TATA MOTORS
Connecting Aspirations

TATA

Effect of Environmental management initiatives on life cycle assessment – Typical PV Model

Asmita Sathaye, Drishya Chandran, Alka Kumari & Dipti Kakade

ENGINEERING RESEARCH CENTER

TATA MOTORS LTD.

Issue On ELV Treatment And Substance of Concern (SoC)

Motor vehicles which have reached the end of their useful lives created 7 lakh waste in 2015 and predicted 28 lakh by 2021 in India

Asia's biggest Mayapuri Scrap yard

Table 1: CPCB-GIZ estimate of ELVs for 2015 and projected for 2025

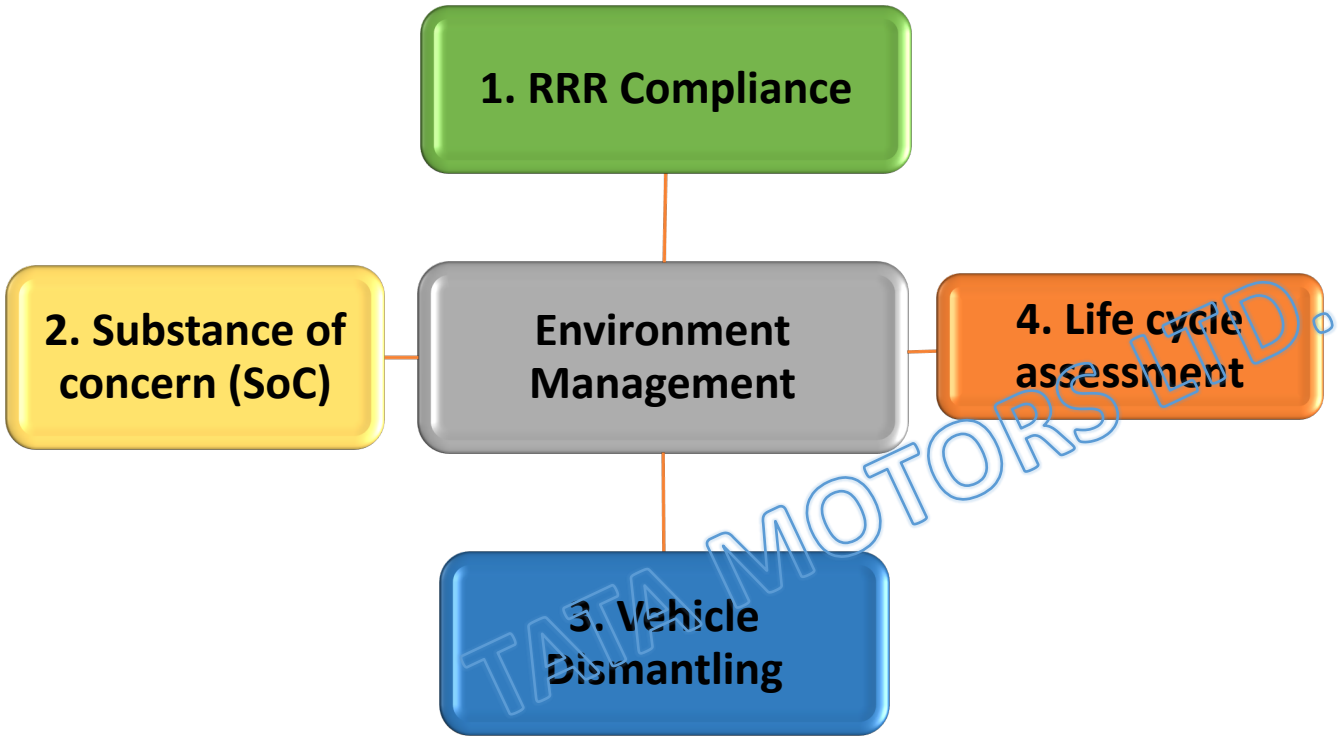
Type of vehicle	Total ELV count in 2015	Total ELV count in 2025
Two-wheelers	7,289,442	17,723,951
Three-wheelers	262,439	757,932
Private cars/SUVs	721,558	2,809,966

Increased numbers of ELVs in India causes major environmental issues.

Serious concerns about Li-ion batteries recycling - Toxic, Hazardous & flammable materials -Negative Business Case for Recycling, No recycling Infrastructure in India

Global Health & Hazard Issues due Hazardous Materials (Lead, Mercury, Chromium, Cadmium, PFOA,PCB etc)

Effect of Environmental Management Initiatives On Life Cycle Assessment



RRR Compliance:

a) Tata Motors Vehicles are Designed for recycling – Tata Motors typical PV model has 93 % of recyclability and 95 % of recoverability rate as per ISO 22628

b) Developed advanced In house substance management system "ENVIRONEXT" to ensure and monitor vehicle level RRR and SOC compliance

Substance of concern (SoC):

Tata Motors is currently complying all global and Indian regulatory requirements on substance of concerns (SoC)

Vehicle Dismantling:

Tata Motors is the First Indian OEM to have vehicle Dismantling information in Public Domain

VEHICLE LIFE CYCLE ASSESSMENT (LCA):

Estimated CO_2 footprint in the entire life cycle of typical PV model and effect of environment management initiatives – CO_2 foot print reduction of 6 Tons /Vehicle

1. RRR: Design For Recycling Guideline For Tata Motors

6. DESIGN FOR RECYCLING GUIDELINES FOR PARTS / ASSEMBLIES

Following generic guidelines should be considered during the design phase of th mponent in order to improve the dismantle-ability, recyclability.

6.1 Removal of Operating Fluids :

a) Operating fluids should be quick and easy to dra

b) Operating fluids must be capable of drain dependent of one another.

6.2 Disassembly / Dismantling :

a) Promote Standardisation of f rs size and optimize number of fasteners.

b) Minimize the type and d t size fasteners within the assembly.

c) Limit the suitable f g elements to a minimum necessary to fulfil the function.

6.3 Selection of Mate

a) Avoid hazardous heavy metals as per Annex II of ELV directive 2000 /53 /EC and ANN A, Table 1 for M1 category of vehicles of AIS 129

b) Do not use asbestos.

c) Promote rationalization of the materials / material grades used i.e. reduce in the variety and grade of materials used.

Design for recycling guideline for Tata Motors

In order to comply with the set requirements, directive specifies that the aspects for meeting the recyclability, recoverability targets should be considered during the design stage of the vehicle.

