

# Green Audit Report

## 2022-2023



Raghu Engineering College (Autonomous)

Dakamarri, Visakhapatnam- 531162

2023

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## ENVIRO KAMKAR LLP

An ISO/IEC 17020: 2012 compliant company  
VISAKHAPATNAM – 530 017

This is to certify that a

# Green Audit

for

## Raghu Engineering College (Autonomous)

Dakamarri, Visakhapatnam 531 162

was conducted to assess the planning, implementation and impacts of

the **Green Initiatives of the College**

for the year 2022 – 2023

and was awarded with Grade

“A”

On this Day, 6<sup>th</sup> February, 2024 at Visakhapatnam.

Certificate No. GAEKL202302



*(Signature)*

(Ms. K. S. Aparna)

Chief Audit Officer, Enviro Kamkar LLP

**GREEN AUDIT  
TEAM 2022 - 2023**



**Raghu Engineering College (Autonomous)  
Green Audit Report**

**Conducted by**  
**ENVIRO KAMKAR LLP**  
*compliant with the requirements of: ISO/IEC 17020:2012*  
*Certificate Number: UQ - 2022082258*  
*for the Academic year 2022 -2023*

***Audit Team:***

***K. Srinija Aparna***

***V.Meghamala***

***as External Auditors***

***&***

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***Associate Professor Civil Engineering***

***as Internal Auditors***



**LIST OF ABBREVIATIONS USED**

|    |                  |  |
|----|------------------|--|
| 1  | AICTE            | All India Council for Technical Education                        |
| 2  | APSRTC           | Andhra Pradesh State Road Transport Corporation                  |
| 3  | B. Tech          | Bachelor of Technology   |
| 4  | C                | Carbon   |
| 5  | Ca               | Calcium  |
| 6  | CAD              | Computer Aided design  |
| 7  | CAM              | Computer Aided Manufacturing                                     |
| 8  | CO <sub>3</sub>  | Carbonates   |
| 9  | DO               | Dissolved Oxygen   |
| 10 | E waste          | Electrical & Electronic Waste                                    |
| 11 | EC               | Electrical Conductivity  |
| 12 | EKL              | Enviro Kamka3r LLP   |
| 13 | Fig.             | Figure   |
| 14 | Fe               | Ferrous ion  |
| 15 | GHRDC            | Global Human Resource Development Centre                         |
| 16 | ha               | Hectare  |
| 17 | HCO <sub>3</sub> | Bicarbonates   |
| 18 | Hp               | Horse Power  |
| 19 | HSD              | High Speed Diesel  |
| 20 | HW               | Hazardous Waste  |
| 21 | ISO              | International Standards Organization                             |
| 22 | JNTUK            | Jawaharlal Nehru Technological University Kakinada               |
| 23 | JNTU GV          | Jawaharlal Nehru Technological University -Gurajada Vizianagaram |
| 24 | K                | Potassium  |
| 25 | kg               | Kilo Grams   |
| 26 | KL               | Kilo litres  |
| 27 | KLD              | Kilo litres Day  |
| 28 | km               | Kilo Meters  |
| 29 | KVAh             | Kilo volts amps per hour   |
| 30 | KW               | Kilo Watts   |
| 31 | LPG              | Liquefied Petroleum Gas  |
| 32 | lph              | Litres per hour  |
| 33 | M Tech           | Masters of Technology  |
| 34 | Mg               | Magnesium  |
| 35 | MSW              | Municipal Solid Waste  |
| 36 | Na               | Sodium   |
| 37 | NAAC             | National Assessment and Accreditation Council                    |
| 38 | NBA              | National Board of Accreditation                                  |
| 39 | NCC              | National Cadet Corps   |

|    |           |  |
|----|-----------|--|
| 40 | NSS       | National Service Scheme                |
| 41 | pH        | Potential of Hydrogen                  |
| 42 | PW        | Plastic Waste                          |
| 43 | REC       | Raghu Engineering College (Autonomous) |
| 44 | RO        | Reverse Osmosis water plant            |
| 45 | SO Carbon | Soil Organic Carbon                    |
| 46 | sq m      | Square meter                           |
| 47 | TA        | Total Alkalinity                       |
| 48 | TDS       | Total dissolved solids                 |
| 49 | TH        | Total Hardness                         |
| 50 | UGC       | University Grants Commission           |
| 5  | UKcert    | UK Certification and Inspection        |

