

**EVALUATION OF THE ENVIRONMENTAL IMPACTS  
OF THERMOCOL USING LIFE CYCLE  
ASSESSMENT: A STUDY IN INDIA**

---

**by**

**Assistant professor**

**Dr. P. Sridhar**

**NIT Warangal**

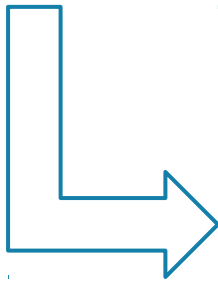
# Contents

- Introduction
- Current Status
- Methodology adopted
- Results and Discussion
- Conclusion

# Introduction

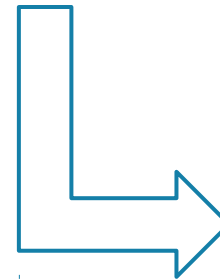
## Solid waste

### Source based classification



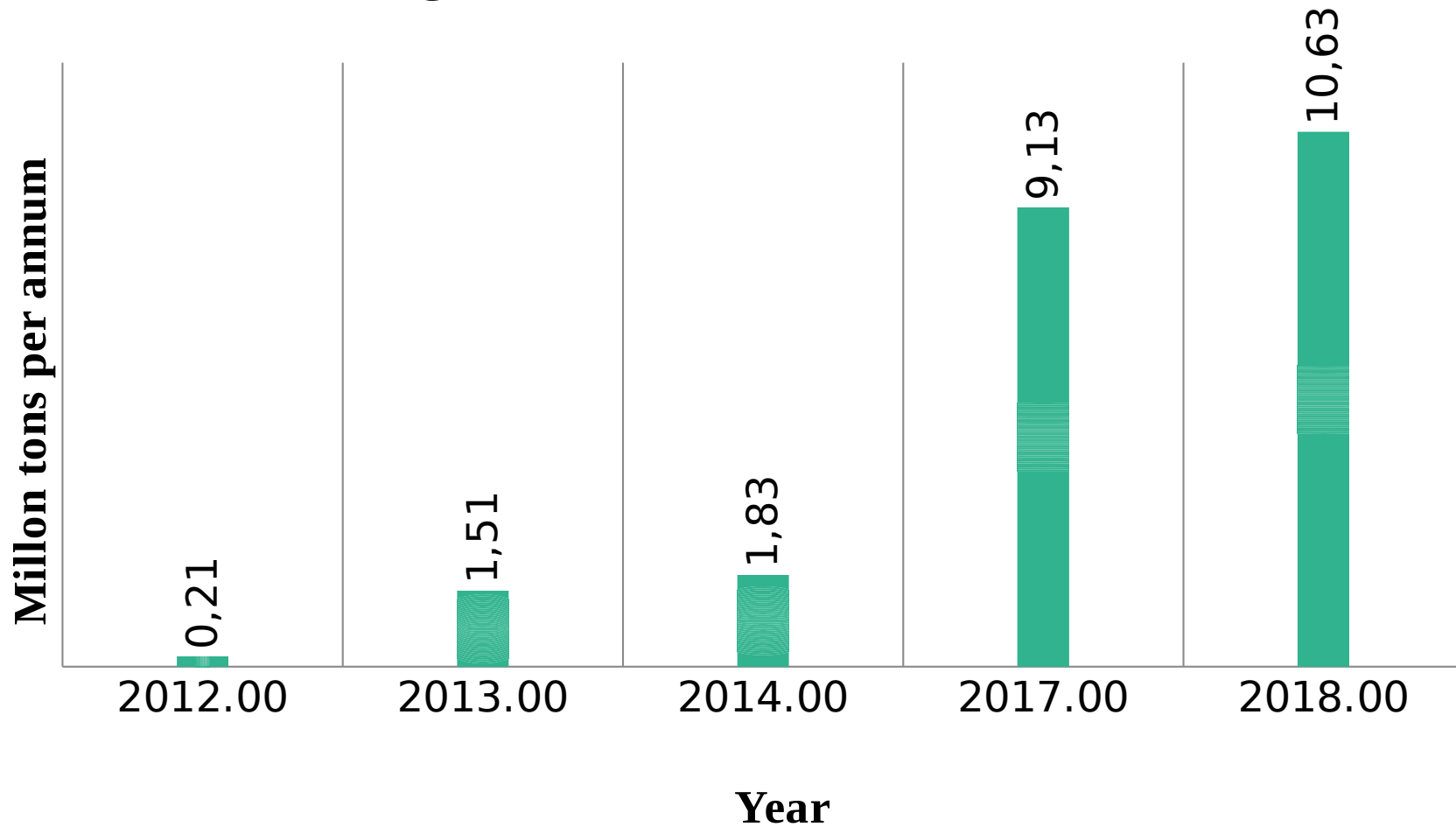
Residential  
Commercial  
Institutional  
Municipal  
Industrial  
Agricultural

