Energy Management System at Passenger Vehicle Business Unit, Sanand

Presenting Team:

Mukesh Maloo (General Manager- Paint Shop Operations)
Debi Chatterjee (Dy. General Manager – TCF Shop Operations)
Anil Yadav (Dy. General Manager – CPED - Energy Cell)

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‘NEW FOREVER’ Range of Vehicles

TML Sanand Plant - AN INTEGRATED FACILITY WITH VENDOR PARK

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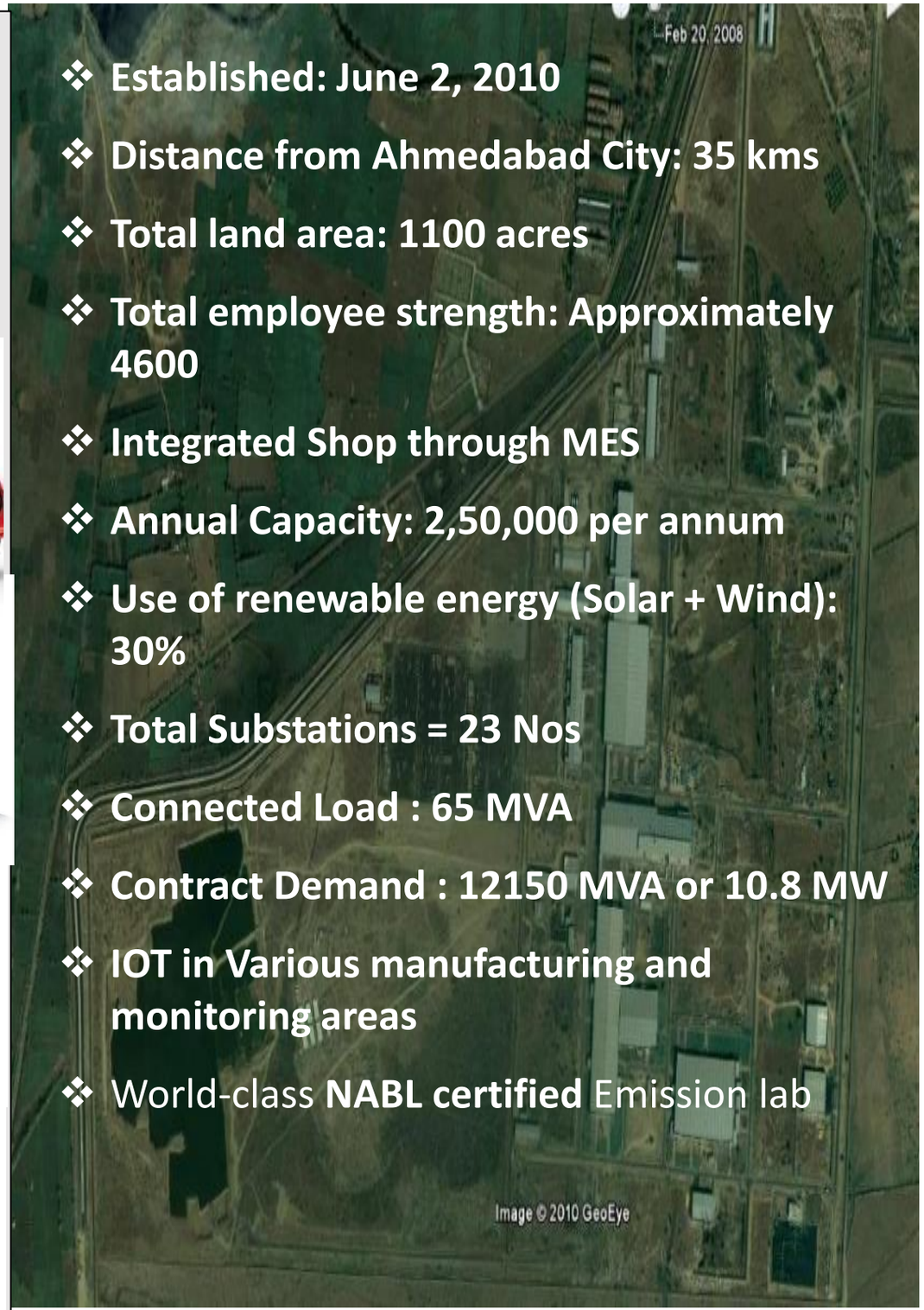
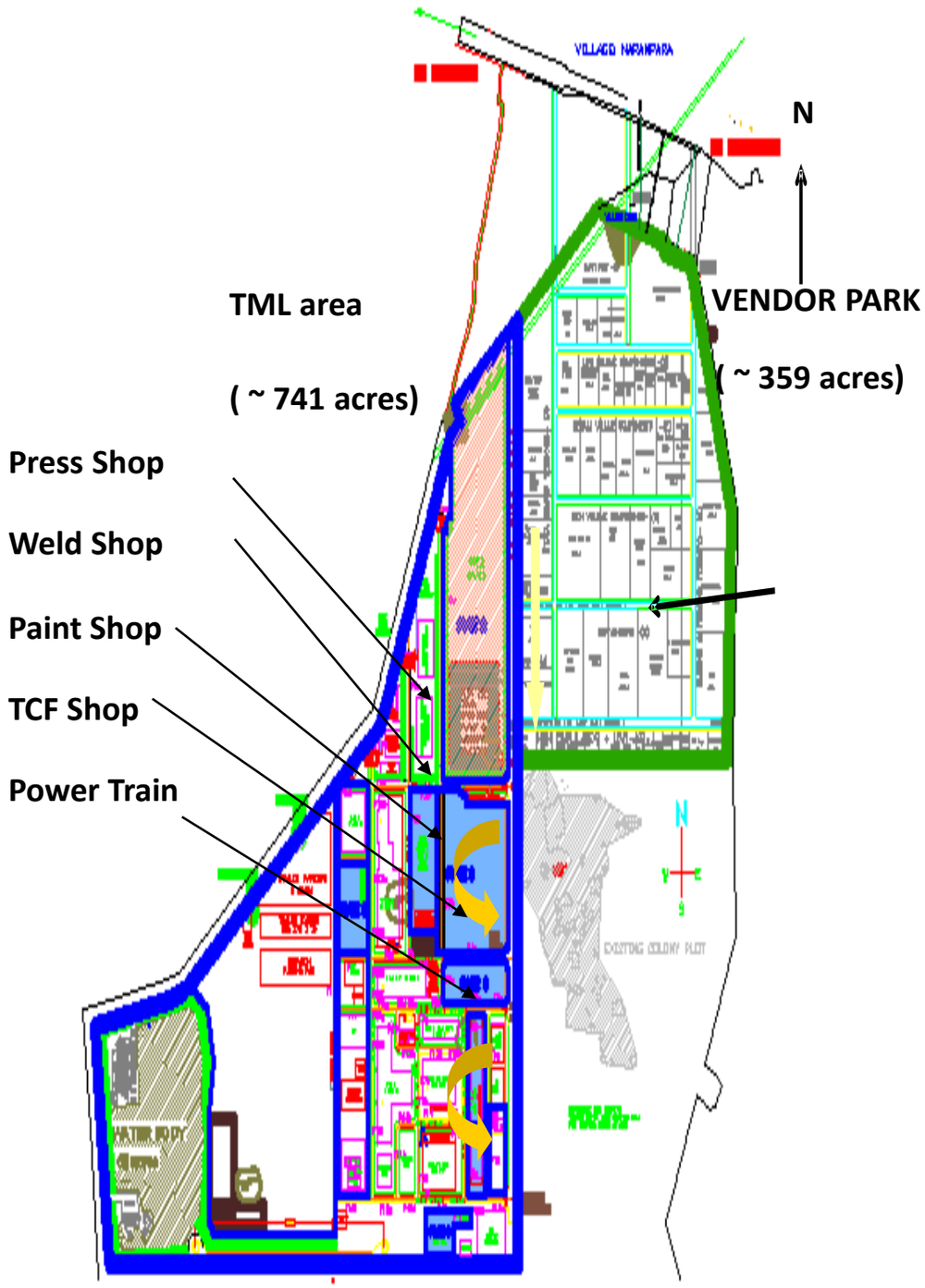
Sanand Plant: Salient Features and key features along with products

Products:
Nano
Tiago
Tigor
Tigor EV
694 CC Engine
Nexon Petrol Engine



- Established: June 2, 2010
- Distance from Ahmedabad City: 35 kms
- Total land area: 1100 acres
- Total employee strength: Approximately 4600
- Integrated Shop through MES
- Annual Capacity: 2,50,000 per annum
- Use of renewable energy (Solar + Wind): 30%
- Total Substations = 23 Nos
- Connected Load : 65 MVA
- Contract Demand : 12150 MVA or 10.8 MW
- IOT in Various manufacturing and monitoring areas
- World-class **NABL certified** Emission lab

Plant Lay-out



Sanand Plant: Facility Snapshot

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Press Shop

- Komatsu High Speed Tandem Line
- Stroke/Min: 12
- Die Change Time: 1 min SMED
- Dies: 155 Nos
- Overhead Carnes: 03 No

Weld Shop

- Robots:166 Nos
- Jigs & Fixtures:452 Nos
- Geo Pallets: 77 Nos
- Welding Guns: 422 Nos

Paint Shop

- Machine & Eqpt: PT/ED-RODIP Conveyor
- Robots: 14 Nos
- Handling by Skid Conveyor
- Top Coat Shades: 10 Nos

Powertrain Shop

- Engine Assembly Line: 2 No (2/ 3 Cyl)
- Transaxle Assembly Line: 1 No
- 100% Engine testing in Engine Test Beds
- Horizontal Machining Centre:
  Cylinder Block : 21 Nos.
  Cylinder Head: 23 Nos.
  Crankshaft line: 03 Nos.

TCF Shop

- Station Pitch: 4.5 Meters
- Testing: 100% Roll-Brake
- 100% Shower Testing
- Robots for Glass Glazing
- RGVs for Engine stuffing
- Multi-filling machine for all oil/gas filling

Sanand plant equipped with state-of-the-art facilities

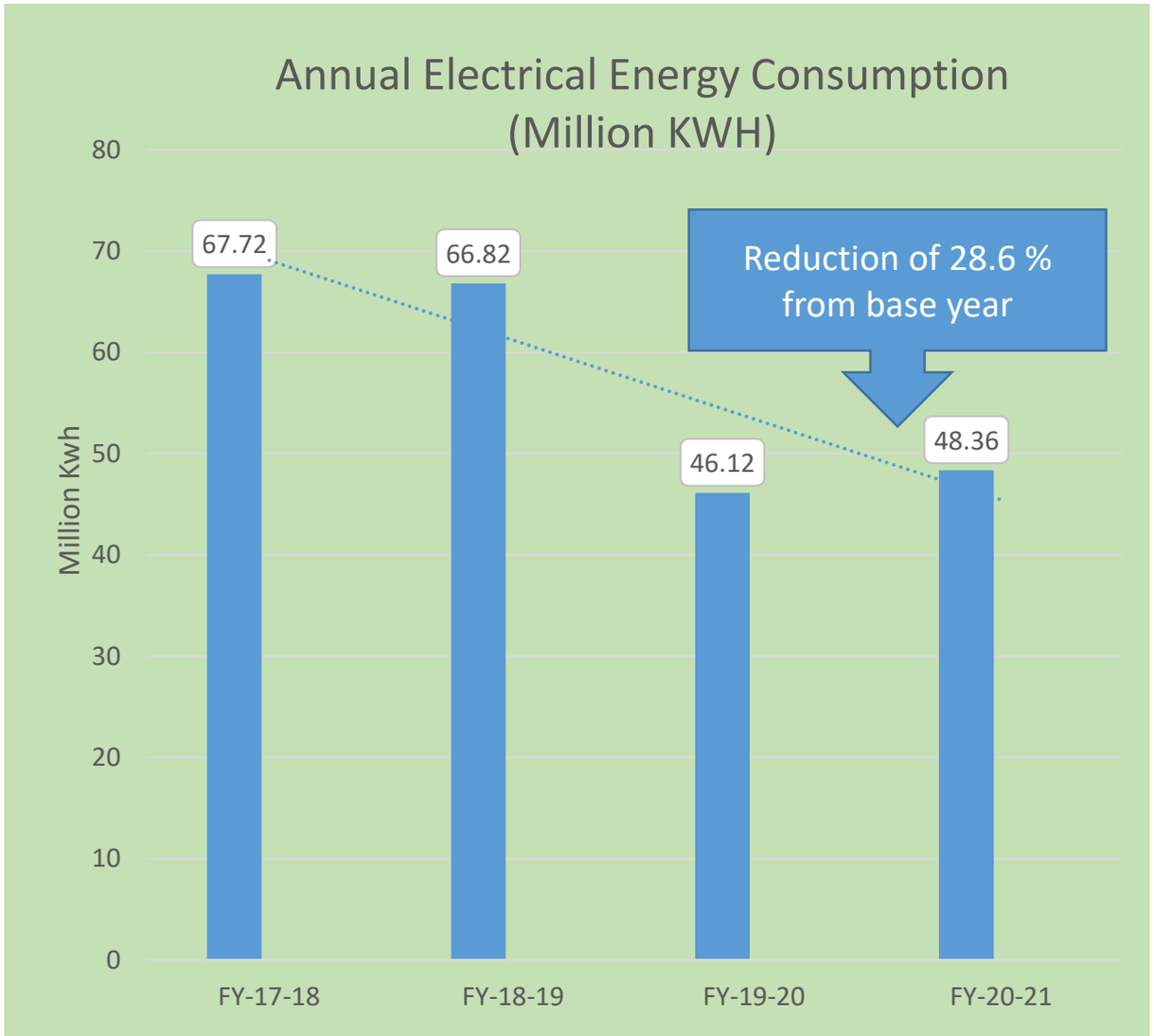
Sanand Plant- 10 Glorious Years & Journey Continues

TIMELINE	MILESTONE
2010	Plant Inaugurated
2011	WCQ Level 1
2013	NANO CNG Launch
2014	NANO Twist WCQ Level 2
2016	TIAGO Launch
2017	TIGOR Launch 1 Lakh TIAGO Rolled out TIGOR EV flagged off
2018	2 lakh TIAGO + TIGOR rolled out WCQ Level 3 5 lakh vehicle rolled out
2019	1.19 lakh: Highest ever production in a financial year in 2018-19
2019	1000th Tigor EV Rolled Out
2020	6 Lakhs vehicle rolled out 3 lakh Tiago rolled out

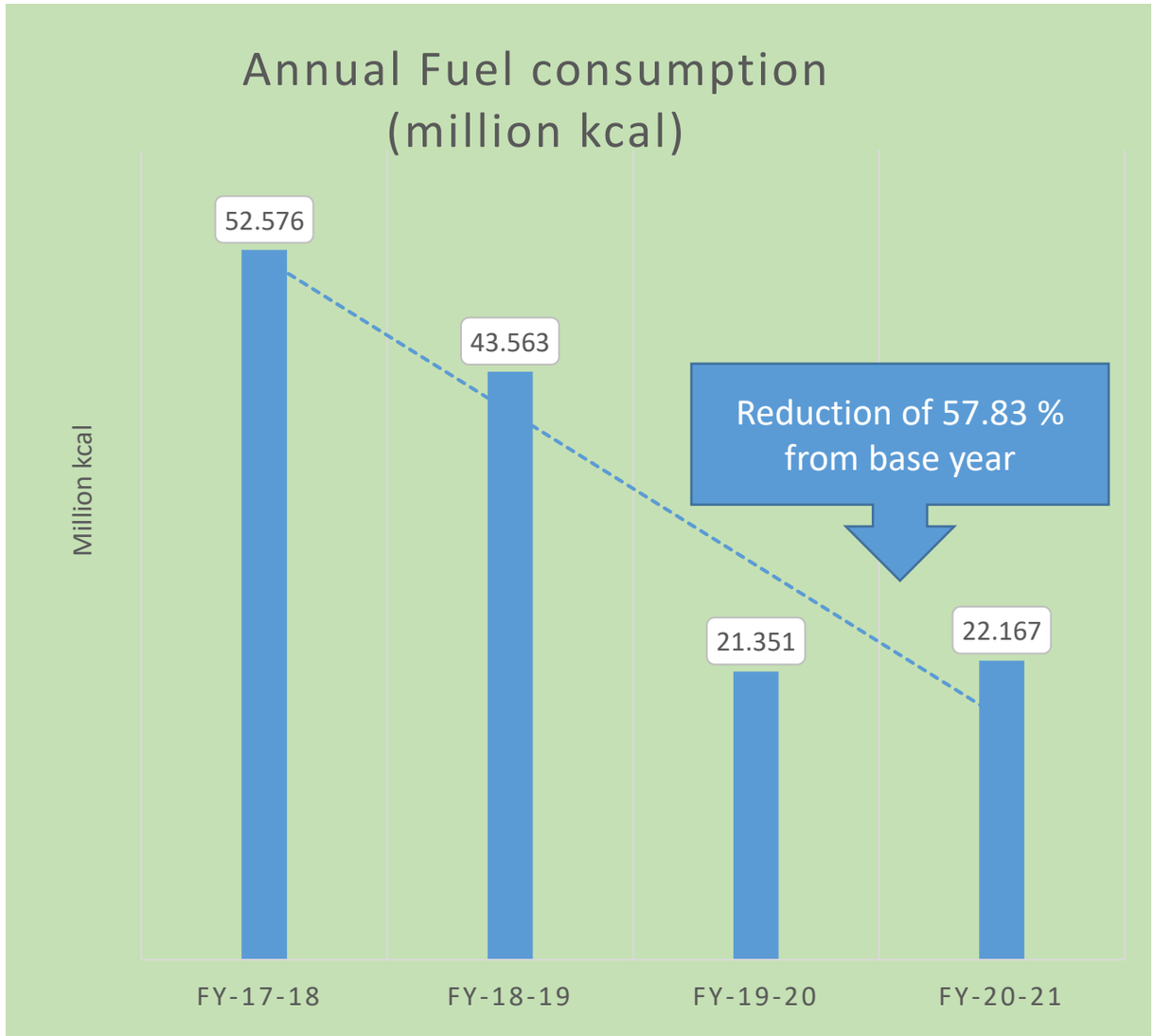
Sanand Plant contributes over 40% of total PV production volumes

1. Energy Consumption Overview

Electrical Energy Consumption



Thermal Energy Consumption



Take Away : As a result of various Encon initiatives Annual Electrical Consumption and Fuel Consumption has reduced by 28.6 % & 57.83 % from Base year FY 17-18

2. Specific Energy Consumption

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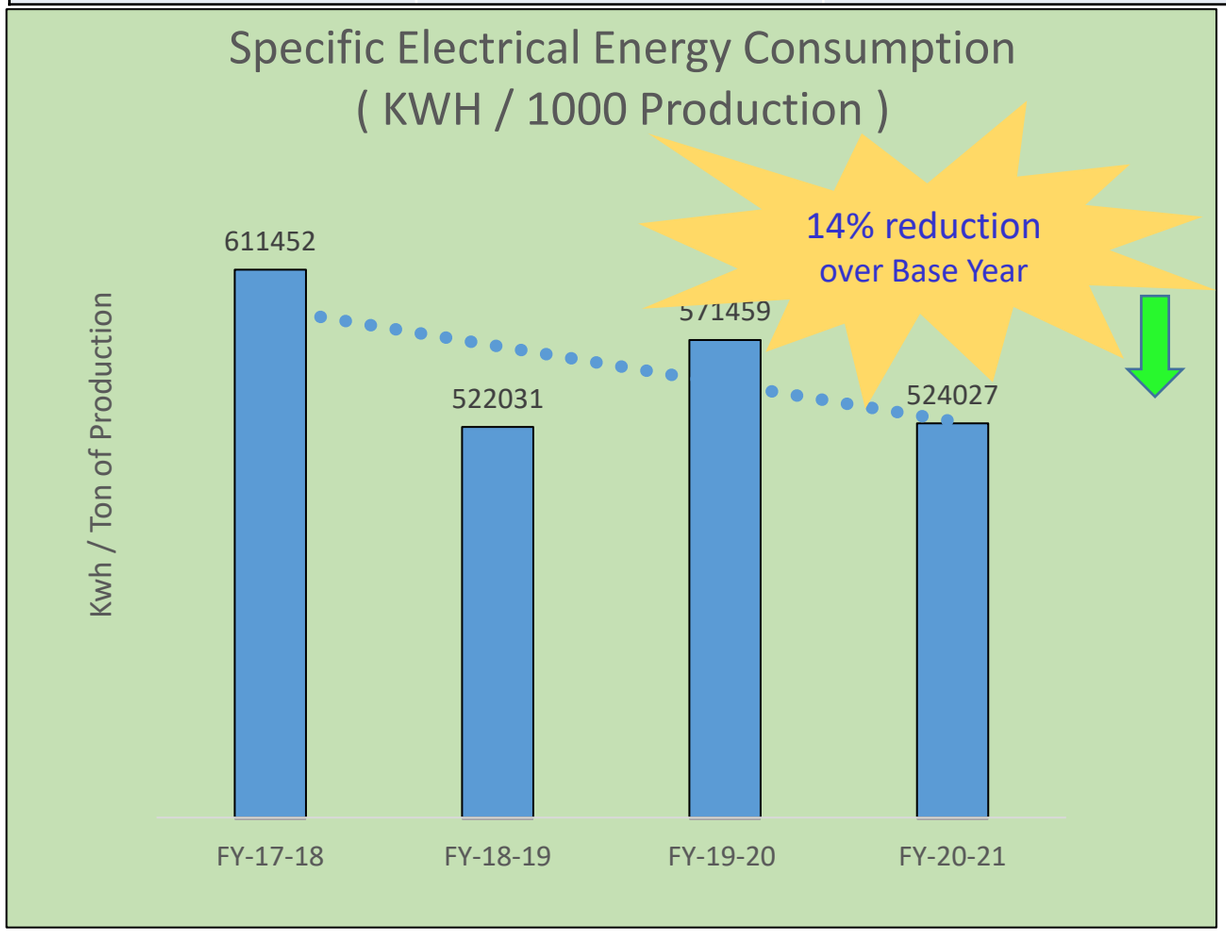
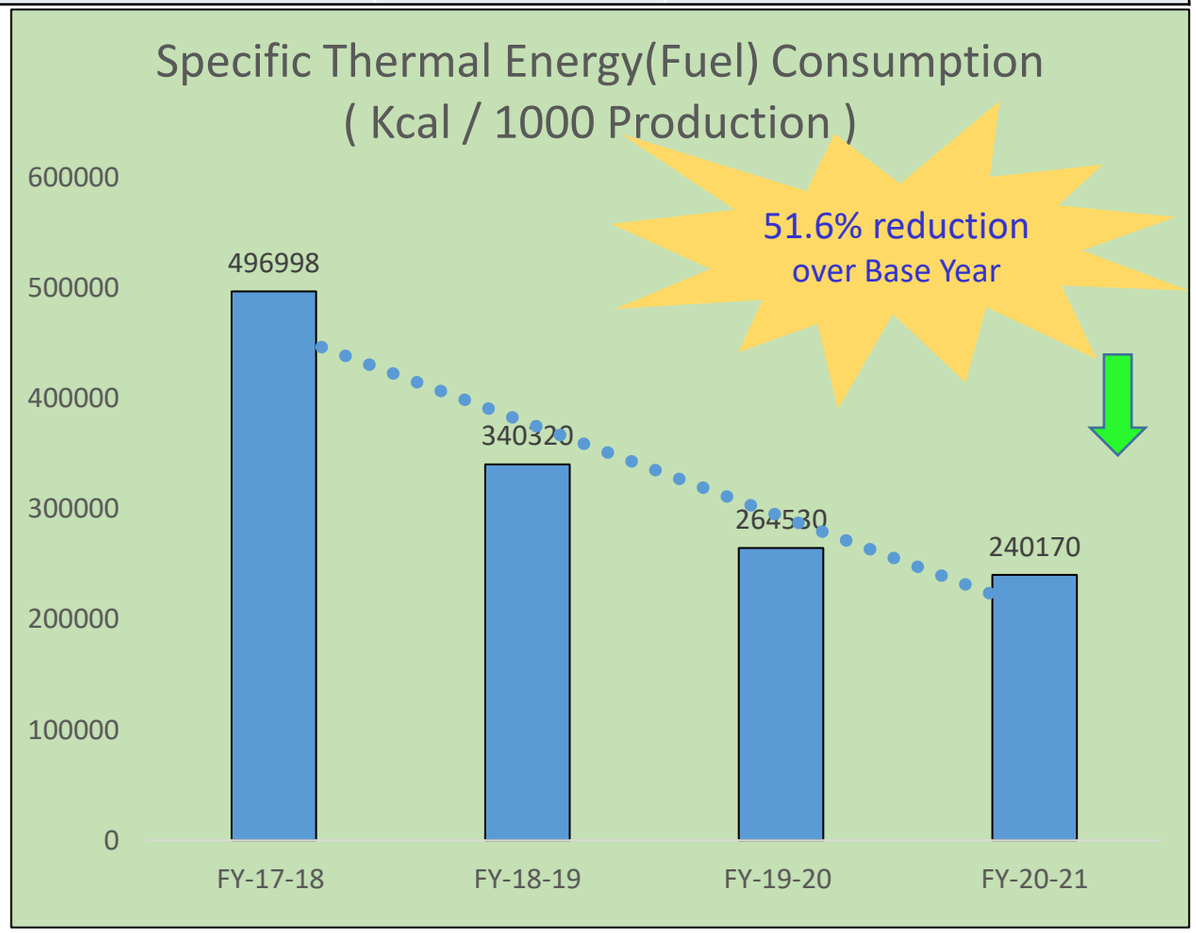
Capacity utilization & Energy performance

Financial year	Installed Capacity	Actual Roll down	% Utilization	Eq. Vehicle	% Change from base
2017-18	250000	108397	43.35 %	105788	Base
2018-19	250000	119250	47.70 %	128007	+ 21.00 %
2019-20	250000	63416	25.36 %	80714	- 23.70 %
2020-21	250000	71855	28.74 %	92298	- 12.75 %





Take Away : In FY20-21, Specific Electrical Energy Consumption and Specific Thermal Energy Consumption reduced by 8% and 9.2% respectively w.r.t to last year. In spite of reduction in volume, Specific consumption reduced.