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## 1.PREAMBLE:

Raghu Engineering College (Autonomous) has maintained a consistent partnership with Enviro KAMKAR LLP of Visakhapatnam for six consecutive years since the 2017-2018 academic year, utilizing their expertise as third-party auditors. EKR's accreditation under ISO/IEC 17020:2012 by UKCert/UKAF ensures credibility in the auditing process. The audit conducted from July 2022 to June 2023, based on institution log book data, reflects ongoing improvements in resource management systems. Notably, the merger of Raghu Institute of Technology (RIT) with REC has prompted adjustments in land use patterns and resource management strategies. Nevertheless, REC remains steadfast in meeting institutional environmental policy targets.

## 2. ABOUT THE COLLEGE:

Raghu Engineering College (Autonomous) is part of the Raghu Educational Institutions Group in Visakhapatnam, Andhra Pradesh. Started in 2001, it was affiliated by Jawaharlal Nehru Technological University, Kakinada (JNTUK), and continued for the preceding years, However, commencing from the academic year 2022 to 2023, it has transitioned its affiliation to Jawaharlal Nehru Technological University – Gurajada Vizianagaram (JNTU GV). This significant transformation marks a noteworthy development for the institution in this academic year. REC (A) was also approved by the All-India Council for Technical Education (AICTE). The college has a big campus of

about 6 hectares in Dakamarri Village, away from city noise and pollution. It is a key college for engineering studies in North Andhra.

Since the beginning, Raghu Engineering College has focused on giving students the latest skills needed in technology and management. A strong alumni group spread all over the world indicate the academic success of REC. The institution was accredited by NAAC as A+ institution, and accreditation from NBA, certified for ISO 9001 and 14001 are all indicative of the REC's commitment to the values, standards, and environment. The following academic programs are offered by the REC.



**Graduate Programs:**

- B. Tech in Mechanical Engineering
- B. Tech in Electronics & Communication Engineering
- B. Tech in Electrical & Electronics Engineering
- B. Tech in Civil Engineering
- B. Tech in Computer Science & Engineering

**Post-Graduate Programs:**

- M. Tech in CAD & CAM
- M. Tech in Computer Science & Engineering
- M. Tech in Embedded Systems
- M. Tech in Power Electronics

**2.1. COLLEGE POPULATION:**

The REC campus community comprises both day scholars and residents. According to enrolment records for the academic year 2022-2023, the campus hosts nearly 4949 individuals, categorized into four main groups: students, teaching staff, supporting staff, and associates. Students make up approximately 88.82% (around

4396 individuals) of the total population, while teaching staff, supporting staff, and associates make up about 5.46%, 3.70%, and 2.02%, respectively. Other associates include individuals such as material suppliers, contract workers, and canteen staff. Approximately 16% of the REC community are campus residents, with the majority being day scholars who commute to and from the campus daily. Among the total individuals, women constitute 64% of the student population and 28% of the other three groups combined.

### 3. SCOPE OF GREEN AUDIT

The scope of Green Audit for this academic year (2022-2023) encompasses a general evaluation of basic environmental indicators. It goes beyond defining the state of environmental components and extends to comparing the institution's programs and activities over different years, and with peer institutions. The scope includes the following:

- a. Environmental Component Assessment: The Green Audit assesses the environmental conditions and impacts of the institution across multiple areas such as energy consumption, waste management, water usage, transportation, and emissions. It examines the institution's practices and activities related to sustainability and resource conservation.
- b. Year-to-Year Comparison: The Green Audit enables the institution to analyse its environmental performance over different years. By tracking progress and identifying trends, it helps in understanding the effectiveness of implemented initiatives and in setting targets for future improvements.