### Type based classification



Garbage  
Ashes and residues  
Combustible and non-combustible wastes  
Bulky wastes  
Biodegradable and  
**Non-Biodegradable**  
wastes

## Plastic waste generated in India



# Introduction (Contd...)

- Thermocol is a high volume low density material which consists of 98% air.
- Expanded polystyrene (Thermocol) is also a type of plastic, made from monomer styrene can be solid or foamed which is clear, hard and rather a brittle packing material.
- The high density (16-640 kg/m<sup>3</sup>) and tensile strength (46-60 MPa).

## Properties

Shock absorption

Thermal absorption

Low weight

Retention of vitamin C

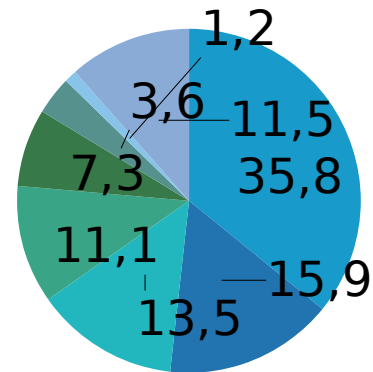
Resistance to humidity

Compressive resistance

Chemical resistance

Hygienic in nature

## Applications of Thermocol



packaging

construction

textiles

consumer

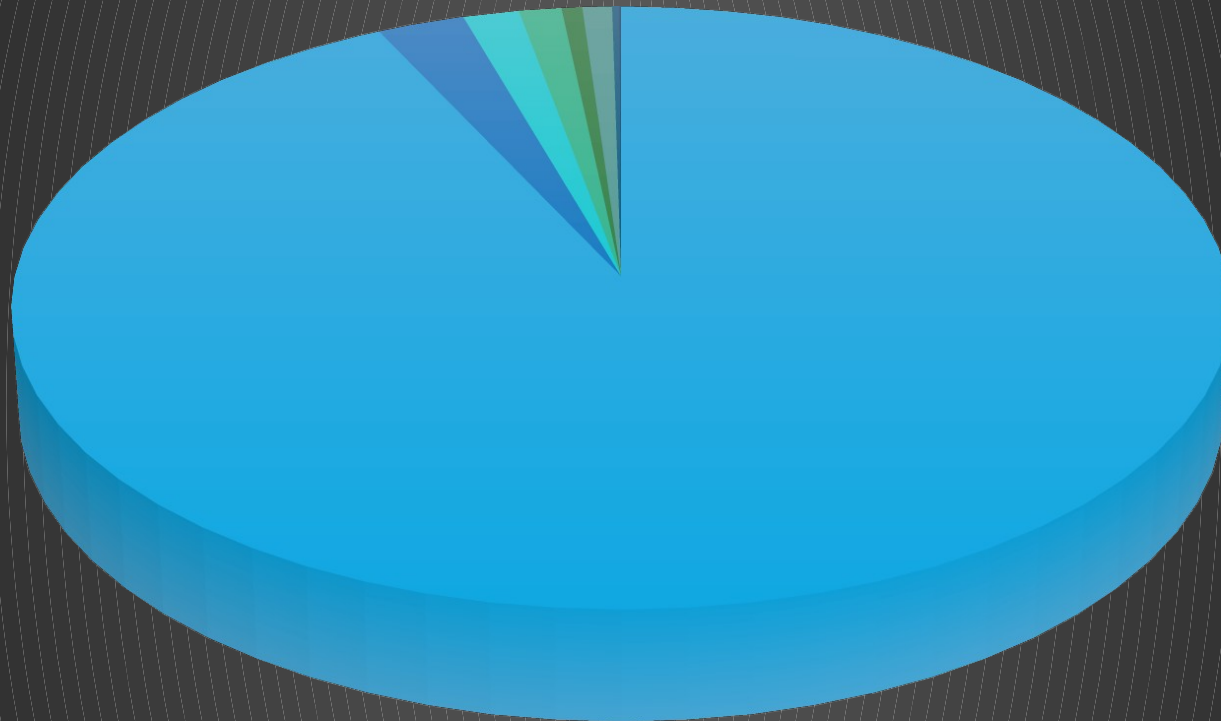
transportation

electrical

industrial

others

# Import Data of Polystyrene Beads



■ China (92.77%)      ■ Korea (2.57%)  
■ Vietnam (1.64%)    ■ Italy (1.25%)  
■ Belgium (0.602%)   ■ Spain (0.87%)  
■ Denmark (0.21%)    ■ United Arab Emirates (0.05%)

# Current Status Of Expanded Polystyrene (Disposal) In India

- **Landfill :**

EPS being non-biodegradable and resistant to degradation, they continue to remain intact in the soil, without undergoing decomposition for a long amount time.

- **Burning :**

