CII National Award for Excellence In Energy Management 2021

Mahindra
Rise.

Novokesh Mishra
Mahadeo Salunkhe

Mahindra Nashik Plant

Journey Towards Carbon & Water Neutrality

We Are

MAHINDRA

7+ Decades

100+ Countries

150+ Companies

250K People

We're spearheading and paving new paths. We are...

- World's Largest Tractor Company by Volume
- No.1 Hospitality Company outside of the USA
- India's No.1 Multi-Brand Certified Used-Car Company
- Pioneer in Building Smart Cities in India through Mahindra World Cities
- Only Indian OEM in Formula E All-Electric Car Racing Championship
- Among India's Top 5 IT Service Providers
- Amongst India's Largest Solar EPC Companies
- One of India's Largest Utility Vehicle Maker
- Among India's Largest Third-Party Logistics Service Providers
- World's 1st All-Electric Hypercar – Pininfarina Battista

US$ 19.4 BN GROUP

BUSINESS PRESENCE IN **100+ COUNTRIES**

R&D FACILITIES ACROSS **10** COUNTRIES

256,000+ EMPLOYEES

50% REVENUE FROM OUTSIDE INDIA*

72 MANUFACTURING FACILITIES, GLOBALLY

Mahindra

Rise.

GREAT PLACE TO WORK®

Mahindra & Mahindra Ltd. Nashik Plant

- Plant Established : 1981
- Area : 47000 M²
- 40 % Greenery
- Employees : Avg. 7500 per day

- Innovative automation
- ZERO discharge plant
- Water Positive

Nashik Plant : Key Manufacturing Facilities

Press Shop(Tandem line)

Body Shop (Robotic Welding) - 4 Body Shops

Paint Shop-CED Process

Paint Shop - Robotic painting - 2 Paint Shops

Conveyorised Assembly Lines - 3 Lines

Milestones : New Products

2020

XUV300

Marazzo

2019

- 2 New Body Shops with Robotic line for XUV , Marrazo and Thar
- New TCF line for XUV300

Scorpio Refresh, Scorpio SCDC

2018

Bolero Ambulance, Bolero Power+

2017

eVerito, NUVOSPORTS

2016

Scorpio Refresh, new THAR

2015

Impact of COVID 19

Year 2019-20

Reduction in volume in the months of Feb & Mar-20 due to Pandemic

Year 2020-21

1. Reduction in volume in the months of Apr-Jun-20 due to Lockdown and short supplies from vendor
2. Production volume set at low setup due to Sanitization & Social distancing
3. Vaccination drive for first dose completed for all the employees inhouse through Govt. approved hospitals