2. Specific Energy Consumption

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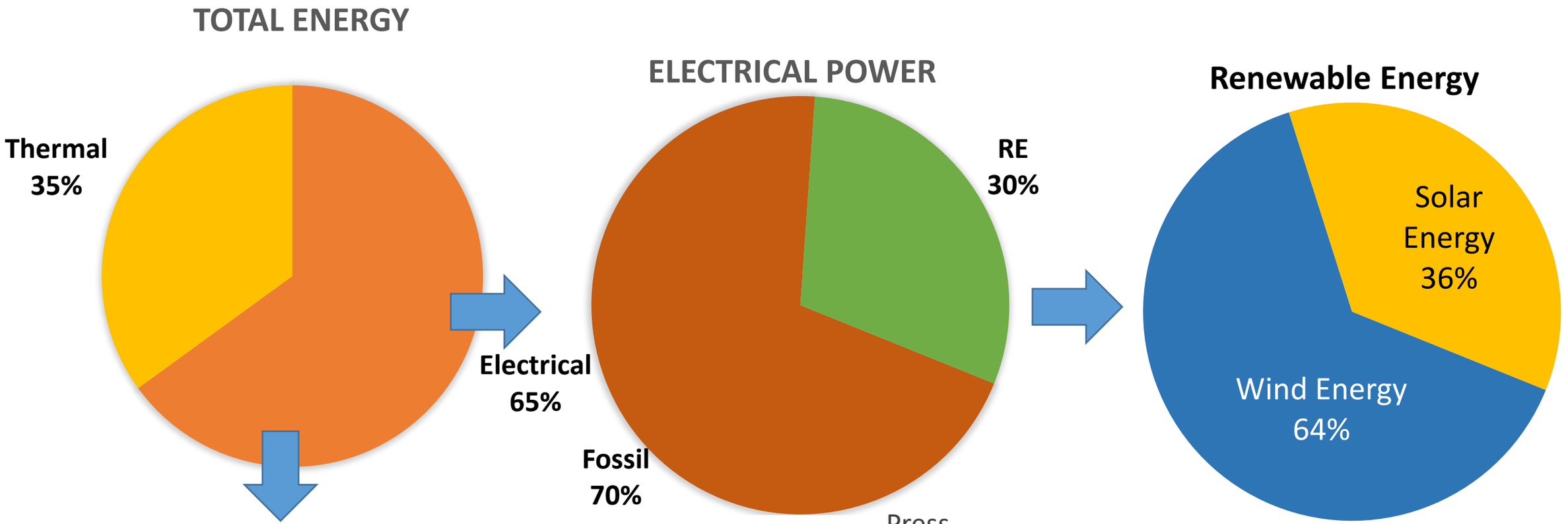
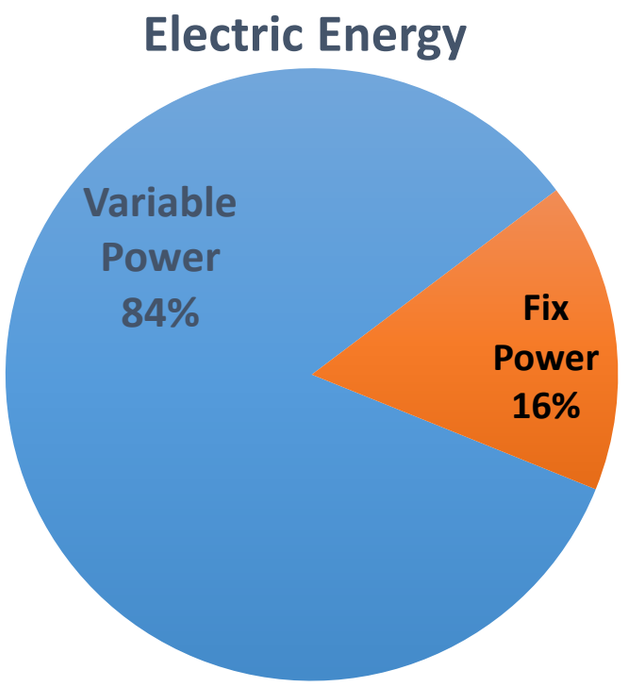
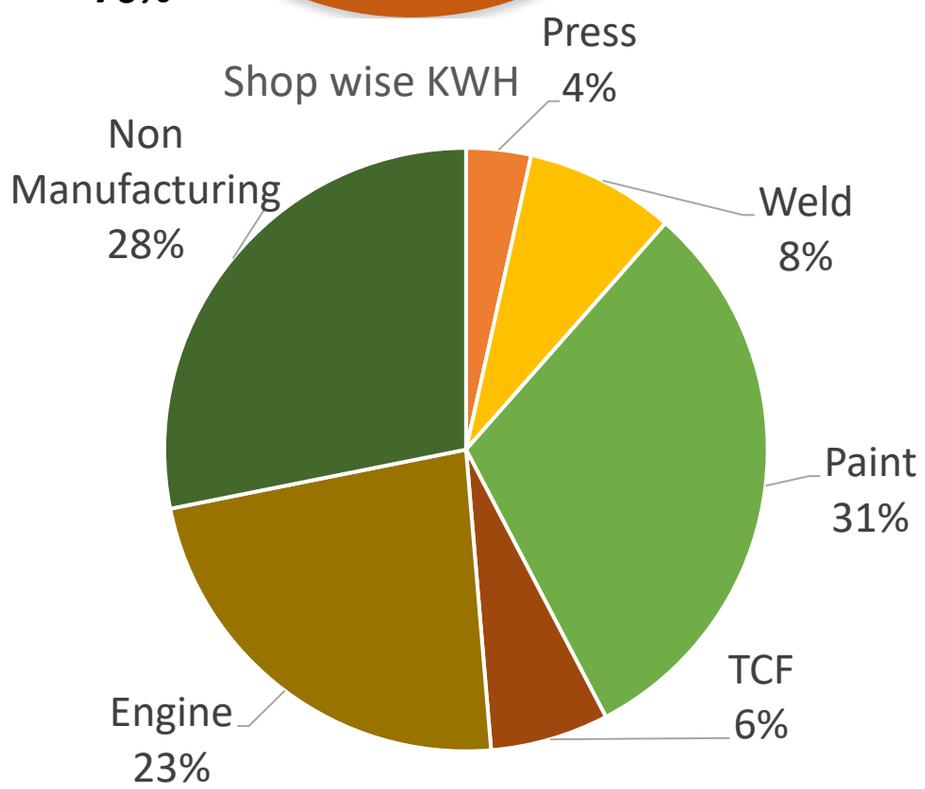
Analysis of Energy performance & Reasons for variation FY 2020-21



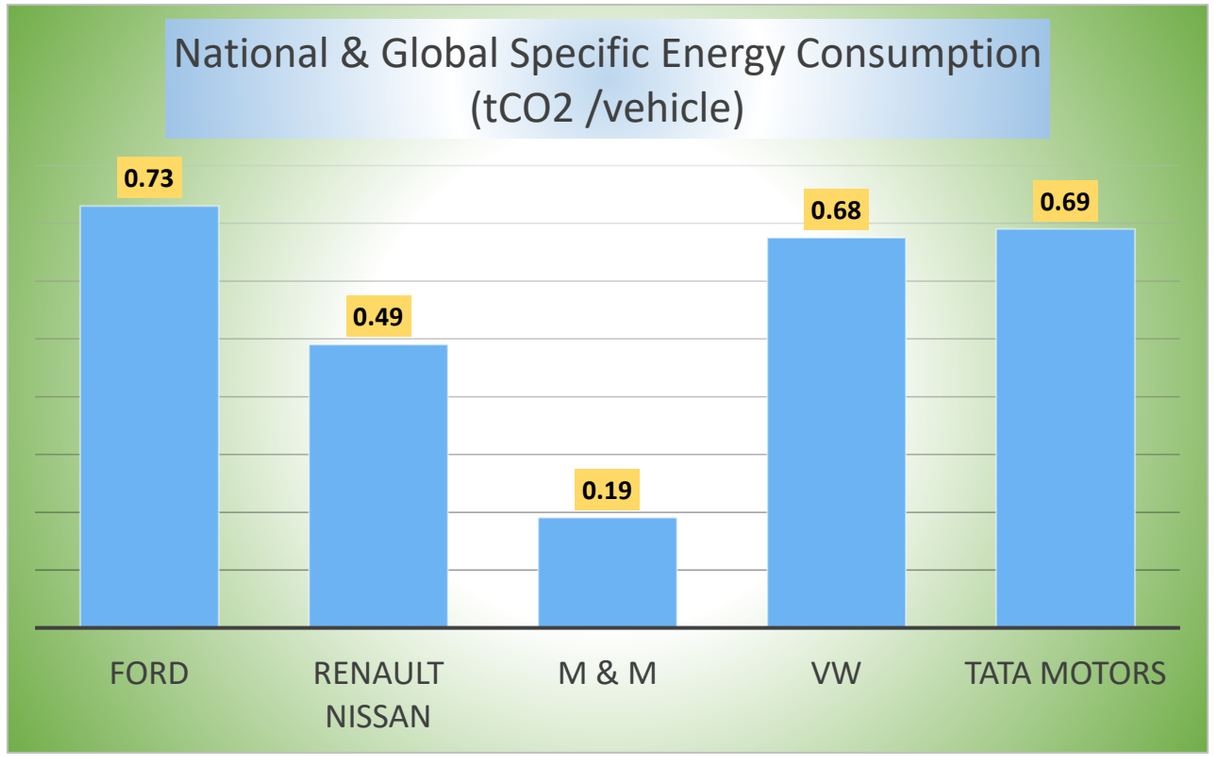


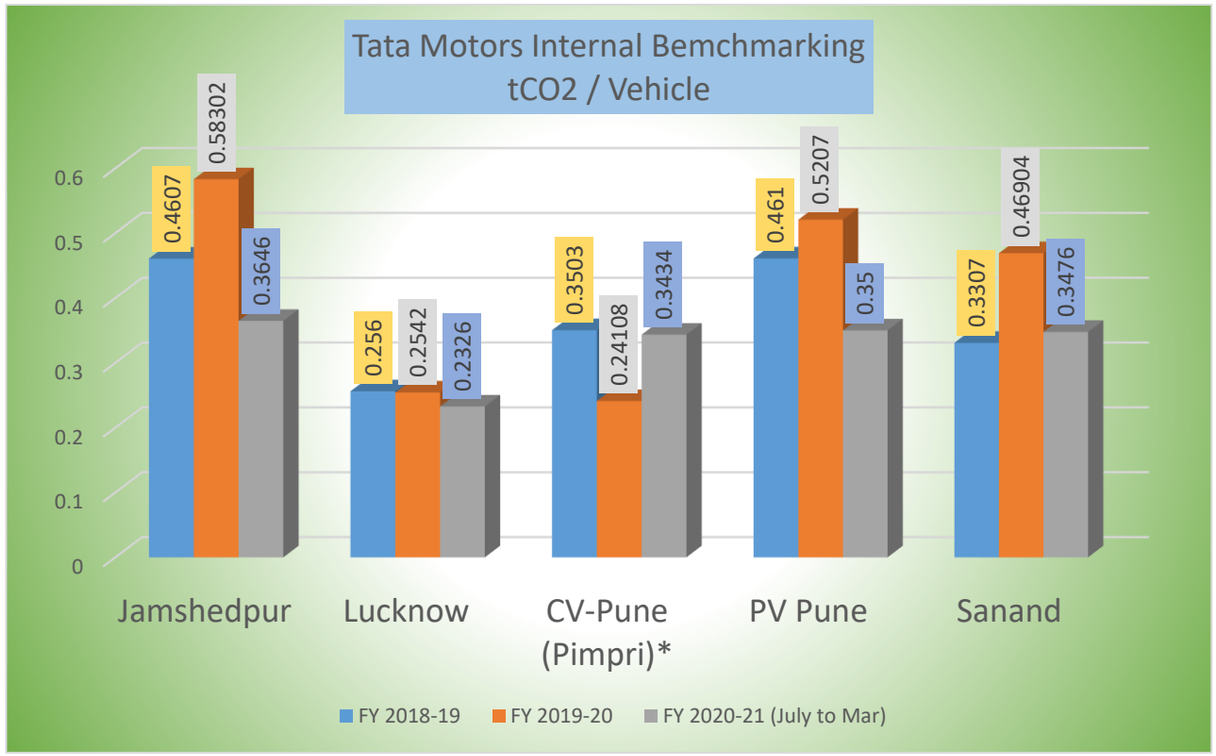


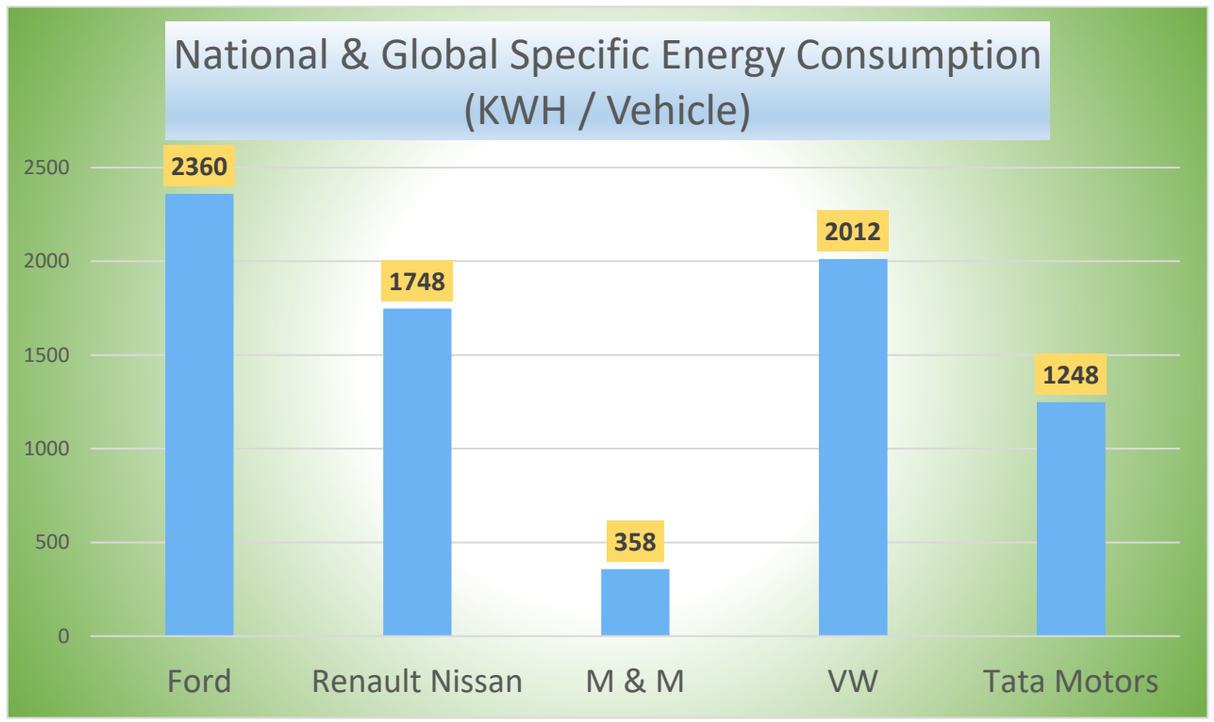
Reason for Variation

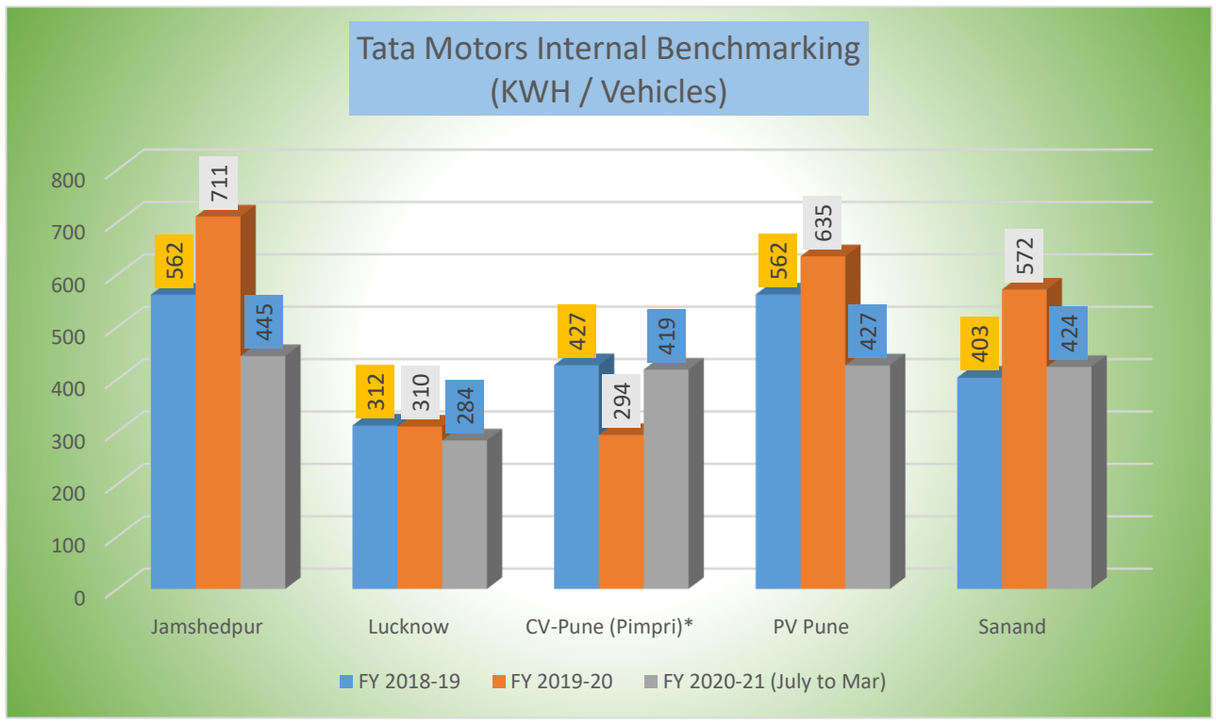
- **Fluctuation in volume.**
- **Variation due to seasonal changes.**
- **Reduced efficiency due to ageing of equipment.**
- **Excess energy consumption due to new product launches due to trial productions**
- **Compressor air leakages.**
- **Running line at lower rate.**

3. National & Global Benchmarking









3. Energy Road Map and Target Cascading

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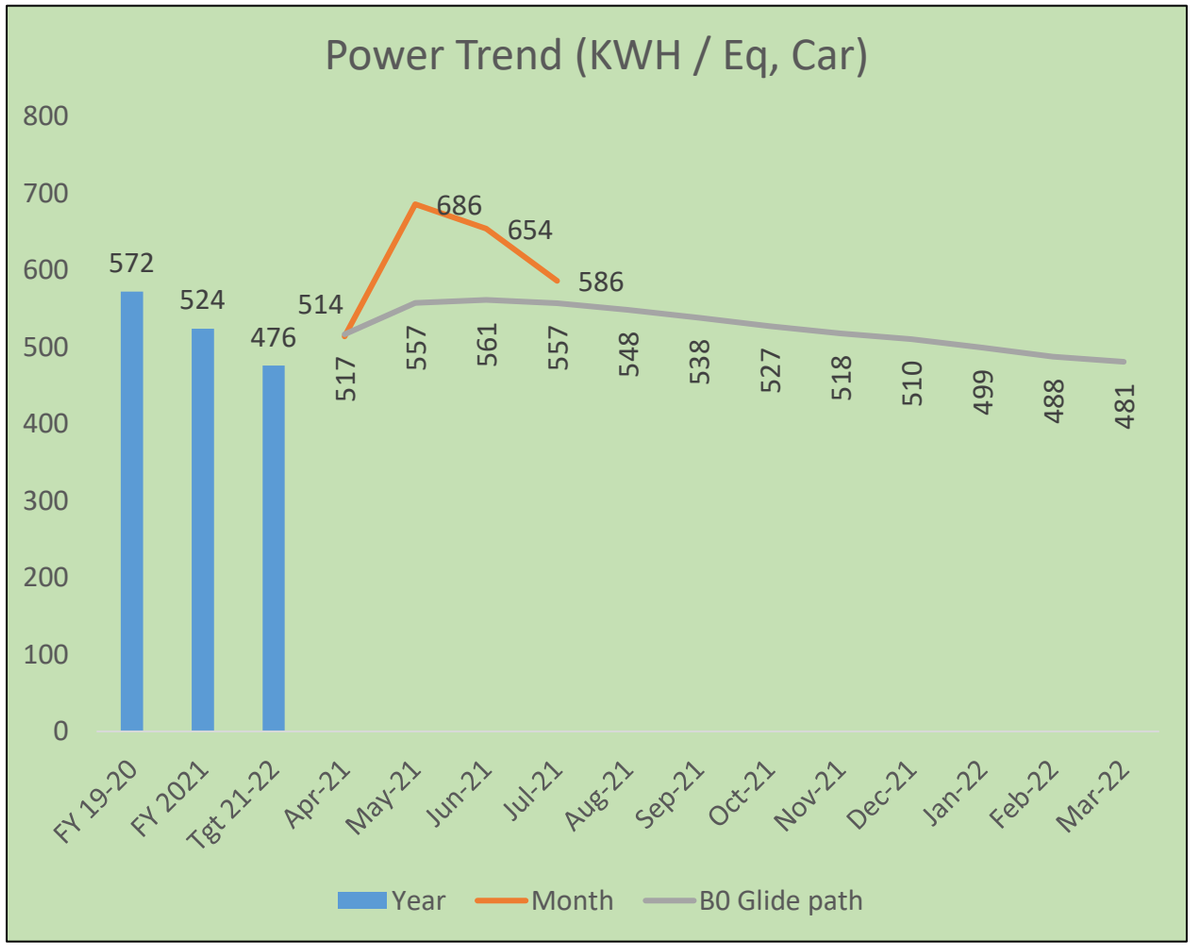