TATA MOTORS
Connecting Aspirations

1. RRR: Solution on ELV treatment - VEHICLE LEVEL RECYCLABILITY & RECOVERABILITY

TATA

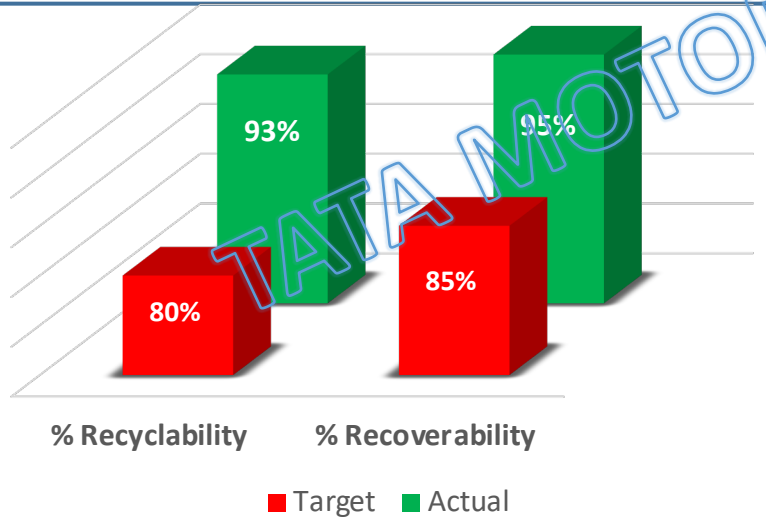
' Reuse': Operation by which components of end-of-life vehicles are used for the same purpose for which they were conceived.

'Recycling': Reprocessing of the material for the original purpose or for other purposes but excluding energy recovery.

'Recovery' : Reprocessing of the material for the original purpose or for other purposes including energy recovery.

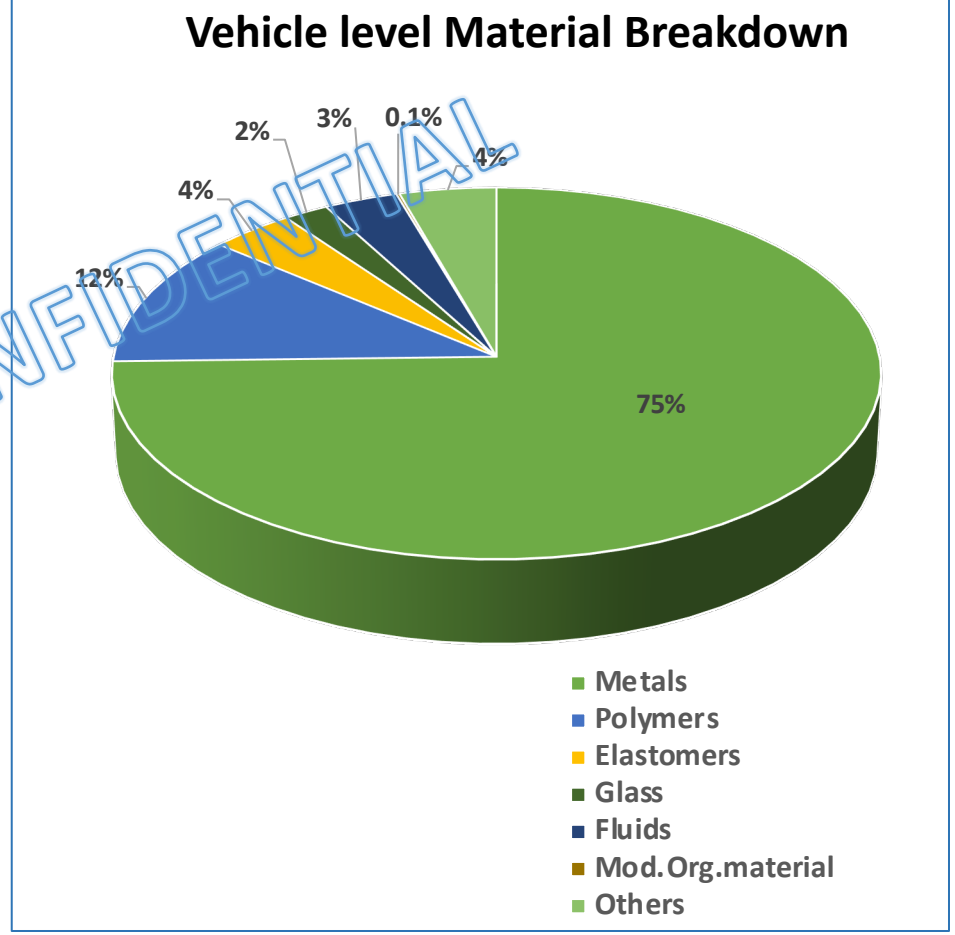
% Recyclability : Reuse + Recycling (Target is 80%)

% Recoverability : Reuse + Recycling + Energy Recovery (Target is 85%)



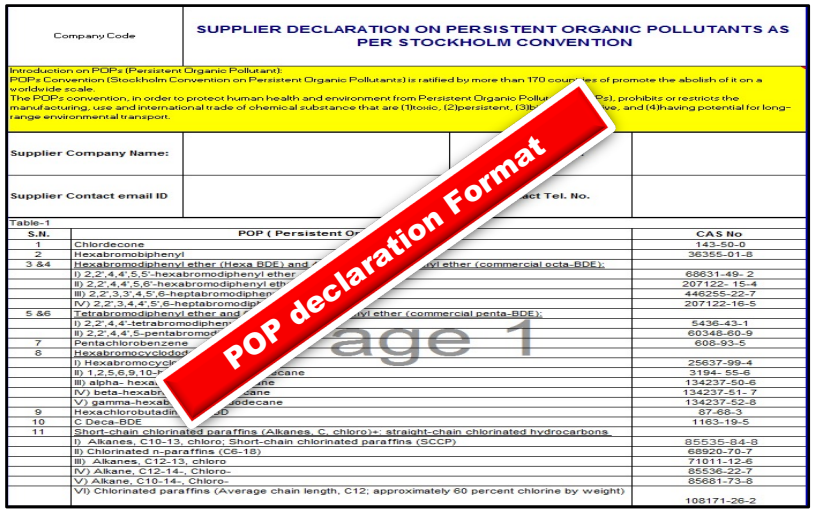
RRR Result of typical PV model as per ISO 22628

RRR Calculation-typical PV model as per ISO 22628



2. SUBSTANCE OF CONCERN(SoC) COMPLIANCE

Tata Motors Proactive in meeting all global & national regulatory requirements.



Company Code

SUPPLIER DECLARATION ON PERSISTENT ORGANIC POLLUTANTS AS PER STOCKHOLM CONVENTION

Introduction on POPs (Persistent Organic Pollutant):
POPs Convention (Stockholm Convention on Persistent Organic Pollutants) is ratified by more than 170 countries of promote the abolish of it on a worldwide scale.
The POPs convention, in order to protect human health and environment from Persistent Organic Pollutants (POPs), prohibits or restricts the manufacturing, use and international trade of chemical substance that are (1)toxic, (2)persistent, (3)bioaccumulative, and (4)having potential for long-range environmental transport.