Methodology

Setting objectives & Targets

Knowledge Sharing

Formation of Plant Energy Focus Team

Verifying results

Act

Plan

Check

Do

Yearly Event Calendar

Energy audits

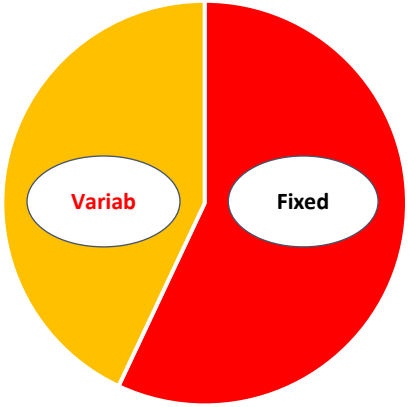
Monthly meetings

Project implementation

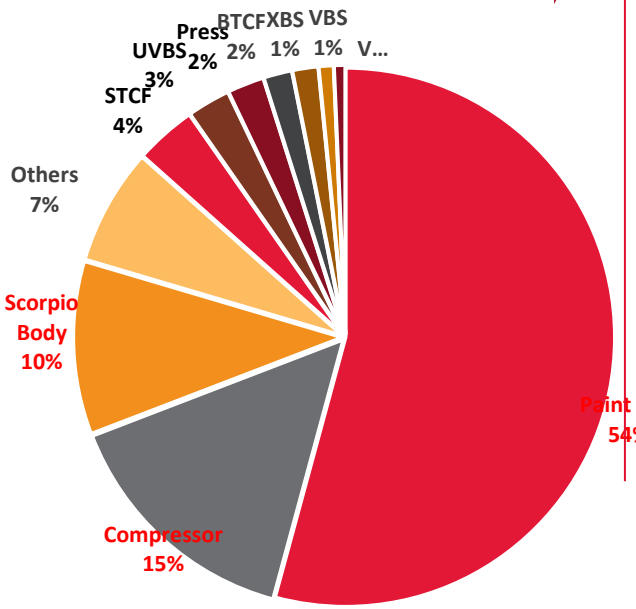
Project identification

Brainstorming

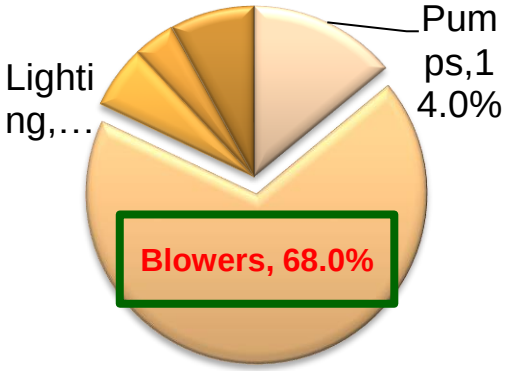
Power Consumption – Past Data Analysis



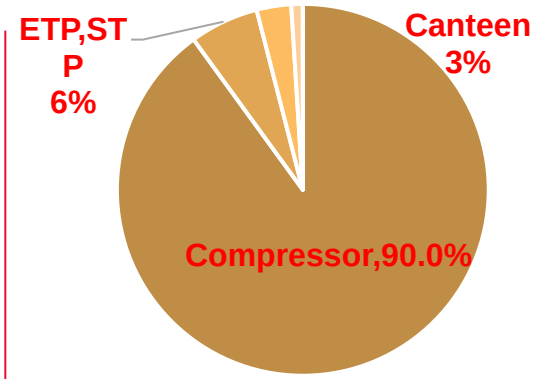
PU Wise Stratification



Paintshop

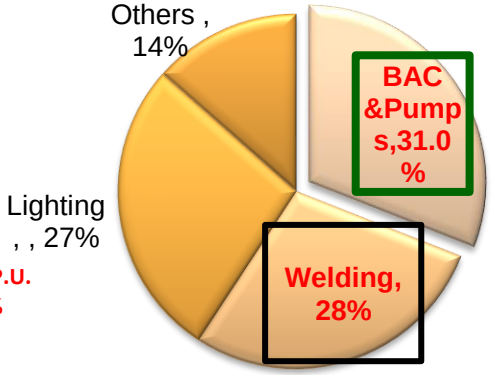


CMD

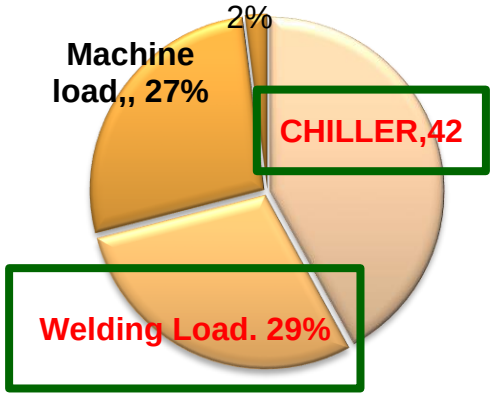


Major Power Consuming Areas

Scorpio Body



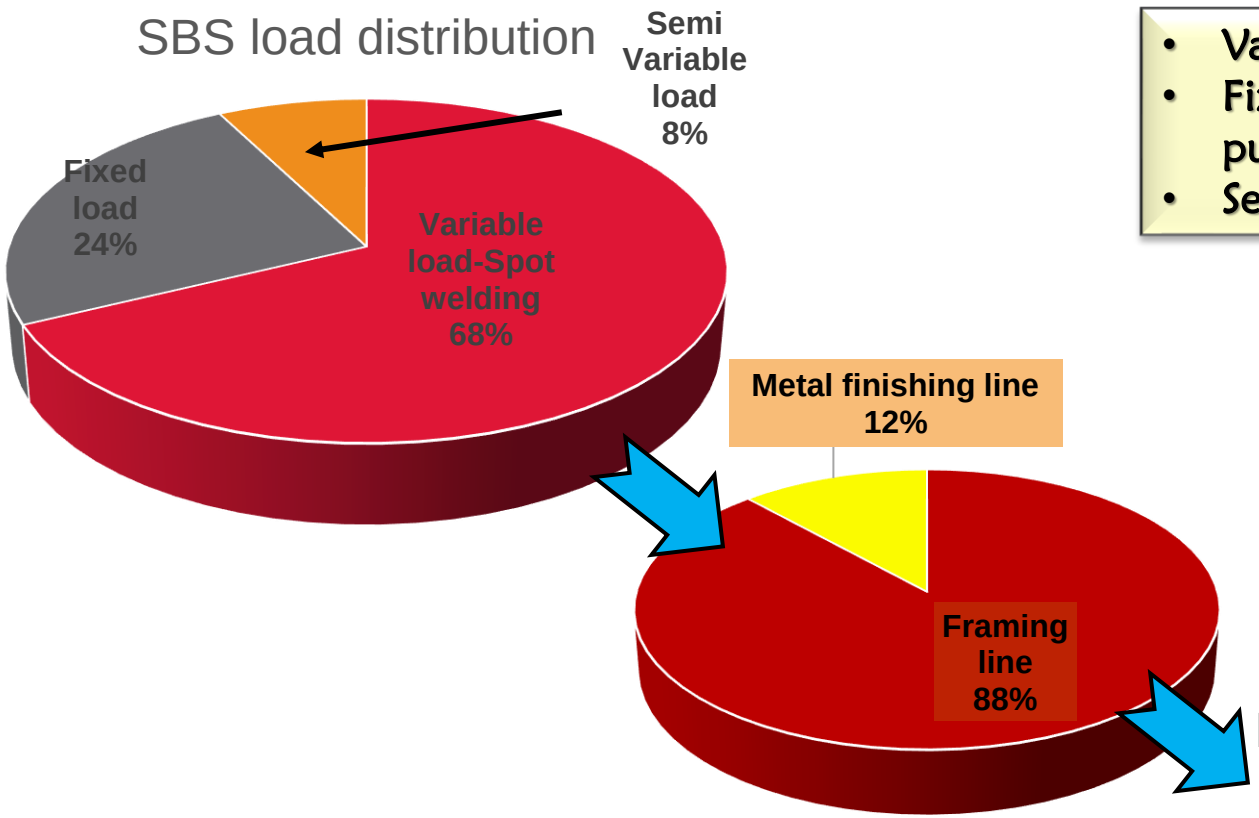
Marazzo Body



INNOVATIVE PROJECT REDUCTION IN POWER CONSUMPTION BY SPOT WELDING PARAMETER OPTIMIZATION

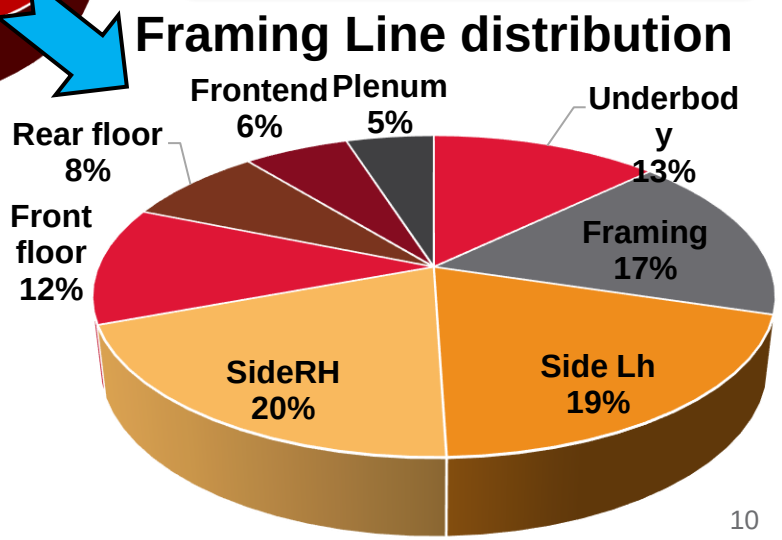
Plant Location – Nashik Plant-1
Department:- Scorpio Bodyshop

The opportunity



- Variable load- Spot welding guns
- Fixed load- Lights, Fans, water pumps
- Semi variable load- BAC, Chillers

Focused Domain



On Utility facility front already optimization done as per standard. Hence no scope available in that domain .....

The Opportunity

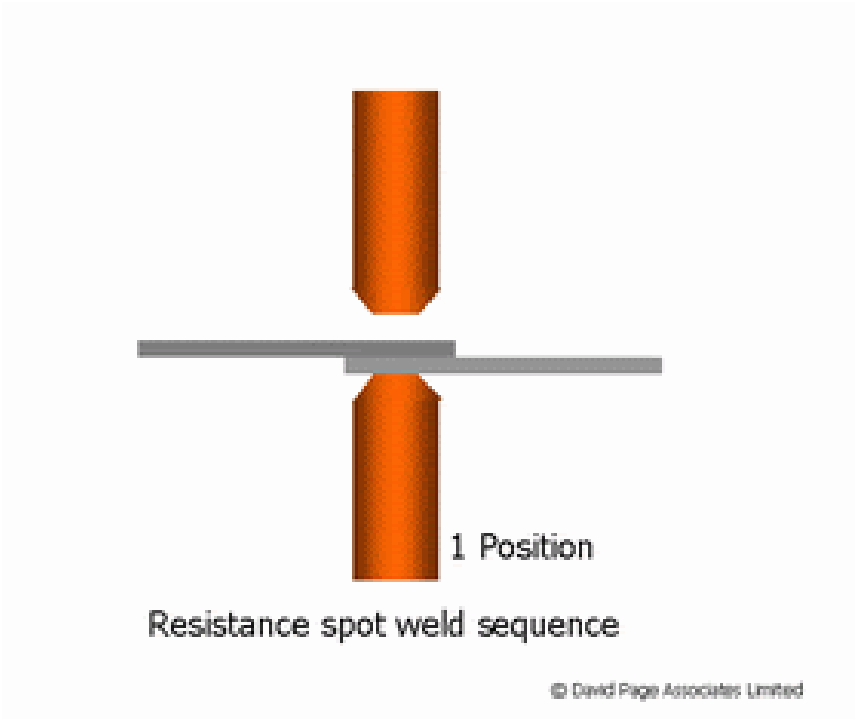
Total 68% of Power load is consumed by Spot welding operation

Number of spot weld guns in Framing line-163 and on Finishing line -26

Following are range of weld parameter
Weld cycle- 18 to 30
Weld current -7.5 to 10.50 KA
Force – 180 to 320 Kgf