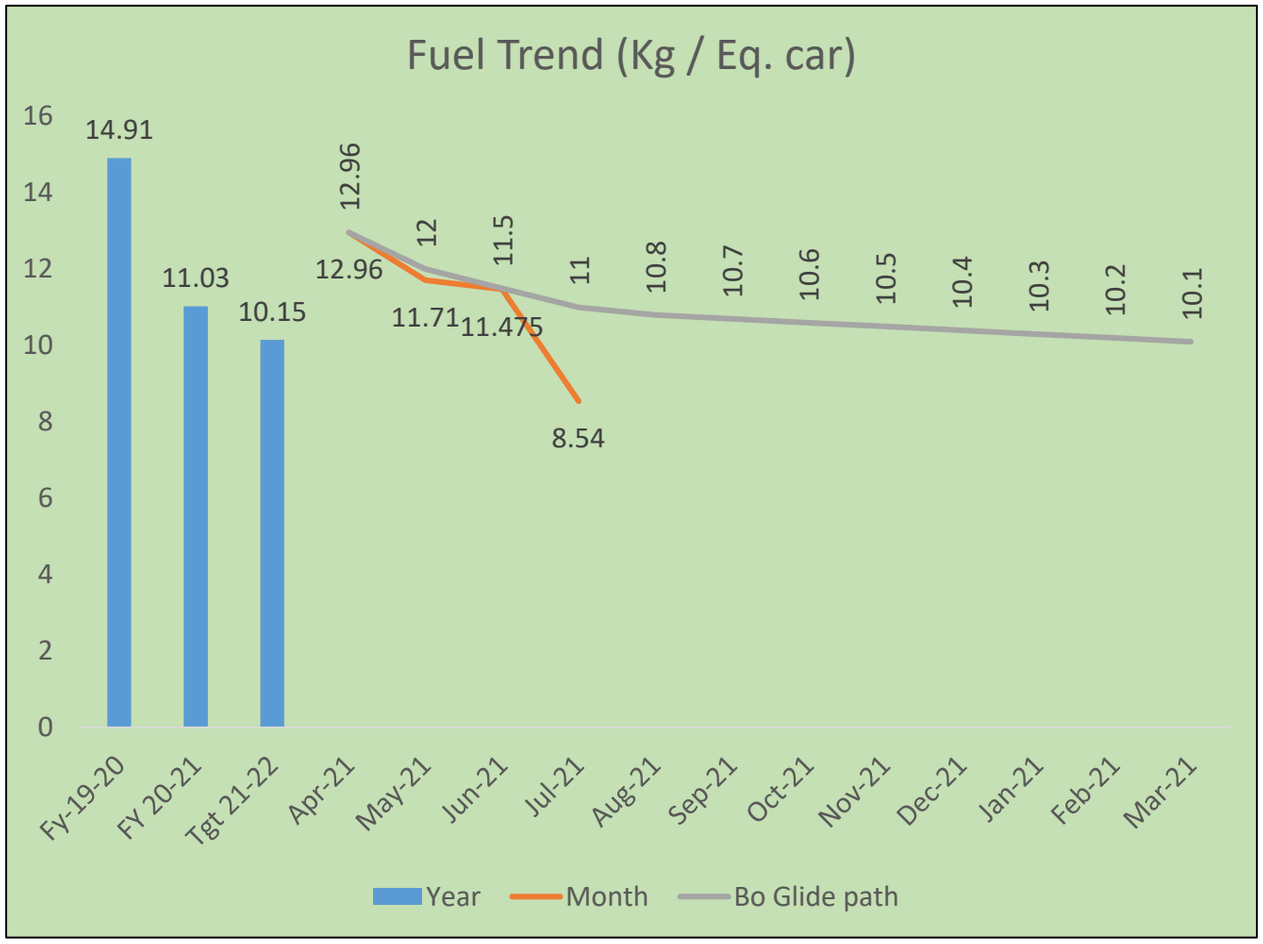

Element	UOM	Press	Weld	Paint	TCF	Powertrain	CPED	Non Manuf. areas	Plant Short term Target	Plant Medium term Target	Plant Long term Target
Energy	Owner	Nitin Barge		Mukesh Maloo	Mahesh S	Harish K	Anil Yadav	P Mohanty	Neeraj Agarwal Plant Head		
Power	KWH/Eq.Car	21	37	132	32	114	113	27	**476**	**470**	**465**
Fuel	Kg / Eq.Car	0	0	10.15	0	0	0	0	**10.15**	**10**	**9**

Annual Target setting is done and all the targets are cascaded down to each shop level for monitoring and better control

5. Projects implemented FY 2018-19

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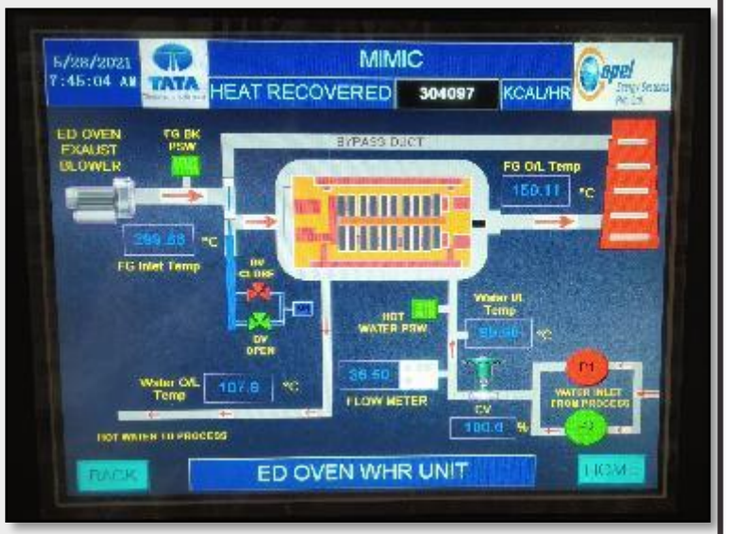
ENCON Project : Waste heat recovery system for TC & ED oven — Paint Shop

Before

N/A

After



Consumption
195120 Kwh per year

Consumption
124200 Kwh per year

Equipment Details – TC & ED oven

Process Change- Flue gas temperature reused by installation of Heat recovery system for TC & ED oven

Details of Energy Saving Achieved		
Energy	KG Unit	677099
Emission Reduction	tCO_2 Reduction	555.22
Savings	INR in Lacs	230
Specific Consumption	Kg / Eq Vehicle	5.5

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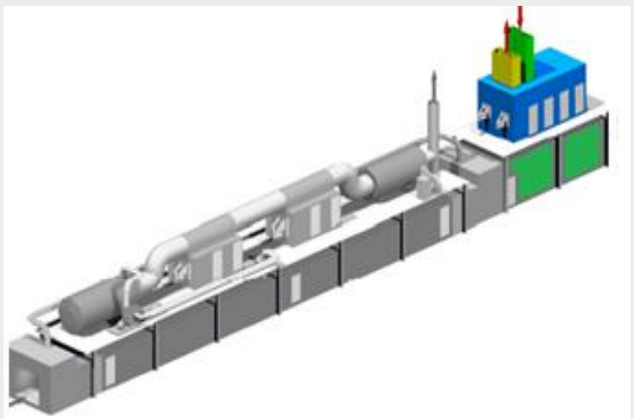
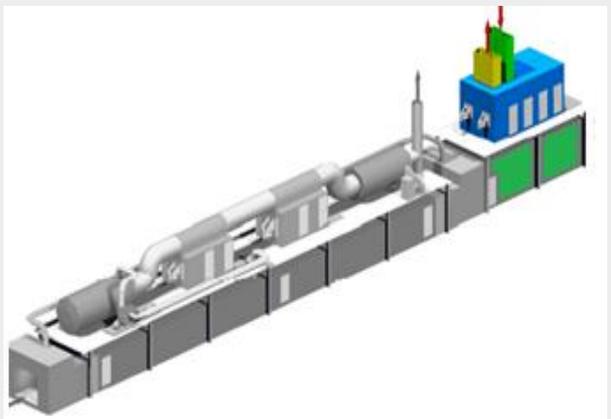
ENCON Project : Oven cooling zone fan - auto logic — Paint Shop

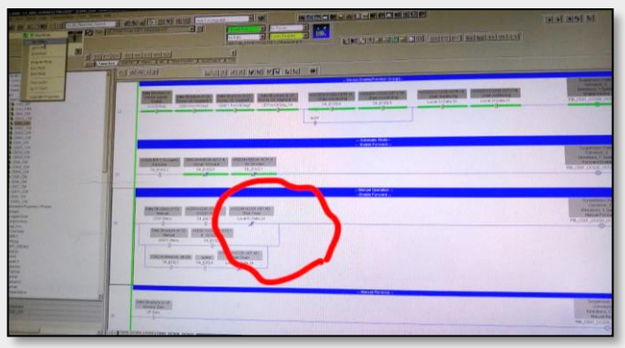
Before



Cooling zone fan is on without body

After





Cooling zone fan is on when body present at cooling zone

Equipment Details – CED, Top coat & Sealer oven

Process Change- Auto logic for cooling zone supply & exhaust fan done & run only if body is present

Details of Energy Saving Achieved		
Energy	Kwh Unit	332394
Emission Reduction	tCO_2 Reduction	272.56
Savings	INR in Lacs	26.60
Specific Consumption	Kwh / Eq Vehicle	2.7

TATA MOTORS
Connecting Aspirations

ENCON Project : Shop Ventilation ASU run on reduced frequency — Paint Shop

Before

Consumption
195120 Kwh per year

After

Consumption
124200 Kwh per year

Equipment Details – Air supply units
Process Change- VFD Provided and frequency reduced from 50 to 40 HZ

Details of Energy Saving Achieved		
Energy	Kwh Unit	167070
Emission Reduction	tCO_2 Reduction	136.99
Savings	INR in Lacs	13.36
Specific Consumption	Kwh / Eq Vehicle	2.2

TATA MOTORS
Connecting Aspirations

ENCON Project : Chilled water temperature optimization in CED Chiller Paint Shop

Before

Set point 7 Deg centigrade

After

Set point 8.5 Deg centigrade

Equipment Details – CED CHILLER
Process Change- Chilled water set point changed from 7 to 8.5 Deg centigrade

Details of Energy Saving Achieved		
Energy	Kwh Unit	221596
Emission Reduction	tCO_2 Reduction	181.708
Savings	INR in Lacs	17.72
Specific Consumption	Kwh / Eq Vehicle	1.8

5. Projects implemented FY 2019-20

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ENCON Project : PTED and Top coat booth run as per WIP level — Paint Shop

Before	After
	
White Body buffer Empty and PT-ED system started	PT-ED process started with sufficient WIP
	
Color selection buffer Empty and Booth started	Paint Booth process started with sufficient WIP

Equipment Details – – PT & Top coat booth equipment

Process Change- Equipment start up done only if required
WIP is available in paint shop

Details of Energy Saving Achieved		
Energy	Kwh Unit	738654
Emission Reduction	tCO_2 Reduction	605.69
Savings	INR in Lacs	59.1
Specific Consumption	Kwh / Eq Vehicle	6

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Connecting Aspirations

ENCON Project : VFD provided to ED oven recirculation fan — Paint Shop

Before

After

Set speed 45 Hz

Equipment Details – ED oven recirculation fan

Process Change- ED oven recirculation fan VFD provided and frequency reduced from 50 to 45 HZ

Details of Energy Saving Achieved		
Energy	Kwh Unit	91129
Emission Reduction	tCO_2 Reduction	74.73
Savings	INR in Lacs	7.29
Specific Consumption	Kwh / Eq Vehicle	1.2

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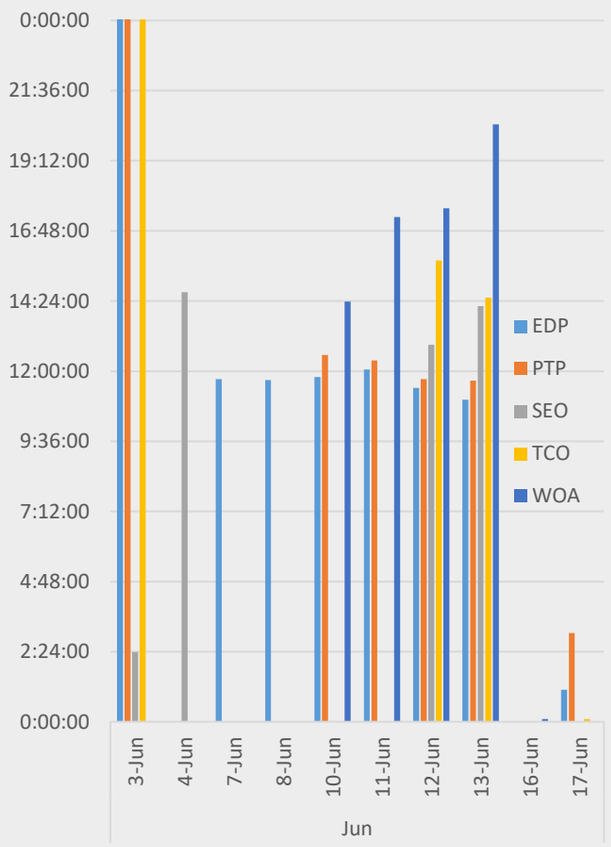
ENCON Project : PT & Top coat area running hour optimization — Paint Shop

Before

N/A

After



Equipment Details – PT and TC booth

Process Change

- Equipment's are run only if WIP is available

Details of Energy Saving Achieved		
Energy	kg Unit	151882
Emission Reduction	tCO_2 Reduction	124.54
Savings	INR in Lacs	51.63
Specific Consumption	Kg / Eq Vehicle	2

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ENCON Project :Magnetic fuel saver for HWG & Sealer oven burners Paint Shop

Before

After

Equipment Details – Burners – HWG & Sealer oven- 3 nos
Process Change- Magnetic resonators provided for burners pipelines

Details of Energy Saving Achieved per year		
Energy	Kg Unit	37970
Emission Reduction	tCO_2 Reduction	31.135
Savings	INR in Lacs	12.90
Specific Consumption	Kg / Eq Vehicle	0.5

TATA MOTORS
Connecting Aspirations

ENCON Project : Work deck ASU VFD provided

Paint Shop

Before

After

Equipment Details – Work Deck air supply unit

Process Change - VFD provided work deck air supply unit and frequency reduced from 50 to 45 Hz

Details of Energy Saving Achieved		
Energy	Kwh Unit	139113
Emission Reduction	tCO_2 Reduction	114.072
Savings	INR in Lacs	11.12
Specific Consumption	Kwh / Eq Vehicle	1.57

TATA MOTORS
Connecting Aspirations

ENCON Project : VFD provided to booth supply & exhaust fans — Paint Shop

Before

After

Equipment Details – Supply & Exhaust fan – 04 nos

Process Change - VFD provided and frequency reduced from 50 to 40 Hz

Details of Energy Saving Achieved		
Energy	Kwh Unit	653033
Emission Reduction	tCO_2 Reduction	535.487
Savings	INR in Lacs	52.24
Specific Consumption	Kwh / Eq Vehicle	7.37

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ENCON Project : LED lights for working area — Paint Shop

Before

Conventional Light

After

LED Light

Equipment Details – Working area tube lights

Process Change- Conventional lights changed with LED lights

Details of Energy Saving Achieved		
Energy	Kwh Unit	172783
Emission Reduction	tCO_2 Reduction	141.682
Savings	INR in Lacs	13.82
Specific Consumption	Kwh / Eq Vehicle	1.95

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ENCON Project : ED oven balancing and temp. optimization — Paint Shop

Before

After

Set point optimized

Equipment Details – ED oven – TWO burners

Process Change - TAR burner temperature reduced from 710 to 650 while Hold zone 3 temperature reduced from 220 to 170 deg centigrade

Details of Energy Saving Achieved		
Energy	Kg Unit	44303
Emission Reduction	tCO_2 Reduction	36.328
Savings	INR in Lacs	19.05
Specific Consumption	Kg / Eq Vehicle	0.5

5. Projects implemented FY 2020-21

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Connecting Aspirations

ENCON Project : Sealer oven burner temperature optimized — Paint Shop

Before

Set point at 165◦C

After

Set point at 130◦C

Equipment Details – Sealer oven burner – 02 nos

Process Change - Both burner temperature reduced from 165 to 130 deg centigrade

Details of Energy Saving Achieved		
Energy	Kg Unit	42531
Emission Reduction	tCO_2 Reduction	34.875
Savings	INR in Lacs	18.28
Specific Consumption	Kg / Eq Vehicle	0.48

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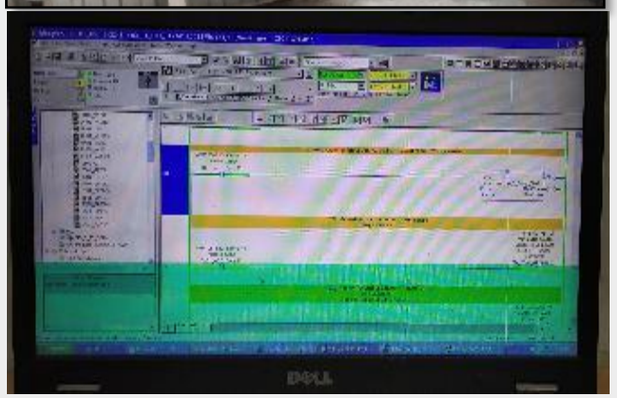
ENCON Project : ED oven hold zone 3 burner start up time reduction — Paint Shop

Before

Burner was running during other zone heat up process

After



Burner running hour optimized

Equipment Details – ED oven hold zone 3 burner

Process Change - Burner start up hour reduced by 45 minutes

Details of Energy Saving Achieved		
Energy	Kg Unit	22151
Emission Reduction	tCO_2 Reduction	18.163
Savings	INR in Lacs	9.52
Specific Consumption	Kg / Eq Vehicle	0.25

5. Energy Saving Summary for Last 3 years

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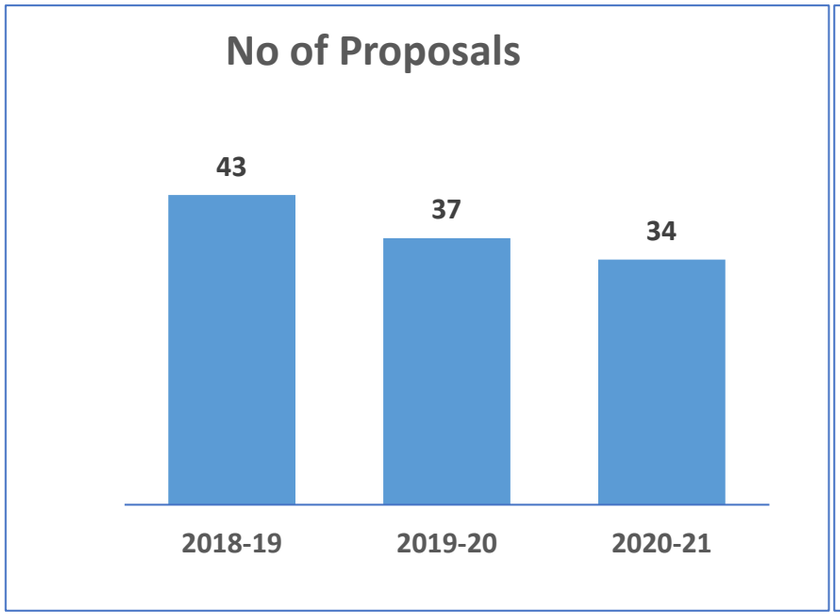

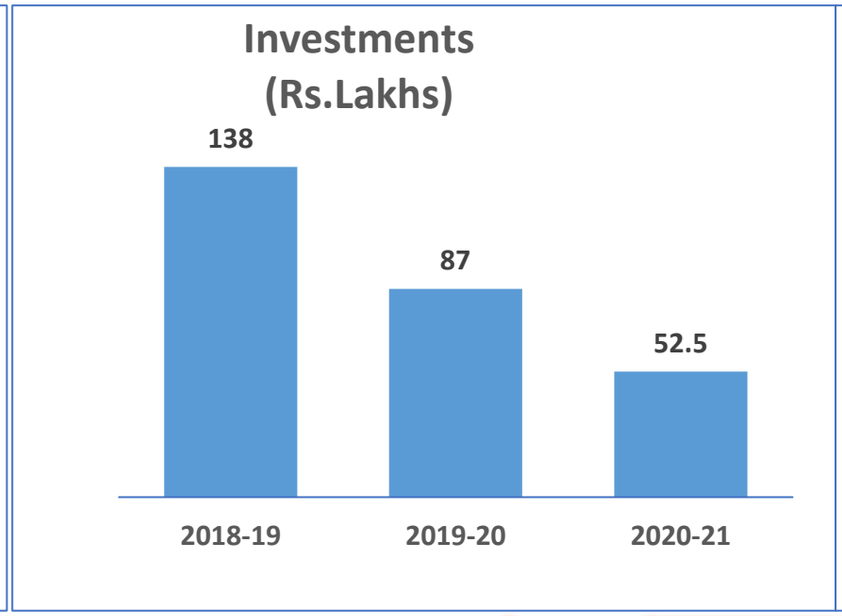

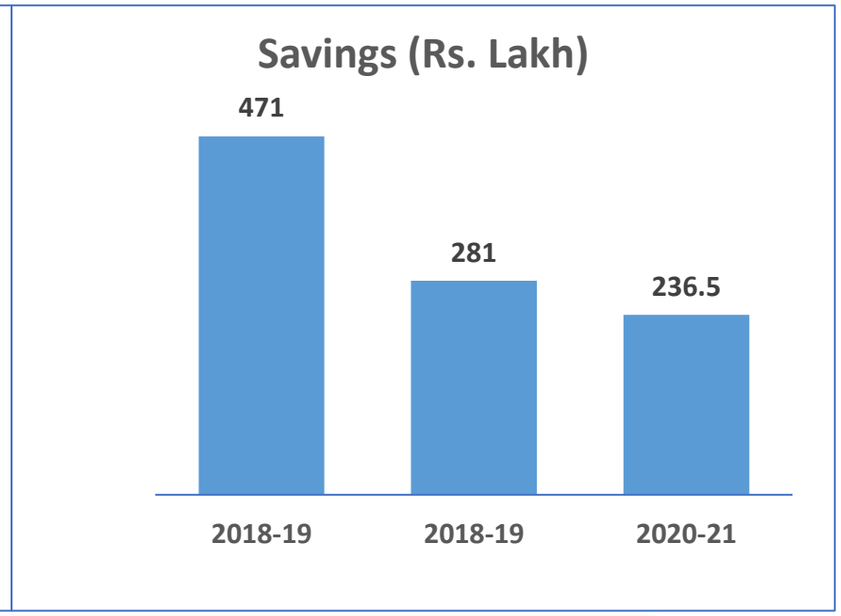

Year	No of Proposals	Investments Lakhs	Savings	Payback months
2018-19	43	138	471	3 months to 2 years
2019-20	37	87	281	3 months to 2 years
2020-21	34	52.50	236.5	3 months to 2 years
Total	114	277.50	988.5	

Cumulative Saving of **Rs. 10 Cr achieved against investment of Rs. 2.78 Cr in last 3 years with 114 proposals** whose payback period varied from 3 months to 24 months.

06. Innovations - Vehicle simulated Engine Fire Test Set-up - 694 cc

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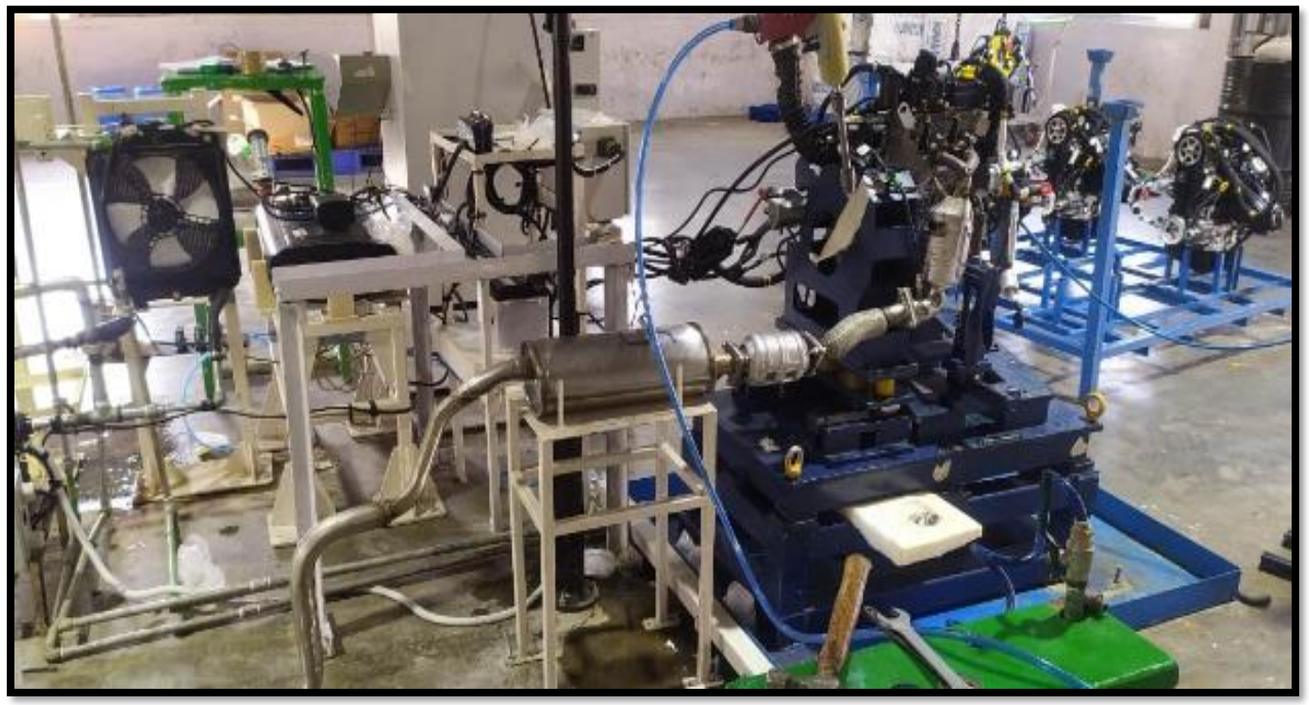

- Engine mounted on Fixture with radiator, Fuel tank, ED panel for DTCs display.
- Some manual interventions are required for Drain, Coolant filling, fuel filling.