Supplier Company Name:

Supplier Contact email ID

Table-1

S.N.	POP (Persistent Or	CAS No
1	Chlordecone	143-50-0
2	Hexabromobiphenyl	36355-01-8
3 &4	Hexabromodiphenyl ether (Hexa BDE) and	
	i) 2,2',4,4',5,5'-hexabromodiphenyl ether	68631-49- 2
	ii) 2,2',4,4',5,6'-hexabromodiphenyl eth	207122- 15-4
	iii) 2,2',3,3',4,5',6-heptabromodiphen	446255-22-7
	iv) 2,2',3,4,4',5',6-heptabromodip	207122-16-5
5 &6	Tetrabromodiphenyl ether and	
	i) 2,2',4,4'-tetrabromodiphen	5436-43-1
	ii) 2,2',4,4',5-pentabromod	60348-60-9
7	Pentachlorobenzene	608-93-5
8	Hexabromocyclodo	
	i) Hexabromocyclo	25637-99-4
	ii) 1,2,5,6,9,10-H	3194- 55-6
	iii) alpha- hexa	134237-50-6
	iv) beta-hexabr	134237-51- 7
	v) gamma-hexab	134237-52-8
9	Hexachlorobutadi	87-68-3
10	C Deca-BDE	1163-19-5
11	Short-chain chlorinated paraffins (Alkanes, C, chloro)+: straight-chain chlorinated hydrocarbons	
	i) Alkanes, C10-13, chloro; Short-chain chlorinated paraffins (SCCP)	85535-84-8
	ii) Chlorinated n-paraffins (C6-18)	68920-70-7
	iii) Alkanes, C12-13, chloro	71011-12-6
	iv) Alkane, C12-14-, Chloro-	85536-22-7
	v) Alkane, C10-14-, Chloro-	85681-73-8
	vi) Chlorinated paraffins (Average chain length, C12; approximately 60 percent chlorine by weight)	108171-26-2

POP declaration Format

(Note: DECLARATION TO BE FILED BY THE AUTHORISED REPRESENTATIVE OF THE COMPANY ON THEIR COMPANY LETTER HEAD)

Voluntary declaration On RESTRICTION OF HEAVY METALS

To,
The Executive Director, Society of Indian Automobile Manufacturers (SIAM)

Subject: Voluntary declaration to meet upcoming End-of-Life Vehicle (AIS ... on Restriction of Heavy Metals.

We hereby declare that in order to ensure Heavy Metal Restricti... of AIS 129, below systems /processes are put in place/followed by our c...

(Tick whichever is applicable)

1. **Material Data Collection system**
   IMDS / In house system ... details for in-house system)
2. **Process**
   i) ***In-house sta... ons
   ii) ***Engineeri... ngineering Drawings)
   iii) Commercia... mmunicate requirements with suppliers (e.g. Rec...)/Supply agreement/Declaration/Verification)
3. **Audit**
   i) ... ertificate of compliance for Preliminary assessment as per ... f Life regulation 2005/64/EC' issued by authorized regulatory ...
   ii) ***... revious Whole Vehicle Type Approval (WVTA) certification as per European 'RRR (Reuse, recyclability & Recoverability) regulation 2005/54/EC' Issued by authorized regulatory authority.
   (Mention Models) _____

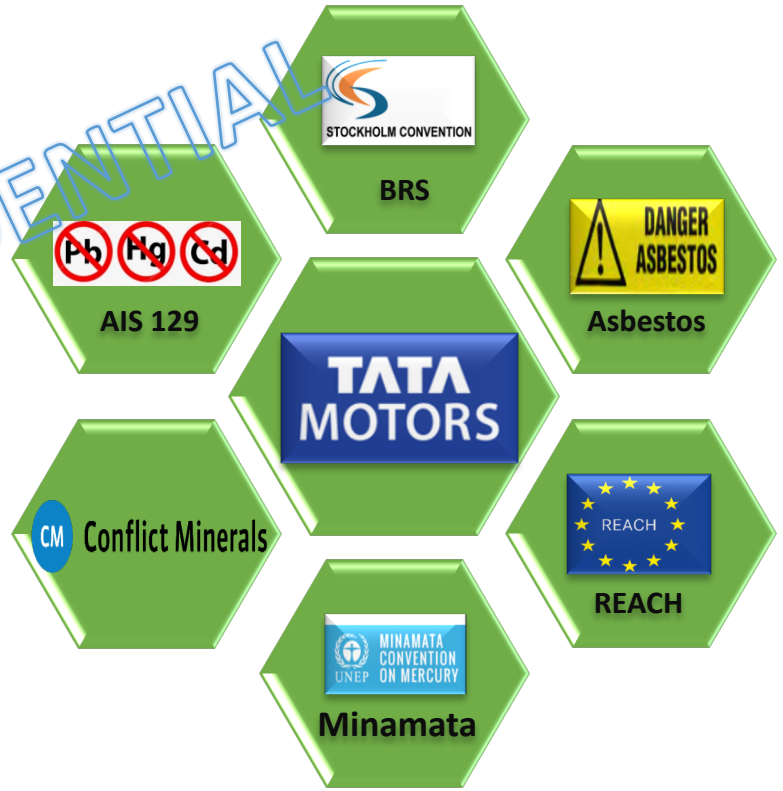
Note (***) : For all ticked boxes, evidences / back-up documents are to be provided to SIAM. These back-up documents are strictly and entirely confidential between SIAM (and the manufacturer)

(Signature of the Authorized person): _____
(Name in Block Letters): _____
(Designation of the signatory): _____
(Date): _____

Haz Mat declaration Format

Substance of Concern

Tracking & preventing the use of hazardous and/or banned materials in vehicles.



- **With alternate material strategy in place at our supply chain, we are meeting all upcoming global & national regulations.**
- Tata Motors all PVBU models comply Hazardous Material Compliance for lead, Mercury, chromium & cadmium.
- Being leading Indian vehicle manufacturer, we take pride in providing mentoring & guiding. Our models does not only meet upcoming regulations on hazardous heavy metals & Persistent Organic pollutants, but being role to entire Indian Automobile Industry thro" SIAM.

