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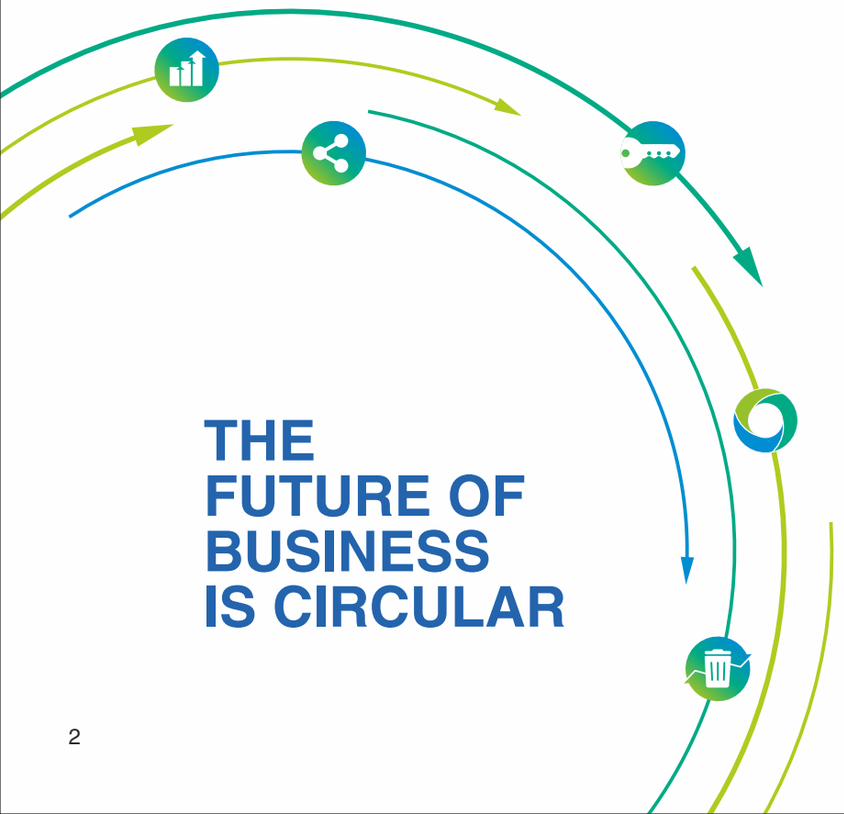
CLOSING THE LOOP

THE CIRCULAR ECONOMY IN ACTION

TATA GROUP COMPANIES' CASE STUDIES



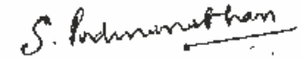
THE FUTURE OF BUSINESS IS CIRCULAR

CONTENTS

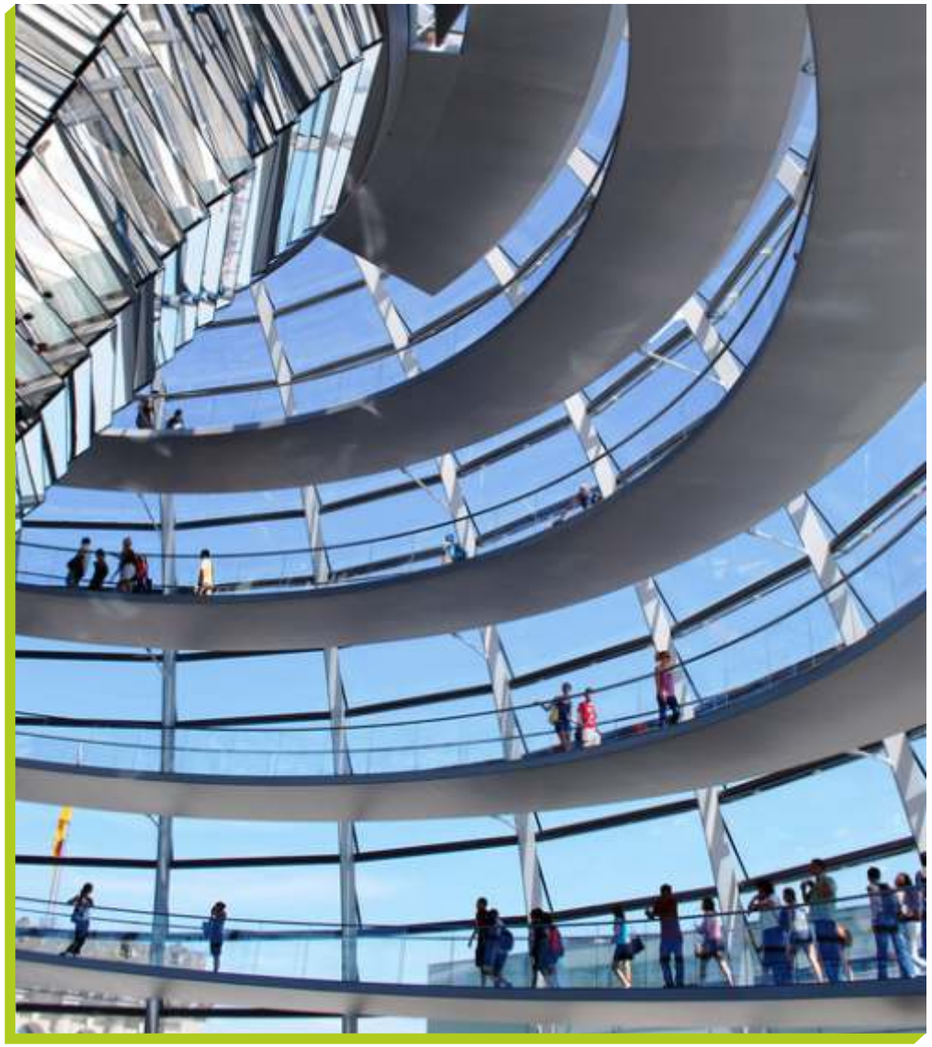
Foreword

We are delighted to launch a compendium of case studies on Resource Efficiency from the Tata group of companies. The compendium, ‘Closing the Loop’ is a collection of 10 resource efficiency initiatives of leading Tata companies using circular economy principles.These initiatives range from increased recyclability of solid wastes to creating an e-platform to auction industrial by-products.