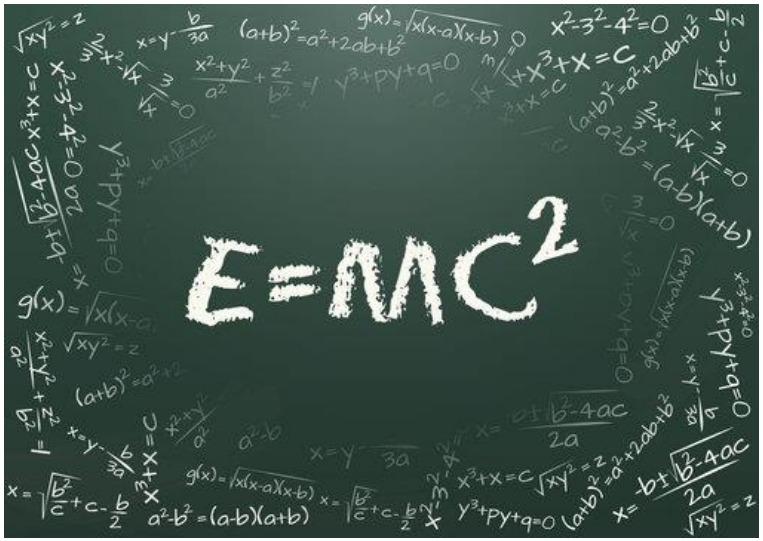
These weld parameter vitally weld current and weld cycle plays vital role in energy consumption and weld quality

Per day avg energy units per BIW are 74 in which the spot welding process share is 68%

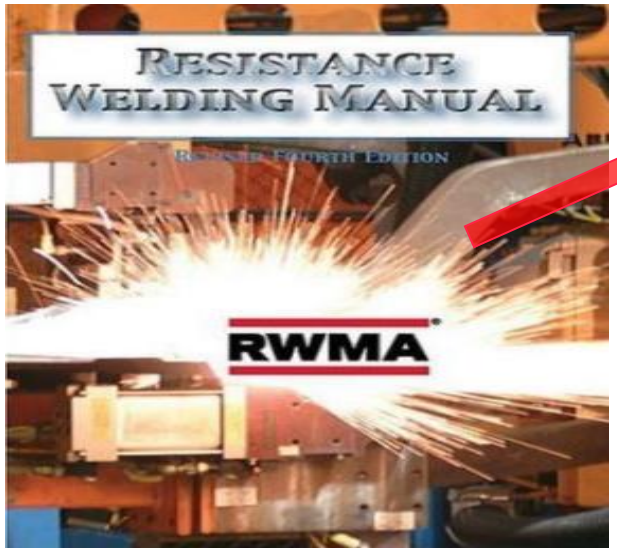


Inspiration

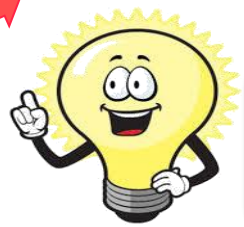
$E= MC^2$: Conversion of mass and energy ……..



- **E= MC2 speaks about first time mass and energy equivalence & this was been proved and established**
- **It was biggest of the find at that time proved by Sir Einstein by breaking orthodox theories of physics**
- **It was breakthrough find and has opened door for many quantum theories**



Can we challenge fundamentals in spot welding process and establish benchmark ?



This has been never tried or implemented in Mahindra as well as in Indian Automobile MNC

Focus : Weld quality should remain intact and energy consumption to be reduced

Innovative solution

Theoretical Analysis

Aim – To Design model for correlating weld cycle & current with energy consumption

Method 1:- Engineering theories and principles ….

$H = I^2RT$ (H = heat required for fusion for rolled steel can be calculated if Value of I (Current) & R (Resistance) known and same paradigm used to find current and weld time required to produce required heat for welding)

Method 2:- Data Analytics

weld cycles and current analogy with power can be calculated from Data analysis of previous year data of spot welding energy consumption

Theoretical Equation Derived with regression analysis and Integration by part theory using above two methods . This yielded the below expression

Energy consumed per spot = 0.00067 X (Weld Cycle)

Above relation verified by Power analyser

This relation establishment is biggest find and even on Google its not available

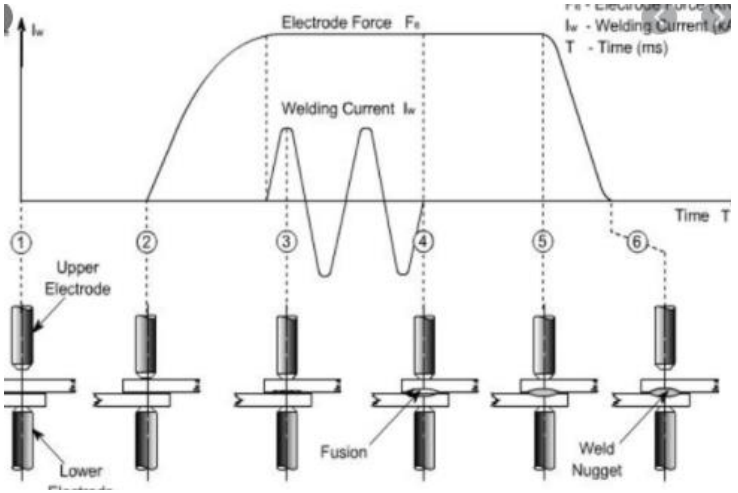
New set of spot weld parameter derived with newly derived expression and DOE to check the scope for reduction

Process followed for Innovation

Deriving new spot weld parameters for different combination of sheet metal thickness ranging from 0.7 mm to 1. 8 mm

There are world wide 3 welding class types in resistance spot welding

- **A Class Welding**
- **B Class Welding**
- **C Class welding**



We have invented new type which combines A class and C class weld which implies new theory of " getting more heat generated in spot welding with lower force, High current and reduced weld cycles"

New weld class innovated – " Energy efficient and more superior in weld integrity"