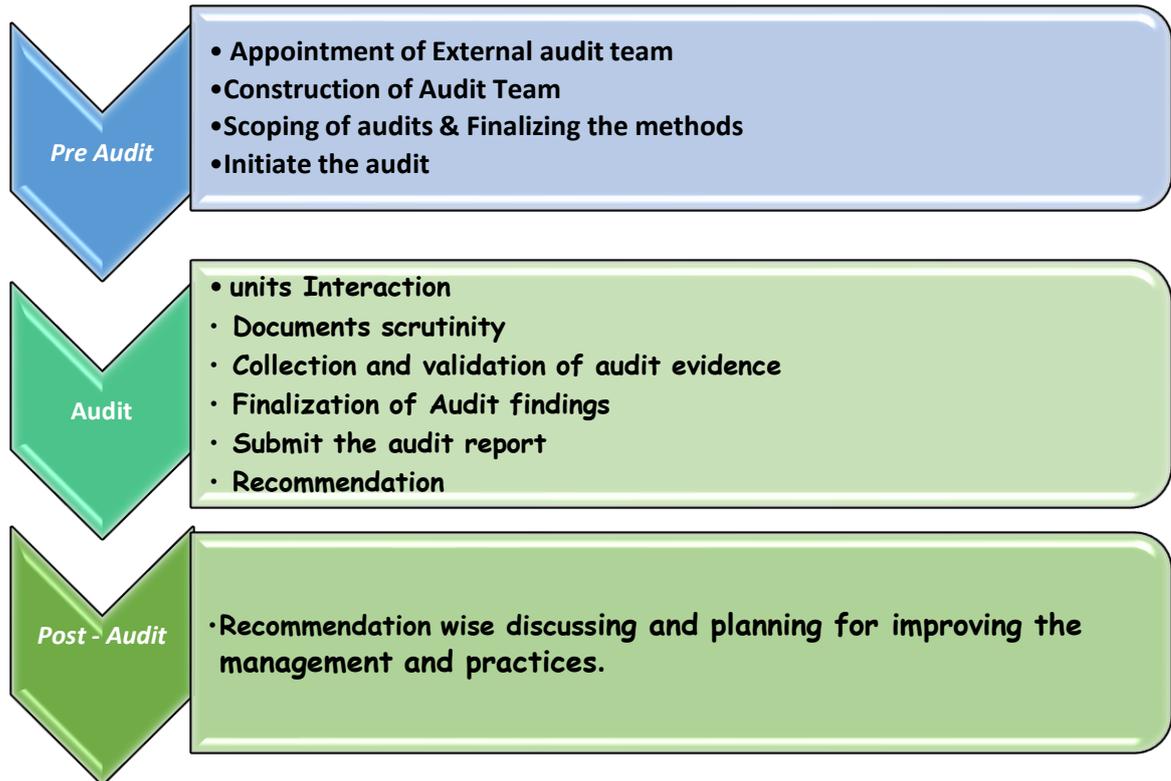
- c. Peer Institution Comparison: The Green Audit provides a means to benchmark the institution's environmental performance against similar educational institutions. This comparison helps identify areas where the institution can learn from others' best practices, set goals for improvement, and enhance its overall environmental performance.
- d. Education and Awareness: The Green Audit serves as an educational tool, raising awareness among students and employees about environmental issues and promoting a culture of sustainability. It helps in instilling environmental responsibility and inspiring individuals to contribute to a positive environmental change.
- e. Improvement Prioritization: Through the Green Audit, areas for improvement are identified, allowing the institution to prioritize future projects and initiatives. This enables the institution to allocate resources effectively and implement measures that will have the most significant impact on environmental and economic performance.
- f. Additionally, the audit will cover the utilization of natural resources such as land and water, energy management, waste generation and management, assessment of carbon footprint, and participation from all members, including students, faculty, staff, institution associates, and management.