3. VEHICLE DISMANTLING INFORMATION (IDIS)

IDIS(International Dismantling Information System) is the central repository for treatment operators providing information on all areas of ELV

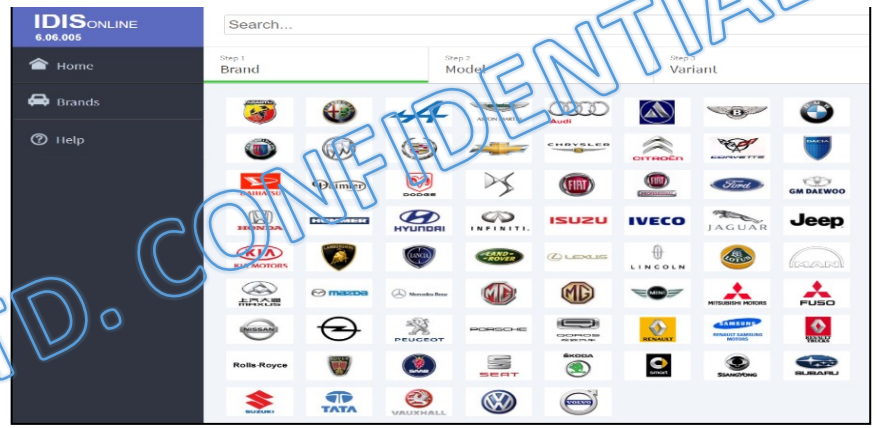
Safety Information
Common and model specific information on HV, Pyrotechnics, Gas, Air Suspension, etc...

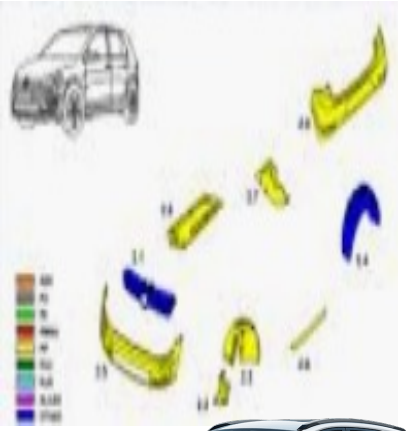
Practical Information
Easy and fast identification of plastic parts, incl. material family, tools, fixings...

- Batteries
- Pyrotechnic
- Fuel
- A/C
- Drainage
- Catalyst
- Controlled Parts
- Tyres
- Other Pre-treatment
- Dismantling

TATA MOTORS unique Approach over the other OEMS

Tata Motors is the First Indian OEM to have vehicle Dismantling information in Public Domain.

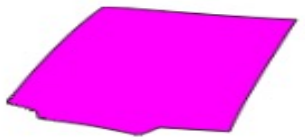


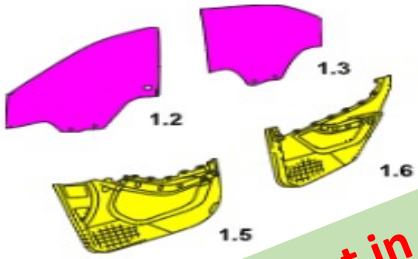


IDIS ONLINE

Nexon

ABS
PA
PE
PMMA
PP
PVC
PUR
GLASS
OTHER





First in India!

4. Life Cycle Assessment – Scope And Boundary Conditions

Life cycle assessment (LCA) : Methodology used to evaluate the overall environmental impacts of a product's life cycle, starting from extraction of natural resources, production and use phase of the product until its final disposal at end-of-life.

➢ Goal

The goal of the Life Cycle Assessment are,

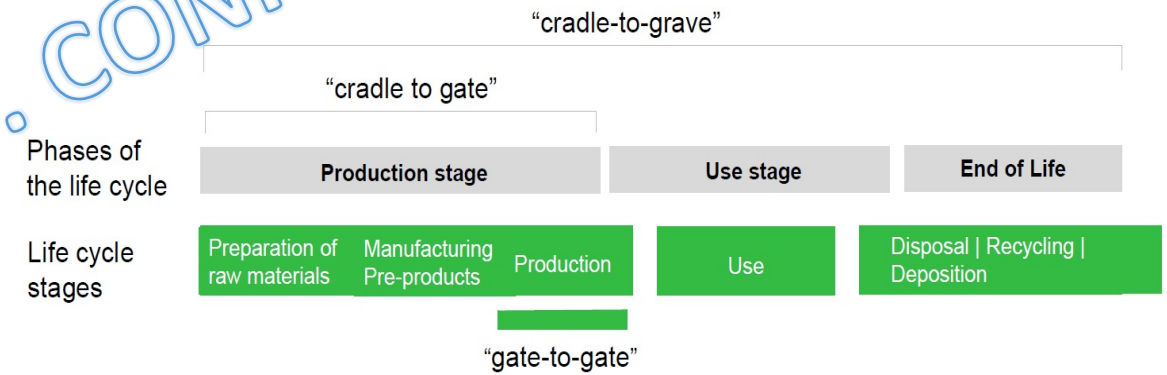
- Establishes and benchmark the environmental impact of typical PV model across its life cycle phases
- Effect of environment management initiatives on CO2 foot print at EOL phase

➢ Assumption in Use Phase

- KM Travelled in it's complete life span : As per Industry norms
- ELV years: As per Industry norms
- Emission Factor: India

➢ Boundary Condition

- Cradle to Grave
- Phases of Life Cycle : Raw material , manufacture , Use & EOL

