide range of applications, such as displacing conventional black coals, fueling high efficiency electricity generation, and providing the raw material into further upgrading processes such as those which are able to produce high value chemicals and other materials (CTx).

Then there is ECTs Matmor technology. A unique and higher value utilisation of brown coal. The technology produces Iron, or crude Steel, from low rank coals and a wide range of iron ore raw materials.

ECT's technologies, and Coldry in particular, allow Lignite asset owners to climb the value chain, entering markets where the revenue they realise for each tonne of material they extract is greater. Further, when processed through Coldry technology, the CO2 intensity associated with that additional revenue is significantly less than the conventional utilisation pathway.

Coldry Value Proposition

The Coldry process moves low rank coal up the value chain.

- 1) Traditional utilisation pathway is 'low value'.
- 2) Cost effective low rank coal drying is the 'gateway' enabler to higher value applications.

Coldry Technology Introduction

Low-rank coal drying

- Enhanced efficiency
- Greater energy security
- High value applications
- Low emissions

Process Features	Benefits
Low temperature, low pressure	Lower opex cost per tonne
Simple, patented mechanical design	Lower capital intensity, robust, reliable, lower operating & maintenance cost
Unique 'Densification' & waste heat utilisation approach	Enables low temperature, low pressure removal of moisture resulting in net energy uplift, low opex and zero CO ₂
Modular	Scalable, cost effective

Example Coldry Plant

Commercial Scale Module Design Coal Input: 765,000 tonnes per year @ 60% moisture Output: 340,000 tonnes per year @ 12% moisture

2

Coal feed hopper
 Primary Processing & pelletization
 Conditioning
 Drying

Coldry Process

"One distinct advantage of Coldry is the relative low heat requirements in the drying process, allowing for the opportunity to make use of waste heat from an industrial facility or power plant."

> Dr Victor Der Former Assistant Secretary for Fossil Energy, US Dept. of Energy General Manager, North America, Global CCS Institute

Process Steps

- Raw coal from the mine is milled and screened to <8mm and a small quantity of water is added to the raw coal
- 2. The raw coal is subjected to mechanical shear, further reducing the particle size and releasing trapped moisture to form a paste.
- 3. The coal paste is extruded.
- 4. Warm air toughening of the extruded pellets on a conditioning conveyer is performed prior to discharge to the main dryer. This increases the pellet strength and reduces fines generation within the dryer.
- 5. Removal of moisture in a pack bed dryer occurs at low temperature via waste heat.
- 6. Water can be recovered from the process (Optional).
- 7. Stockpiling of high-energy Coldry pellets ready for use or transport.

Coldry: Pilot Plant

The Coldry process has been proven to pilot plant scale over several years. Located 50km North West of Melbourne near the Maddingley Coal Mine at Bacchus Marsh, our pilot plant is the centre of R&D for the Coldry process as well as for our Matmor technology.

The Coldry Process has been incrementally developed from lab-scale through to batch-scale and then to a continuous process pilot plant, with over 4,000 operational hours, informing refinement and optimisation of the commercial scale design.

Matmor Value Proposition

- Lower cost raw materials
- Lower capital cost plant
- Lower emissions
- Higher value products
- Resource diversity & security

Unlike the Coldry technology, Matmor performs a task which other technologies currently serve, and have served well for many years.

Coke-based iron production was first developed by Abraham Darby in England in the early 1700s, which was a significant enhancement over charcoal based processes that existed earlier.

The "Blast Furnace" and Steel-making was first developed in 1855 by Henry Bessemer, which led to large-scale production of more competitively produced steel than at any time in history.

Matmor seeks to provide a significant step change in the capabilities associated with the manufacturing of iron (crude steel).

At the core, the technology has significant competitive advantages. The raw materials Matmor processes are lower cost. The process operates at lower temperature, providing for several distinct and complementary advantages:

Lower energy consumption - The process doesn't operate at the very high temperatures associated with Blast Furnace operations, and

Lower capital cost - Since the plant doesn't have to withstand the extremes of the blast furnace operating environment, it is able to be constructed of lower cost, lower weight materials.

Since the process is more energy efficient, and since it operates via a different chemical pathway, the process generates less CO₂ emissions compared to current commercial processes.

Matmor technology

Process Features	Benefits
Uses low-rank coal and alternative iron ore materials.	 Low rank coal replaces coking coal Wide range of iron oxide sources Ability to use lower grades of iron ore Lower raw material cost Diversified supply chain Decoupling from coking coal and high grade iron ore improves energy and resource security Waste remediation solution improves environmental outcomes Economic advantages: Import replacement, monetise waste streams and add value to lower grade coal and iron oxide resources
Lower operating temperature, <1,000°C	 Lower capital cost plant Higher quality metal product Increased energy efficiency
Uses Coldry as the feed preparation process	 Low cost, zero CO₂ drying and pelletising Eliminates coking ovens and sinter plants

Matmor Test Plant

The Matmor Test Plant (right) will be the focus of upcoming work in preparation for advancement to Pilot Scale. The Test Plant has a design capacity of approximately 1 tonne per day of hot liquid metal.