While the initiatives highlighted in the case studies are unique to their respective contexts, one important aspect they reveal is that early and sustained engagement and partnerships among industry, government and communities are critical for the success of circular economy. Our endeavour will be to continuously highlight good practices from Tata group companies on various aspects of sustainability as an opportunity for others to learn and draw inspiration from.



S Padmanabhan
Head, Tata Sustainability Group and
Executive Chairman,
Tata Business Excellence Group



HOW CAN COMPANIES GET STARTED?

Accenture has identified five business models and three business technologies that can help companies implement the circular economy.

FIVE BUSINESS MODELS

CIRCULAR SUPPLIES
Use renewable energy and bio-based or fully recyclable inputs

RESOURCE RECOVERY
Recover useful resources out of materials, by-products or waste

SHARING PLATFORM
Connect product users to one another and encourage shared use, access or ownership to increase product use

PRODUCT LIFE-EXTENSION
Extend product life-cycles by repairing, upgrading and reselling, as well as through innovation and product design

PRODUCTS AS A SERVICE
Move away from product ownership and offer customers paid access to products, allowing companies to retain the benefits of circular resource productivity or ownership to increase product use

THREE BUSINESS TECHNOLOGIES

DIGITAL TECHNOLOGIES
such as Internet of Things (IoT), big data, blockchain, and RFID help companies track resources and monitor utilization and waste capacity

PHYSICAL TECHNOLOGIES
such as 3D printing, robotics, energy storage and harvesting, modular design technology and nanotechnology help companies reduce production and material costs and reduce environmental impact

BIOLOGICAL TECHNOLOGIES
such as bio-energy, bio-based materials, biocatalysis, hydroponics and aeroponics help companies move away from fossil-based energy sources

CASE STUDY 1

REALCAR
Recycled Aluminium Car

JAGUAR LAND ROVER

ABOUT THE INITIATIVE:

Under increasing pressure to optimise the use of man-made materials, Jaguar Land Rover started using aluminium in its vehicles' bodies to reduce weight and tailpipe emissions and improve fuel consumption. However, with aluminium more energy-intensive to produce, the manufacturer needed a new method to reduce costs and environmental impact during production. Its material supplier Novelis also had a long-standing commitment to increasing its use of recycled materials year-on-year and required a like-minded customer with a similar appetite for improving sustainability performance.

This vision, shared by Jaguar Land Rover and Novelis, and a willingness to tackle the technical challenges together, inspired the REALCAR project.

Recycled ALuminium CAR, launched in 2008 and funded by Innovate UK, sought to create a closed-loop value chain to recycle vehicles at the end of their lifecycles. REALCAR took the post-industrial waste from aluminium body panel stamping and recycled it back to the supplier (Novelis) to be incorporated into new body panels.

This involved technical innovations, such as the creation of a new aluminium grade that would be best suited to the closed-loop process, and business culture innovations amongst key stakeholders, most notably the principal partners.

Further research to investigate recycling opportunities from post-consumer and End of Life Vehicle (ELV) were explored with a second phase research project REALCAR 2. A third phase project called REALITY is due to start working in conjunction with the recycling industry to exploit the growing source of recycled aluminium from ELV.

CHALLENGES FACED:

A. New material solutions can take considerable time to develop due to the level of complexity and challenge requiring technical innovation. The REALCAR project extended beyond its original three-year funding period with technical development taking around five years. REALCAR defined a number of aluminium grades, focused on testing the effects of differing additions during the recycling process. Laboratory and full production trials resulted in the development of a new aluminium grade that met all of Jaguar Land Rover's criteria. Material development accounted for a significant part of the REALCAR project budget and was funded in part by a £1.3m grant from Innovate UK.

B. The segregation of 'scrap' is key to ensure purity and therefore the greatest value recovery. Nonetheless, scrap segregation requires significant effort, appropriate production planning, specific tooling, co-ordination and stakeholder

buy- in to ensure that everyone is aligned to the same goals of segregation. Due to the complexity and cost involved in scrap segregation for an existing product or facility, it is far easier to build in segregation from the start, rather than retrofitting. Without appropriate scrap segregation, impurities will negatively affect product performance, quality and value. In REALCAR, waste aluminium from Jaguar Land Rover vehicle production is sold back to the supplier, Novelis (rather than entering the general aluminium recycling system), where the high purity and high-quality Jaguar Land Rover/Novelis alloy would be blended with other, potentially lower purity, materials.

C. In REALCAR, multiple research workstreams were established to develop technical knowledge and wider organisational understanding. As the project progressed, further innovations were needed. For example, an essential technical innovation was the development of material chemistry to create a revised aluminium grade. This involved complex studies evaluating small changes in chemistry that could have a significant impact on the material's performance. But this new grade of aluminium could only be implemented following practical studies of its recyclability, and identification of potential applications. The workstreams also extended into the commercial arrangements between Jaguar Land Rover and Novelis, and, ultimately, into a revised purchasing model for the closed loop. Flexibility within the project allowed new sub-innovations to be explored, potentially as separate projects.

D. Transforming a value chain involves commitment from a wide range of stakeholders. It is essential that a thorough stakeholder communication and engagement plan is in place from the outset.

E. The natural infrastructure supporting established processes tends to deliver a linear (open loop) model. Moving to a closed loop approach is disruptive and necessitates infrastructural change and thus investment. This can present risks that a business may not be willing to entertain without direct support from external stakeholders. If a third party can be engaged to fund some of the initial research, foster collaboration and help demonstrate the value to all participants, or to provide hard deadlines for implementation, faster progress and more focused discussions on the disruptive closed loop proposals can result. Within the REALCAR example, Innovate UK (formerly The Technology Strategy Board) undertook that role.

It is acknowledged that due to the unstable wider economic environment during the early days of REALCAR, the project would have been unlikely to continue without Innovate UK's support.

IMPACT OF INITIATIVE:

A. Recycled tolerant material: REALCAR delivered an aluminium sheet alloy specifically developed to accept a higher percentage of recovered scrap. This alloy was introduced first in the Jaguar XE and has been rolled out across all Jaguar and Land Rover aluminium body architectures.