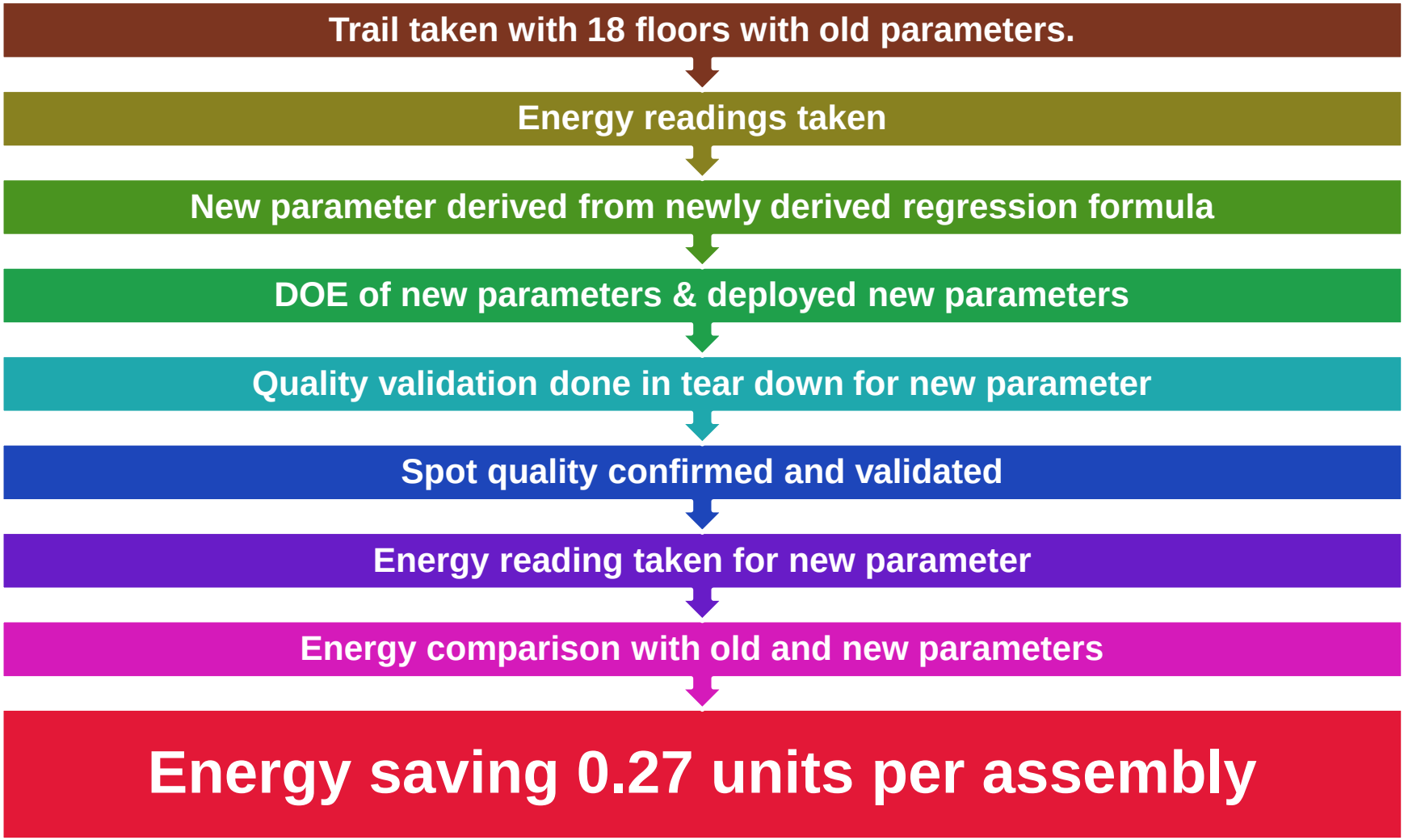
Total 2533 iterations tried for deriving spot weld parameters

Area wise parameter deployed and verified in BIW tear down for quality aspect

Total investment done = 0

Process followed for Innovation

Trail was being initiated on one assembly stage-Rear floor assembly



“ FTR & ETR getting followed with quality indices remaining intact

Uniqueness

- Spot welding operation falls in variable load in energy consumption and since it is a standard so no one looks to it as an opportunity
- Our aim was to take a leap jump and challenge this domain as it has got 67% share in total energy consumption
- Being addicted to “RISE” philosophy , we thought lets not get limited to any boundary and create something unique which should establish benchmark

Innovation: We have challenged the standard and established the exact correlation between weld cycle ,current and energy consumption. We have innovated forth weld standard class (Prior 3 welding class exists –A class/B class/C class)

Applicability of solution : The implemented solution is applicable to all spot welding process in all industries but this domain is not identified for power cost reduction aspect by any industry. We are the first one in Nasik plant who thought about it and implemented successfully

Tools used in innovation :

- Limit theory with integrals
- Erehwon’s model
- Regression analysis
- Design of Experiment
- Integration By part theory
- Euler's theorem

Benefits of the Innovation

- Our innovation has given a breakthrough solution for energy reduction in spot welding process which was never being thought off before
- Benefits on the Triple Bottom Line are as under-

People

- Optimized weld cycles resulted in reduction of work content
- Human safety improved and fatigue reduced.

Planet

Carbon foot print reduced by **263 Tons.**

spares consumption reduced by **16%**

Profit

- Power saving per BIW = 6 units \ BIW (**Rs. 42 saving per BIW)**
- **Annualized power cost saving = 25.2 lacs**
- Spares cost of Rs. **2.15 Lakhs** reduced.
- *Potential saving of* ***Rs. 80 Lakhs*** *through Horizontal deployment in Nashik plant*.

Hurdles/ Challenges/ Risks

Sr. No.	Hurdles/Challenges / Risks	Hurdles/Challenges / Risks	How it was managed
1	Hurdle	Thinking beyond conventional weld process	**Detailed calculations** for establishment of weld parameters Various possible **alternatives** were evaluated.
2	Challenge	Deriving new weld parameters	**5 advanced engineering tools used to derive parameter which will result in to energy saving**.
3	Challenge	Maintain current quality indices intact in process change	We have **derived\innovated new weld class** adjoining A class and C class welding so that weld integrity is improved than prior
4	Challenge	Frugal Innovation	By applying **Mind philosophy** and various engineering tool we challenged the established\ available standard
5	Risk	Spot breakage and quality issues	Detailed FMEA and PFMEA was being made resulted in zero trauma implementation with enhanced quality indices

Sustainable Manufacturing – Green Projects

Electrical

- 602 projects
- Solar & wind energy
- Day lighting
- LED lighting
- Efficient pumping
- Efficient motors
- Compressed air boosters
- Compressed air management

Thermal

- 36 projects
- 2156 ton fuel saved
- 4721 MT of CO2 mitigated
- 100% heat recovery
- Clean fuel LNG
- Recuperate for all ovens

Water

- 89 projects
- 329459 M3 saved
- 16 RWH Projects
- 75334 KL saved since F08
- Water by gravity
- Daily water balance
- ZERO water discharge
- HDPE pipes for sewage
- TW for fire fighting & gardens

Waste

- 100% recycling of non hazardous waste
- Eska for paint sludge
- Paint sludge drier machine
- 100% Paint sludge recycle
- Filter press for Phosphate and ETP sludge
- Solvent recovery

Year	No Of projects	Investments (INR Million)	Electrical savings (Million kWh)	Thermal savings (MT LNG)	Savings (INR Million)	Impact on SEC (Electrical, thermal)
F19	19	0.89	0.27	0	2.09	2
F20	45	13.66	2.48	0	17.00	16
F21	39	3.86	0.85	138.4	7.23	6

Plant Lighting

(Philips, Wipro, Goldwyn)

Planned through EESL - 37150 Nos.
Investment – 217 Rs. Lacs
Savings – 13.34 Lac Units
Payback - 2.33 Years
Completed – 100%

IE3 Motors

(Siemens ,CG)

Completed so far – 65Nos.
Investment – 58.31 Rs. Lacs
Savings – 40622 Units
Payback –2.2 Years
Completed 100%(With Payback <2 Years)