Advantages :

1) A complete fire test bed cost approx. 96 Lacs saved as the bed is made in house which is costed 4 lacs. (new fire test bed cost approx. 1.0 Cr)
2) Time line for new fire test bed is approx. 6 months from RFQ stage to Installation & Commissioning. However this test set up took only 1.5 months to complete Installation & Commissioning.

Model	Test Bed type	Cycle-Time	Rigging + Derigging	Total Cycle Time (Min)	Capacity / Bed/ Day
694 cc	In-house test bed	10	15	25	20
Total capacity for 694 cc for 2 shift basis					**40**

- New fire test set up made in house is ready for testing 694 cc engines.
- Shed available adjacent to Hot Test Bed Facility will be used for in house new 694 cc Fire test Setup(Similar to vehicle set up)
- 30 Engines tested, data collected and shared with ERC and CQ. All performance parameters are meeting specifications in line with existing fire test bed. Cumulative numbers of engine tested : 500 Nos + Running
- Green engine testing go ahead given from ERC and CQ.
- ED panel is mounted where DTCs detection, Performance parameters, Data saving etc are displayed.
- Tested data will be saved and sent to main ED server.

Around 500 engines tested and dispatched to UTK with this set up. Testing & Data collection is going on & will be referred and reviewed.

06. Innovations - Zero Defect Station Mapping through MES

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Zero Defect Station Mapping through MES

Background

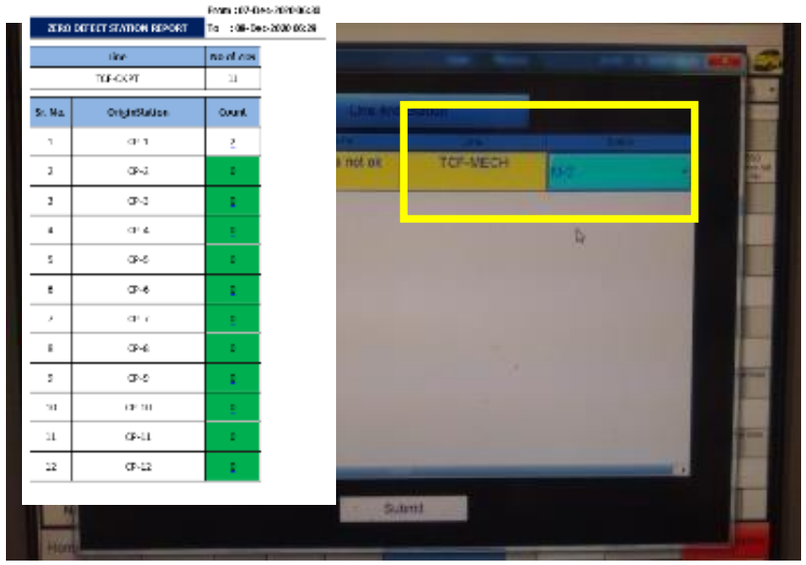
- Zero Defect Station is a Important Performance Quality Parameter.
- ZDS Trend will help in Narrow Down the Defect Generating Stations & Improvement via Preventive actions in Process.
- For Transparent & Effective Mapping of ZDS. is necessary for quality enhancement.

Existing Current Mapping Process

- Downloading 8000`9000 Defect Dump from Defect booking.
- Assigning Defect origin line to each defect
- Assigning Defect Origin Station to each defect
- Declaration of Defect Generating stations & ZDS

Introduction of Option of ZDS Allocation in MES Defect booking system itself

- Option of Allocation of Defect Origin Line & Defect Origin station have been provided in MES
- At the time of Defect booking itself, Operator will assign Defect origin line & Station.
- Later on ZDS Report can be retrieved from Vantage Portal for required Time period.



Benefits

- Transparent & Effective declaration of ZDS
- Saving in Huge Manpower time in manual calculation of ZDS & ZDS Declaration.
- Real time ZDS Calculation. ZDS can be retrieved for the particular day, shift, month, year.

Future Development

- For Repetitive Defect, Option of auto assign Origin Line & station can be provided

Horizontal Deployment

- Can be implemented across all shops, all plants with MES Defect booking system.

Declaration of ZDS through MES system by New option of allocation of Defect Origin Line & station

06. Innovations - IoT Real Time Inventory Monitoring System

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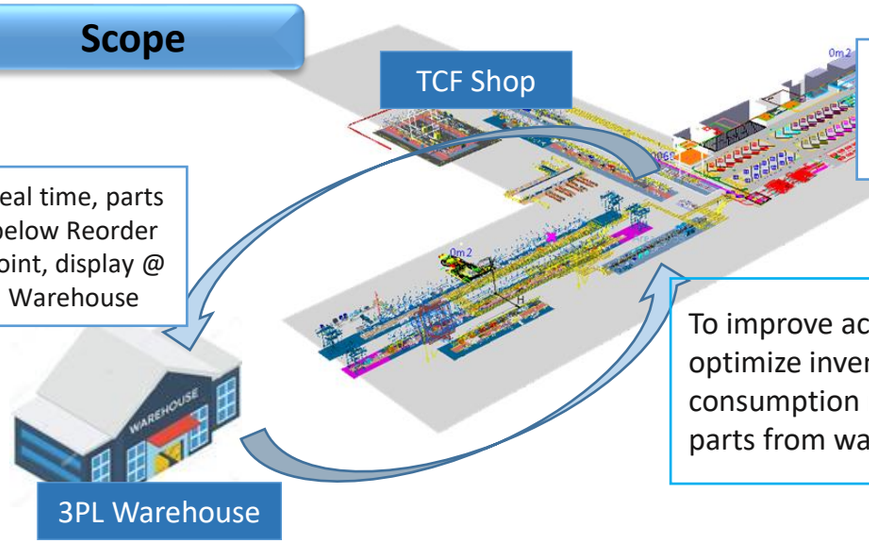
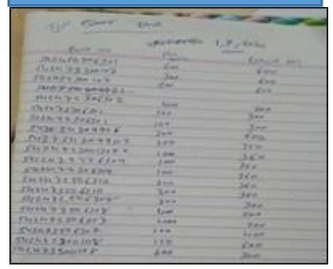
Scope



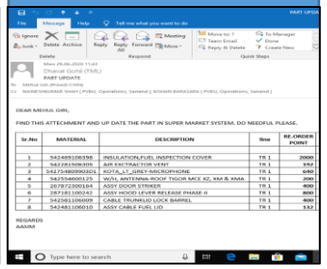
Current State

- Manual mapping of inventory at line side everyday at start of shift
- Communication of shortage list to warehouse team by TCF logistics team
- Chances of parts shortages and line stoppages due to miscommunication or manual errors

Manual inventory recording sheet



Communication through mail & phone to 3PL



TCF Supermarket

Communication of critical parts over phone manually

3PL Warehouse

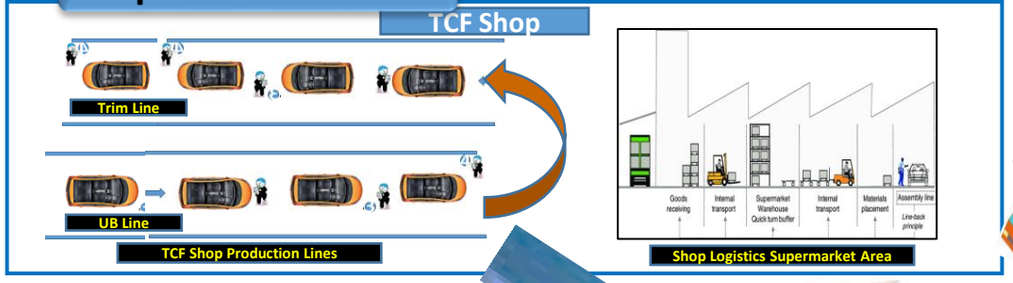
Business Benefits

Metric	Plant level FY 19-20	Baseline for POC	Benefits Incurred
Minimize Stores and Line side inventory at Trim Chassis and Fitment (TCF) line	17 DOH *DOH = Days on hand	1.5 DOH	2.5 DOH (Diff Value)
Efforts required to carry out Physical Inventory	2 hrs/ day	2 hrs/ day	0 hrs/day
Space Saving due to reduction in inventory levels at lineside, supermarket	2500 sq. m.	250 sq. m.	140 sq. m

Intangible Benefits:

- ZERO surprises in supplying material from warehouse to line side
- Reliable Supply Chain
- Accurate Pull List Generation
- Real time replenishment trigger
- Inventory Control & Accuracy

Implemented State



- Real time consumption mapping using RFID technology (@ car indexing)
- Real time trigger to warehouse

Implementation of e-replenishment of TCF parts based on real time consumption mapping in TCF shop

06. Innovation - IoT Digital Version Matrix Display @ TCF shop

TATA MOTORS
Connecting Aspirations

Scope

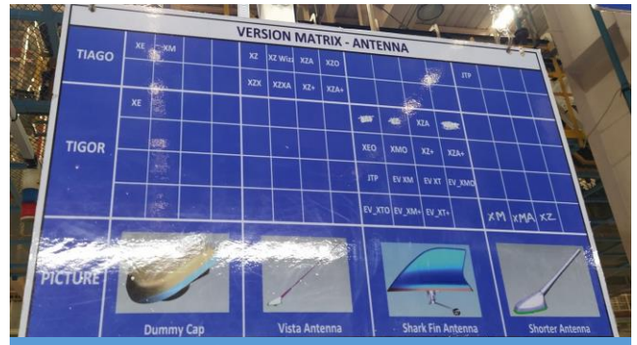
- Digital version matrix application on 5 stations of Trim-01 and Trim-02 lines in TCF shop
- As the car enters a station, digital version matrix of the part as per VC should be displayed on Andon with VIN, DSN Number & VC details

Stations identified for Implementation

Line	Station No.	Part Name	Remarks
TR 01	19	Sunvisor	Mirror, Without Mirror, Airbag Symbol
TR 01	16	Antenna	Dummy, Rod Type/ Shark Fin
TR 01		Roof liner	High, Low
TR 01	17	A Mount	Tiago/Tigor
TR 01		B Mount	Tiago/Tigor
TR 01		B Mount Bracket	AMT/Non AMT
TR 02	8	Gear shift Bezel	Piano Black/Silver
TR 02	18	Gear shift nob/handle	Black/Silver/AMT

Current State

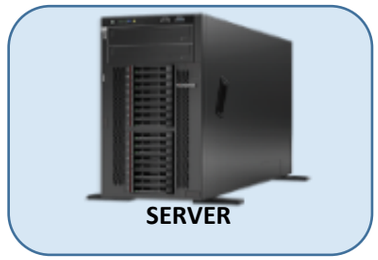
- Currently operators refer version matrix at lineside to identify the correct part in Tiago & Tigor variants.
- Due to complexity of variants operator may make mistake and can fit wrong part as part identification is difficult from version matrix display



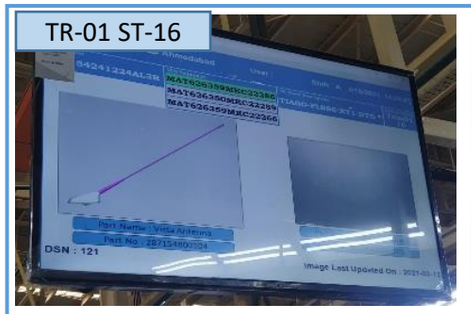
Sample version matrix displayed at lineside

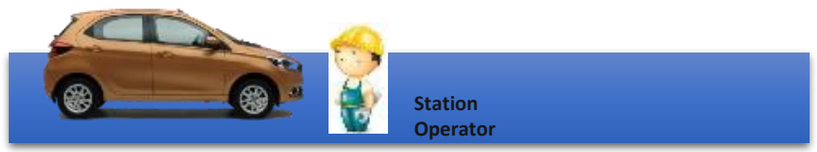
Implemented State

Application Development by MES team for VC wise version matrix display



Ncomputing edge device connected to andon for display of version matrix





Potential avoidance of 360 man-hours/year through Version Matrix Display implemented on 5 stations of Trim-1 and Trim-2 in TCF shop

Plan for FY 21-22 : system will be deployed on remaining 32 stations

06. Innovations - IoT Predictive Maintenance in Paint Shop Blower

TATA MOTORS
Connecting Aspirations

Scope

- POC implemented on basecoat exhaust blower through M/s Banner
- Installation of sensors and controller for real time measurement.
- System generated data tracking and recording with help of MES network.
- Program development for hierarchal alerts escalation and data acquisition in portal itself.

Existing State

- **Real time continuous monitoring & reporting is a challenge**. Two persons for 30 minutes per exhaust blower are required every weekend.
- **Time based monitoring leads to surprise failure of blowers**. For example in FY'19-20, two incidents of blower failure happened in Topcoat blowers leading to down time of 8 hours and production loss of 224 cars.

Vibration Measurement of Paint Exhaust Blower

Benefits

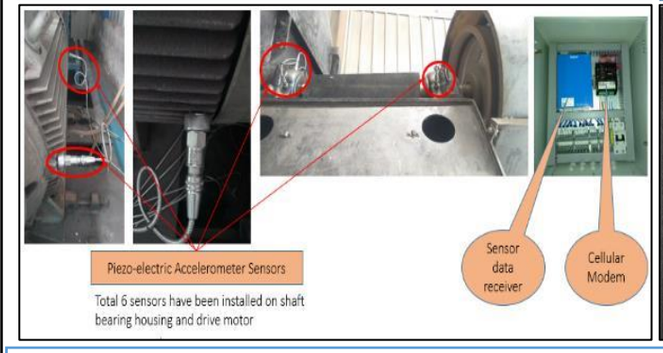
Incident	Email Alert	Reason & Actions Taken	POC Benefits
31st Jan'20	Z – axis vibration of shaft non-drive end out of bound	Impeller cleaning done on 1st & 2nd Feb'2020	• 3 hour breakdown saved • 5.5 lac spare cost saved
5th March' 20	X - axis vibration of motor sensor out of bound	Problem in motor bearing; motor replaced on 9th March'2020	• 3 hour breakdown saved • 2.4 lac spare cost saved

Intangible Benefits :

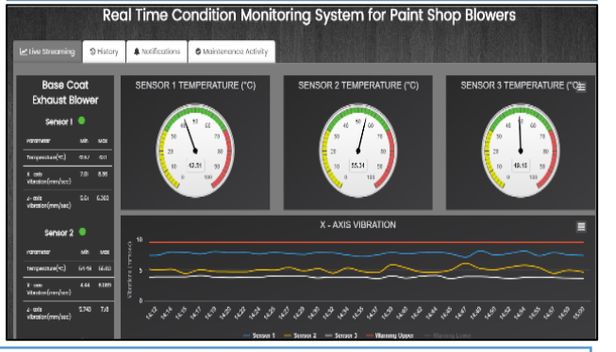
- Uptime of machine will increase as the system moves from time based monitoring to condition based monitoring
- Avoidance of surprise failures by Early failure mode detection with **email/mobile alerts**.
- Spare cost reduction.

Implemented State

Implemented Architecture



Real time Condition Monitoring Dashboard



Real time vibration and temperature monitoring & alert generations

IOT system installed on one blower for PdM Paint POC Project giving successful results; **Plan to install 4 blowers in FY21-22**

06. Innovations - IoT Online PIST Monitoring Report _ Weld Shop

TATA MOTORS
Connecting Aspirations

Real time data Acquisition

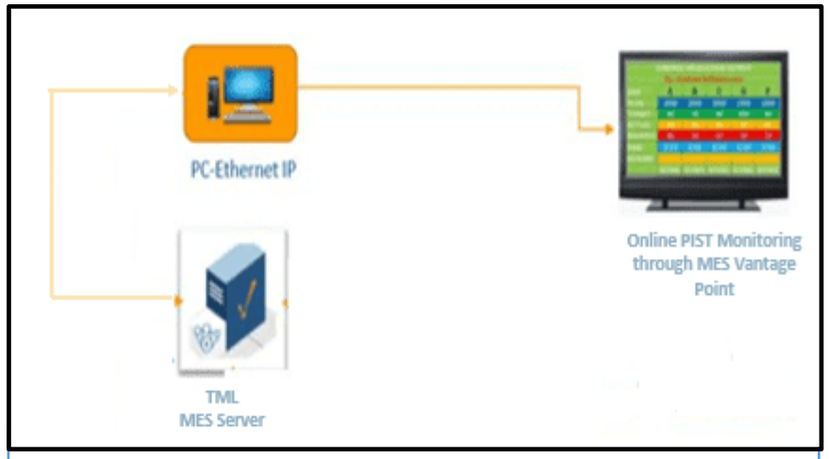
Problem Statement:

- In Weld Shop currently PIST report is generated through CMM System after Vehicle measurement is completed. This report is required to be converted into reported format manually which is quite time consuming. 2 Hrs required to prepare PIST report
- Owing to Quality engineer engagement in Manual reporting activity, less time available to work on quality Problems focusing on CTQ areas where PIST improvement is required.

Solution:

- To overcome existing challenges & address concerns it is need of hour to have a system which can convert CMM report in required format & there will be a central system which will have compatibility with standalone system for data availability & loaded with analytics software for generating various dashboard & provide required insight for actionable inputs

System Architecture



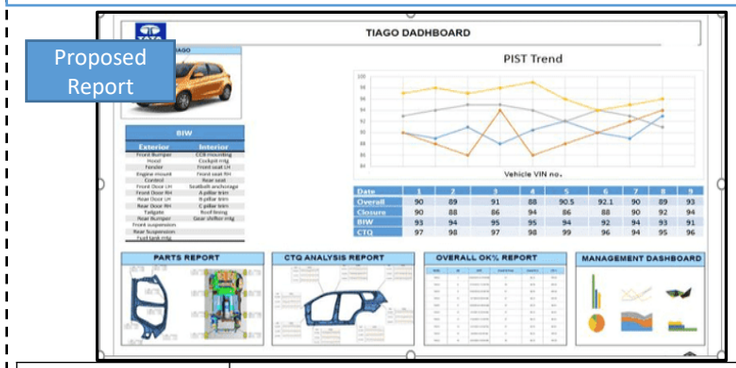
Data Analysis

- All data points of CMM to be captured in MES & different report to be generated as per user requirement
- Based on PIST trend analysis any abnormality can be identified & action can be taken with effective root cause analysis & identification in case of any deviation
- Digital connectivity through Vantage point for analyzing any specific Vehicle CMM reports from database.

Benefits

Key project deliverables:

- Elimination of Non value added work of Manual PIST report preparation can be eliminated through automation of software generated report & conversion in required format & dashboard
- It will assist in achieving consistency in quality as action can be taken based on insight derived through data analysis & data driven decision making.
- It will assist in PIST Sustenance & improvement through online monitoring



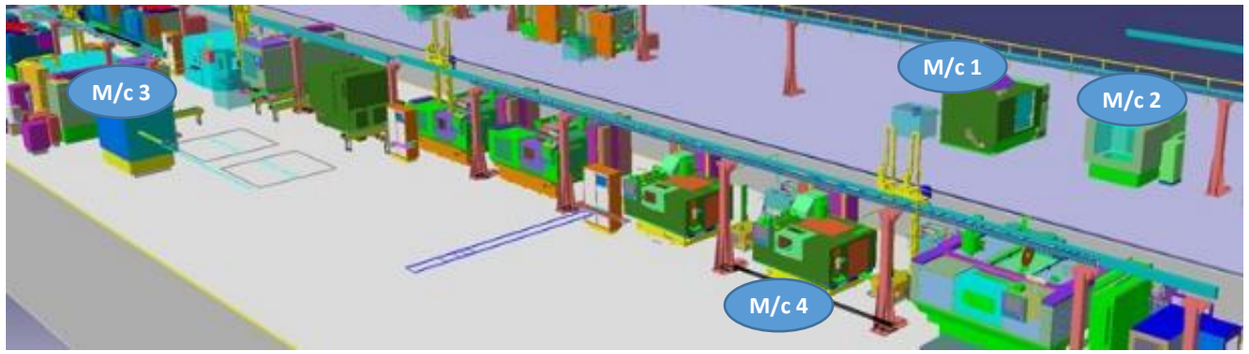
Project Sponsor	CFT		
	TS	CQ	IT
T Suresh/ Abhijit Ghaisas	Ashutosh	Lokendra Goswami	Nitin Tiwari

PIST Sustenance and Improvement through MES based dashboard & trend analysis

06. Innovations - IOT Uptime Improvement in Machine shop

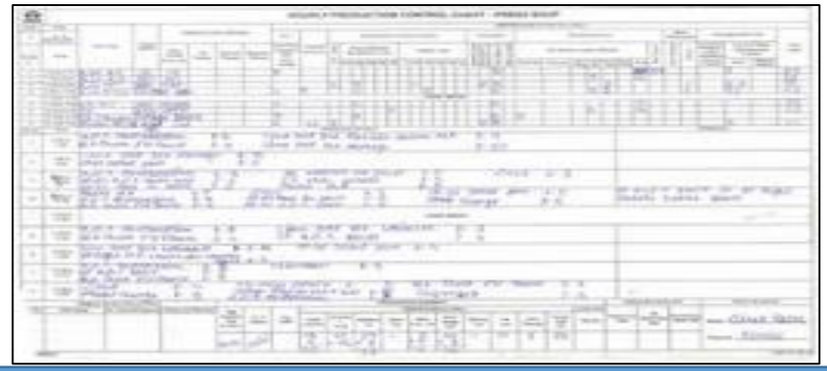
TATA MOTORS
Connecting Aspirations

Scope



Connecting 04 no's critical machines (of Makino, Mori Seiki, Grind Master) on Crankshaft line to common digital platform & collect machine parameters centrally for analysis & improvement alerts

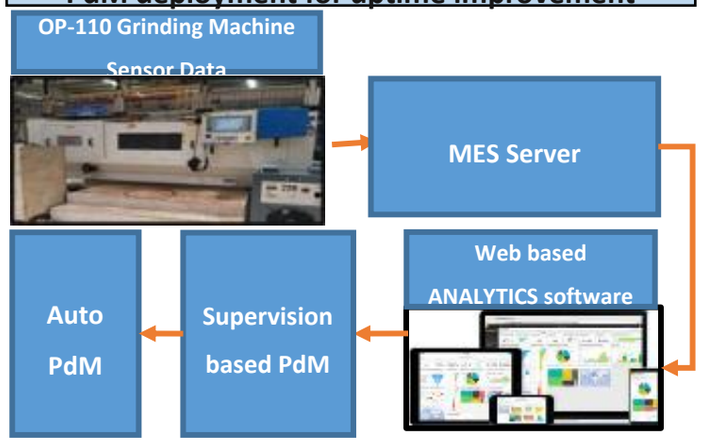
Earlier State



Manual data collection & HPCC chart by team members and executives for downtime, line bits issues capturing

Business Benefits

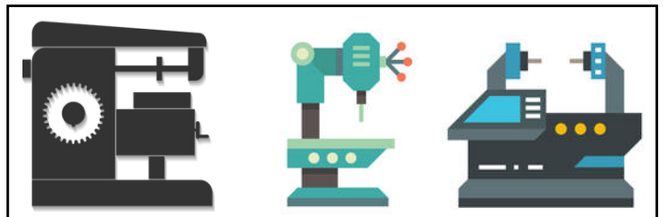
PdM deployment for uptime improvement



PdM Benefits

- Data capturing through 08 critical sensors
- Prediction analysis based on data collected for uptime improvement

Implemented State



Health Parameters Monitoring

Common Digital Platform

Insights on Efficiency Improvement by Uptime and Downtime bifurcations & Predictive Maintenance

Data Consolidation on common platform

Continuous machine utilization improvement through reduction / elimination of identified losses

7. Management Approach for Renewable Energy

TATA MOTORS
Connecting Aspirations

TATA MOTORS

TATA

Climate Change Policy

Tata Motors is committed to ...