B. Closed loop volumes: REALCAR reclaimed over 50,000 tonnes of aluminium press shop scrap in the production process during 2015/16.

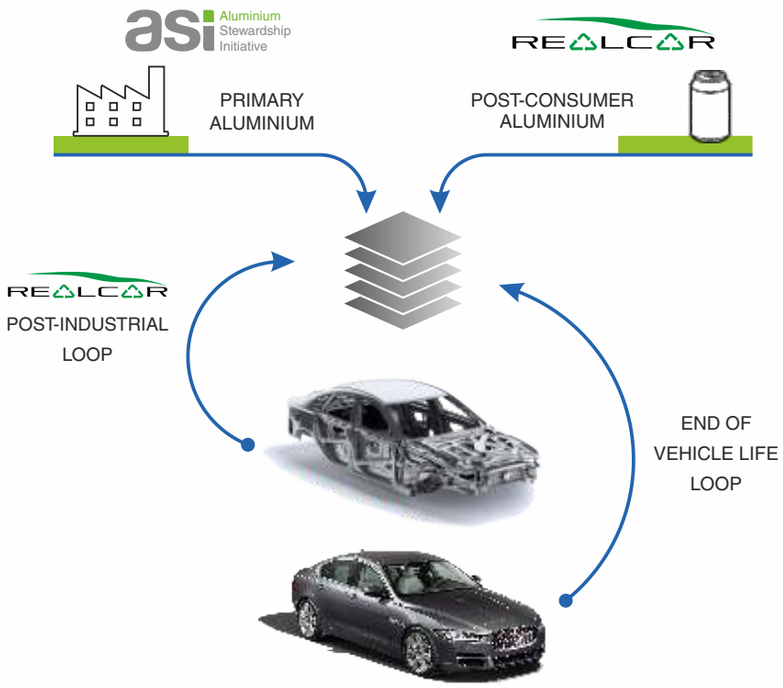
C. Reduced emissions: Aluminium recycling requires up to 95% less energy than primary aluminium production.

D. Retaining material quality: The process of segregating, capturing and returning the aluminium scrap for re-melting, maintains a higher aluminium alloy quality, increases material value and ensures suitability for high-grade automotive sheet.

E. Investment: Over £7m has been invested across Jaguar Land Rover's own Halewood, Castle Bromwich and Solihull press shops to install intricate segregation systems. Novelis completed

a major £6m investment in their UK Latchford recycling facility to increase recycling capacity.

F. Jobs: The project created almost 30 additional full time jobs an a production capacity increase of about 20%.

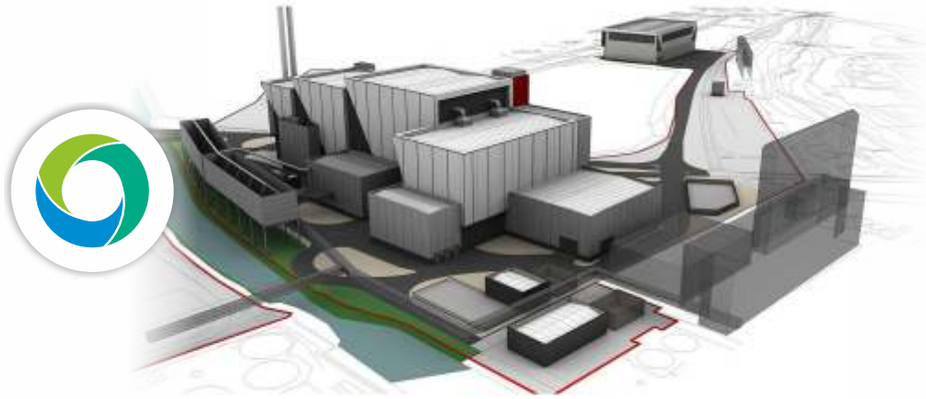


REALCAR is the first stage of the Jaguar Land Rover / Novelis vision for a sustainable value chain which ultimately includes a post-consumer loop, a post-industrial loop, the end of vehicle life loop and material stewardship across the entire value chain.

Source: http://www.circulary.eu/project/jaguar-realcar/
https://www.cisl.cam.ac.uk/publications/low-carbon-transformation-publications/collaboration-for-a-closed-loop-value-chain

CASE STUDY 2

Project Electra - Power from Trash



TATA CHEMICALS (EUROPE)

ABOUT THE INITIATIVE:

Tata Chemicals Europe Ltd initiated Project Electra to diversify its energy supply portfolio by providing a source of renewable energy for its soda ash manufacturing facility in Lostock, Cheshire, United Kingdom.

Project Electra consists of building a ca. 50 MWe energy from waste facility at its Lostock manufacturing facility on the site of a redundant coal fired power station.

The energy from waste facility, termed Lostock SEP (Sustainable Energy Plant),

will burn approximately 600,000 tonnes per annum refuse derived fuel to generate electricity and heat energy in the form of steam. Refuse derived fuel is municipal and commercial waste that has had economic recoverable materials removed and would otherwise be disposed of in landfill.

Project Electra aligns with the Circular Economy principle of Recovery and Recycling as it uses waste material that would otherwise be disposed of in landfills and releases the captured energy to generate electricity and heat energy.

The electricity generated will be exported to the national grid providing a base load of renewable electricity for the UK's consumption. Tata Chemicals Europe will take a portion of the steam generated to be used in its soda ash production process at Lostock, displacing steam otherwise generated from burning fossil fuel (natural gas).

CHALLENGES FACED:

The scale of the project relating to the electricity it generates meant that the planning consent process had to be determined by the United Kingdom central government, in this case the Department of Energy and Climate Change (DECC). This is a complex and detailed planning process requiring a considerable amount of technical, environmental, traffic, ecology and air quality studies to support the planning consent process. Due to the nature of the project the planning process had a Public Inquiry chaired by a Government appointed Planning Inspector.

The SEP is located within the Lostock manufacturing facility on the site of a redundant coal fired power station. The technical and engineering work activities associated with the demolition of the redundant power station and the construction of the new power plant and its integration into the existing chemical manufacturing facilities are complex and challenging. Each work activity stream requires detailed scope development, detailed design, planning and implementation. This requires a wide range of technical and engineering resources within Tata Chemicals Europe and the use of external contractors.