#### 4. METHODS ADOPTED:

The Green Audit was planned in three stages, (1) Pre-Audit Stage; (2) Audit Stage, and (3) Post post-audit stage, and the activities in each stage are presented in

**Figure 1** below:

***Fig. 1. Process Stages and scope of the stages of Green Audit adopted for Raghu Engineering College (A) for the year 2022 – 2023.***



The internal audit team consisted with the following members of the REC to associate with the Third-Party Auditors from EKL:

**Chairman:** Prof. Ch. Srinivasu, Principal  
**Convenor:** Prof. A. Vijay Kumar, Vice Principal  
**Members:** Prof. G.V. Shiva Prasad  
Dr. B. Umamaheswara Rao  
Dr. I. Krishna Chaitanya

The Audit team and the External auditors have designed the audit approach and the methods to be followed. Based on the Audit Scope, the auditors have adopted the criteria for the assessment of different audit components which are appended as **Annexure – 2** to the report.

## 5. Green Audit

## 5. GREEN AUDIT

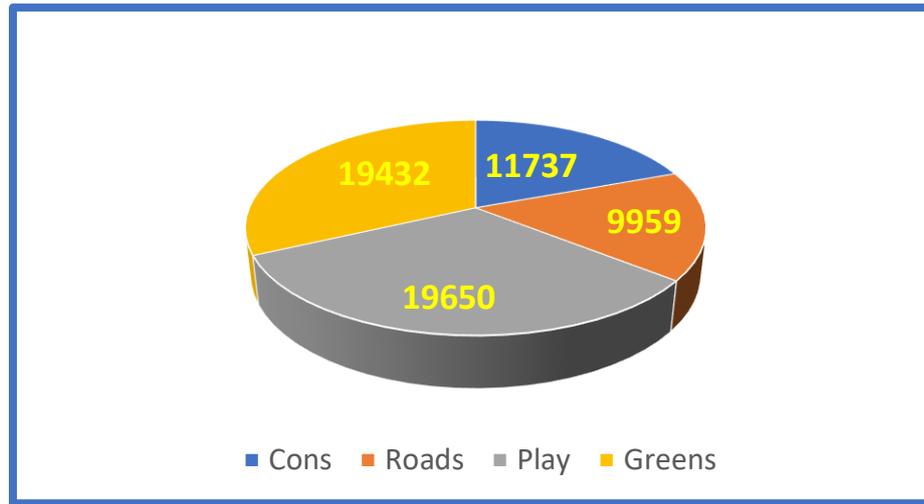
### 5.1 LAND USE AND LAND UTILIZATION

Raghu Engineering College (REC) had a spatial spread of 6 hectares of land within the land of 20-hectares of the Raghu Educational Institutions, at Dakamarri Village, Bheemunipatnam Mandal, Visakhapatnam district. REC by its Environmental Policy, is committed for conservative land use practices. The total land under REC is categorized into four broad land use types – (1) Constructed Area; (2) Roads, Paths and Pavements; (3) Play Grounds; and (4) Green Areas (Table 1). The campus design, focused on optimizing the land use, includes significant open-to-sky areas and landscaping to enhance visual appeal.

*Table 1. Distribution of Land use types of REC campus.*

| LAND USE                 | Area (sq m)  |
|--------------------------|--------------|
| Constructed Area         | 11737        |
| Roads, Pavements & Paths | 9959         |
| Play Grounds             | 19650        |
| Under Greens             | 19432        |
| <b>TOTAL LAND AREA</b>   | <b>60778</b> |

While the overall land use pattern remains largely unchanged, a new building behind the Electrical and Electronic building is under construction. This new building, spanning 1050.33 square meters, will serve for academic purpose. Construction of this contributes to an addition of 1050.33 sq m to the constructed area change in the total constructed area. This has resulted in 2% of area under Greens. The Greens area now accounts for 32% of the total area (Fig. 2).