EPS is also commonly burnt, since it is a petroleum product it naturally has a high energy content and combusts easily. But improper uncontrolled burning of EPS causes release of compounds like benzenes and Carbon monoxide which have high air pollution index.

- **Thrown in sewers and drains :**

EPS is also often thrown into the open drains from where it travels, gets collected and ends up chocking the whole drain system resulting in flood. This is a serious problem and civic authorities have just come to



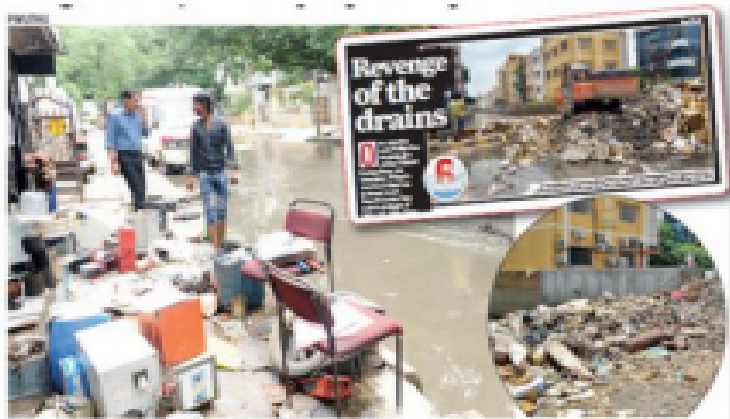
9:19, 04.08.2017 AM IST

# BangaloreMirror

MUMBAI MIRROR | AHMEDABAD MIRROR | PUNE MIRROR

## THERMOCOL IS THE NEW PLASTIC? BBMP BLAMES E-COM, SHOPPERS FOR BENGALURU'S DRAIN DAMAGE

Bangalore Mirror Bureau | Updated: Aug 17, 2017, 04:00 AM IST



**HUNG OUT TO DRY:** Damaged goods in Wilson Garden; (R) the muck in Koramangala; (top) BM's Aug 10 edition

*By Manoj Sharma*

*Three truckloads of packaging material removed from storm water drain near Sony Junction in Koramangala alone; civic body says nearby malls at fault too*

Now that the drain water has receded, reptiles driven out of houses and power lines restored, people are looking at the Bruhat Bengaluru Mahanagara Palike (BBMP) for an answer to why their localities were submerged after Monday night's torrential rain. The BBMP, however, is pointing at trucks full of plastic wraps and thermocol it dragged out of drains in Koramangala.