A number of key stakeholders at the site have to be consulted to ensure that existing manufacturing operations are not interrupted or impacted by the demolition, construction and commissioning works.

Due to the nature and scale of the project, communications, public relations and stakeholder management have been extremely important. The use of newsletters, public exhibitions, press briefings and press release statements, together with a project website, provide platforms to communicate information to local communities and other project stakeholders. A Local Liaison Committee has been formed for the project with formal Terms of Reference. The purpose of the committee is to provide timely information to the local communities and businesses and to provide a robust vehicle for two-way communication during the project.

IMPACT OF INITIATIVE:

Project Electra yields positive impacts for Tata Chemicals Europe (TCE) across a number of key business areas. The project will provide revenue growth from new income streams associated with the operational structure of the new energy generating facility. The energy plant will use Briskarb® as the flue gas cleaning agent. Briskarb® is produced at TCE's sodium bicarbonate plant on the Lostock site.

The steam supplied to TCE's soda ash manufacturing facility will introduce a variable cost saving compared to steam produced from the combustion of natural gas. The element of steam supplied from the energy from waste plant will reduce the carbon footprint associated with TCE's soda ash manufacturing facility at Lostock.

The project will remove an ageing asset and associated liability through the demolition of the redundant coal fired power station and associated structures.

The project will divert 600,000 tonnes per annum of municipal and commercial waste that would otherwise be disposed of in landfill facilities within the United Kingdom. This has a significant environmental benefit for the country.

The energy from waste plant will provide new local employment opportunities. It is estimated that approximately 50 new direct roles will be generated.

It is estimated that 200 new indirect

employment roles to support the energy from waste plant will be generated. As highlighted above, Project Electra has several positive impacts that improve TCE's brand equity. It is also recognized that historically energy from waste power plants in the United Kingdom attract some local opposition. Through the life of Project Electra low scale local opposition has been experienced. This has been proactively and successfully managed to protect brand equity.

For more details, visit the project website: http://www.lostockpower.co.uk/

CASE STUDY 3

A Step Closer to Sustainable Packaging

TATA CHEMICALS LIMITED

ABOUT THE INITIATIVE:

TATA Chemicals' consumer products business uses 4000 tons of multi-layer plastic film every year for packing of its products in retail pouches. As is the practice with packaged foods, once bought by the end consumer, the contents of the packet are transferred into a container and the packaging material is thrown away.

The multilayer plastic packaging used currently is difficult to recycle; as a result, most of it goes to the landfill, impacts the environment through emission of different gases and can cause health issues.

As a part of the company's sustainability initiative, options like biodegradable and recyclable packaging material have been

explored. The limited availability of 100% biodegradable packaging material, and the underlying fact that biodegradable packs require proper segregation and specific conditions to decompose, makes this option unfeasible to use commercially.

The packaging team worked extensively with Dow Chemicals to achieve a PE (Polyethylene) based film which could provide the same print quality and other functional requirement as the PET (Polyethylene Terephthalate) being used in the existing packs.

The newly developed recyclable pack is an adhesive laminate of the same polymer (PE-PE) and is comparable in aesthetics and shelf life to the existing packs. A comparison of the two structures is given below:

EXISTING LAMINATE	RECYCLABLE LAMINATE
PET - 12	PE - 22
Ink	Ink
Adhesive	Adhesive
Natural PE - 40	Natural PE - 36

Since the laminate is made of the same polymer (PE), as opposed to two different substrates (PET-PE), the recycling agencies have to essentially deal with only one material. The material can therefore be re- engineered without the challenge of working with differing temperatures. Thus the single polymer structure makes the pack more easily recyclable by converting it into energy through a variety of processes including combustion, gasification, pyrolisation, anaerobic digestion and landfill gas recovery in compliance with the current notification.

CHALLENGES FACED:

The Tata Salt brand has a presence across India with a reach to approximately 143 million households. The key success factor for this project is the **collection and sorting** of used packaging material disposed off by the consumer. The respective municipal corporations across geographies should have mechanisms to collect the waste, sort the packs from other non-recyclable material and handover to the respective agencies that can recycle the material.

Another challenge is **Successful scale-up**, which means full-scale production with competitive advantage and cost optimization. There are a few potential scale-up problems as mentioned below:

A. Compatibility Issues with existing machines: The pilot production was with pre-formed pouches. The centre sealed pouches were manufactured by packaging material converter, filled with salt and sealed at the salt packing centre. However, this is not viable for large scale production which needs automation, where packaging material is in a roll form. The runnability of packing film on the existing machines needs to be ensured without compromise on packing speed, and not exceeding wastage norms. Since there is a change in substrate of laminate to PE-PE which is a soft material, a knife sealer is recommended.

B. Investment in Infrastructure: All existing machines are equipped with heat sealing jaws and components. These are to be replaced with components for knife sealers. A suitable budget would need to be allocated for the change in machine components wherever required.

IMPACT OF INITIATIVE:

Usage of special grade of Polymer for printing of recyclable laminate is expected to cost a little more than the existing laminate. There is increasing environmental awareness amongst consumers and the availability of recyclable packs in the market gives consumers a choice of adopting the sustainable packaging option. When incorporated into strategic planning and supported by marketing activities, the recyclable packs can engage customers, attract investors and accelerate revenue growth.

Consumers' developing awareness on environmental issues encourages them to adopt environment friendly packaging. Embedding the recyclable packs into campaigns, advertisements or other marketing activities will leverage existing brand equity.

The Government's notification on Plastic Waste Management rules 2016, emphasises the phasing out of non-recyclable multilayer laminate. The usage of recyclable packs will mitigate the business risk of non- compliance.

Dumping of used packs is a social issue as well as an environmental one. Recycling of packaging material will help reduce the waste that goes into incineration and landfills which harm the environment. Recycling also opens up employment opportunities for waste collectors, segregators and processors.

CASE STUDY 4

Waste to Energy: Towards Manufacturing of 'Green' Coffee

TATA COFFEE - INSTANT COFFEE DIVISION (ICD)

ABOUT THE INITIATIVE:

In the instant coffee manufacturing process, there is generation of approximately 10 MT/day of coffee waste. The company evaluated the option of utilizing this coffee waste. It conducted a Gross Calorific Value (GCV) test and found that coffee waste has considerable heat value of 3200 kcal/kg which was more than the conventional fuel fired in the boiler.