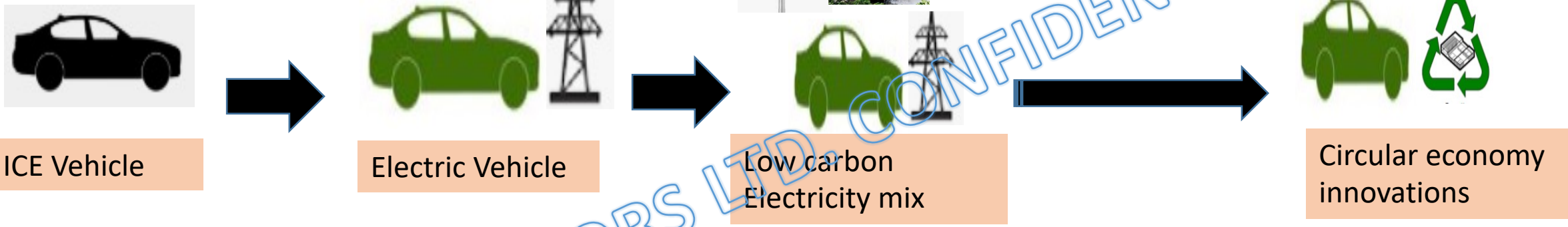


Cradle to Grave phases as per ISO 14040/44

TATA MOTORS
Connecting Aspirations

Road Map for Automotive Decarbonization

TATA

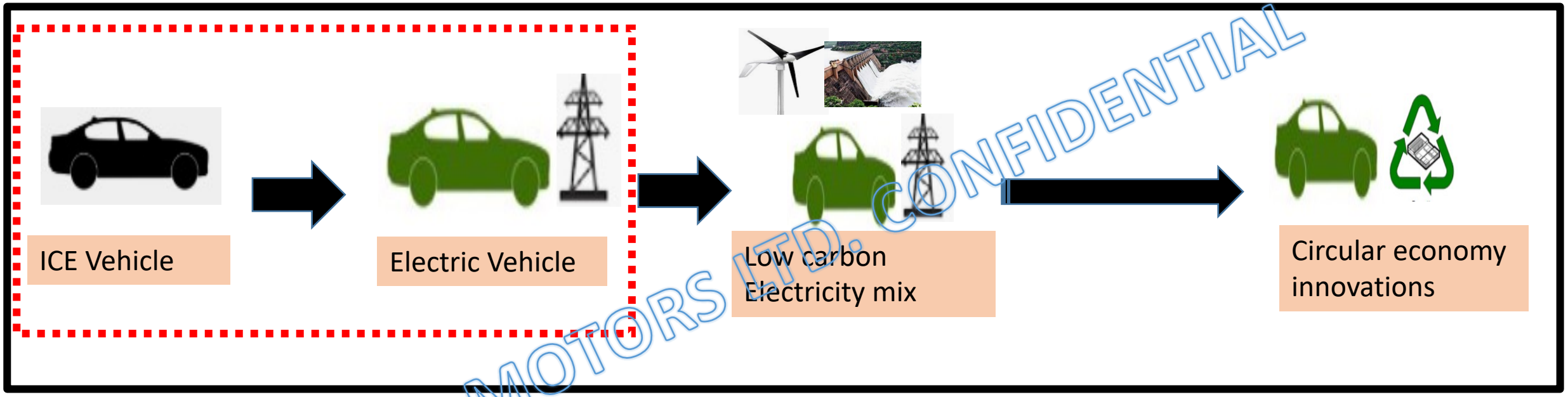


- **Circular Car** is a theoretical car that has maximum material efficiency
- Circularity and Electrification are core strategies to decarbonize the car

TATA MOTORS
Connecting Aspirations

Road Map for Automotive Decarbonization

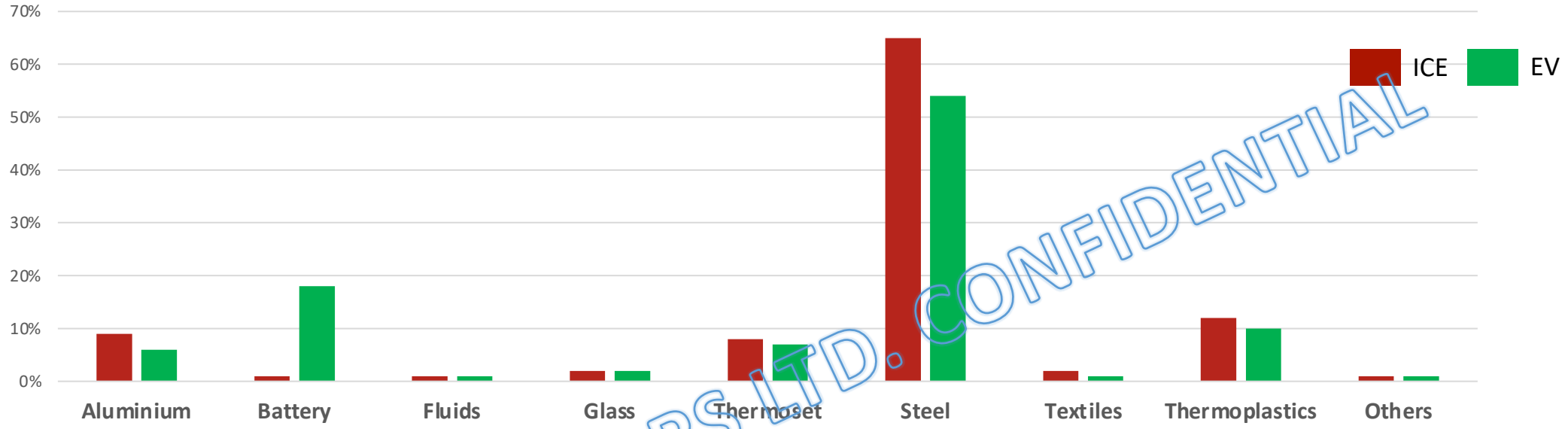
TATA



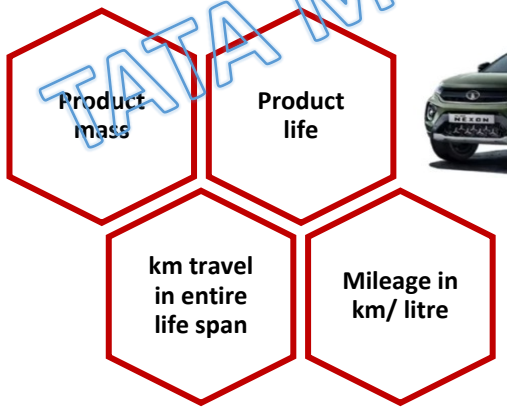
- Reduction in CO_2 footprint in use phase during ICE to EV transition
- Increase in CO_2 footprint in material and manufacturing phase because of HV battery manufacturing