- Leading the automobile sector in minimizing year on year Green House Gas emissions from its products, operations and services by adopting eco friendly technologies/ practices.
- Developing products powered by alternate fuels and having higher recyclable and recoverable content.
- Promoting fuel blends sourced from non-fossil fuel sources.
- Maximizing use of renewable energy.
- Proactively engaging with Government, forums and institutions in shaping related regulations.
- Facilitating and maximizing reduction in carbon foot print throughout value chain.
- Actively working for carbon sequestra initiatives for resource conservation.

March 18, 2016

Guenter Butschek
Chief Executive Officer and Managing Director

RE 100 ABOUT RE100 PARTNERS GOING 100% JOIN NOW

Tata Motors Limited

Tata Motors Limited, India's largest automobile company, has set itself the goal of using entirely renewable energy – including a switch to 100% renewable electricity for its own operations. Here, **Mr. Arvind Bodhankar, Global Head – Health, Safety, Environment and Chief Sustainability Officer**, explains why the company is taking a lead on shifting India's manufacturing sector to renewables.

HQ: India
Sector: Automobile
Revenue: US$41.6 billion* (2016)
Employees: 47,920* (2016)
Target year for 100% renewable electricity: 2030
Interim goal: -
Total electricity use: 463,309 MWh (2016)*
Total renewable electricity: 75,877 MWh (2016) [16%]*
**Not including subsidiaries*

Why is your company striving to be '100% renewable'?

"The manufacturing sector accounts for enormous electricity consumption. Helping to switch this demand to renewables will not only reduce our carbon emissions but also will lead to long term financial savings. This will also help us align our corporate goals with our policy statements."

How did you decide on your 100% goal?

"Tata Motors has a long standing commitment to sustainable development, evident from the fact that we have dedicated group level and company level policies to address the same. We have a climate change policy and a climate change strategy already in place.

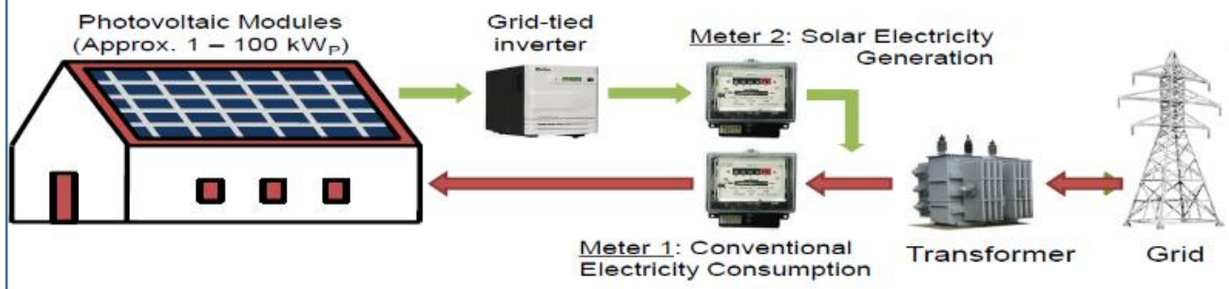
"Going forward with an aspiration to switch our manufacturing operations to 100% renewable energy is a logical step. It will support our policy commitment to focus on optimizing energy consumption and maximizing use of renewable energy in our manufacturing operations."

7. Renewable Power at TML Sanand

TATA MOTORS
Connecting Aspirations

❖ Roof Top Solar Power Plant

- Relatively simple to install, operate and maintain.
- Most popular and globally accepted configuration.
- Disadvantage: No availability when grid is down.



❑2MW Roof top solar power plant onsite installation

❖ Offsite Wind + Solar Power

Tripartite Agreement done TPTCL(Trader), (power generator),DISCOM(UGVCL) and GETCO for availing power at TML Sanand

Signing off Power Purchase Agreement with DISCOM / Power Transmission Authority

Medium Term Open Access agreement done with all the parties involved.

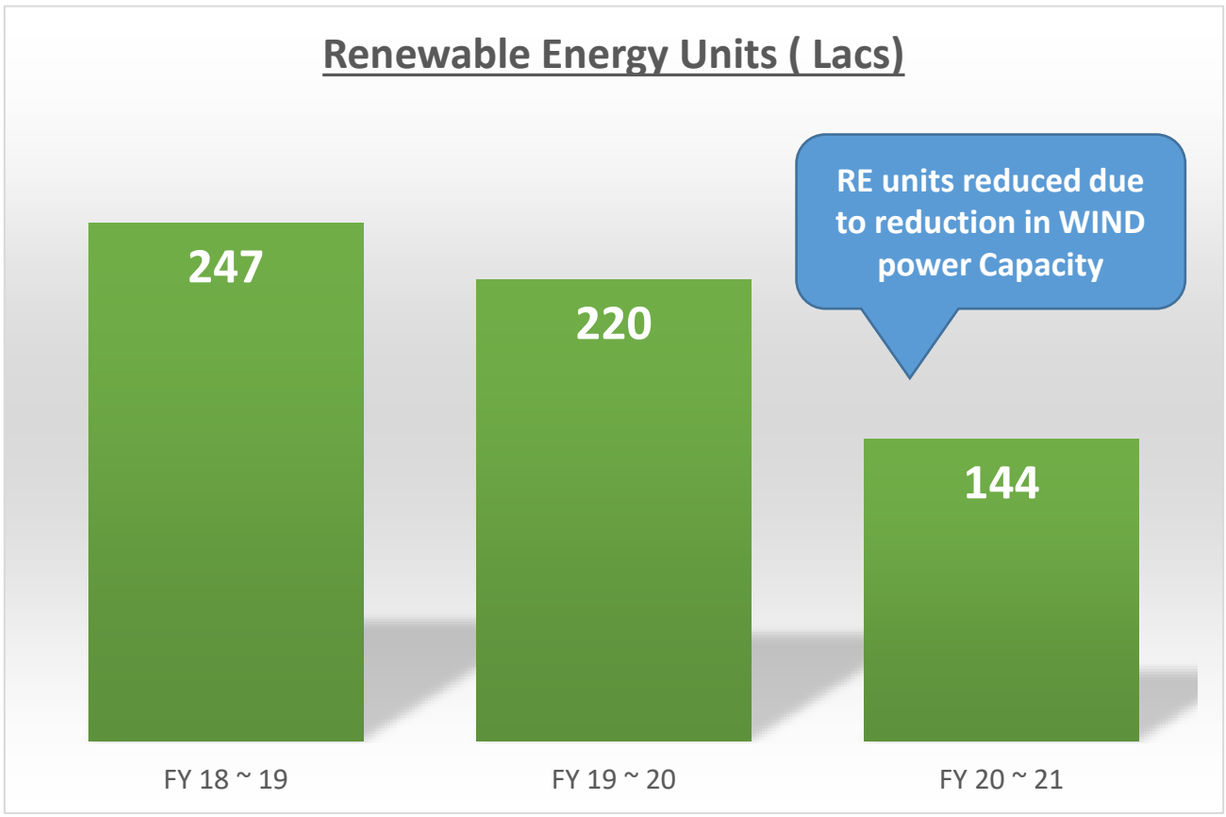
Wind Turbines commissioned at Kutch (Gujarat) / Solar plant commissioned at Dahej (Gujarat)

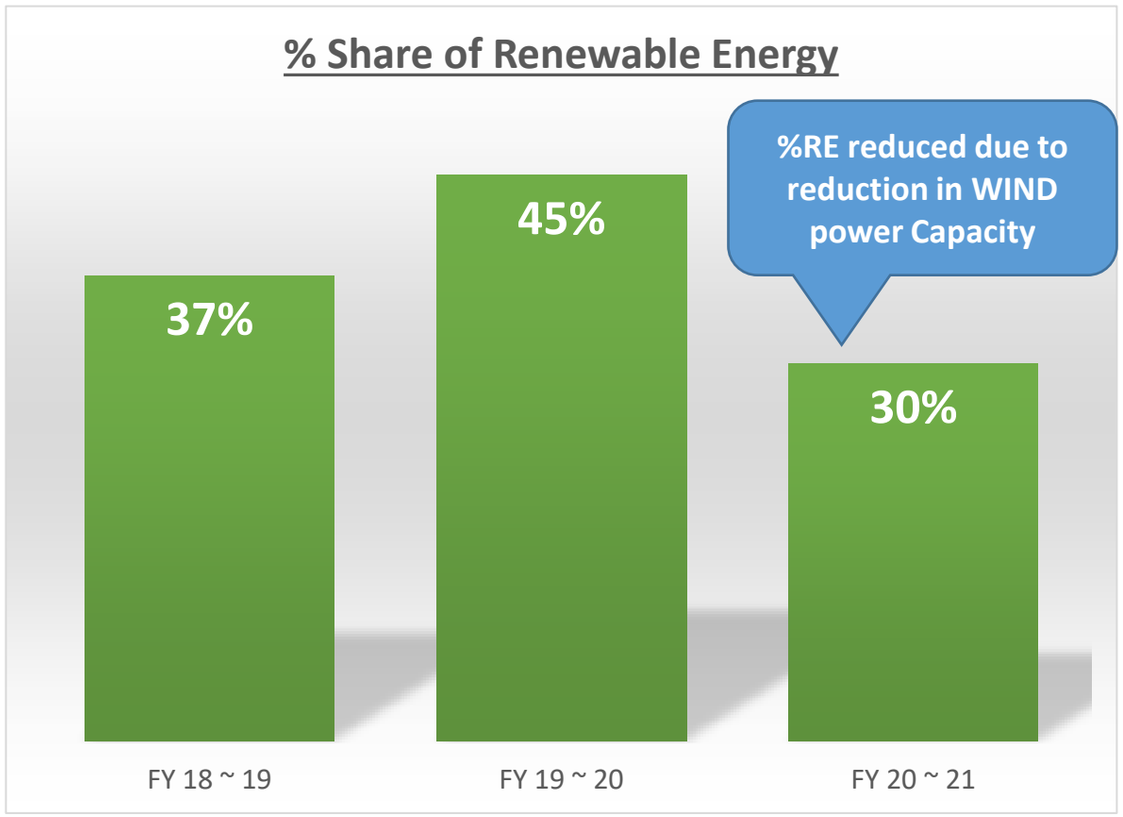
Availability Wind Power ABT meter at Switch yard in TML Sanand plant

❑5.4 MW wind + 1.83 MW offsite Solar installation

7. Renewable Energy Utilisation at TML Sanand plant

TATA MOTORS
Connecting Aspirations





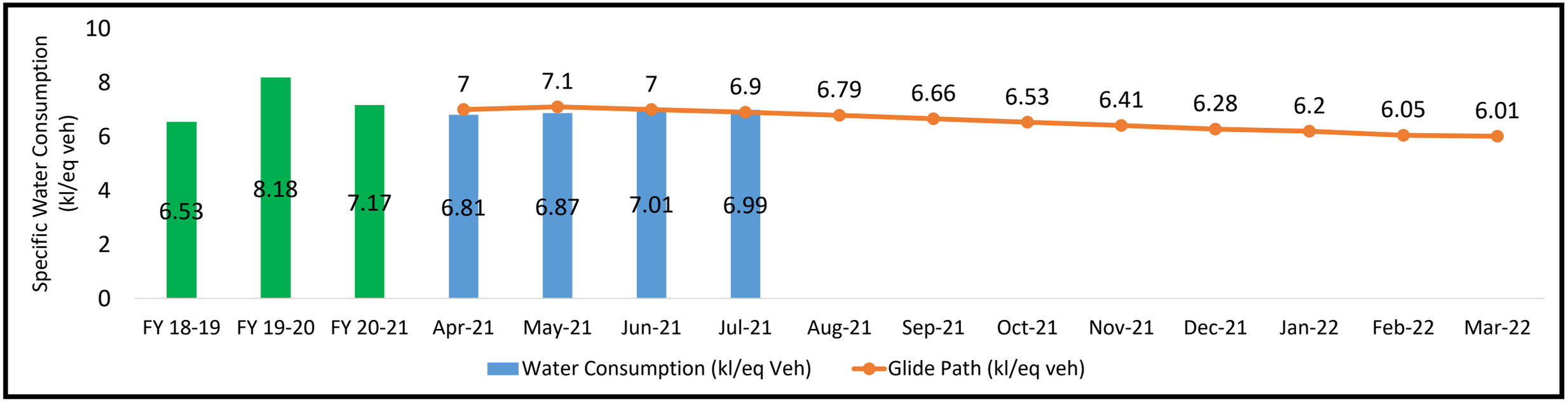
Substitution of Conventional Energy with Renewable Energy											
FY	Type of RE	Installed Capacity	Generation (Lacs KWH)	Type of RE	Installed Capacity	Generation (Lacs KWH)	Type of RE	Installed Capacity	Generation (Lacs KWH)	Total Utilisation (KWH Lacs)	% Share
FY 18 ~ 19	Offsite Wind	9 MW	221	Onsite Solar	2 MW	26	Offsite Solar	0	0	247	37%
FY 19 ~ 20		9 MW	183			27		1.83 MW	10	220	45%
FY 20 ~ 21		5.4 MW	93			26		1.83 MW	25	144	30%

Due to New Wind power policy of Gujarat, PPA of 3.6 MW Wind generator not renewed by DISCOM, as it was exceeding 50 % of Electrical Contract Demand. (CD = 10.8 MW)
9 MW generation unit reduced to 5.4 MW

8. Overview of Water & Waste Management

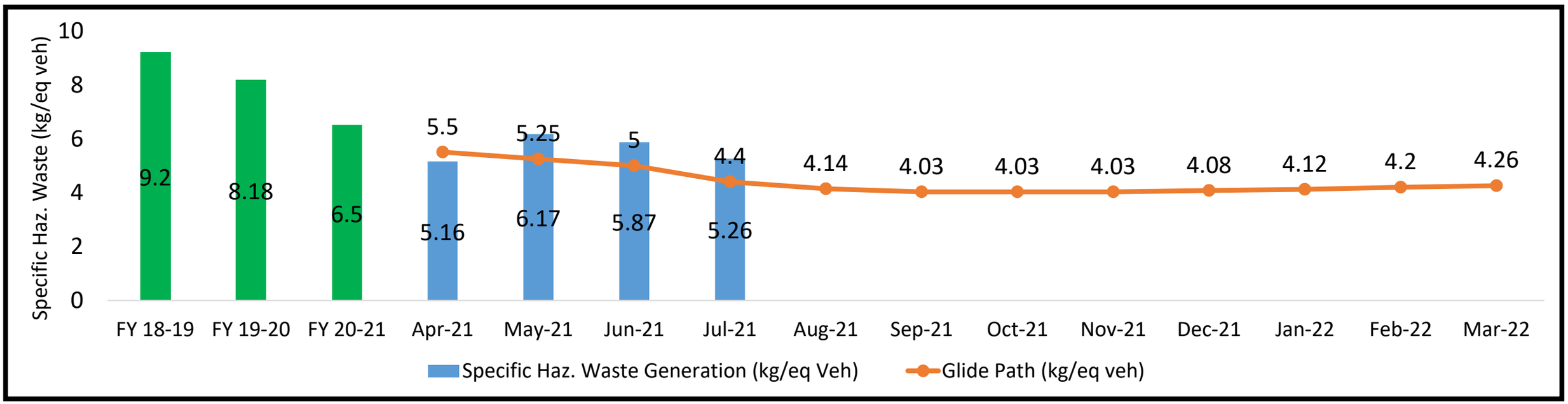
TATA MOTORS
Connecting Aspirations

Trend of Specific Water Consumption (Kl/Eq Veh)



- Water Consumption being monitored regularly along with the action plan status
- In FY 20-21 till average water consumption is 7.17 Kl/eq car which is 12% reduction over FY19-20

Specific Hazardous Waste Disposal (Kg/Eq Veh)



- Specific Hazardous waste disposal reduced by 34% through reuse of haz waste and initiatives like value creation from hazardous waste

8. Initiative for Waste Management Reduction in Paint & Thinner Consumption

TATA MOTORS
Connecting Aspirations

Project Triggers:

Top Coat painting was a bottleneck station in paint shop due to ICC in base coat robots that led to:

1. Higher color changeover time.
2. Frequent breakdowns and line stoppage due to HT fault.
3. More Paint & thinner consumption during flushing due to longer hoses.
4. More rework due to paint defects.

Activities Carried Out:

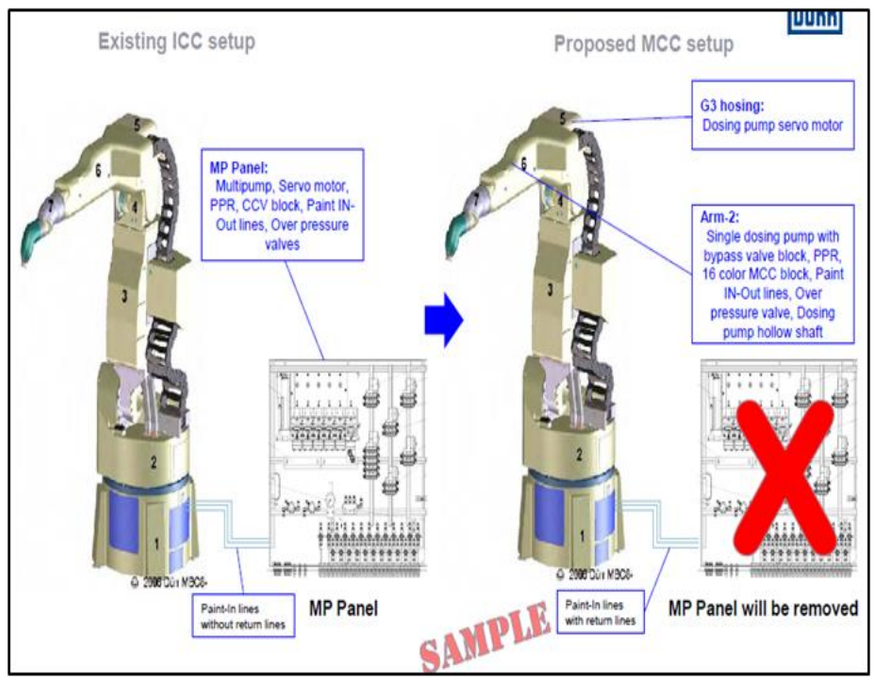
1. Root cause analysis done with CFT comprising of TS, Quality, Maintenance, production etc.
2. Budget approval from Product line and budget release from corporate finance.
3. Purchase Order release in Jan'18. Project DAP & kick-off.
4. Old components removal from Robot.
5. New components i.e. base plate, energy guide chain, dosing pump, CCV & paint hoses installation on robot arm.
6. Offline programming & modification of RC, PLC & Visu - Eco Screen Visu Screen development Win mode simulation
7. Paint charging and SOP after trials started in Nov'18.

Realized Benefits:

1. Color changeover time will be reduced.
2. Line stoppages will be eliminated.
3. Saving in Paint & thinner used during flushing.
4. No breakdown due to HT fault in robots.
5. Reduction in rework.
6. Reduction in power & Fuel consumption.

	Flushing Thinner	Basecoat Paint	Primer	Mixing thinner	Fuel (Propane)	Power
Reduction in consumption	4190	4210	1887	5487	3000	1.5 Lacs
Unit	Lit/Month	Lit/Month	Lit/Month	Lit/Month	Kg/Month	KWh/ month

Photos:



8. Initiative for Waste Management: Use of Recycled Paint

TATA MOTORS
Connecting Aspirations

Project Triggers:

1. Earlier Chassis Wax was being used for UB coating.
2. Paint sludge generated from painting was being disposed-off as hazardous waste.
3. Under the "War Against Waste" drive, we replaced the underbody chassis wax application with sludge based recycled paint application.

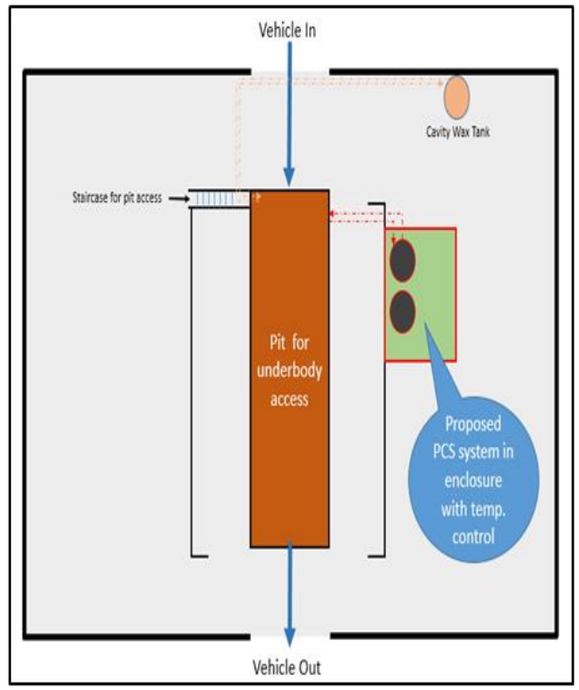
Activities Carried Out:

1. Plan prepared to send the paint sludge to authorized recycler at Pune who converts the paint sludge into reusable paint.
2. Plan & finalization of scope for modification required in existing facility for application of sludge paint.
3. Purchase Order release to M/s VR Coatings. Planning & Scheduling with all stakeholders.
4. Trials and commissioning of the system.
5. Training to Maintenance personnel & put to use from April'19.

Realized Benefits:

1. Sludge (hazardous waste) produced from painting in top coat booth is being recycled.
2. **Reduction in Dinitrol Chassis Wax by 60,000 liters annually**.
3. This resulted in **cost saving of Rs. 5/Car.**

Photos:



8. Initiative for waste management: Phosphate Sludge Reduction

TATA MOTORS
Connecting Aspirations

Project Triggers:

1. Earlier traditional phosphating chemicals were used in CED process which worked at temperature range of 48-52° C.
2. During brainstorming, chemical supplier suggested the innovative phosphating chemicals which work at temperature range of 38-42°C.

Activities Carried Out:

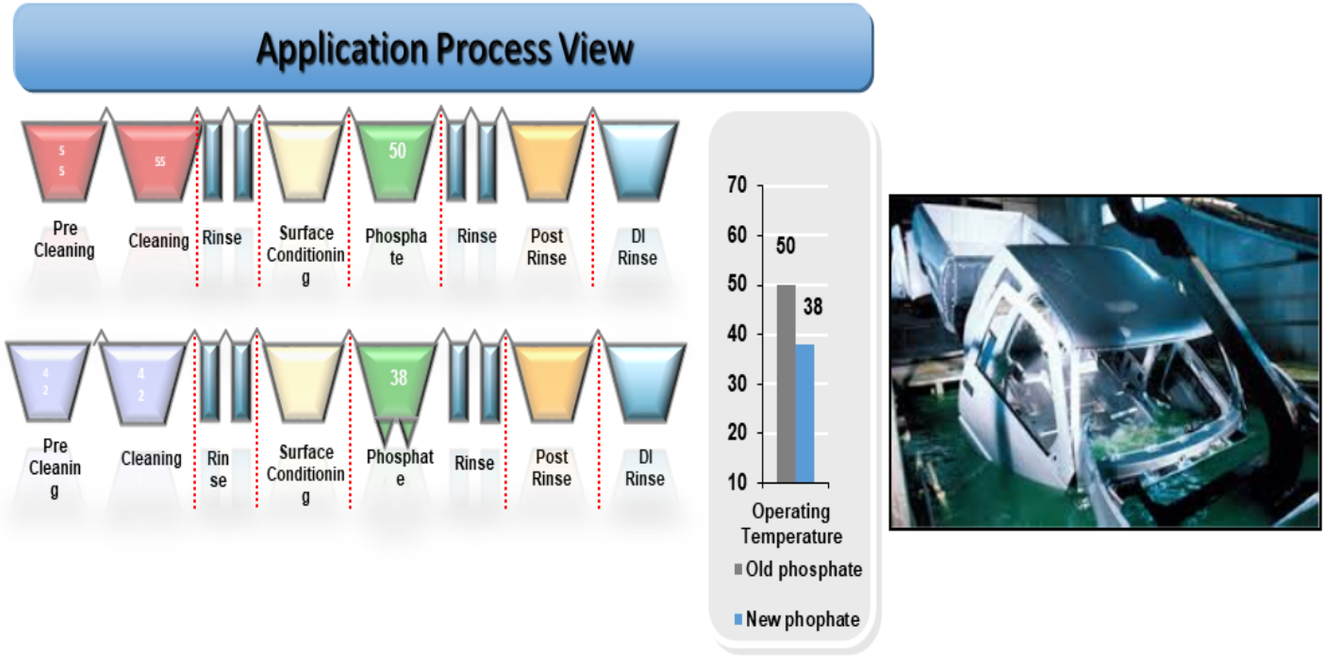
1. Panels with innovative phosphating coating submitted by vendor.
2. Panel coating quality was examined by quality team and was approved for implementation.
3. Flushing of the existing phosphating chemicals.
4. Filling of new low temperature phosphate chemicals.
5. Trials & start of production done in Nov'18.