The coffee waste is being utilized to meet the energy demands for the company's ICD operations.

CHALLENGES FACED:

The following issues were faced during the usage of coffee waste:

A. The initial trials showed the coffee waste had higher density leading to unburnt char in the boiler fluidized bed. To overcome this challenge, modifications were done in the boiler tubes and bed nozzles to generate more forced draft air.

B. The high moisture content (90%) in the coffee waste was brought down to 50% by sun drying. However, this presented a challenge during the monsoon and required huge space for storage. During the summer season, there were chances of this stored waste catching fire. To overcome these challenges, the company installed a spent squeezer at the outlet of the coffee waste storage which reduced the moisture levels to below 50%. This made it possible to utilize 100% of coffee waste in meeting the energy demand of the plant.

Coffee Waste

IMPACT OF INITIATIVE:

The initiative enabled the plant operations to move towards using a renewable resource to meet its thermal energy demand and become truly circular in meeting its energy demand. The switch towards coffee waste resulted in cost savings of INR 78 Lacs per annum.

Earlier, coffee waste had to be stored and now the space freed has been converted into a green belt with more than 10,000 trees planted.

The initiative has helped in overcoming shortage of fuel by use of in-house “coffee wastes”.

Spent Squeezer
(online drying system)

CASE STUDY 5

Unlocking the value from Steel

TATA STEEL

ABOUT THE INITIATIVE:

Tata Steel produces ~ 10 MTPA crude steel at Jamshedpur facility. During this process, large quantities of by-products are generated in all states of matter. Details of the same are mentioned in the table on the next page.

Tata Steel Industrial By-product Management Division (IBMD) follows the 4-R principle of Reduce, Recover, Recycle and Reuse. Volume wise, the main by-products are Blast Furnace (BF) slag and LD slag.

No.	Particulars	UoM	Quantity
1.	Solid waste	MTPA	6.70
2.	Liquid waste (coal tar, grease, oil, etc.)	MTPA	0.36
3.	By-product gases	Million GKal	19.70

A. Blast Furnace Slag

Presently, BF slag is generated in two forms – Granulated BF slag (GBFS) and Air Cooled BF slag (ACBFS). The total quantity is ~ 3.6 MTPA.

• GBFS is old primarily to Portland Slag Cement (PSC) makers.

• Tata Steel has also taken the initiative to make GGBFS – Ground Granulated Blast Furnace Slag, which can replace OPC Cement to the extent of 70%. Tata Steel GGBFS is one of the first Green Pro Certified GGBFS brand in India. The usage of BFS and GGBFS is primarily as replacement of limestone and high glass content silica.

• ACBFS at Tata Steel is used primarily for road making, as a replacement of natural aggregates. ACBFS has significant usage in the mineral wool industry and the trend of consumption and value addition is increasing.

B. Steel Making Slag

~ 1.8 mtpa steel slag is generated at Tata Steel Jamshepdur. Steel slag is then processed and used in many applications. Some of them are as follows:

• **The metallic** from slag is recovered with magnetic separation. This is called MRP scrap. The metallic is then used in steel making in Tata Steel and other small steel making. This is used as a replacement for pig iron and clean scrap.

• The slag is used in **Sinter making** as a replacement for limestone and pyroxnite.

• The slag is used in **Road making** replacing natural aggregates. Concomitantly, an equivalent amount of mountain rocks are being preserved. In one stroke, it is addressing two major environmental problems.

• The slag is used in **Clinker making** for cement manufacturing, as a replacement for limestone.

• The slag is used in **fly ash brick making** as a replacement for limestone (as binder) and river sand (as filler material).

• LD slag is used for **preparing hardstand** (hard surfaces for parking area and making roads, etc.), thereby eliminating the need for detailed civil work.

CHALLENGES FACED:

LD slag is generated during the process of steel making. It has a very high amount of free lime, which makes it susceptible to expansion on addition of water. It also has the tendency to leach to the ground water table, impacting the natural water bodies in an area. Steel being the prime metal driving any economy, this makes steel/LD slag a national problem.

There are very limited established usages of LD slag and therefore it is dumped / stored by the steel companies at specially developed spaces. It is a by-product of the steel making process. The product is received at very high temperatures from the steel making process.
Processing and establishing the usage has its own challenges, such as:

A. Establishing a very high Fe recovery rate from the slag.

B. Due to **excess free lime**, there is a **tendency of LD slag to expand** up to ~6% on addition of water. This has restricted the usage of LD slag in road making. Presently, there are **no standards in India** for usage of LD slag in road making.

C. High phosphorous content limits the usage of LD slag in sinter making.

D. Fly ash brick being a **highly un-organized sector,** market mapping and creating awareness of the right processes and methods to use LD slag is required.

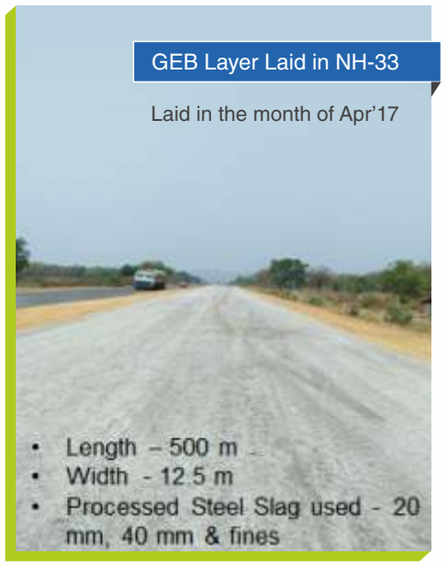
IMPACT OF INITIATIVE:

Details of impact - financial, environmental and social are furnished in table below.