Monday night's heavy rain brought the city to its knees, inundating several localities, especially in the south part of the city. The civic body says it has found the culprit – the packing material used heavily in the online shipment of goods.

K Siddegowda, Chief Engineer, Storm Water Drains, BBMP, said: "At Sony World Junction [Koramangala] alone, we lifted about three loads of thermocol on Monday. It weighed about 6 tonnes and took us several hours to clear. And this is the garbage that piles up every 10 days." He said this was the case in several other parts of the city too.

- This advantageous material also has several negative effects when disposed in an unscientific manner.

## • LIFE CYCLE ANALYSIS (LCA)

1. LCA generally gives a complete picture of a product's life cycle.
2. As the raw material extraction and polystyrene bead production for this product is not from India a **gate to gate life cycle assessment** study is done.
3. The life cycle assessment tool SimaPro helped in determining the various emissions and the problems it could cause through the production.
4. The principles and methodology have chosen according to ISO 14040:2006 and ISO 14044:2006.

## Goal of LCA:

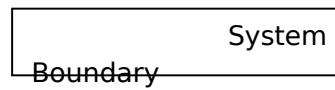
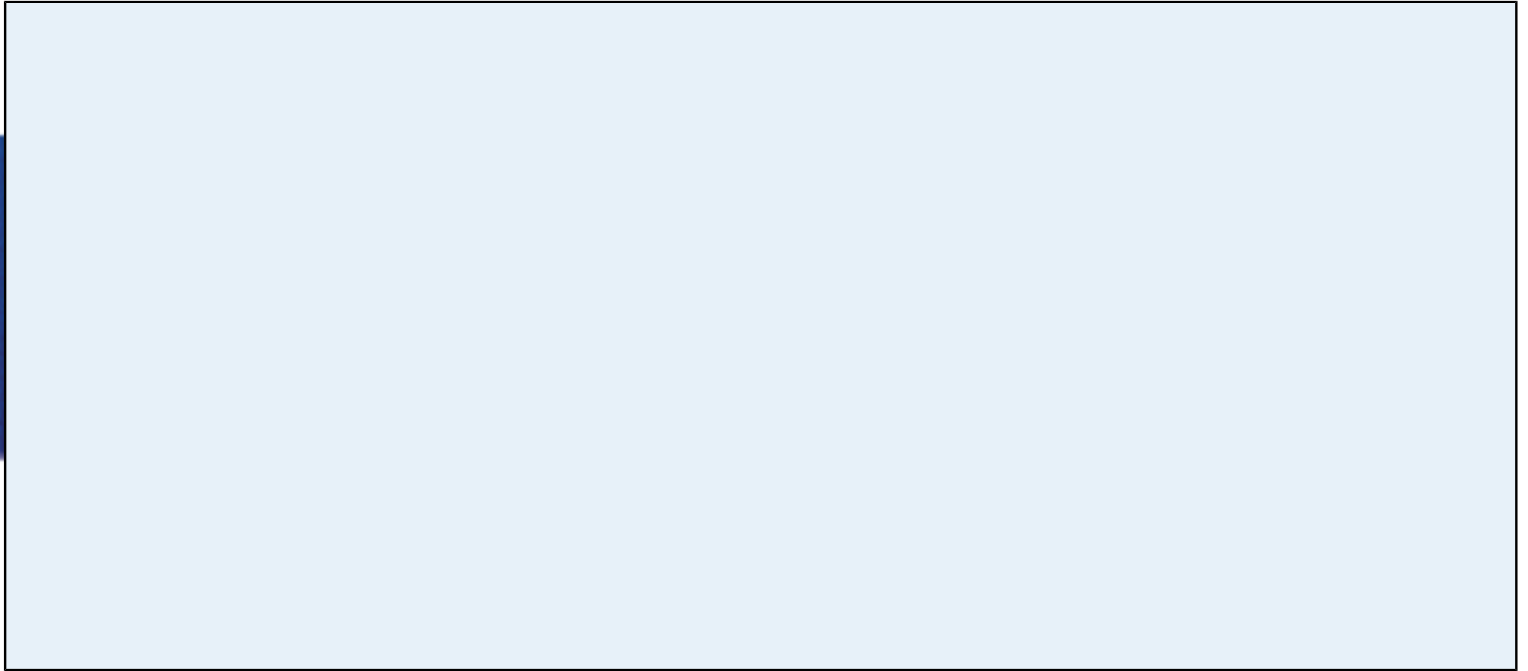
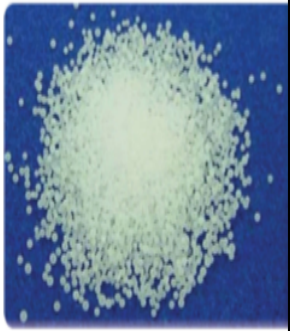
1. The objective of this LCA is to assess the environmental impacts of these production process that are affecting India.
2. The goal of this analysis is to help the product development process to reduce the environmental impacts and a gate-to-gate variant is chosen for the life cycle assessment of the product.