Life Cycle Assessment – Inventory Collection

Material weight comparison table - ICE VS EV

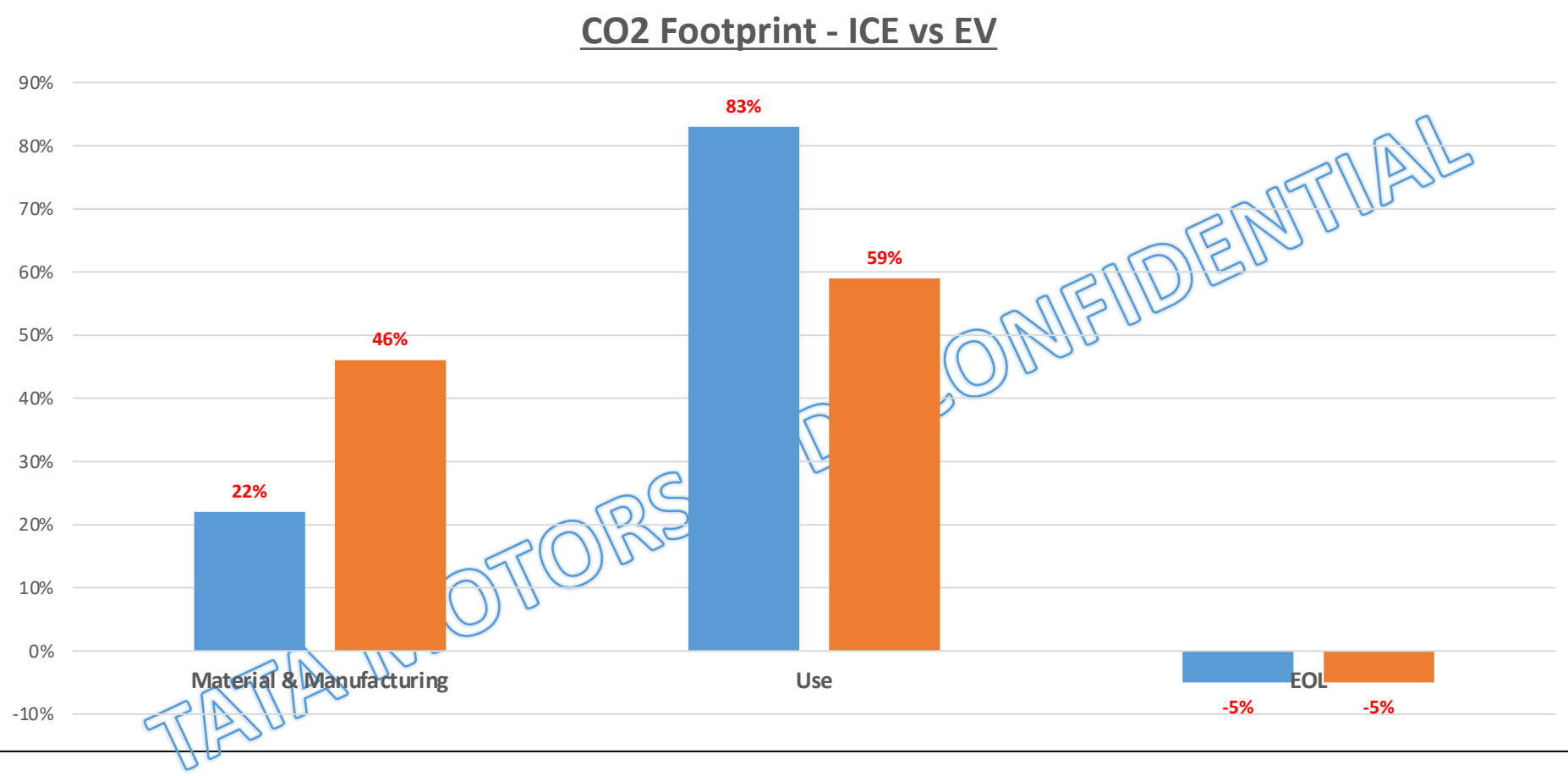


	Aluminium	Battery	Fluids	Glass	Thermoset	Steel	Textiles	Thermoplastics	Others
ICE	9%	1%	1%	2%	8%	65%	2%	12%	1%
EV	6%	18%	1%	2%	7%	54%	1%	10%	1%



- Used IMDS system and Tata Motors developed IT system to collect and integrate material and part details for LCA study.
- Contacted 250 Suppliers for approximately 3000 parts

Life Cycle Assessment Result – ICE vs EV (2021 Yr)

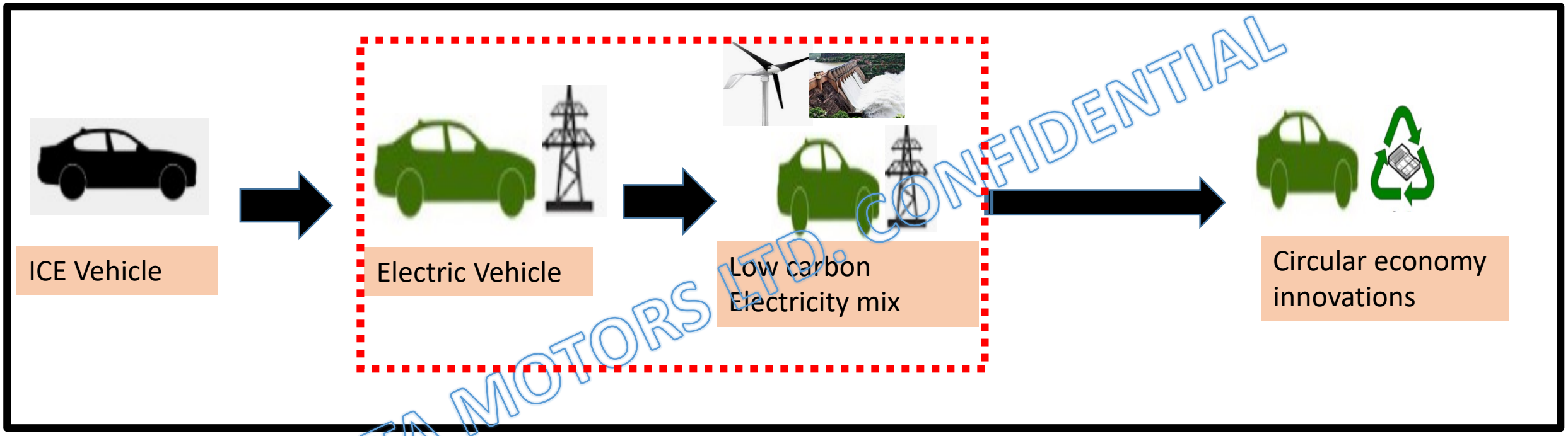


- 24% CO2 footprint reduction in use phase
- Use phase is the major CO2 footprint contributor among all life phases for both ICE & EV
- For EV, Use phase CO2 footprint depends on electricity emission factor (Electricity grid mix) on specific geographic location
- Indian Electricity Grid Mix based (Coal @ 60%major).