PARTICULARS	WASTE	DESCRIPTION OF USAGE / CONSUMPTION	IMPACT	
			FINANCIAL (RS. CRS.)	ENVIRONMENT & SOCIETY
Revenue Maximization	BF slag	Ensuring 100% sales and utilization in cement making by increasing customer base and establishing robust supply chain	151	Saving exploitation of limestone miles for cement making
		Development of Tata Steel Ground Granulated Blast Furnace Slag (GGBFS) as test of resistance	2.40	GGBFS is a green product, which can substitute cement (upto 70%) in cement mix
	LD slag	Increase in LD slag metallic recovery from ~13% to ~20% for sales and internal consumption	100	Reduces extraction / processing of Iron bearing raw materials for steel making
		Usage in clinker of PSC cement		Preservation of bio-diversity: lesser mining of natural aggregates, limestone, etc.
		Usage in road making as replacement of natural aggregate		
		Usage in Fly ash brick making	1	Saves river sand mining and limestone mining and transportation across large distances Creation of small enterprises for job creation as manufacturers and traders
	Coal by-products	As fuel in power plants, brick kilns, etc.	900	Utilizing by-products generated during coking coal preparation for steelmaking eliminates the mining of coal / alternative fuel
Cost Reduction	LD Slag	Use of LD slag in sinter making	65	Lesser procurement of limestone, pyroxnite, iron ore fines, etc.
		Reduction in cost of LD slag transportation and storage (fresh land and infrastructure development)		Less exploitation of virgin land Lesser pollution due to LD slag transportation

Weathering Facilities at Galudih

Bhagabandh Road



GEB Layer Laid in NH-33

Laid in the month of Apr'17

- Length – 500 m
- Width - 12.5 m
- Processed Steel Slag used - 20 mm, 40 mm & fines

CASE STUDY 6

Making Some Room

TATA GLOBAL BEVERAGES

ABOUT THE INITIATIVE:

The Tata Global Beverages factory in Eaglescliffe has been a Zero to Landfill site since 2012. This achievement involved some significant changes to the waste system and the site is still continuously improving this process 5 years later, with the aim of driving the waste up the Hierarchy of Waste disposal. In 17/18 to date the factory has sent 10% of all waste through re-use routes, 74% through recycle routes and 16% through energy recovery routes.

At the start of the Zero to Landfill change, the 3 main waste streams from the manufacturing processes on site were General Waste, Mixed Recycling and Cardboard. This has since been streamlined further and the Mixed Recycling has been replaced with a Polythene stream which has resulted in both environmental and financial benefits for the site.

There is a site objective looking at Waste this year involving liaising with suppliers to reduce the amount of secondary packaging waste and also focusing on each of the manufacturing areas to improve processes and reduce waste produced on the lines.

In regards to the Recovery and Recycling business model, the Eaglescliffe site has many innovative waste methods. Waste tea bags that have not made it into the finished product are put through a 'shred' process and re-introduced into tea blends in small percentages. A large proportion of the site's electronic waste is sold to a company that refurbishes and re-uses it. Tea dust is extracted throughout the manufacturing process and is taken to a pig farmer who uses this in Pig Feed.

Circular Supply Chain – The site has a Supplier Relationship Management process (SRM) whereby they work with suppliers to improve CSR credentials, energy policies etc.

CHALLENGES FACED:

As with many changes, the biggest challenge faced during the Zero Waste to Landfill initiative was the behavioral element; people tend not to like change. This is still an issue being faced by the teams involved as they continue to push for waste reduction and segregation improvements.

One way of helping combat this challenge was to provide basic waste training for all manufacturing employees on site. This was carried out by the site's waste contractor, Total Recycling Services. They gave the employees a brief understanding of WHY they are being asked to segregate waste and the legal implications behind the changes.

This training has been met with a very positive reaction and off the back of this, there are small improvement groups known as ACE's (Area Champions for the

Environment) being introduced in each manufacturing area. These individuals will help drive the changes going forward to ensure buy in from all levels.

Another challenge that is still being faced is the constantly changing waste/ recycling market. As the recycling industry improves, certain waste streams lose/gain value and there is a requirement for every organization to keep up with this demand. This has meant regular changes in waste streams and segregation processes to ensure that the site is always employing the Waste Hierarchy when making decisions around waste disposal.

IMPACT OF INITIATIVE:

The financial benefits of improving waste segregation processes on site can be clearly seen in the rebate figures for the past 3 years. Between 15/16 and 16/17 the waste rebates received on site grew from £6,878 to £9,828 despite some items like cardboard reducing in value. The 17/18 figure is on track to reach £13,000 by the end of March 18. This saving does not take into account the cost avoidance of disposing of some of these items in waste streams further down the Hierarchy of Waste disposal, which would make the overall saving even greater.

The Eaglescliffe factory supports a local charity that works with children with behavioral and learning difficulties (Eaglescliffe Forest School) by providing waste items for use in crafts and activities. Not only does this help in the area of Zero to Landfill but it also helps with the site's 'Doing Good' agenda through community development.

New Bin Labels for Waste Segregation

To know more about the Zero Landfill case study and TGB Eaglescliffe, visit:
http://www.tataglobalbeverages.com/sustainability/waste-management/the-initiatives/eaglescliffe-a-zero-waste-to-landfill-factory

CASE STUDY 7

GeoGreen - A Product Rooted in Nature

RALLIS INDIA LIMITED

ABOUT THE INITIATIVE:

Rallis is connected to Indian farmers for more than a century and serving them through giving products for crop protection, good quality seeds and services to increase farm income. Its ear on ground approach has helped it to understand the changing dynamics of agriculture and the needs of the farmers. Though the productivity in agriculture has improved over decades, the condition of the soil has deteriorated in the course of time due to the indiscriminate use of

chemical fertilizers. The nutrient content of the soil like N (Nitrogen) P (Phosphorus) and K (Potash) has gone down in almost all areas.

Rallis took up as an aim to find ways and means to help farmers in restoring the soil, ultimately helping them in achieving higher productivity. It is the starting point of thinking for development of a suitable bio- fertilizer with no impact on the environment.

India has a large number of sugar factories, mostly in the states of Maharashtra, Karnataka, Tamil Nadu and Uttar Pradesh. It was a challenge for sugar factories to deal with the huge amount of effluent/waste generated after crushing of sugarcane. So far the industry does not have a successful way to use or dispose all such waste.

Rallis India took up this problem and looked at how the waste can be used productively in agriculture, and used as a bio-fertilizer to restore soil quality. Finally, it found a way to develop a product by using effluents, mud waste and bagasse of the sugar factories and converting them to compost by treating them with microbes and adding nutrients in the process which spreads across a cycle of 6-8 weeks.