## Scope of LCA:

### Functional unit and system boundaries:

3. The functional unit of this study is 1 kg of Thermocol Production.
4. The system consists of input material flows (energy, polystyrene beads, expanding agent) and the output material flows like (Thermocol, emissions to air)

# Methodology adopted (contd.)



## • Inventory Data:

The data for the assessment is collected completely from the literature review

INPUTS		
s.no	Name	Quantity per kg Thermocol
1	Pentane	0.08 kg
2	Steam	48800 kj
3	Electricity	90 Mj
OUTPUT		
1	Thermocol	1 kg
EMISSIONS TO AIR		
1	Carbon dioxide	2600000 mg
2	Methane	32000 mg
3	Nitrous oxides	5000 mg
4	Sulphur oxides	7200 mg
5	Carbon monoxide	3900 mg

## **ASSUMPTIONS:**

- Transportation of beads is neglected.
- The use phase is not considered.
- Uncertainty analysis is not considered.

## **IMPACT ASSESSMENT:**

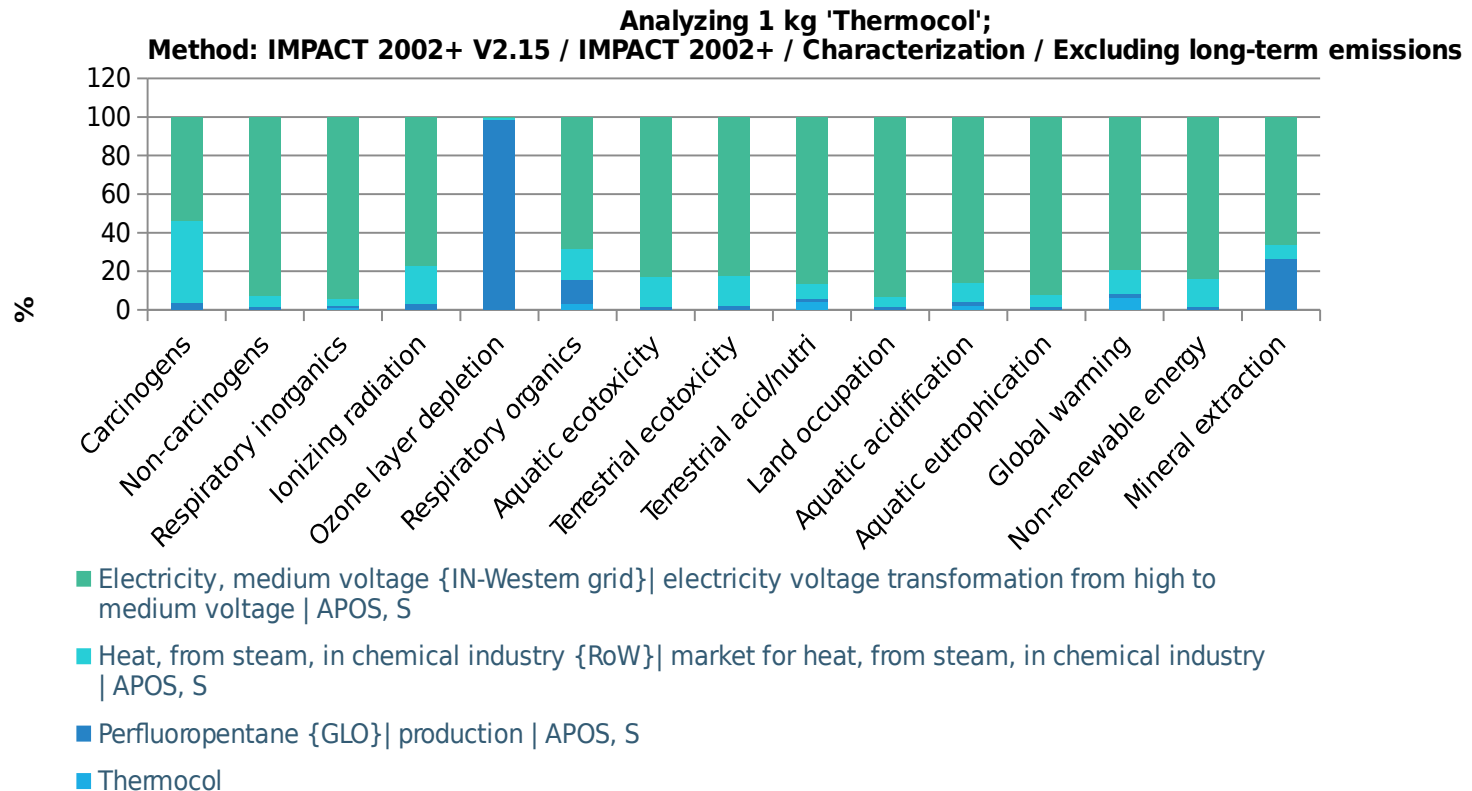