**Fig. 2. Proportional distribution of Land Use types at REC(A)**

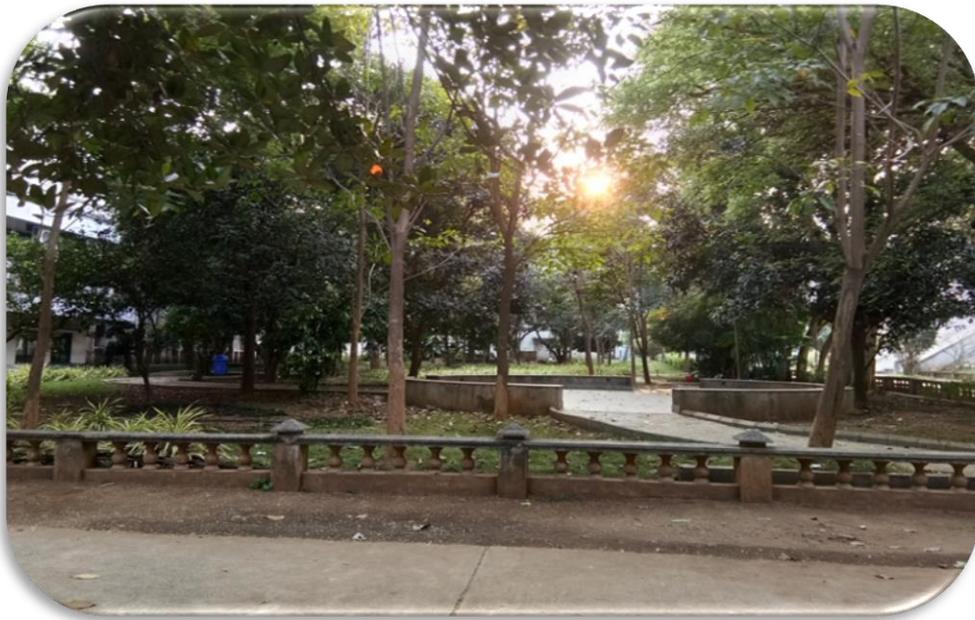
The reduction in green area suggests a need for careful planning and management strategies to maintain environmental balance. It's essential to prioritize conservation efforts, optimize existing green spaces, and explore innovative solutions to mitigate the impact of the decreased green area. Additionally, promoting sustainable practices and environmental awareness within the college community can play a crucial role in effective land use management despite the decrease in green area. Additionally, a significant portion of the playgrounds contributes to the non-built-up area, facilitating water percolation. The proportion of land dedicated to roads, pavements, and paths remains relatively low compared to other uses. Overall, the college's land use plan has been fully implemented and demonstrates commendable utilization

## **5.2. CAMPUS VEGETATION & BIODIVERSITY:**

Previously, approximately 32% of the total land area of the campus was dedicated to green development. A satellite image of the REC campus layout reveals that the eastern half is densely vegetated, primarily with native species, while the western front facing the National Highway is sparsely vegetated, featuring ornamental

palms and other species. An inventory of plant species on the REC campus was conducted, including vegetation analysis and assessment of tree species diversity. The audit results indicate that about 34% of the land area is covered with vegetation, which is predominantly peripheral and scattered. The assessment also considered species diversity, tree count, and biomass quantities

**Fig3: Green Belts:**



#### **A. FLORA**

The campus flora consists of 14 species of trees, 2 species of shrubs, and approximately 13 species of herbs, including grasses, climbers, and creepers (Table 2). Along with these native species, ornamental garden plants, predominantly exotic varieties, adorn the landscaping around major buildings and pathways. While most tree species are native, the shrubs and herbs include a mix of native and exotic species.

#### **B. TREE ENUMERATION**

The three most prevalent tree species on campus are (1) Foxtail palm, (2) Teak, and (3) Palmyra tree, which is known for its highly commercial wood. A total of

approximately 282 trees were enumerated, with the top five species, including the afore mentioned three, as well as mango and almond trees, collectively accounting for 75% of the total tree population. There is potential for further tree development and expansion on campus.

### C. PLANT DIVERSITY:

Comparatively, there hasn't been much difference from last year's assessment, with some scope for improvement identified. The maximum possible diversity for the 14 tree species remained consistent at 3.81 bits, while the actual diversity saw a slight decrease to 3.09 bits. Despite this, the species evenness remained high at 0.81. There remains room for enhancement, particularly given the educational nature of the institution. However, it's noted that the diversity levels are relatively fair when compared to similar institutions.