Realized Benefits:

1. Reduction in Acidic Fumes at phosphating stage.
2. Reduction in phosphate sludge generation.
3. Reduction in water consumption & Propane consumption.

Sr.	Saving per annum	INR
1	Propane saving per annum	3,81,326
2	Sludge disposal cost saving	79,898 (20% reduction)
3	Water saving	27,300 (30% reduction)
Total saving per annum with Low temp phosphate		**4,88,524**

Photos:



8. Initiative for Waste Management: Improvement in Extraction of Seam Sealer

TATA MOTORS
Connecting Aspirations

Project Triggers:

1. Approx. 5-6 Kg of seam sealer is leftover in each drum after use.
2. The sealer is leftover in order to avoid entrapment when drum get empty.
3. This leftover seam sealer goes to waste and is disposed-off as hazardous waste.
4. This leftover sealer can be retrieved and reused through small 20 Kg sealer pump.

Activities Carried Out:

1. Requirement of small pump with 20 Kg capacity finalized with stakeholders.
2. Budget approval for facility procurement.
3. PO released to vendor.
4. DAP and material receipt.
5. Installation of the pump at line side.
6. Trials and start of sealer application through new pump.

Realized Benefits:

1. Leftover seam sealer can be recycled 100%.
2. **Reduction in generation of hazardous waste.**
3. **Cost saving approx. ₹ 12.30 per car.**

Photos:

Leftover Sealer

Sealer Pump

8. Initiative: Rain water Harvesting through storm water accumulation in lake

TATA MOTORS
Connecting Aspirations

Storm Water Accumulated in lake → Pumping through existing horticulture pump & piping Network → Treatment at Water treatment plant → Reuse after treatment



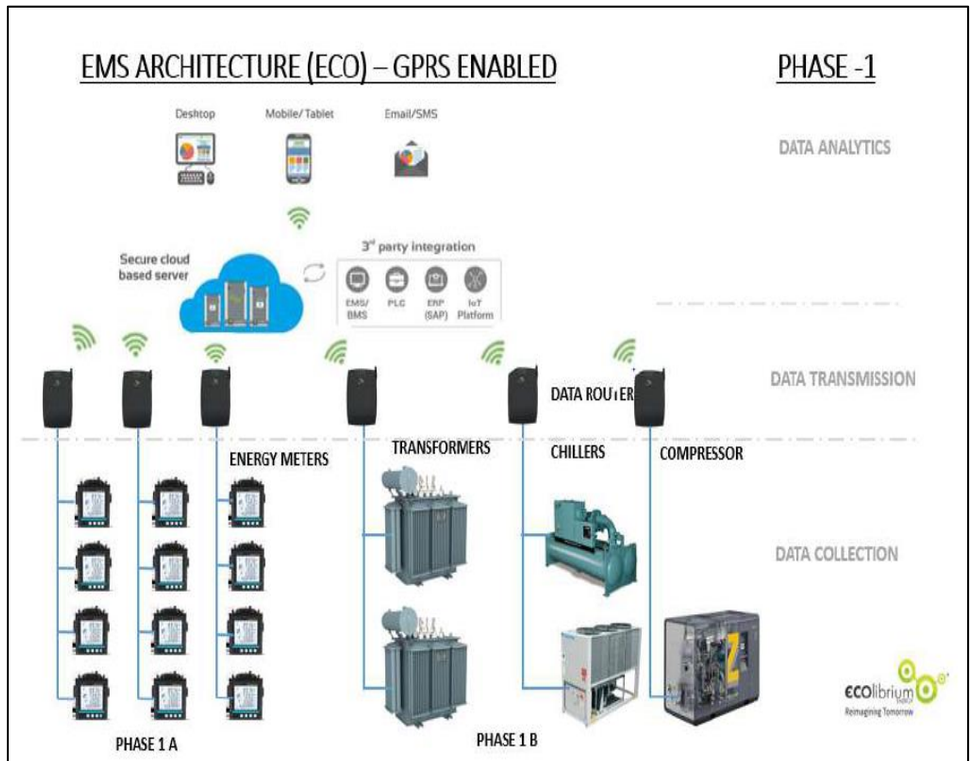

- Rain water harvesting started from 3rd week of September:20 through storm water accumulated in lake.
- Total Rain water harvesting & reuse is approx.26000 KL till January:21. Equivalent to 0.8Kl/Eq Vehicle
- **Estimated monthly water harvesting using existing horticulture network 7500 Kl per month. However overall quantity will be limited to approx. 30,000 to 35,000 KL for the want of infrastructure facility**
- With dedicated pumping & piping system with preliminary treatment the water harvesting can be done up to approx. 1.5 -2.0 lacs KL annually which is 20-25% of overall annual requirement of main plant (approx. 8,00,000 KL)

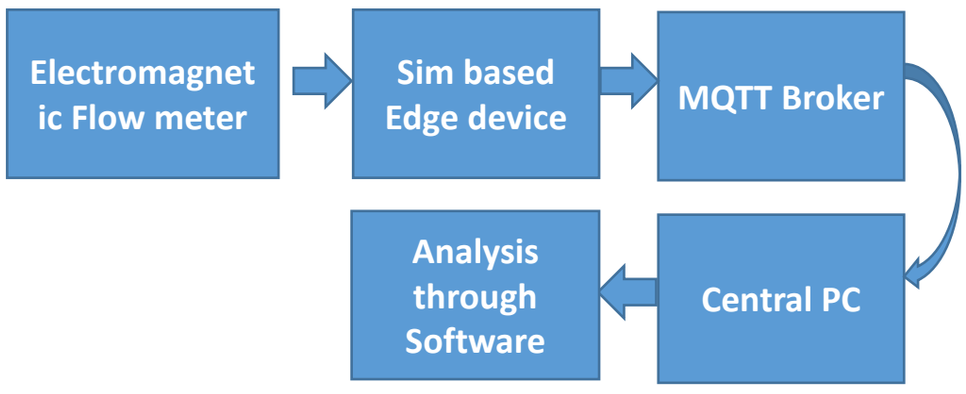
Storm water accumulated in lake can be utilized for process after adequate treatment

8. Initiative: Water Consumption & Conservation through IoT

TATA MOTORS
Connecting Aspirations

IoT -Implementation Architecture





Benefits of the IoT project

Objective

Improving water balance and quick identification of areas with high water consumption to initiate actions for water conservation

Scope

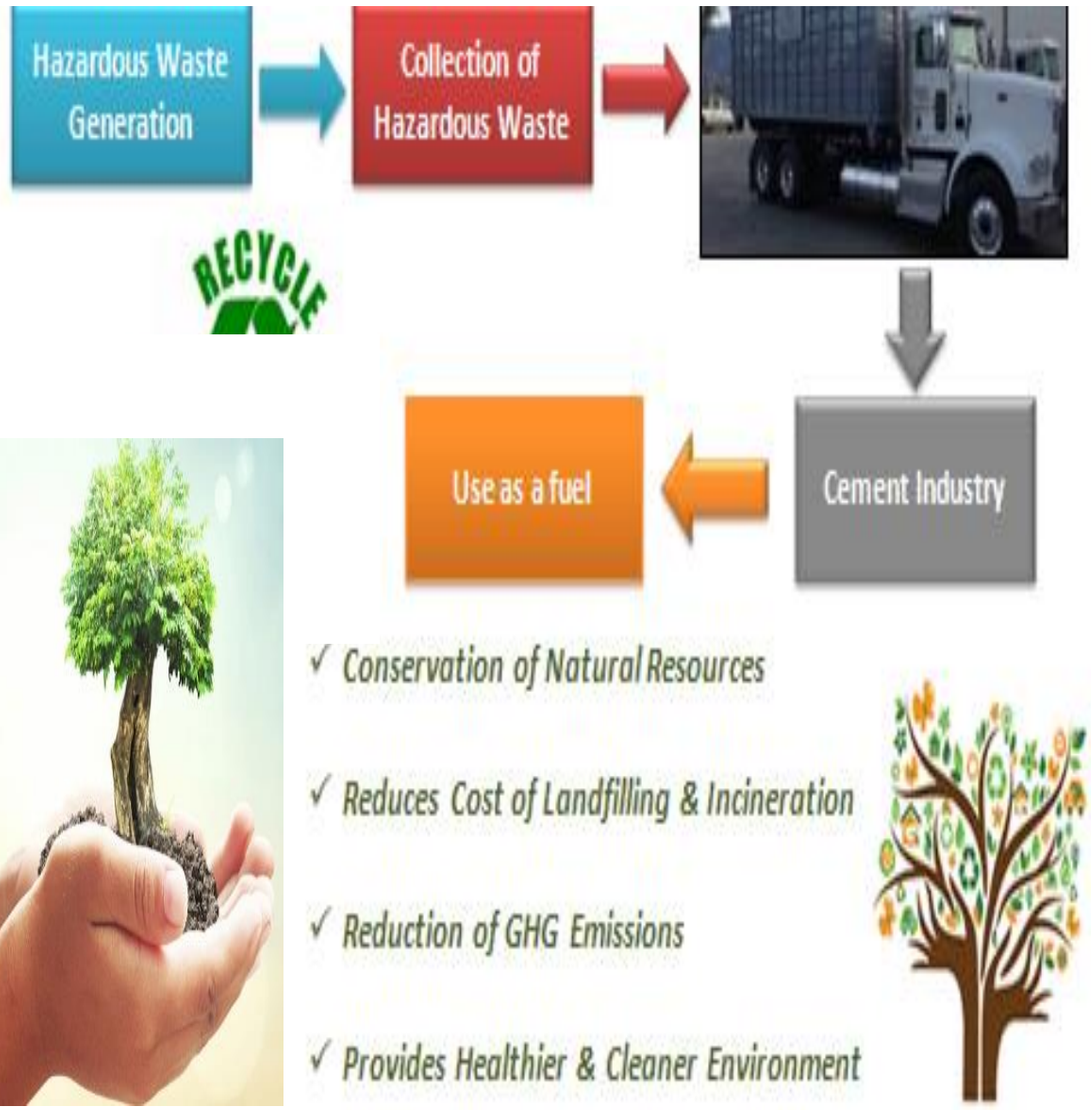
- Real time tracking of process & domestic water consumption in each areas
- Program development for communication through IoT hardware's

Estimated tangible benefits (INR CR, Productivity Imp etc..)

- Potential water conservation by 100 Kl per day, i.e. annual saving of INR 18.25 lacs with ROI of 2 years
- Strengthened water balance from water supply to effluent generation
- Reduction in dependency on GIDC specifically during reduced water supply during summer

8. Sanand Plant- Zero Effluent Discharge Plant

TATA MOTORS
Connecting Aspirations



Disposal method

Co-processing	Recycling	Incineration	Landfill	Effluent Discharge
74%	26%	0%	0%	0%

- Co-processing
  - Paint sludge
  - Waste Sealant
  - Phosphate Sludge
  - cotton waste
  - Grinding Sludge
  - ETP sludge
- Recycling
  - Empty Drums
  - Oil
  - Thinner
  - Lead Acid Battery
  - E-waste

- **100% of Hazardous waste - sent for Co processing in cement industry (i.e. Using it as a fuel) /for recycling through Authorized Recyclers**
- **No Hazardous waste used for Land filling or Incineration which is Non sustainable**
- **100% Treated effluent – used for Horticulture & Gardening within premises**

Hazardous Waste Recycle & Reuse

100% Hazardous Waste Recycling & Reuse

8. Green Cover & Lakes - Sanand Plant

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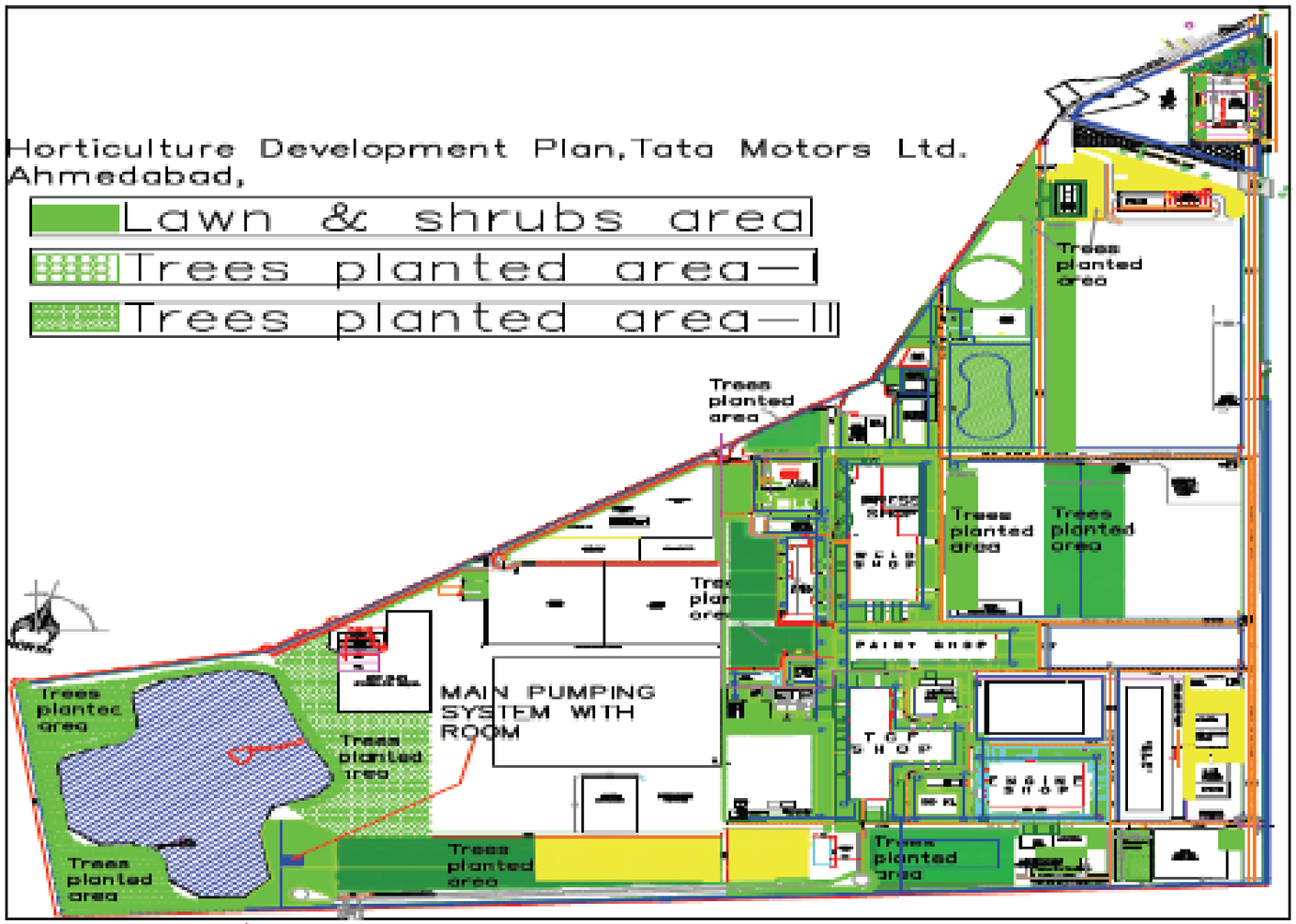
Connecting Aspirations

Horticulture & Gardening

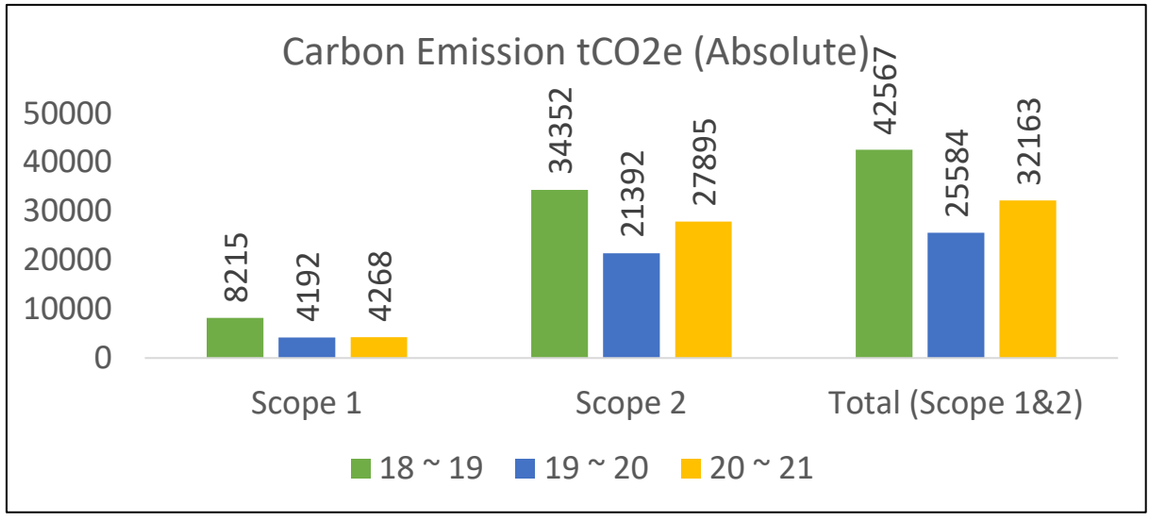


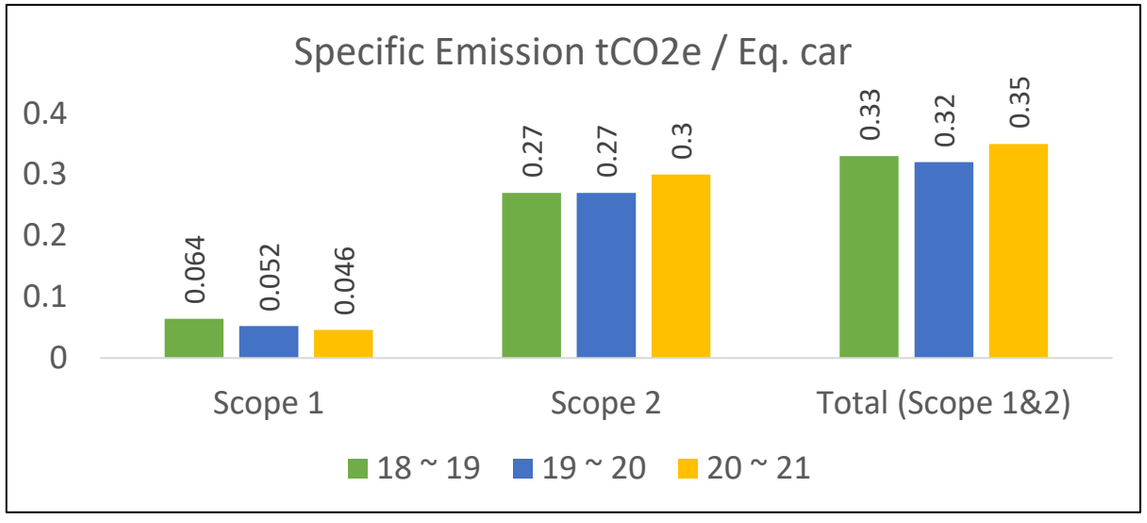
Rain Water harvesting

A view of two lakes

Lakes in Sanand Plant help in ground water recharging which supports water demand of more than 10 villages

9. GHG inventorisation





Though there was the major impact of Covid 19 during FY 20 ~ 21, Specific GHG emission was maintained w.r.t FY 19 ~ 20 results.

Carbon Emission tCO2e			
FY	Scope 1	Scope 2	Total (Scope 1&2)
18 ~ 19	8215	34352	42567
19 ~ 20	4192	21392	25584
20 ~ 21	4268	27895	32163

Specific GHG Emission (tCO2e/Eq. Car)			
FY	Scope 1	Scope 2	Total (Scope 1&2)
18 ~ 19	0.064	0.27	0.33
19 ~ 20	0.052	0.27	0.32
20 ~ 21	0.046	0.30	0.35

Units	Short Term Target (FY21-22)	Long Term Target (By FY24-25)
Total GHG emissions (tonnes)	---	---
GHG intensity (tons per unit of production or specify other unit) Scope - 1	3 % reduction w.r.t. FY 20 ~ 21	10% reduction w.r.t FY20-21
GHG intensity (tons per unit of production or specify other unit) Scope -2	8% reduction w.r.t. FY 20 ~ 21	25% reduction w.r.t FY 20-21

10. Environment Procurement Policy & Sustainability Guidelines

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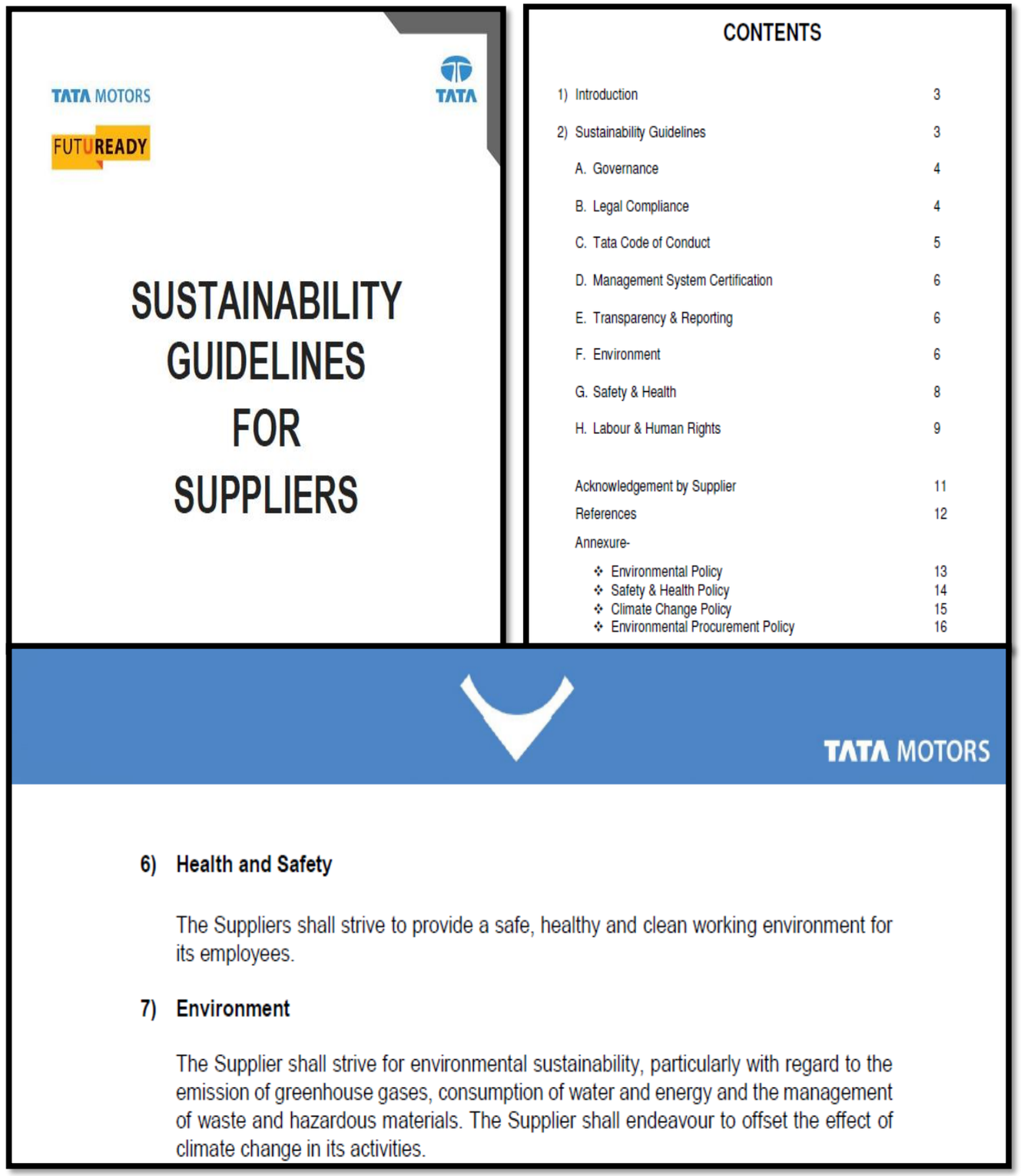
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FUTUREADY

SUSTAINABILITY GUIDELINES FOR SUPPLIERS

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1) Introduction 3
2) Sustainability Guidelines 3
A. Governance 4
B. Legal Compliance 4
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- Environmental Policy 13
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6) Health and Safety

The Suppliers shall strive to provide a safe, healthy and clean working environment for its employees.