Air Conditioners

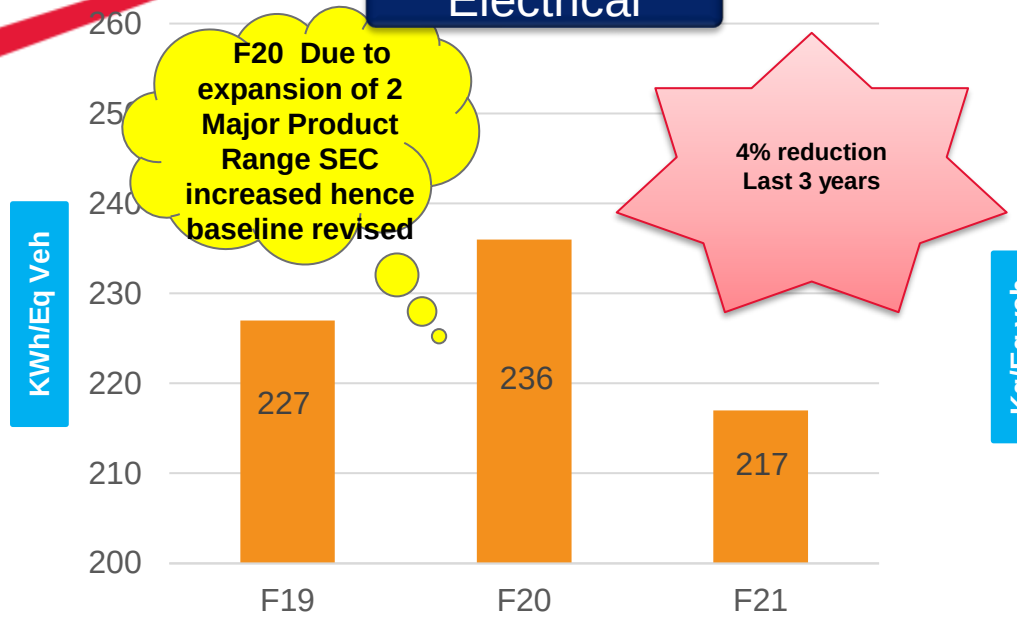
Completed so far – 270 Nos.

Planned through EESL in F22 Qty. 100 Nos
(By F22 end 100% implementation)