The assessment method chosen in SimaPro is Impact 2002+ world 2000 for getting the results of:

1. Characterization
  2. Damage assessment
  3. Normalization
- The interpretation is not done due to the lack of company specified data but these assessed results shows the impacts caused due to Thermocol production.
  - The results are used to develop the production process and substitution of the alternate raw materials.
  - The article currently did not focused on the alternatives but focused on the easy collection and compaction technique followed in India.
  - The damage assessment results given the overall damage caused by production process but the normalization results is restricted to particular locality (India).

# Results and Discussions

## Life Cycle Assessment Results:

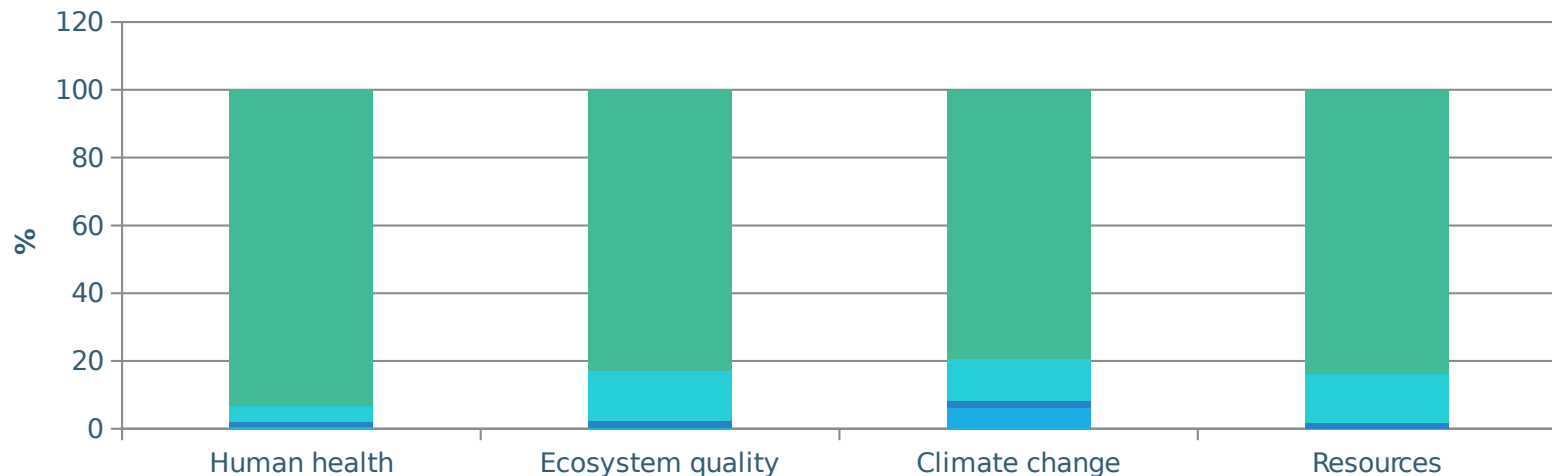
### 1. Characterisation:



# Results and Discussions

## 2. Damage assessment:

Analyzing 1 kg 'Thermocol';  
Method: IMPACT 2002+ V2.15 / IMPACT 2002+ / Damage assessment / Excluding long-term emissions



■ Electricity, medium voltage {IN-Western grid} | electricity voltage transformation from high to medium voltage | APOS, S

■ Heat, from steam, in chemical industry {RoW} | market for heat, from steam, in chemical industry | APOS, S

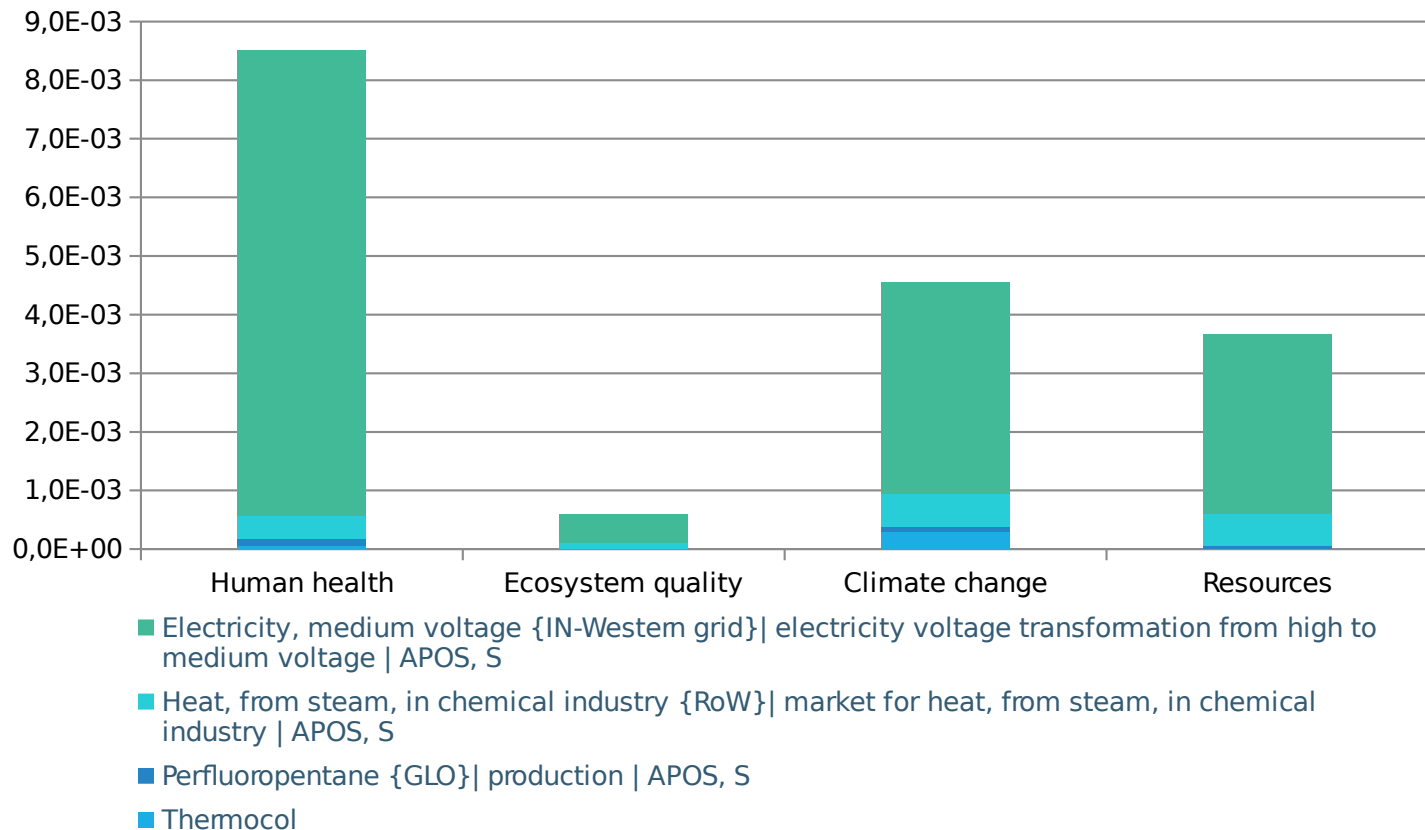
■ Perfluoropentane {GLO} | production | APOS, S