7) Environment

The Supplier shall strive for environmental sustainability, particularly with regard to the emission of greenhouse gases, consumption of water and energy and the management of waste and hazardous materials. The Supplier shall endeavour to offset the effect of climate change in its activities.

Strategy & Action Plan for FY21-22

- Screening of top 400 suppliers from overall list of 1000+ suppliers based on the share of business have been identified as CRITICAL suppliers.
- Communication of Sustainability Guidelines to 100 shortlisted suppliers.
- Capacity building of these 100 shortlisted suppliers and supply chain team members on sustainability practices, across TML locations.
- Baseline mapping of 100 shortlisted suppliers w.r.t sustainability.
- Site assessment of 22 critical suppliers located in plant zone area.
- Development of sustainable supply chain model for remaining suppliers.

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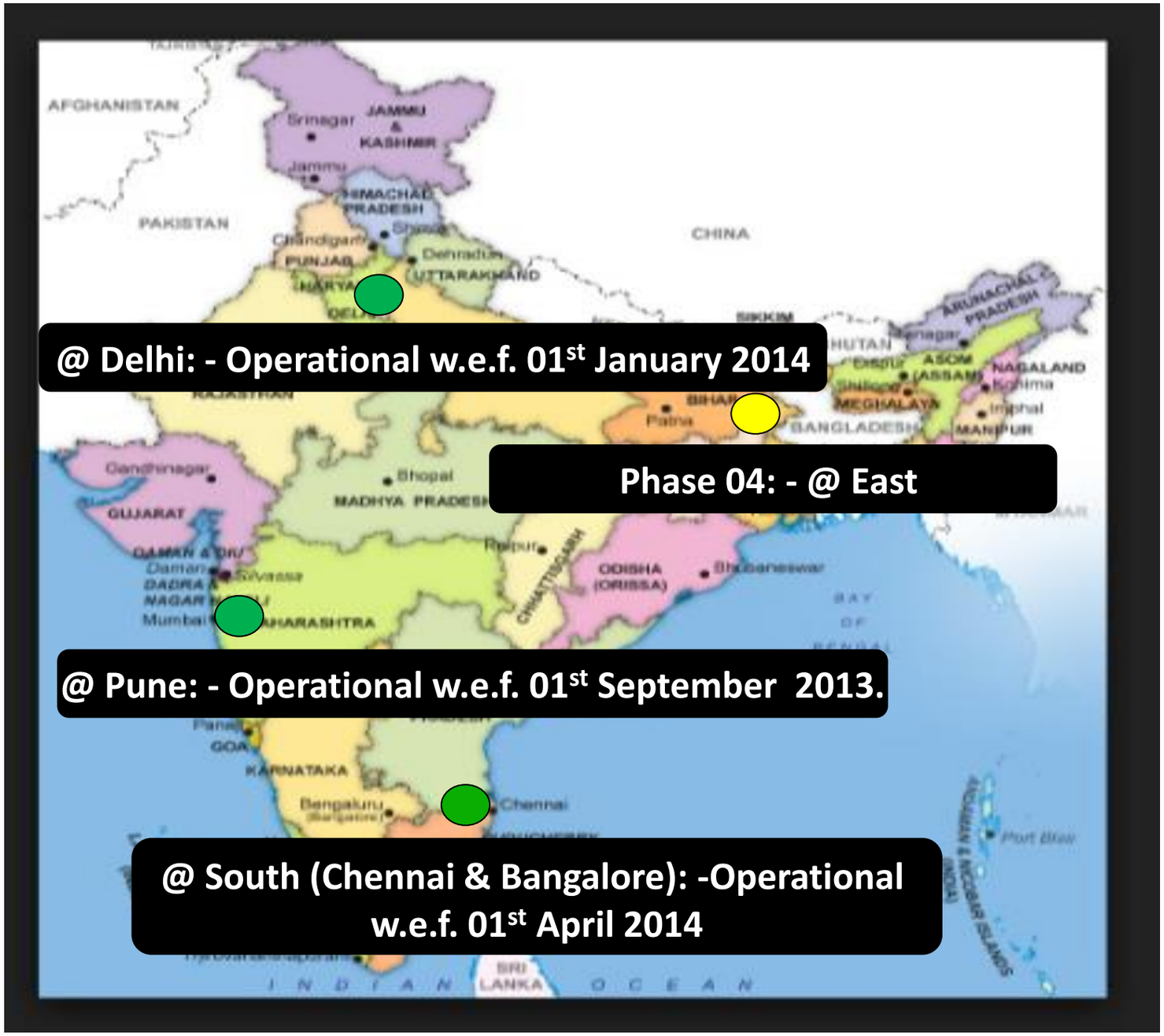
Logistic Consolidation Centers at TML -



Benefits: -

- Improved scheduling efficiency
- Adherence to transit times
- Stock in transit visibility
- Damage free transportation
- Carbon footprint reduction
- Reduction in in-plant traffic
- Increased vendor satisfaction
- Smaller lot, higher frequency enabling better inventory controls.
- Cost savings
- Alignment of shipments with manufacturing plans.
- Milk run activity in vendor park underway in FY 2018-19

10. Resource allocation for vendor park

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Benefits of Vendor Park

- Logistic and packing cost reduced.
- Parts delivered in JIT / JIS
- Minimum inventory at TML by using just in time concept.
- No transportation damage
- Minimum quality issues and quick response to issues.
- Environmentally sustainable – CO2 emission due to transportation is reduced by 95% and disposable packing is eliminated. All material comes in returnable bins / trolleys
- Local investment and employment generation.

Resources Allocated for Vendor Park

- Common **effluent treatment plant** to treat the effluent of the vendors
- **Water supply** to ensure continued operations of the vendors
- Common Infrastructure related to **power supply**
- Other facilities like house keeping & security arrangements for common areas in vendor park
- **Training & capability building programs** for Vendors to enhance productivity & reducing resource consumption by vendors

10. Carbon credit through Load Optimization in transportation

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Before

4 engines per pallet dispatch resulting in 64 engines per 40 Ft trailer.

Transportation Description	Engine Forward Transportation	Engine Pallet Return Transportation
No. of Parts / Pallet	4	4
No. of pallets in One Truck	16	32
Total No. of Engines	64	128

After

6 engines per pallet dispatch resulting in 96 engines per 40 Ft trailer

Transportation Description	Engine Forward Transportation	Engine Pallet Return Transportation
No. of Parts / Pallet	6	6
No. of pallets in One Truck	16	32
Total No. of Engines	96	192

For every 384 engines transported, we have save 1 vehicle to and from transportation from Sanand to Pune.

Monthly to and fro trips saved based on volumes = **6 trips**

To and fro distance from sanand to pune corresponds to 1358 km.

CO_2 emission savings per to and fro trip = 179.26 kg of CO_2 = **0.179 ton CO_2 per round trip**

Total annual CO_2 emission savings = 0.179 x 6 x 12 = 13 ton.

10. Green Supply Chain

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Connecting Aspirations

Sustainable Warehousing: Best Practices

Blanks storage Racks-Space & electricity savings by 2x.

High Bay Racks in Central WH –Construction & Space Savings by 2x

Metallic returnable trolleys used for carrying parts from Vendor park to Shop

Direct to line Supply from Vendor park

Sustainable Packaging: Plastic packaging elimination

Before

After

Before

After

10. Green Supply Chain

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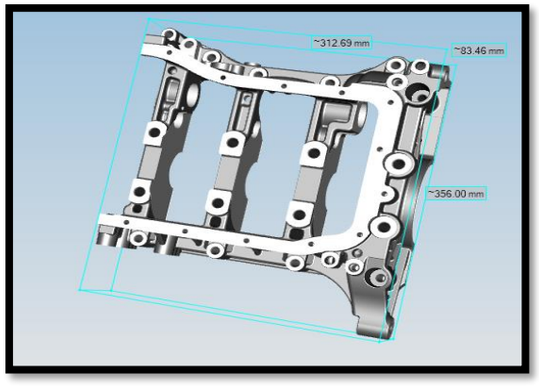
Connecting Aspirations

Sustainable packaging & Warehousing

Part Description	Present Situation	Proposed Measure	Estimated Results
Part Name: Bed plate Part No: **571501103820 (3 diff parts)** Vendor – Global Auto / Sound Casting	QTY /Box: 16 QTY / Truck: NA Packaging material: Individual CB with Horizontal & Verticle Layer Partition, clubbed in big size pallet Issue : Box damage	QTY/Box: 48 QTY / Truck: NA Proposed solution: FLC introduced , Each FLC box consist 8 layers accumulates 48 numbers of parts	Result:R Implemented on 15.11.2020

Before		New packaging	
			
			

10. Green Supply Chain

TATA MOTORS
Connecting Aspirations

Sustainable packaging & Warehousing

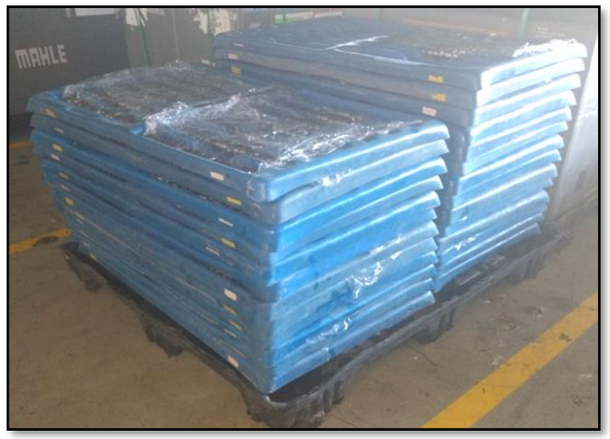
Part Description	Present Situation	Proposed Measure	Estimated Results
Part Name : Camshaft ▪ Part No: 571505107903 Location: TR-2A Vendor – Mahale Engine Comp Ind PL	QTY /Box: 40 QTY / Truck: NA Packaging material: Individual Polybag, Corrugated Box with wooden pallet Issue : Disposal packaging, transit damages	QTY/Box: 200 QTY / Truck: NA Proposed solution: FLC box with in Built partition for each part	Result: Wood , box waste elimination. Savings – 25 Rs/Part Implemented on 07.03.2020

Existing packaging

Primary view

Secondary view

Proposed packaging



10. Green Supply Chain

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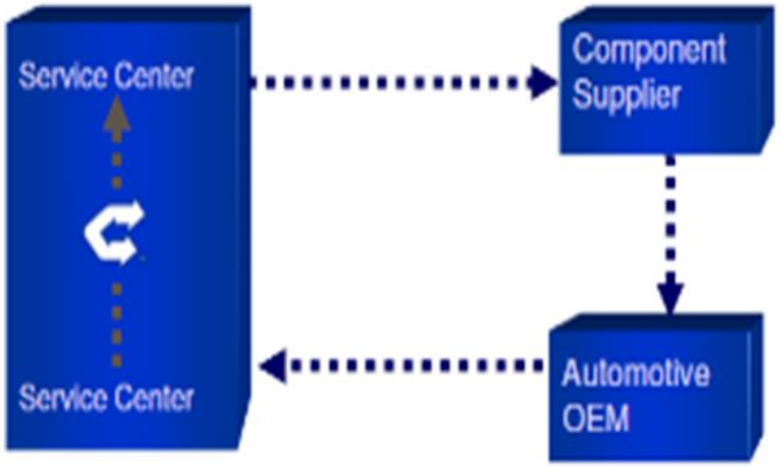
Global rental packaging for Outstation material transportation



Pooling Model for Rental Packaging

Outstation material transportation – NO capital investment

Rental Model : Reusable Packaging Implementation for corrugated box on rental basis thus optimizing the overall resource requirement basically for supplies from Outstation Supplier

Partners engaged on PAN India Network – Leap India Pvt Ltd., Chep India Pvt Ltd. ,CKD Pack,M/s Auto Pool, Triauto Auto Group, Goodpack

Vendors are getting engaged in phased manner across all vendor zones for transformation.

10. Green Supply Chain

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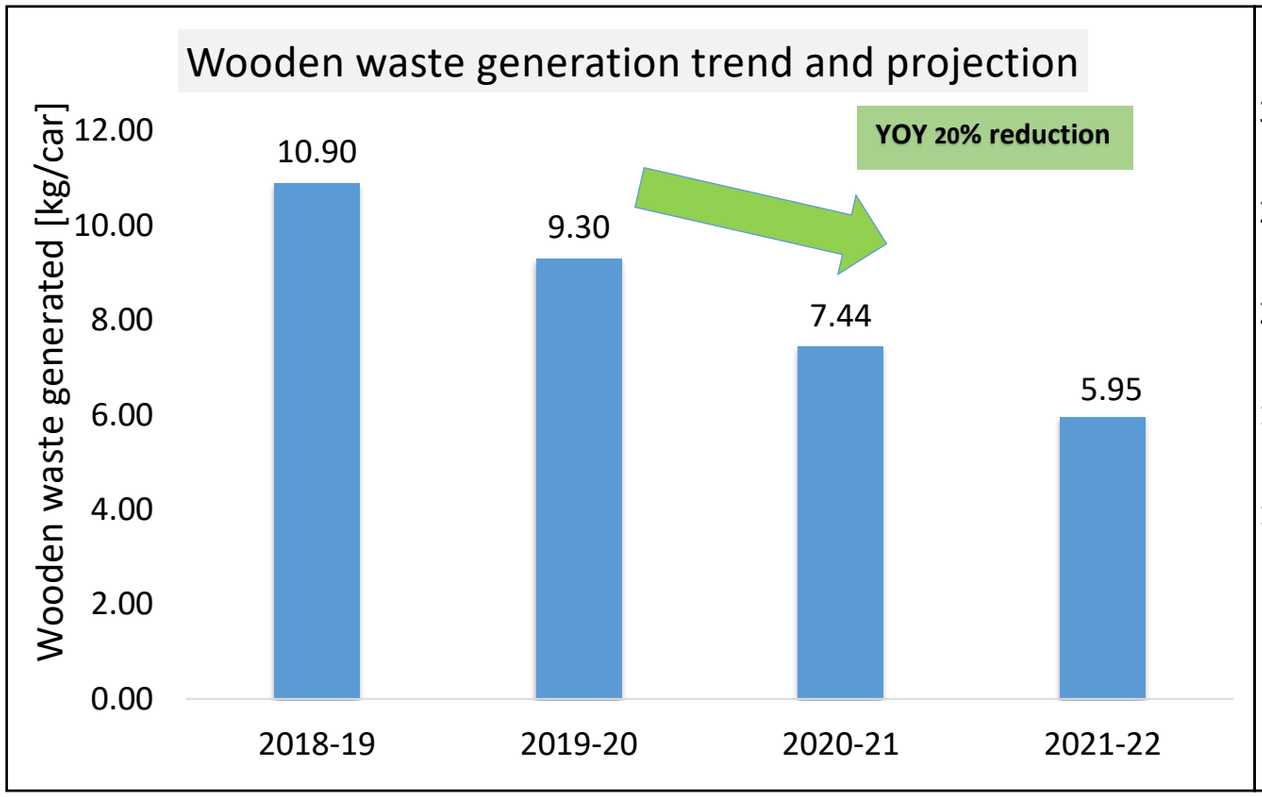
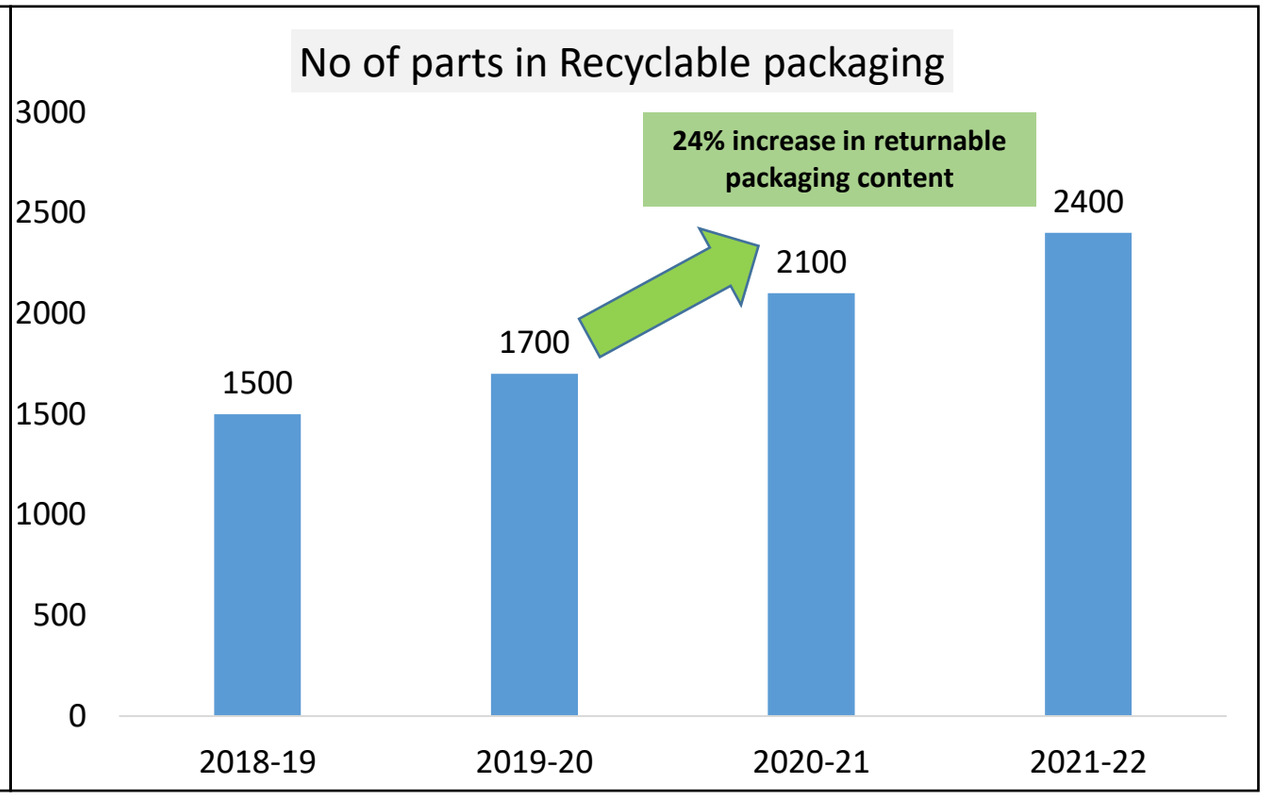
Connecting Aspirations

Results of Sustainable packaging initiative





Out of total **5400** Nos parts**, 2100 Nos** i.e. **38%** are coming in **recyclable packaging – avoiding scrap/waste generation and deforestations**

Total carbon foot print reduction due to recyclable packaging & avoidance of deforestation estimated as 275.57 TCO2 per annum*

10. Green Supply Chain

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Education and Awareness creation: Vendor Capacity Building

Training at Caparo on Kaizen and KPO

Reward & Recognition

Full day training on Improvement in manufacturing by TML to Caparo

Down the level training basic welding and fixture practices

Team member awareness at critical vendors in vendor park regarding reduction in process rejection, awareness for DO IT FIRST TIME RIGHT [DIFTR] approach

11. Energy Management Team

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Connecting Aspirations

	Shop Champions	Power	Fuel	IDM	Tools/PTP	Rejection	Freight
PRESS	Radharaman Sharma	Radharaman Sharma	NA	Radharaman Sharma	Navin Kumar	Navin Kumar	NA
WELD	Mangesh Maslekar	Mangesh Maslekar	NA	Vivek Gupta	Snehal Chauhan	Jitendra Singh	NA
PAINT	Pankaj Marathe	Khandu Waghmare	Chandrakant Malviya	Puneet Garg	Bhavin Mistry	Krunal Raval	NA
TCF	Kuldeep Chaudhary	Debi Chatterjee	NA	Ajhesh Sethuraman	NA	Amrut Patil	Mehul Prajapati
ENGINE	Sagnik Roy	Nikhil Kulkarni	Ajay Agarwal	Sudhanshu Bajpai	Vijay Baswatkar	Sudhanshu Bajpai	NA
UTILITY	K Subhash	K Subhash	Nimesh Vyas	Nimesh Vyas	NA	NA	NA
NON MANUFACTURING	Pradipta Mohanty	NA	NA	NA	Davinder Singh	Deepak G / Dev Thakore	Rinkesh R / Shakti S

Shop wise and component wise teams created to drive VCC reduction

11. Employee Participation

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TATA

Theme: Energy Conservation

Celebration of Energy Conservation week

Categories of Awards

- Best Energy Conservation Kaizen.
- Maximum Kaizen on Energy Conservation by an Individual.

For any further queries, please contact your Shop/Department Suggestion Coordinator, Mr. Niraj Chaube / Mr. Vipul Radadiya - BES.