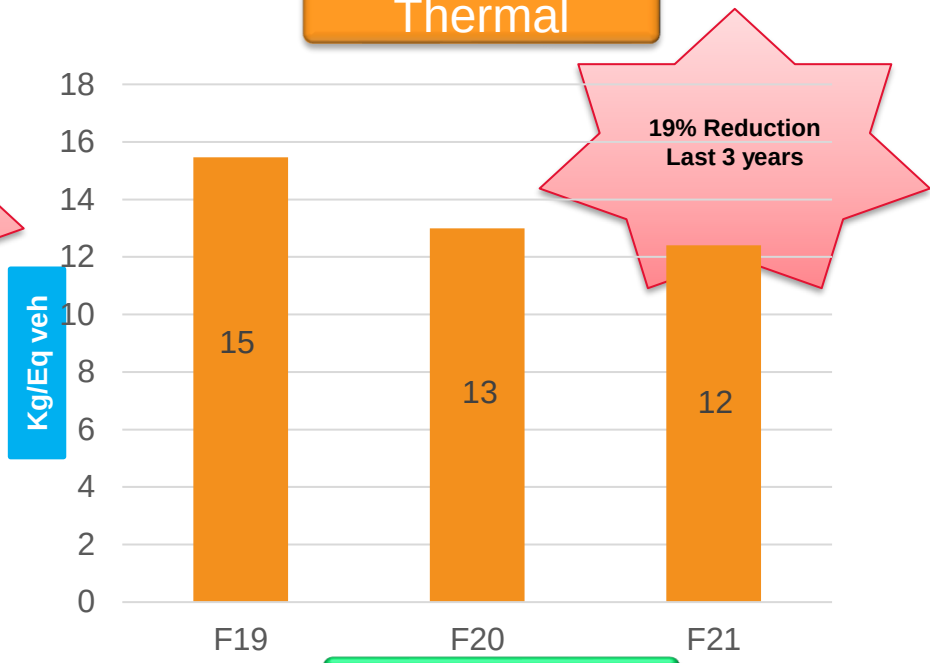
Specific Consumption

BETTER

Electrical

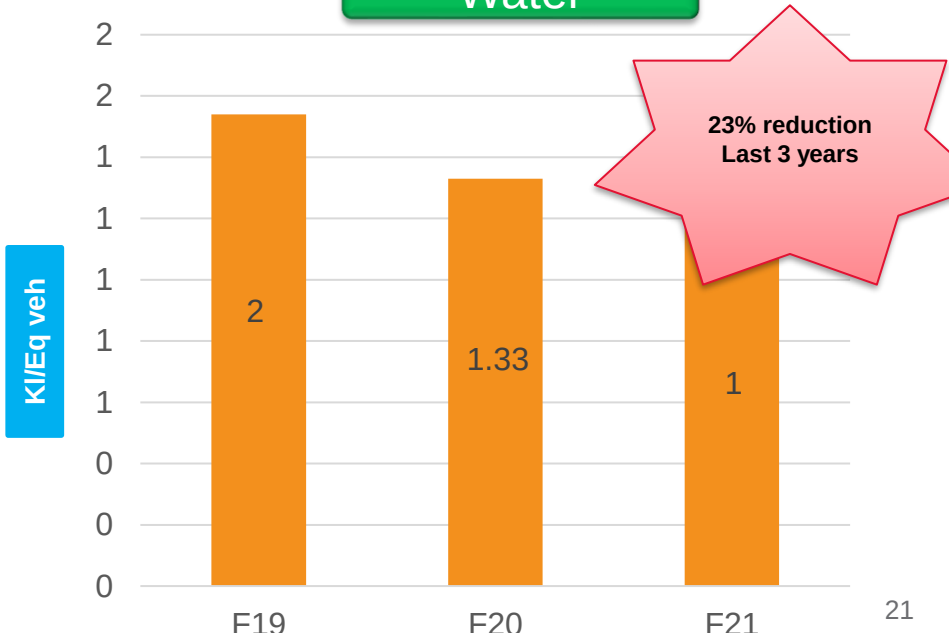


Thermal

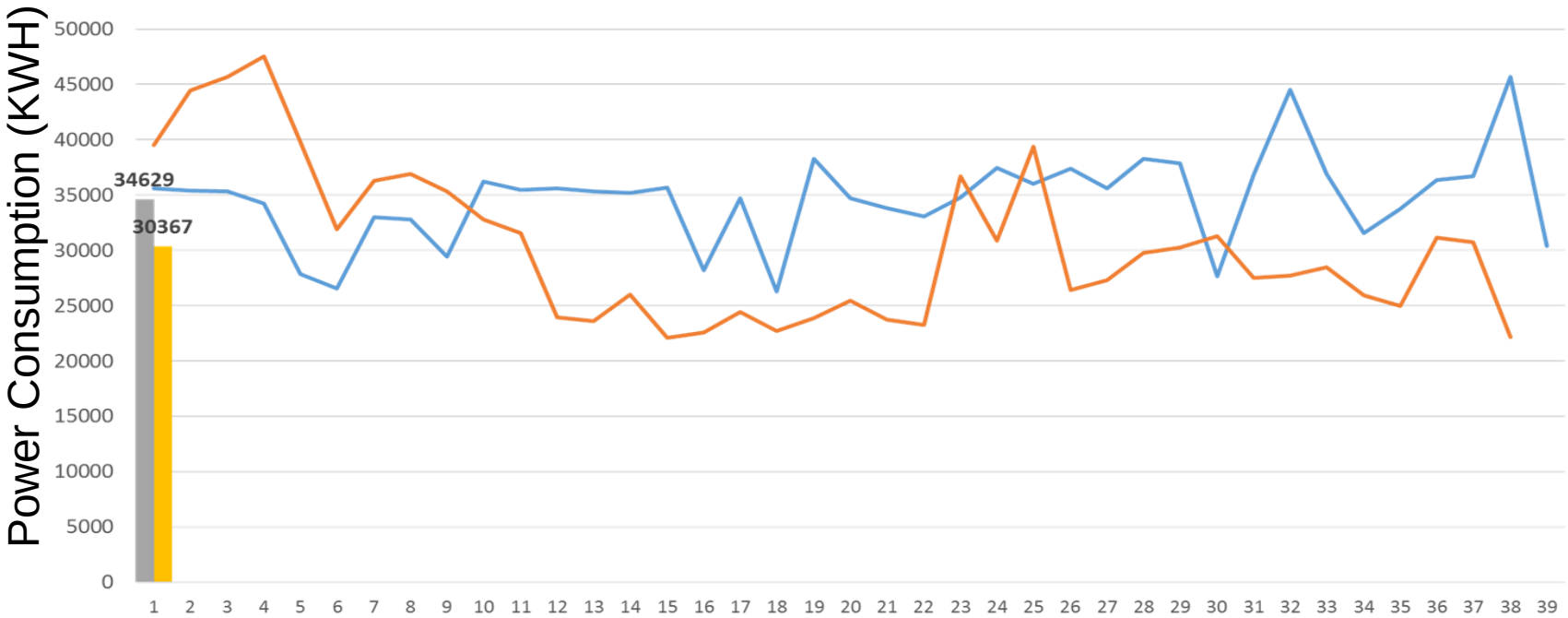


Compressor

Water



Reduction of Plant holiday fixed power consumption



A] Paint:

1. Only must equipment's run
2. Switching off lights

B] Marazzo Body Shop:

1. Switching off welding loads

C] Scorpio Body Shop:

1. Switching off of welding loads
2. Andon switched off
3. Panel AC switched off
4. PLC based Fans & Lights

D] Compressor:

1. Only emergency compressor run

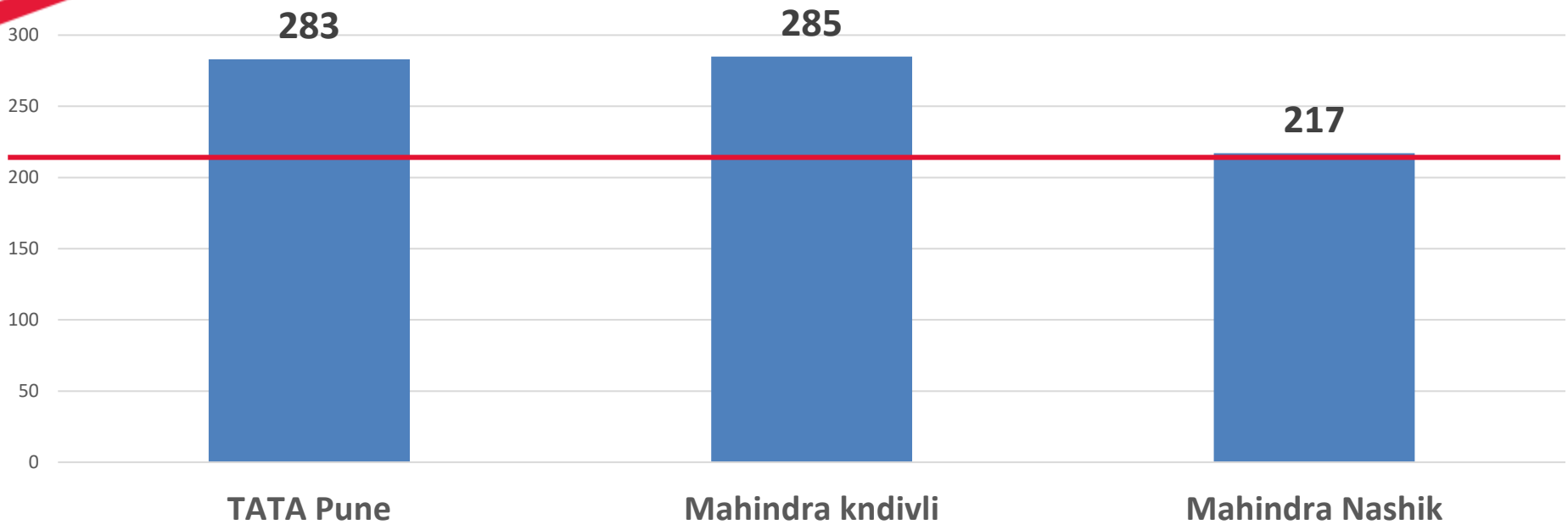
E] Others:

Office on single switch - Supply kept off for Offices (Lights, Fan, AC)

Power consumption reduced by 4262 Units/NPD

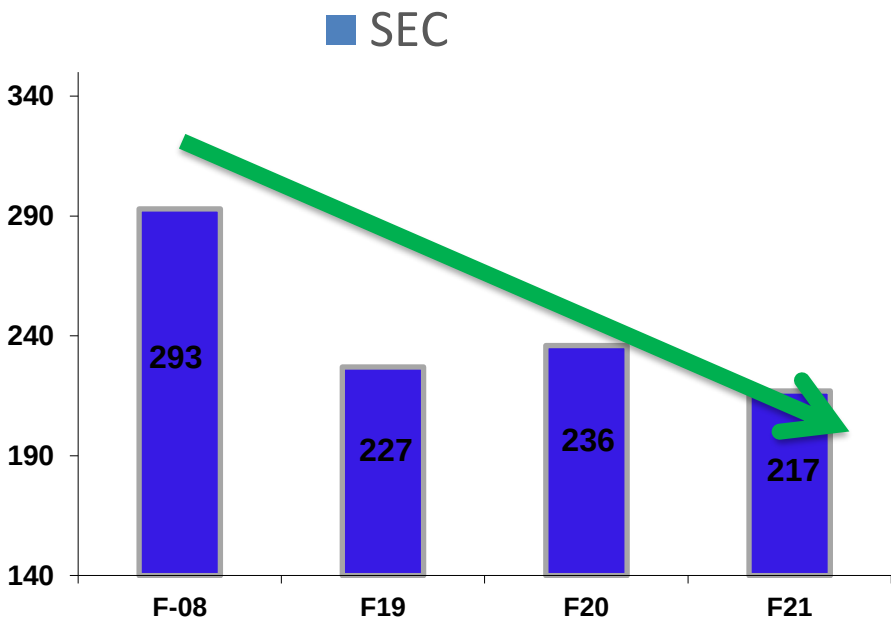
Benchmarking of Energy Conservation Norms

National level Bench Marking



Mahindra Rise.

Nashik Plant

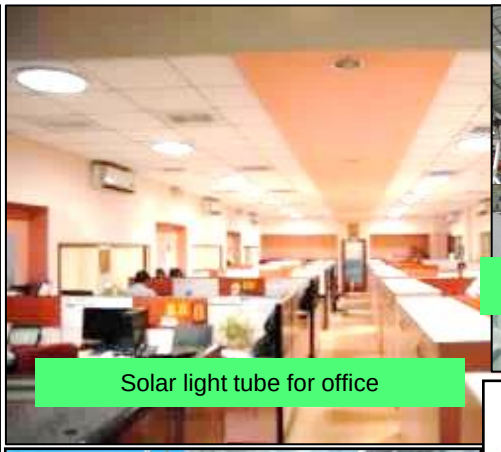


26% Reduction over F-08

Renewable Energy

- Capacity of Plant : **302 KWp**
- Installation : Carport Structure
  Generation(Annual) : 4.08 Lacs KWh
- Annual CO_2 reduction : 383 tons

Solar Power



Solar light tube for office

Solar sky light for shop floor

Solar lighting for office

Solar Water Heating system

Wind Power

- Capacity of Plant : 1050 KW
- Installed : At Jath Sangli
- Generation(Annual) : 20 Lacs KWh
- Annual CO_2 reduction : 1880 tons