TATA MOTORS
Connecting Aspirations

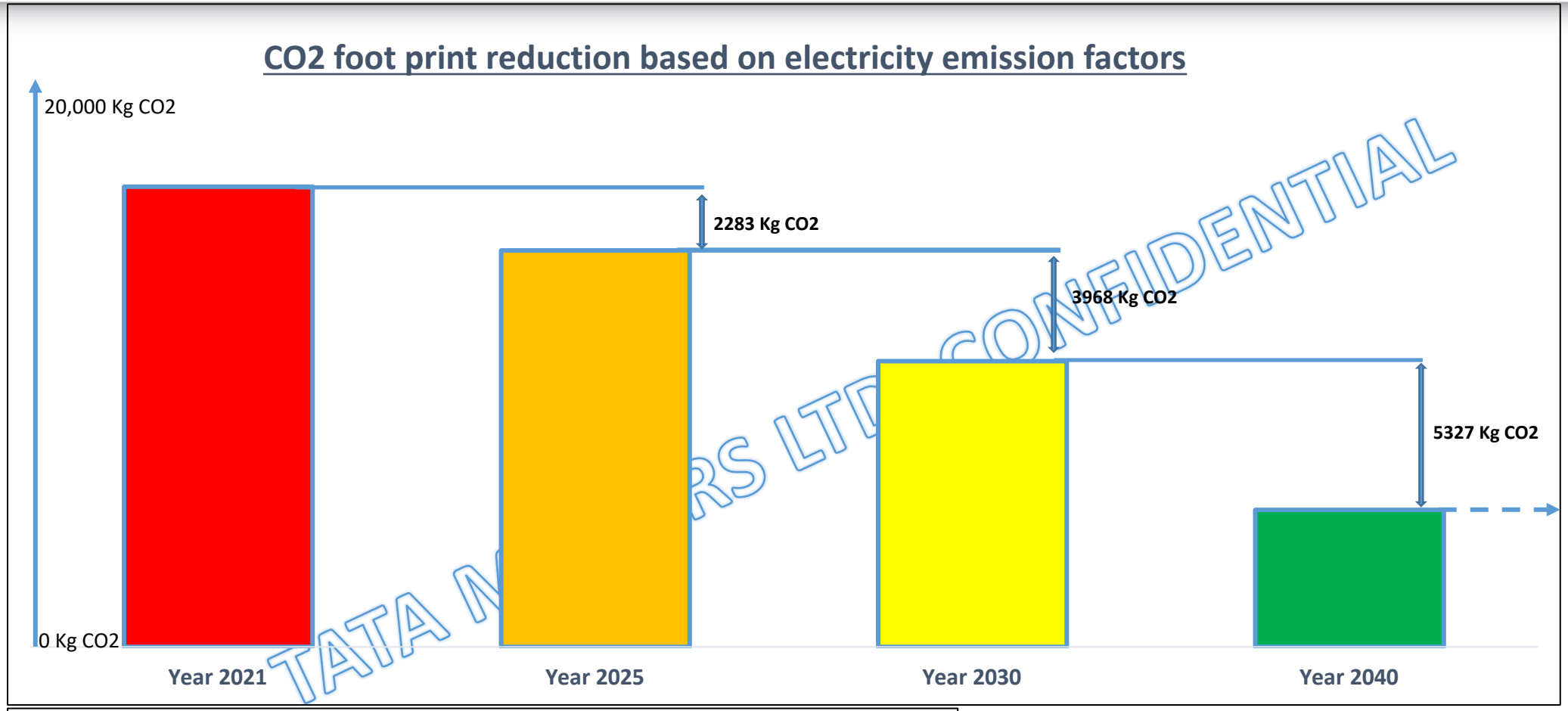
Road Map for Automotive Decarbonization

TATA



- Electricity generation has to move towards more renewable resources in order to achieve this targets
- Increased prioritization of clean energy projects and promotion of policies that support renewable energy are helping India to develop a more efficient clean energy mix

Life Cycle Assessment Use Phase – EV (Future)



- Reduction in CO2 emission in use phase from 2021 to 2040 by reducing electricity emission factor.
- Currently Indian Electricity Grid Mix based (Coal @ 60%major).
- GaBi emission -
- For EV, Use phase CO2 footprint depends on electricity emission factor (Electricity grid mix) on specific geographic location

Year	2021	2025	2030	2040
Emission Factor (Kg CO2)	0.91	0.784	0.565	0.271

*Data from – GaBi Tool

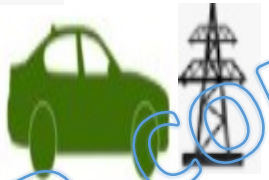
TATA MOTORS
Connecting Aspirations

Road Map for Automotive Decarbonization

TATA

ICE Vehicle

Electric Vehicle



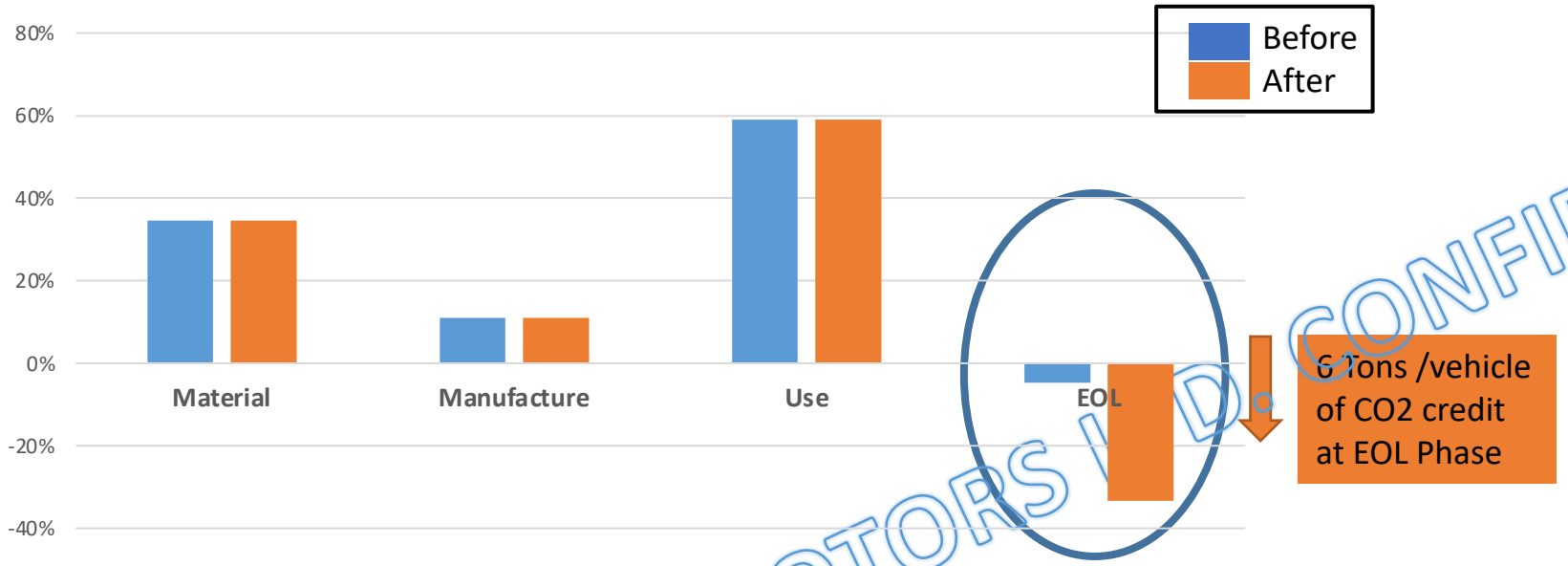
Low carbon Electricity mix

Circular economy innovations

- **Circular Car** is a theoretical car that has maximum material efficiency
- Circularity and Electrification are core strategies to decarbonize the car

CO2 Emission Reduction Due to ENV Initiatives at EOL

Reduction in CO2 footprint with ENV Mgmt. Initiatives



- ✓ By improving recyclability rate for complete vehicle
- ✓ Implementing design for recyclability
- ✓ Publishing dismantling information on public domain
- ✓ Battery recyclability

Life Cycle Assessment Results Shows Significant amount of CO2 Emission Reduction(6 Tons /Vehicle Co2 emission reduction) After Implementation of green technologies such as Battery Recycling and Dismantling of Plastics and Glass at EOL phase.