■ Thermocol



# Results and Discussions

## 3. Normalization:



- ✓ The impact assessment of Thermocol at present time may look like is needed because of its high usage.
- ✓ This method will help in developing environmentally benign production process effectively culminates to reduce the impacts and makes the product more sustainable.

1. B. Selukar, N., V. Lande, C., & G. Ingole, C. (2014). Waste Thermocol to Adhesive for Better Environment. *International Journal of Innovative Research in Advanced Engineering (IJIRAE) I*, 98-101.
2. CPCB. (2012). *Implementation status of plastic waste (waste management and handling) amendment rules*. CPCB.
3. EMISSIONS FROM WASTE INCENERATION. (n.d.).
4. EPS Packaging Group. (2012). *Expanded Polystyrene and the Environment*. EPS PAckaging Group.
5. Franklin Associates. (2016). *CRADLE-TO-GATE LIFE CYCLE ANALYSIS OF EXPANDED POLYSTYRENE RESIN*. Franklin Associates, A division of ERG.
6. G, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy - A new sustainability Paradigm? *Journal of Cleaner Productions*, 757-768.
7. Geyer, R., Jenna R., J., & Lavender Law, K. (2017). Production, use, and fate of all plastics ever made. *Sciences Advances*.
8. Gifford, D. (2017). Retrieved from small foot print family.
9. Grand View Research. (2017). *Expanded Polystyrene (EPS) Market Analysis By Product, By Application (Construction, Automotive, Packaging), By Region (North America, Europe, Asia Pacific, Central & South America, MEA), And Segment Forecasts, 2018 - 2025*. GRAND NEW RESEARCH.
10. ISO 14040:2006. (2006). *Environmental management — Life cycle assessment — Principles and framework*. ISO.
11. Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. (2018). *Information Handbook on Bio-Medical Waste Management for Administrators*.
12. SEAIR Exim Solution. (2016). *SEAIR Exim Solution*. Retrieved from SEAIR Exim Solution: <https://www.seair.co.in/thermocool-export-data.aspx>
13. Sylvester, F., Kumar, P., & Vidyaranya, V. (2017). *THERMOCOL WASTE MANAGEMENT AND RECYCLING - THERMINATOR*. ECOBEL SOLUTIONS.
14. Usmani, A. (2018). Retrieved from Bloomberg: [https://www.bloombergquint.com/charts/worlds-plastic-burden-weight-of-a-billion-african-elephants#gs\\_gIvixVO](https://www.bloombergquint.com/charts/worlds-plastic-burden-weight-of-a-billion-african-elephants#gs_gIvixVO)

**THANK YOU AND  
QUESTIONS**

---