Solar diesel dispensing

Solar lighting for ETP & RWH

Renewable Energy

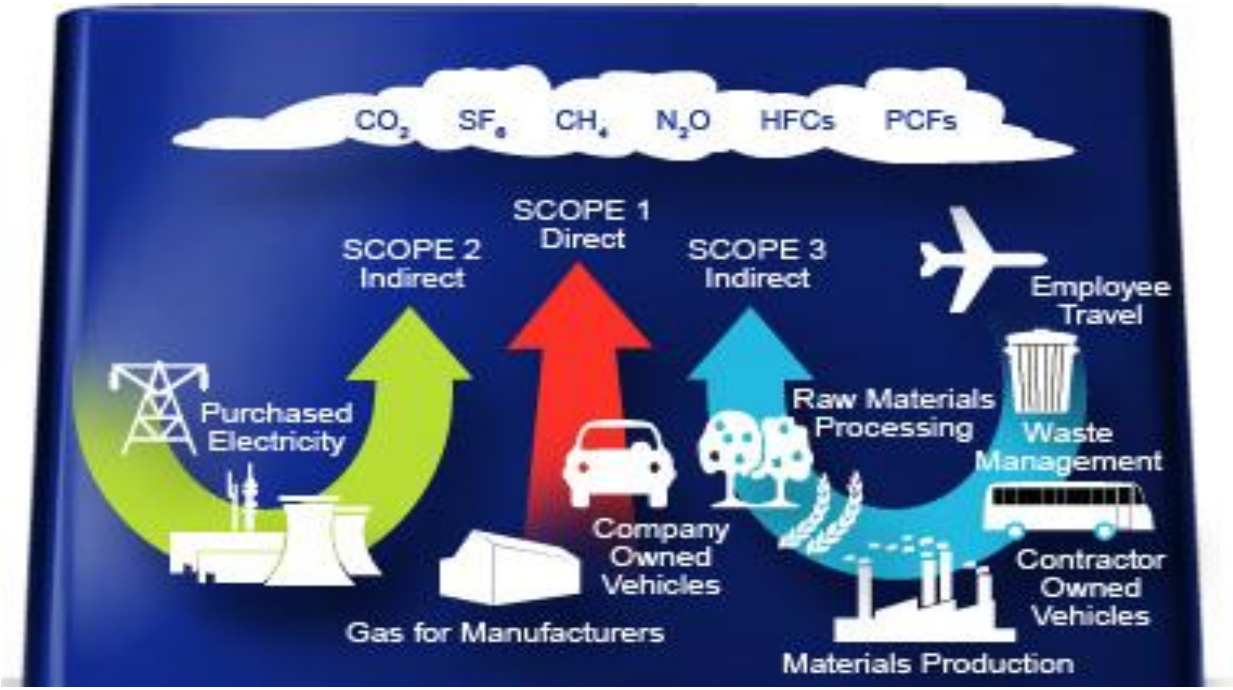
Year	Technology (Electrical)	Type of Energy	Onsite/Offsite	Installed Capacity (MW)	Generation (million kWh)	% of overall electrical energy
FY 2018-19	Windmill+Photovoltaic Solar	Windmill, Solar	Off-site Windmill +Onsite Solar	1.35	2.3	6%
FY 2019-20	Windmill+Photovoltaic Solar	Windmill, Solar	Off-site Windmill +Onsite Solar	1.35	2.6	7%
FY 2020-21	Windmill+Photovoltaic Solar	Windmill, Solar	Off-site Windmill +Onsite Solar	1.39	1.9	7%

Group Captive Solar approved - 22 Million KWH/Annum

22% in F22 & 52% of Total Consumption in F23

GHG INVENTORISATION

Year	Scope 1 + Scope 2 Kg CO2/ Eq. Vehicle
FY 2017-18	0.18
FY 2018-19	0.17
FY 2019-20	0.16
FY 2020-21	0.16



Green SCM Initiatives/Waste Utilization

Non Hazardous waste

Theme: Elimination Of wood Packaging by returnable crate

Wood Packaging

Recyclable Packaging

Theme: Corrugated Packaging Replaced By Returnable Trolley Of radiator .

Corrugated Packaging

Recyclable Trolley

Theme: Elimination of Polybag Packaging From Deflector.

Polybag Packaging

Without Packaging

Reduce

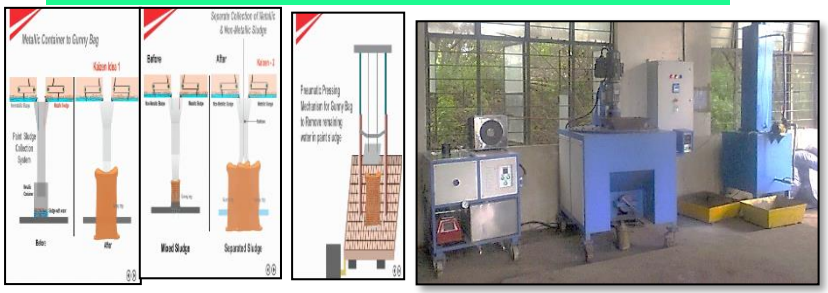
Reuse

Hazardous waste

Manual to Robotic painting 23%
Reduction in paint consumption

Spent solvent Recovery & Reuse
1.8 lac lit /year saving fresh solvent

Recycle



Eliminate

Dewatering & drying of paint sludge
Recycling project in process

Packaging Waste Reduction

Eliminate….by Accepting No Limits

Theme: Elimination Of wood Packaging by returnable crate

Wood Packaging

Recyclable

Theme: Elimination of Corrugated Packaging By Bubble Bag .

Bubble Bag

81 KAIZENs Implemented

Theme: Elimination of Wooden Pa… Steering Column By Plastic Crate…

…tion of Polybag Packaging From Deflector.

Wooden Packaging

Recyclable Packaging

Polybag Packaging

Without Packaging

Packaging Waste Reduction

Recycle Packaging Of Instrumental panel

Theme: Corrugated Packaging of Footstep Replaced with Recyclable Packaging

Corrugated Packaging

Recyclab[illegible]

53 KAIZENs Implemented

Theme: Corrugated Packaging Replaced By Returnable Trolley Of radiator .

[illegible]ckaging

Recyclable Trolley

Theme: Corrugated Packaging of IP Replaced with Recyclable Packaging

Corrugated Packaging

Recyclable Packaging

Theme: Wooden Packaging Replaced By Returnable crates .