Bench scale testing

Optimising process parameters relevant to coal and iron ore characteristics requires hands on, fundamental research to generate the necessary data. Such iterative work is performed at bench scale on our 10kg batch retort, reducing the lead time and cost of experiments compared to performing the same work via the Test Plant.

Matmor technology

Product Features	Benefits
High Fe yield	 Metallic yield of 95%+ means maximum value extracted Fe content of the finished product is 97%-99%, delivering a high quality iron with minimal impurities
High Fe content	Low impuritiesLower downstream processing cost
Flexible output:DRI pelletHot Liquid metal	 Flexible applications Integrate seamlessly with existing steelmaking operations Feed Induction or Electric Arc furnaces
Solid Iron	• Export

Direct Reduced Iron (DRI) pellet

Product Output Formats

Hot liquid metal

Solid iron / steel

Coldry-Matmor Integrated Steel Plant

Integrated process description

The integrated commercial-scale plant evaluated for the TEF study is designed to produce 500,000 tpa of mild steel billet. To achieve this the Coldry and Matmor plants have been configured with an electric arc furnace appropriately sized ladle furnace and billet caster.

The feedstock for the Coldry process assessed as part of this study is assumed to be NLC Lignite and Kumaraswamy low-grade iron ore fines. The feed materials are crushed and screened as required. Kumaraswamy fines are suitable as provided, while the lignite needs to be sized to ~10mm.

The raw materials are mixed in a ratio determined according to the contained iron, required reductant ratio and combined with a small quantity of water to facilitate the mixing and extrusion process.

Once extruded, the resultant pellets are conditioned until semi dry. The "dry to the touch" pellets are then fed into the vertical packed bed dryer where warm air is circulated to remove residual moisture. The dry pellets are discharged into from the bottom of the packed bed dryer and conveyed into the Matmor feed hoppers. The air for drying is heated by the recovery of waste energy from the Matmor retort.

Each Matmor retort consists of a single feed hopper feeding multiple reduction tubes. The reduction tubes are choke fed on a semi-continuous basis from the top feed hopper. The feed rate is determined by the discharge rate from the outlet end, which is controlled to meet reaction time requirements. The tubes are externally heated utilising combustion of retort off-gas as the primary mechanism. Temperatures are controlled to ensure suitable reduction conditions within each retort tube.

Start-up heating of the Matmor retort is achieved by a gas fired burner fuelled by LPG. Start-up time is less than one hour and once at temperature, as long as process parameters are maintained, the reduction reaction is self-sustaining.

As the pellets proceed down the reaction tube, the temperature rises, and residual moisture evaporates, followed by the release of volatile materials within the lignite. Retort off-gas, including the volatiles, are circulated from the top of the retort annular section into the primary combustion chamber section of the retort. In this combustion chamber, the volatiles are ignited and provide heat to the lower tube bundle, driving the reduction reactions. The reduced pellets are discharged at the base of the retort and contain Iron, residual Carbon and Ash from the lignite, and gangue from the iron ore.

The hot pellets are transferred via a high-temperature conveyor into an electric arc furnace where they are melted, and through refining operations, liquid steel is produced. The electric arc furnace and subsequent process stages are standard equipment that is in common use in steel production facilities around the world.

Appendix 2: Dastur Process evaluation

This section has been removed from public release due to its confidential nature. The report covers the following:

- Identification of Process Route Options
 - Options in Hot Metal Production
 - Alternative Ironmaking/Direct Reduced Iron (DRI) Production
 - o Processes
 - New DRI Making Process
 - o Options in Cokemaking Process
 - Options in Liquid Steel Production
- Evaluation of Process Route Options
 - Plant Facilities and Process Flow Diagram
 - o Raw Materials
 - Plant Configuration
 - o Annual Requirement of Major Raw Materials
 - o Annual Requirement of Major Utilities
- Profitability Analysis
 - o Capital Cost Estimate
 - Preliminary & Pre-operative Expenses
 - o Interest During Construction
 - o Total Capital Cost
 - o Annual Manufacturing Expenses
 - Manufacturing Expenses
 - o Income from Sales
 - Return on Investment (ROI)
- Concluding Remarks

The Report by MN Dastur contains detailed proprietary information on Matmor in addition to proprietary information on other processes, belonging to MN Dastur.

Key metrics suitable for public release are provided in earlier pages.

The Report by MN Dastur may be made available to Investment Analysts, under a Non-Disclosure Agreement.

Appendix 3: EY: Globalise or Customise: finding the right balance. Global Steel 2015

This report can be found at the following link:

http://www.ey.com/GL/en/Industries/Mining---Metals/EY-global-steel-2015-2016

Appendix 4: EY: Indian Steel – Strategy to Ambition

This report can be found at the following link:

http://www.ey.com/Publication/vwLUAssets/EY-indian-steel-strategy-to-ambition/\$FILE/EY-indian-steel-strategy-to-ambition.pdf