TATA MOTORS
Connecting Aspirations

HUGE IMPACT : ENVIRONMENT, ECONOMICAL & SOCIAL

TATA

Intangible

Tangible

- CO2 emissions reduction
- Increase in Employment
- RRR – Cost Benefit

"Health & Hygiene" of labours in Unorganized Sector

"Project aims to save and protect environment and human beings "-To Make life for peoples living better as reduction in GHG,Toxics,Hotspot pollution play vital role.

Reduction in Landfill

6 Tons /vehicle of CO2 Reduction

662,114	6,016	535
number of smartphones charged	Pounds of coal burned	gallons of diesel consumed

Increase in Employment

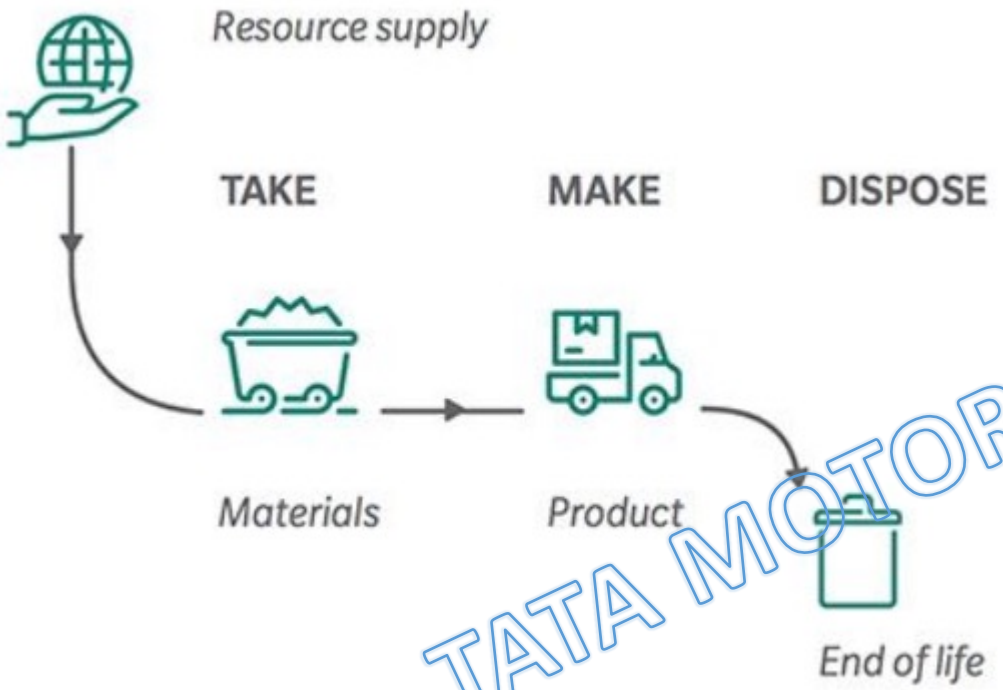
750-800 ManPower

TATA MOTORS
Connecting Aspirations

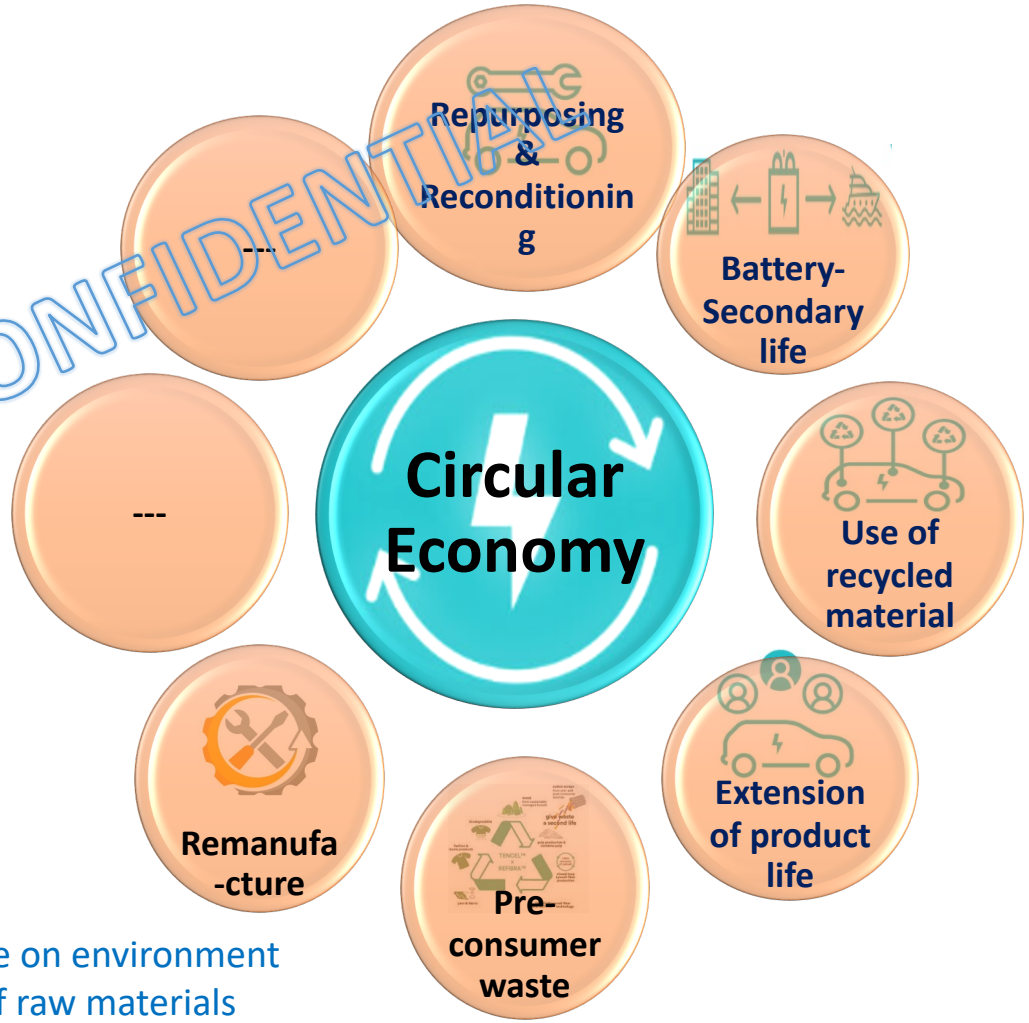
Tata Motors Approach to Circular Economy

TATA

Liner Economy



Circular Economy



- Circular economy reduces pressure on environment
- Improving security of the supply of raw materials
- Stimulating innovations
- Boosting economic growth

A sustainable and inclusive recovery is possible. We must make it happen Together