The product, named GeoGreen, falls under the organic manure category, and helps in improving degraded soils. It is produced through a unique blend of micro- biology and fertilizer manufacturing technology and technique, converting sugar mills' by-products into commodities necessary for agriculture and pollution control.

For technology and microbes, it acquired a company called Zero Waste Agro Organics Limited which was working in this field using some unique techniques first developed in Australia.

GeoGreen not only provides carbon and primary/secondary nutrients to the soil but also helps in keeping the surrounding area clean. Composting can reduce the volume of waste to landfill/dumpsite by converting the waste into useful by-products. This also prevents the production of harmful greenhouse gases (especially methane) and toxic material that pollutes groundwater apart from polluting the environment. The product was taken to the field and excellent results were displayed to farmers in terms of the volume and quality of crop they were producing.

CHALLENGES FACED:

A. **Educating farmers** on the usage of high quality manure v/s FYM (Farm Yard Manure) available near their farm locations.

B. **Ensuring uniformity** in quality - the outsourced model involves unskilled labour and operations undertaken mostly in open yards.

C. **Locating manufacturing closer** to the end-user market as the freight component is significantly high.

D. **Impact on sales** due to drought and weather conditions etc.

E. **Preference of channel partners** to sell more profitable products like seeds, Plant Growth Nutrients, high value pesticides etc. rather than soil health products.

F. **Regulatory changes**

G. **Competition with Government "subsidized" city compost** which includes contaminants like sand, plastics and other impurities.

IMPACT OF INITIATIVE:

The initiative to launch GeoGreen was in line with Rallis's strategy of providing end to end solutions to its customers, while addresing the primary and secondary nutrient deficiencies in the soil.

A. GeoGreen: An important source of organic carbon Organic Carbon is essential for all biological properties of the soil, and balances the physical and chemical properties for maintaining soil health.

B. GeoGreen for:

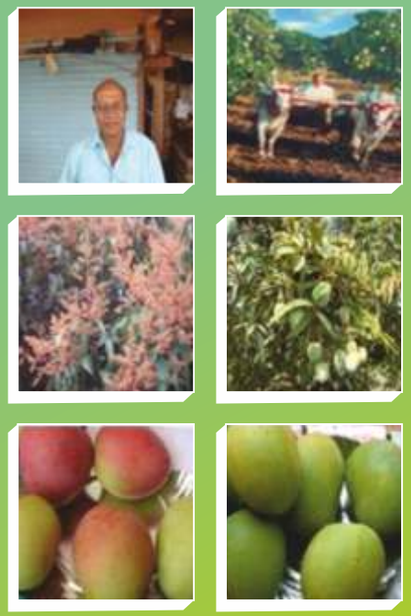
• **Correcting Physical soil conditions** Improves soil structure by acting as adhesive between soil particles. Improves nutrient uptake and yields considerably.

• **Correcting chemical soil conditions** Improves the availability of micro nutrients as enriched organic matter acts as buffering PH.

• Correcting Biological soil conditions

Better nutrient efficiency due to conversion of major micro nutrients to inorganic plant available forms. Humus formation which is lifeline for soil.

Fertile soils, higher yields, quality produce and resistance to diseases and pests has resulted in a better cost benefit ratio for those using GeoGreen



GEOGREEN FARMER CASE STUDY: IMPROVED OVERALL QUALITY AND QUANTITY OF YIELD IN MANGO

Mango Farmer Gadre Jamsande, from Devghad, Ratnagiri, shared the results of consistent application of Rallis's GeoGreen product and it's impact on fruit yield.

"There was good vegetative growth, with an increase in the growth of lateral branches and lush green leaves. Profuse flowering and better fruit setting percentage was noticeable. The Mango tree could withstand water stressed conditions and there was an increase in yield of fruit by 15-20%."

CASE STUDY 8

Fly Ash - A new lease of life!

TATA POWER

ABOUT THE INITIATIVE:

Tata Power generates fly ash as by-product at its thermal power stations. Total fly ash generated per annum is about 3.6 million tones which is about 1.8% of the total ash generated in India as per the Central Electricity Authority (CEA). There is good potential for utilization of ash in the construction industry. Tata Power is successful in utilizing/recycling 38% of the fly ash in various value added products in FY 17.

Tata Power was able to recycle fly ash in various end products through self-use or through third party use.

Following are potential applications of fly ash:

A. Cement 1.16 Million Tone(MT) , Ready Mix Concrete 0.06 MT, Brick Making 0.1 MT, road embankment 0.11 MT, other products 0.03 MT. The total recycled quantity of fly ash was about 1.39 MT. Such use of fly ash has also helped to reduce carbon dioxide emissions.

B. Replacement of natural sand using bottom ash is done at Tata Steel.

C. Use for manufacturing Cable Warning tiles and products such as ceramic tile and Geopolymer cement. The replacement of natural sand in construction application is being explored and yet to be commercialized. Fly Ash Based Paint and ceramic sand which are tested at laboratory scale and pilot scale and are seen to have good potential for commercialization.

CHALLENGES FACED:

Some of the challenges faced by Tata Power in implementing the above initiatives are:

A. Coastal Gujarat Power Limited (CGPL) uses imported coal for its operation. Fly ash generated from the plant is slightly brown in colour. **Initially, end users were reluctant to use this ash due to colour,** though it was known that the colour of fly ash (brown) did not affect the quality of the ash. The fly ash was then ash tested through various Institutes and external parties to prove that its colour of fly ash does not have any effect on its performance of fly ash in end products. In fact, the fly ash gives very good results in structural concrete. People started realizing this and then started using imported coal ash in many products such as cement, RMC brick etc.

B. There was an initial apprehension on the utility of bottom ash. Bottom ash has properties similar to natural sand, except for some amount of unburned carbon content in it. **Many in-house experiments were carried out using bottom ash where it was successfully used in place of sand,** and today Tata Steel uses bottom ash from Tata Power's Maithon Power Limited in place of natural sand.

C. Manufacturing of mortar from pond ash. Different combinations were tested and tried in the field before setting up the final design mix.