Wooden Packaging

Recyclable Packaging

Green Building Certification

Existing Features

- Landscape area with native plants
- Waste management
- LED lights
- Ecofriendly refrigerants
- On site & off site solar
- Use of treated water for irrigation
- Tobacco free environment

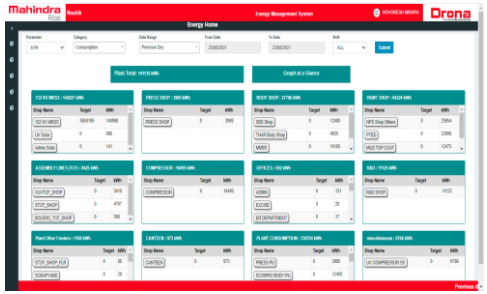
Implemented Features

- Energy Recovery Ventilators for fresh air supply
- Water aerators and waterless urinals
- High SRI paints on roof
- Submetering
- Rain water harvesting
- Education signage
- Reuse of different plant waste in seating, table top, etc

IGBC

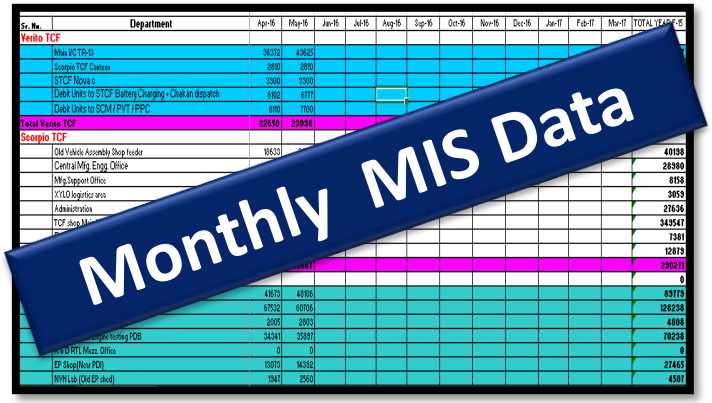
Platinum Rating - 2021

Monitoring & Measurement



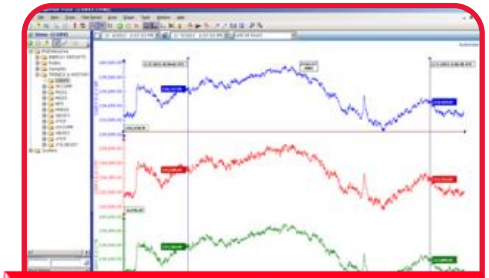
Substation wise Online monitoring

LNG Monitoring with SCADA



Online Trend Analysis

100% Water Monitoring



Trend Analysis

Compressed Air Monitoring with Flow Meters

Water positive plant

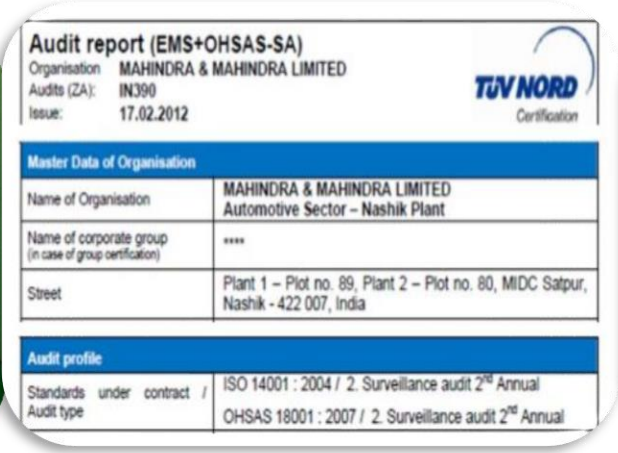
Water positive plant

- Water beyond fence
  - Check Dams
    - 
    - 7 Villages, 7 check Dams
  - River widening
    - 
    - 7 Villages
  - Water reservoir
    - 
    - 1 village
- Water within fence
  - Rain water harvesting
    - 
    - Pond for rain water harvesting

Water Positive Plant

Assurance & Sustenance

Daily Work Management



Audit report (EMS+OHSAS-SA)

Organisation MAHINDRA & MAHINDRA LIMITED
Audits (ZA): IN390
Issue: 17.02.2012

TÜV NORD Certification

Master Data of Organisation	
Name of Organisation	MAHINDRA & MAHINDRA LIMITED Automotive Sector – Nashik Plant
Name of corporate group (in case of group certification)	****
Street	Plant 1 – Plot no. 89, Plant 2 – Plot no. 80, MIDC Satpur, Nashik - 422 007, India

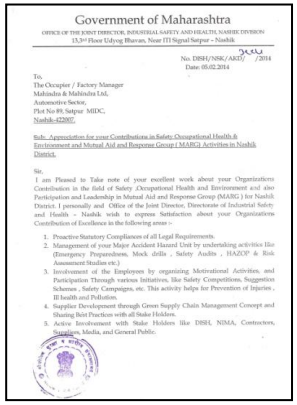
Audit profile	
Standards under contract / Audit type	ISO 14001 : 2004 / 2. Surveillance audit 2nd Annual OHSAS 18001 : 2007 / 2. Surveillance audit 2nd Annual

TUV Audits

TPM Assessment

KPMG Assessment

BEE, CII & MEDA Awards



Government of Maharashtra

OFFICE OF THE JOINT DIRECTOR, INDUSTRIAL SAFETY AND HEALTH, NASHIK DIVISION
13,3rd Floor Udyog Bhavan, Near ITI Signal Satpur – Nashik

No. DISH/NSK/ARD/ /2014
Date: 05.02.2014

To,
The Occupier / Factory Manager
Mahindra & Mahindra Ltd,
Automotive Sector,
Plot No 89, Satpur MIDC,
Nashik-422007.

Sub: - Appreciation for your Contributions in Safety, Occupational Health & Environment and Mutual Aid and Response Group (MARG) Activities in Nashik District.

Sir,

I am Pleased to Take note of your excellent work about your Organizations Contribution in the field of Safety ,Occupational Health and Environment and also Participation and Leadership in Mutual Aid and Response Group (MARG) for Nashik District. I personally and Office of the Joint Director, Directorate of Industrial Safety and Health – Nashik wish to express Satisfaction about your Organizations Contribution of Excellence in the following areas :-

1. Proactive Statutory Compliances of all Legal Requirements.
2. Management of your Major Accident Hazard Unit by undertaking activities like (Emergency Preparedness, Mock drills , Safety Audits , HAZOP & Risk Assessment Studies etc.)
3. Involvement of the Employees by organizing Motivational Activities, and Participation Through various Initiatives, like Safety Competitions, Suggestion Schemes , Safety Campaigns, etc. This activity helps for Prevention of Injuries , Ill health and Pollution.
4. Supplier Development through Green Supply Chain Management Concept and Sharing Best Practices with all Stake Holders.
5. Active Involvement with Stake Holders like: DISH, NIMA, Contractors, Suppliers, Media, and General Public.

Recognitions

EC Week Celebration

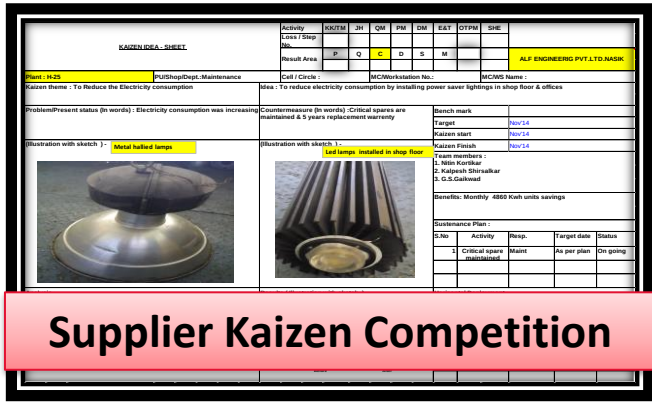
EC Oath with HOD's

EC WEEK Banners

Energy Efficient Product Display & Sale

Zero Compressed-Air Leakage Drive

Wall Painting & Poster Display



Supplier Kaizen Competition

Implementation & Monitoring

Recording & monitoring i4 ideas through specially developed software

Implementation through CFT approach.

Quarterly review of i4 teams by Plant Head.

Future Plans about Energy Conservation

Future Projects

EC Motor for Blowers

Solar Group Captive

Energy Efficient Compressor

IE3 motors for ASU


Thank You