Today is Last Date to submit your Kaizen

Look forward to your enthusiastic participation in Special Suggestion Scheme

11. Training programs and capacity building

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- Identifying and sending selected Energy coordinators for the Participation in the CII related workshops / training programs
- Segregation of waste related training programs for operatives / staff
- Participation in seminars / green initiatives
- EMS ISO 14001 Lead and Internal Auditors for EMS Coordinators by BVC

11. Plant Level Energy Monitoring

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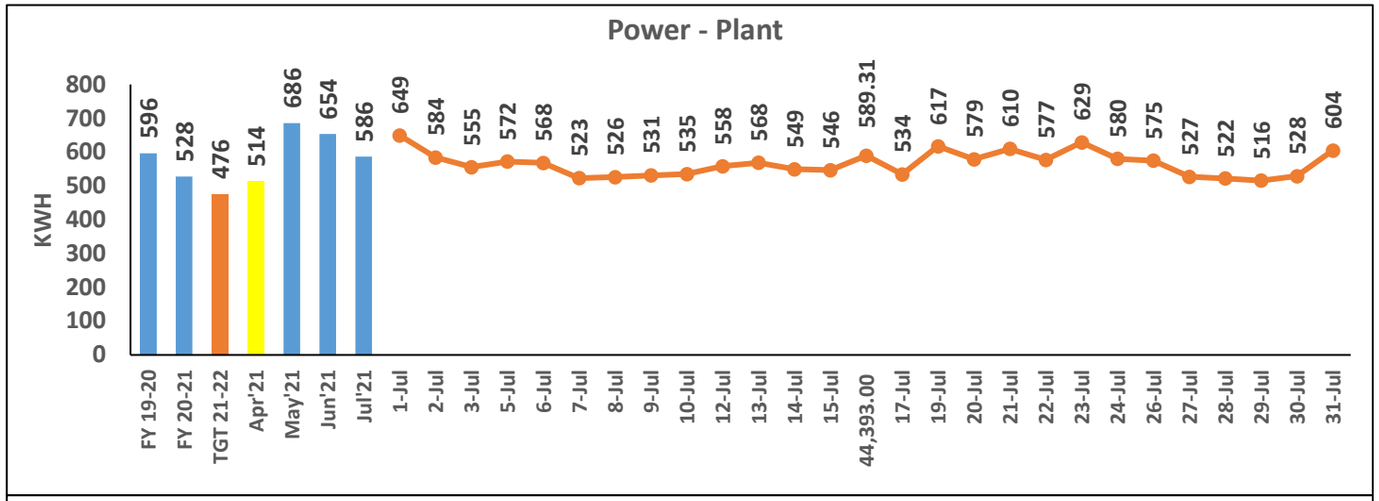

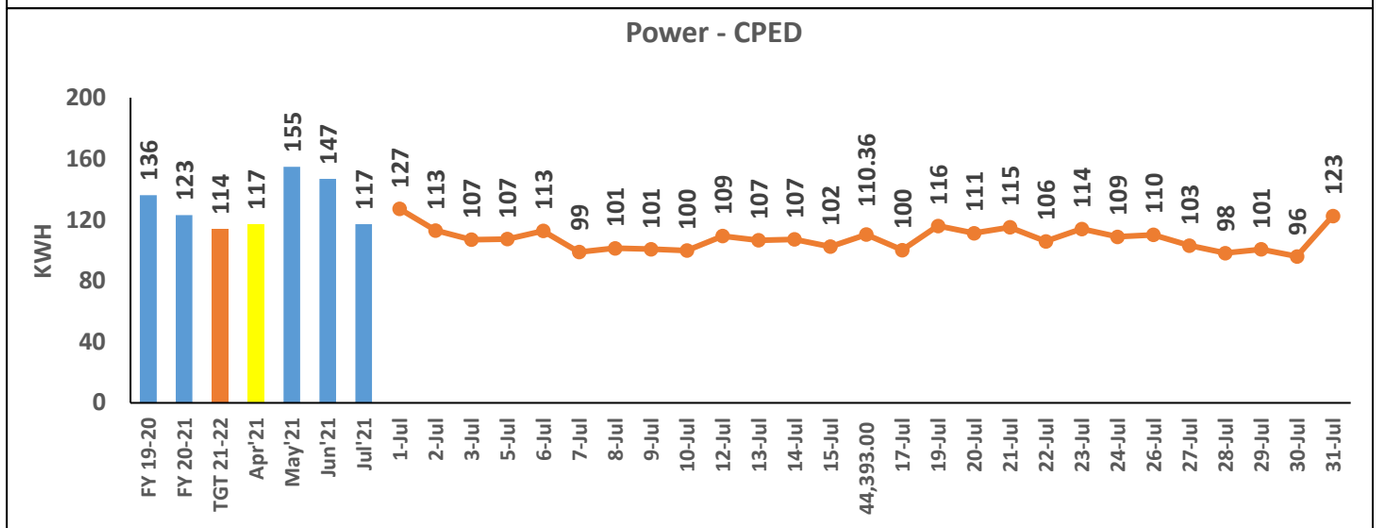

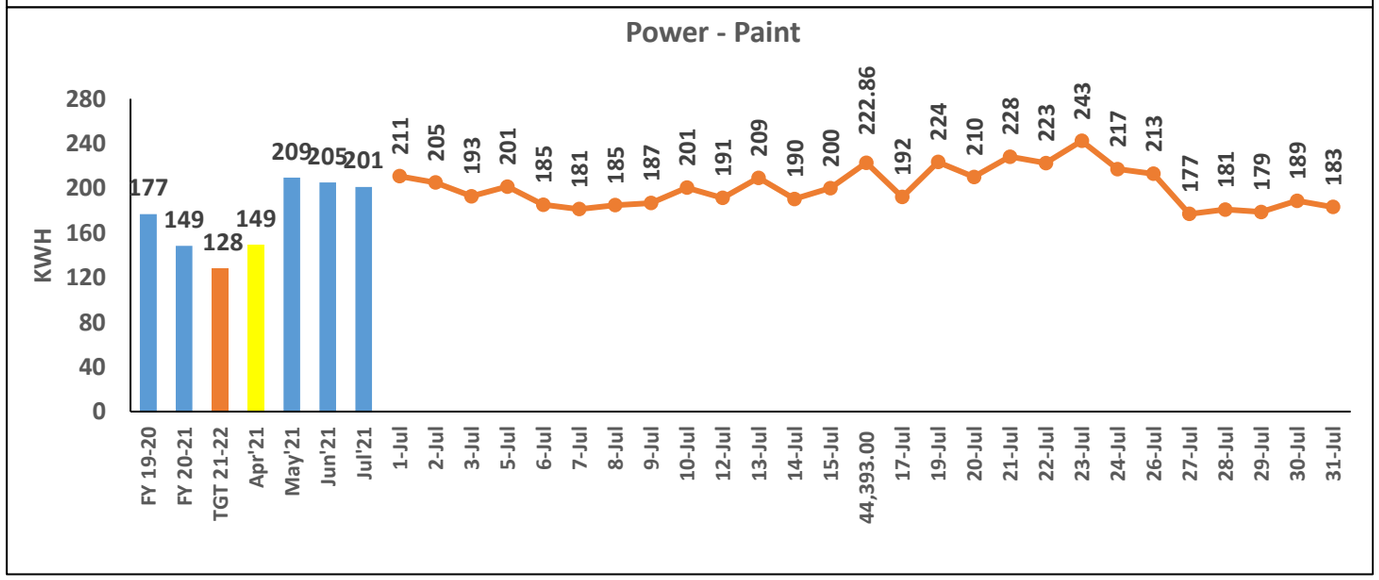

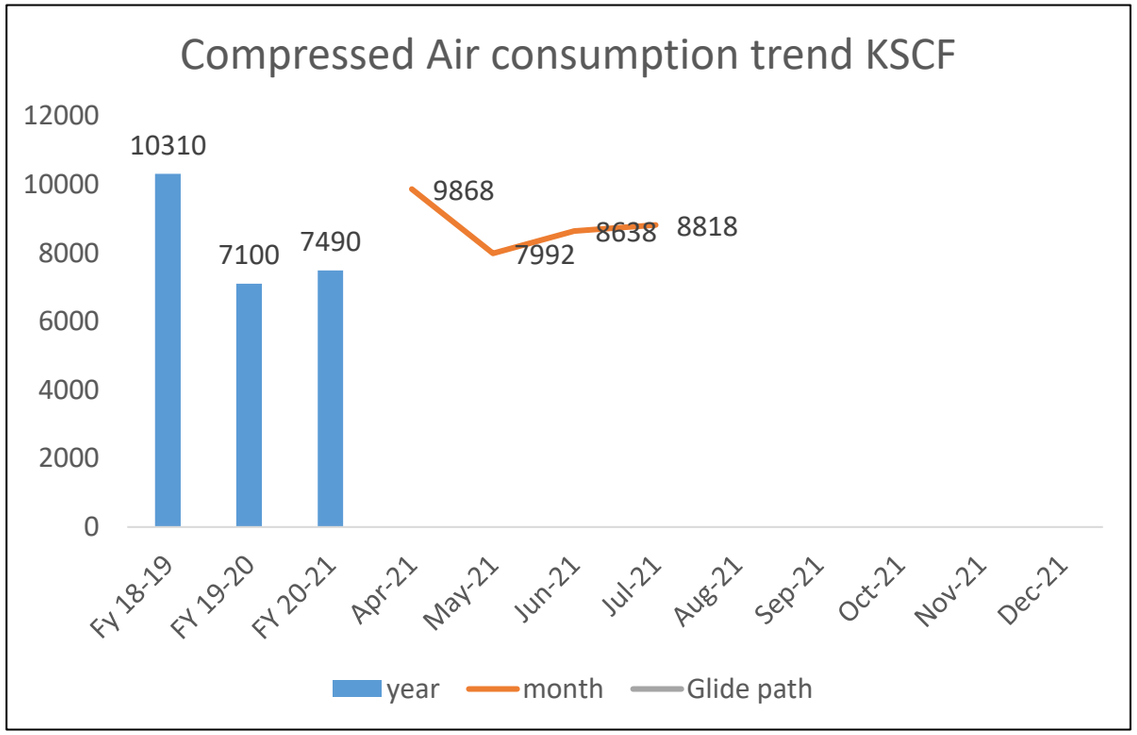

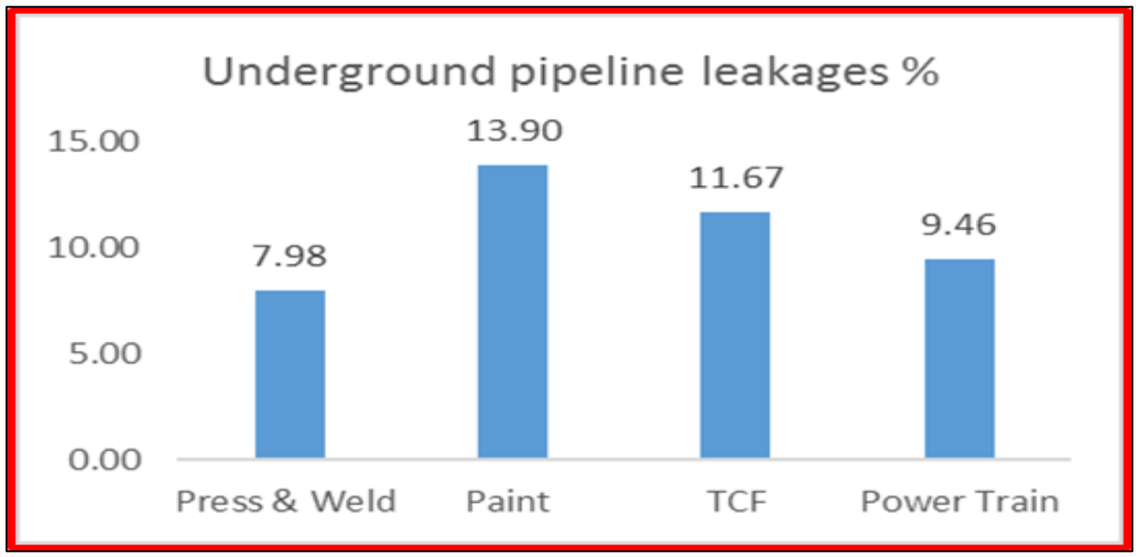

In Order to reduce wastage of Compressed air due to underground compressed air pipeline leakages. Going ahead with above ground compressed air pipeline project. Execution started at site.

11. Employ Involvement for Energy Conservation

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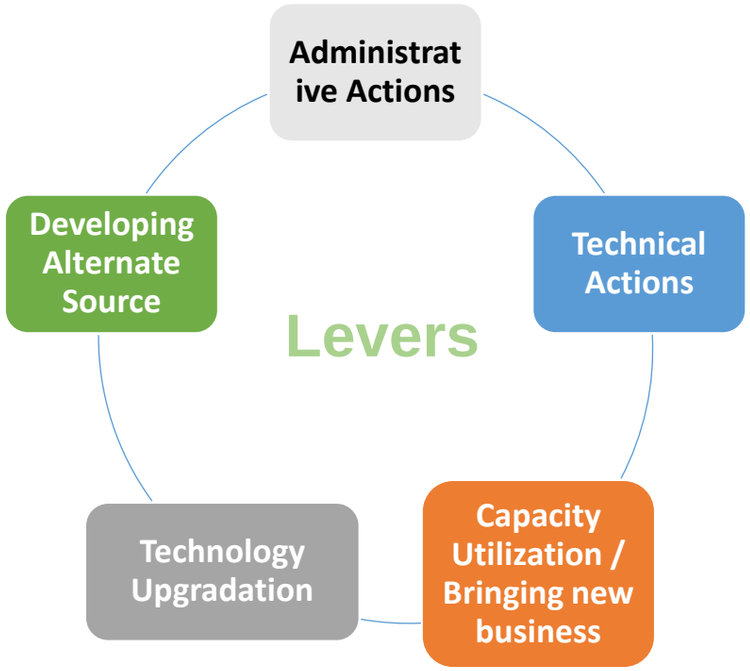
Connecting Aspirations

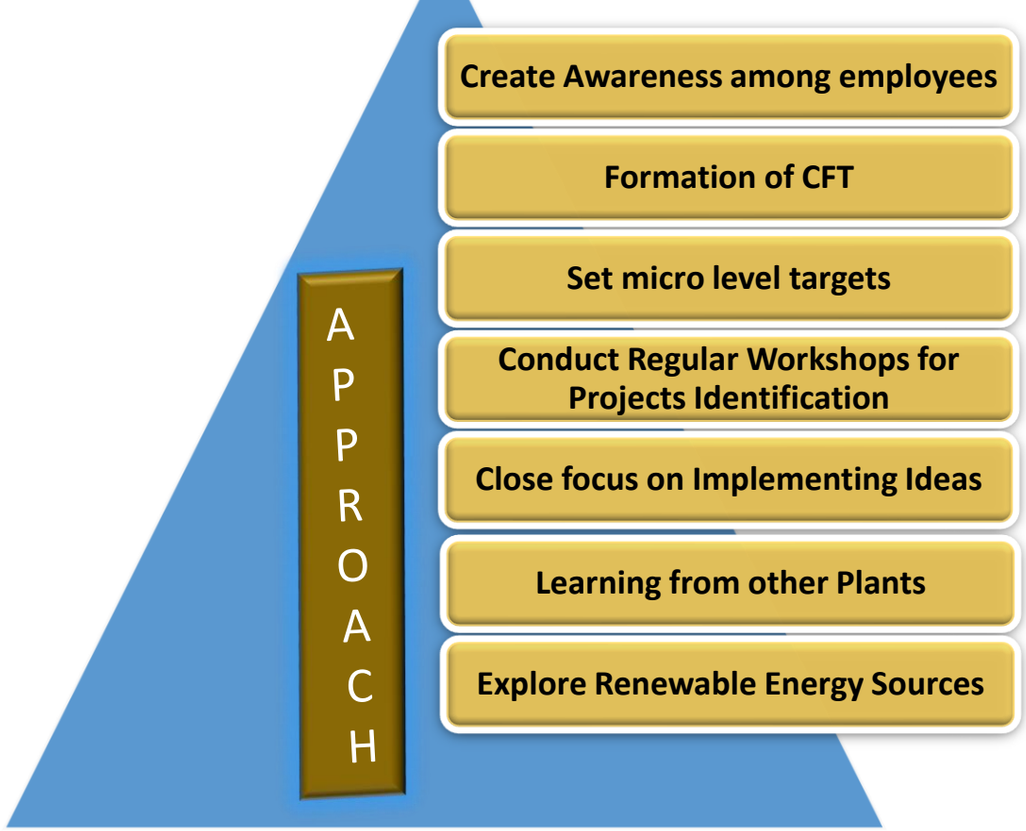
Area of Conservation

Blowers, Pumps & Motors	Heating & Cooling Systems	Paint Booths, Ovens, ASU, Exhaust systems
Furnaces	Washing Machines	WTP & ETP
Process Improvements	Compressed Air & Fuel	Engine & Vehicle Testing
	Lighting & the list goes on ….	



GEAR Methodology

Generation	• Workshop conducted for generation of Ideas
Evaluation	• All Ideas are evaluated and sent for approval where budgets are involved, else are implemented
Approval	• Presentation to Top Management for Budget Approval
Realization	• Deployment of Idea • Sharing with all stake holders • Horizontal Deployment – Do–Demonstrate-Diffuse



FOCUS AREAS FOR VCC REDUCTION

1. Optimum use of Air Conditioning
2. Administrative Control
3. Reduction in Compressed Air Consumption
4. Control in Consumption in Consumables
5. Use of Energy Eff Bearings
6. Use of energy Eff Motors
7. Use of Energy saver
8. Engineering Improvement
9. Use of LED Lights
10. Optimum use of Lighting
11. Process improvement
12. Use of Solar Power
13. Space Optimization for reduction in cooling load
14. Tools life improvement
15. Use of VFDs
16. Purchase of Wind Mills

12. Reward & Recognitions

TATA MOTORS
Connecting Aspirations

CII-Green Co Platinum in First Attempt (June:2018)

CII Green Co Star Performer Award –June:2019

Only 4 wheeler automobiles amongst 9 winners out of almost 60 participating industries

Golden Peacock Environment Management Award- 2020

Tata Motors Sanand was declared winner of Golden Peacock Environment Management Award for the year 2020!

Assessment parameters : Environmental Governance, Water Conservation, Waste Management, Unique Initiatives, Clean Technologies

12. Reward & Recognitions

TATA MOTORS
Connecting Aspirations

Sanand Plant Won Best Environment Performance Plant award.

Press Shop

Weld Shop

Paint Shop

Powertrain Shop

Central Quality

CMS

CPED

Construction

12. Long Term Vision on EE

TATA MOTORS
Connecting Aspirations

Replacement of conventional lighting with LED

Summary

- Replacement of Total plant conventional lighting to LED lighting through LEASE period of 3 years with extended warranty (Part replacement) till 5 years.
- Considerable energy savings leads to reduction in energy bill.
- Spare parts would be taken care by supplier for 5 Years.
- Agreement covers 3 year initial warranty + 2 Year extended warranty and factored in EMI (10.6 L / Month) hence AMC not required.

Benefits

Total Energy Savings would be **23.34 L KWh/Year**

Total Cost Savings would be **188 Lacs / Year**

Reduction in Lighting Load by **52%**

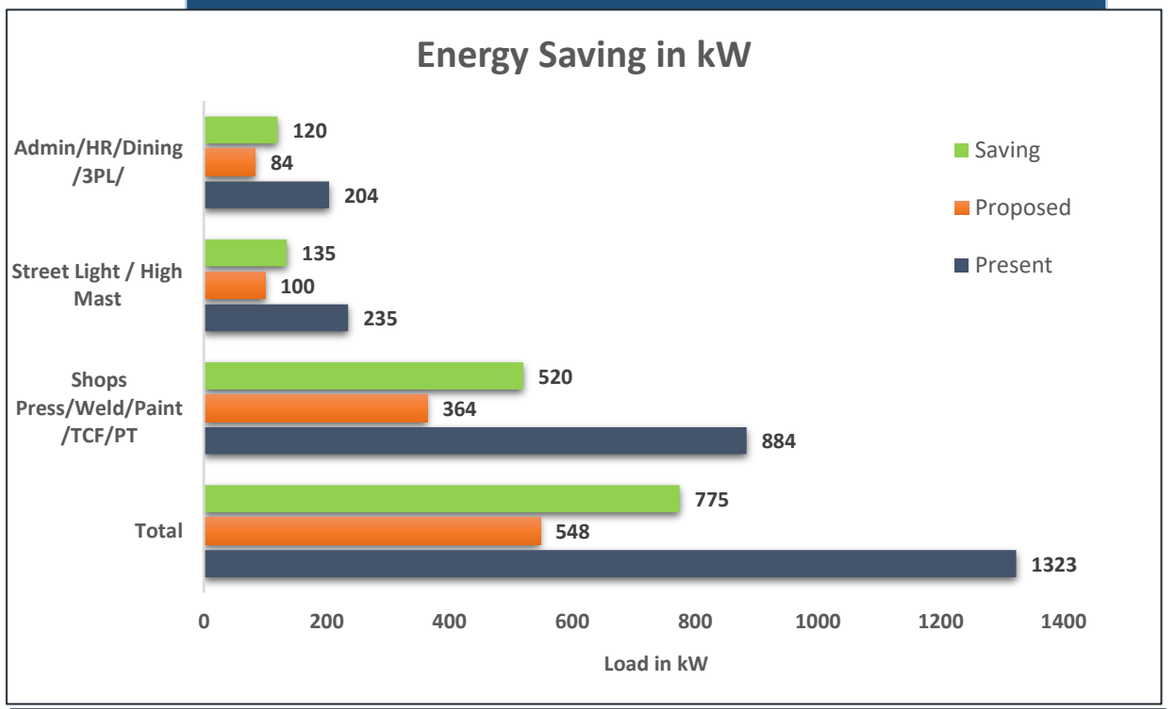
After three years free cash of **14.5 Lacs / Month**

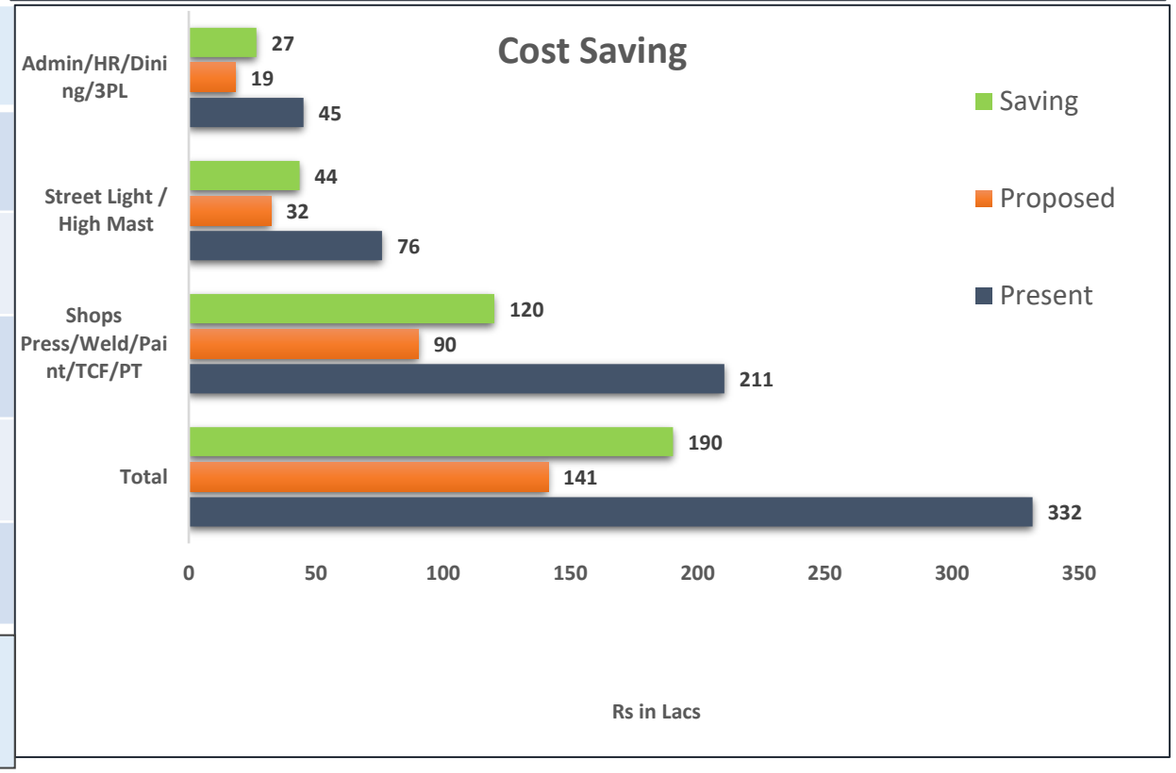
Payback period **3 years @ EMI – 10.6 L / Month, Total – 3.8 Cr**

Reduction in Green house gas emission by 1200 tCO2e per yr.

- Note – Existing average consumption – 40 L KWH / Month
- Existing average energy bill – 327 L / Month for FY20-21

LED Vs Conventional Luminaire





12. Long Term Vision on Renewable Energy

TATA MOTORS
Connecting Aspirations

Proposal for alternate energy sourcing

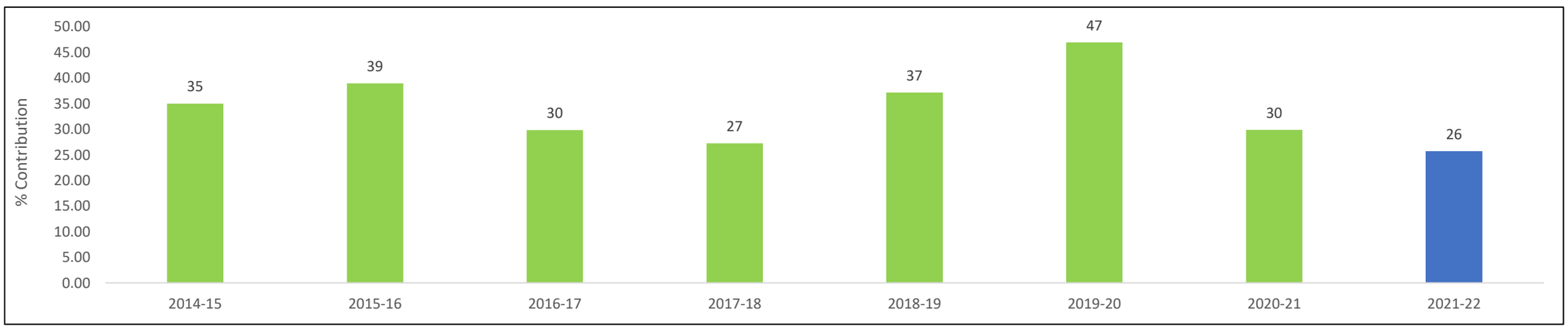
1.5 MW Roof Top solar power plant through Capex

- TML need to purchase the entire system and then contract an authorized system supplier to install the system on rooftop.
- system maintenance can be delegated to an operation and maintenance (O&M) contractor/EPC service provider.

Current Installation	Proposal	Investment	Models Available	Projected Generation	Projected Savings
2 MW Onsite + 1.8 MW Offsite (PPA) Solar power	Additional 1.5 MW Onsite Roof Top solar power plant	Approx. INR 6 Cr.	1. Operating Lease 2. Financial Lease	20 lacs Units (KWH) per Annum PLF @ 17%	INR 140 lacs per Annum

Impact on Renewable energy contribution

By adding 1.5 MW solar the % contribution can be increased up to 29% from estimated 26% .



Thank you for your Attention !

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