IMPACT OF INITIATIVE:

A. Cost Reduction: Overall cost of disposal for Tata Power has come down from Rs 125 per MT to Rs 102 per MT in the year FY 17.

B. Environmental and social benefits:

• Use of fly ash to make end products such as Cement, RMC, Brick, and highway embankments reduces the load on natural resources such as lime, top soil etc. Degradation of the environment is minimized.

• It takes about 1000 years to generate 1 inch of top soil throught natural processes. Brick making plants based on clay destroy top soil and the fertility of the soil. Replacing fly ash with clay reduces the degradation of soil and keeps intact the fertility of the soil.

Cable Warning Tiles from fly ash

• Clay bricks manufacturing generates air pollution as coal is required for baking of the bricks. On the other hand, fly ash bricks do not need baking; this eliminates air pollution and reduces the adverse heath effects on the laborers working in brick making plants.

• Fly ash brick making plants operating in and around our thermal power plants have generated employment opportunities in rural area. About 15 self help groups are making fly ash bricks, generating employment opportunities in rural areas.

Use of fly ash in Cement Paint

UTWT road from fly ash

CASE STUDY 9

The Materials Marketplace

MJUNCTION SERVICES LIMITED

ABOUT THE INITIATIVE:

Businesses produce large quantities of “non-core” products and by-products as a result of their normal operations. Businesses could consider selling these “non-core” products and by-products (i.e. secondary steel, minerals, coal and coal chemicals), as well as obsolete or idle assets, if a market exists.

Leveraging this business opportunity, in 2001 Tata Steel and the Steel Authority of India Ltd. (SAIL) established a joint venture called Mjunction Services

Limited, which has evolved to become the world's largest e- marketplace for steel and India's biggest B2B e-commerce company.

Mjunction's mission is to create robust and sustainable supply chains by bringing more efficiency and transparency to stakeholders.

Extending beyond typical e-commerce buy and sell services, Mjunction also offers financing and consulting services to customers.

However, it is the sell side business that helps customers sell their "non-core" products and by-products.

Mjunction is helping many industries and organizations to find the right buyers for these non-core products, while contributing positively to the environment.

CHALLENGES FACED:

For the market to function efficiently, both buyers and sellers need price transparency, which can be difficult to establish for industrial by-products.

IMPACT OF INITIATIVE:

A. Mjunction has increased its business volumes from Rs 94.35 crores ($13.8M USD) in 2002 to Rs 134137.68 crores ($20.16B USD) in 2016.

B. Participating companies save money by utilizing by-products and getting access to idle asset in the market.

C. Both buyers and sellers experience increased price transparency through the online platform.

D. What was the industry's waste stream is now becoming feedstock for other industries.

The JV has expanded to include almost 30 waste streams.

OUR KEY BUSINESS AREAS

CREATING MEANINGFUL IMPACT THROUGH CONSTANT INNOVATION

coaljunction

coaljunction is mjunction's coal sales division which enables the entire coal buying community in India to buy coal through the Internet. coaljunction conducts e-sales on behalf of Coal India Ltd and its subsidiaries, the largest coal conglomerate in the world. coaljunction has made the entire buying process not only simple but also transparent.

metaljunction

metaljunction is mjunction's steel e-sales division, which enables big as well as small consumers to buy steel directly from large corporates such as SAIL and Tata Steel, among several others, thereby generating simplicity and efficiency into the process. It also helps e-sale of minerals such as iron ore and by-products generated from the steel making process.

buyjunction

buyjunction is mjunction's division which facilitates end-to-end non-core procurement for its clients, enabling them to focus on critical items. A transparent price discovery mechanism, managed and assisted sourcing, optimum lead time, a larger vendor base and an aggregated buy programme are some of the service highlights of the business unit.

valuejunction

valuejunction is mjunction's division responsible for the sale of idle assets, which include industrial assets, stressed assets and retail surplus. An experienced team provides inspection support to make it easier for the buyer. For the seller, it ensures wide access to buyers, the highest possible price and in the shortest possible time.

Know more about mjunction's innovative e-platforms on: http://www.mjunction.in/

CASE STUDY 10

Prolife - New Life Models

TATA MOTORS LIMITED

ABOUT THE INITIATIVE:

On the occasion of World Environment Day in 2013, Tata Motors launched 'Tata Motors Prolife', a customer-focused service programme to recondition engine long blocks, aggregates and parts to ensure quality reconditioning which would result in superior performance of the vehicle. The service programme aimed to help extend the life of aggregates using a reduced quantity of materials compared to that required for a new part or aggregate.

Tata Motors needed to address its customer needs by providing high quality, low cost, replacement parts. Mission critical equipment like engines, if repaired or overhauled in improper plant environment, can pose high operational risks.

The Prolife business is a pioneering after-market product support strategy benefiting Tata Motors' customers. Use of Tata Motors Prolife aggregates ensures Original Equipment-like vehicle performance even after the first life cycle. The customer is provided with reconditioned aggregates in exchange for old aggregates, subject to simple acceptance norms.

Two plants (situated in Lucknow & Coimbatore) are currently in operation, with two new facilities coming up in Surat and Hyderabad.

Prolife has a wide variety of reconditioned products in its portfolio of nearly a dozen components (with efforts in place to include even more). The products range from reconditioned Engine Long Blocks, Gear Boxes, Power Steering Gear Boxes, Turbo Chargers and Air Compressors to electrical components such as starter motors and alternators.

More on customer care services can be viewed here: Link: http://www.customercare-cv.tatamotors.com/value-added-services/prolife.aspx

CHALLENGES FACED:

Tata Motors needed a viable, cost effective alternative to overhaul vehicle aggregates with a nationwide warranty, while maintaining first life cycle component quality.

IMPACT OF INITIATIVE:

A. In 2016, a total of 23,115 components/equivalent engines were reconditioned. The re-conditioned long blocks are also being exported to international markets.

B. Reconditioning offers huge cost advantages compared to the conventional life cycle, operations are simplified and this cuts down inventory and logistics cost.

- Highest quality of aggregates and components.

C. Prolife is environment-friendly, substantialy reducing waste generation and encouraging reutilization.

D. Minimizes the product life cycle cost.