**Table 2. List of Plant species present in REC Campus**

| No. | Family        | Species  | Habit | Common/Telugu Name |
|-----|---------------|--|-------|--------------------|
| 1   | Acanthaceae   | <i>Peristrophe paniculata</i> (Forssk). Brummitt | H     | Cheburu            |
| 2   | Amaranthaceae | <i>Achyranthes aspera</i> L.                     | H     | uttareni           |
| 3   | Amaranthaceae | <i>Alternanthera paronychioides</i> St.          | H     | Ponnaganti         |
| 4   | Amaranthaceae | <i>Alternanthera tenella</i>                     | H     |                    |
| 5   | Amaranthaceae | <i>Amaranthus viridis</i> L.                     | H     | Chilaca thotakura  |
| 10  | Asteraceae    | <i>Ageratum conyzoides</i> L.                    | H     | Poka Banthi        |
| 13  | Euphorbiaceae | <i>Euphorbia hirta</i> L.                        | H     | nanubalu           |
| 17  | Fabaceae      | <i>Cassia obtusifolia</i> L.                     | H     | Tagirasa           |
| 18  | Fabaceae      | <i>Crotalaria calycina</i> L.                    | H     |                    |
| 20  | Fabaceae      | <i>Tephrosia purpurea</i> (L.) Pers              | H     | vempali            |
| 23  | Malvaceae     | <i>Sida acuta</i> Burm F.                        | H     |                    |
| 24  | Malvaceae     | <i>Sida cordifolia</i> L.                        | H     |                    |
| 28  | Nyctaginaceae | <i>Boerhavia erecta</i> L.                       | H     | punarnava          |
| 14  | Fabaceae      | <i>Acacia catechu</i> (L.f.) Willd               | S     |                    |
| 22  | Malvaceae     | <i>Hibiscus rosa-sinensis</i> L.                 | S     | mandara            |
| 6   | Anacardiaceae | <i>Mangifera indica</i>                          | T     | Mango              |
| 7   | Arecaceae     | <i>Borassus flabellifer</i>                      | T     | thati              |
| 8   | Arecaceae     | <i>Cocos nucifera</i>                            | T     | Coconut            |
| 9   | Arecaceae     | <i>Wodyetia bifurcata</i>                        | T     | Foxtail palm       |

|    |              |  |   |              |
|----|--------------|--|---|--------------|
| 11 | Combretaceae | <i>Conocarpus erectus</i>                | T | Conocarpus   |
| 12 | Combretaceae | <i>Terminalia catappa</i>                | T | Badam        |
| 15 | Fabaceae     | <i>Acacia leucophloea</i> (Roxb.) Willd. | T | Tella thumma |
| 16 | Fabaceae     | <i>Caesalpinia pulcherrima</i>           | T | Gulmohor     |
| 19 | Fabaceae     | <i>Tamarindus indica</i>                 | T | Chintha      |
| 21 | Lamiaceae    | <i>Tectona grandis</i>                   | T | Teak         |
| 25 | Meliaceae    | <i>Azadirachta indica</i>                | T | Neem         |
| 26 | Moraceae     | <i>Ficus benghalensis</i>                | T | Marri        |
| 27 | Myrtaceae    | <i>Syzygium cumini</i>                   | T | Neeredu      |
| 29 | Rubiaceae    | <i>Neolamarckia cadamba</i>              | T | Kadambari    |

#### D. BIOMASS OF TREES:

The wood biomass of the trees was estimated during the year 2021-2022 using ecological methods. The next monitoring year will be 2024-2025. Therefore, the same stocks that were reported during the previous year are being reported for biomass and carbon stocks. The tree enumeration revealed that the top five species, which were abundant in numbers, made a significant contribution to the biomass. In total, all the trees collectively contributed 734 tons of dry biomass, encompassing both above-ground and below-ground biomass components.

**Table 3. Tree species Enumeration and Biomass (Dry Weight).**

| T No. | Species                                    | Mean GBH (cm) | Mean Ht (m) | Population | Total BM (Tons) |
|-------|--|---------------|-------------|------------|-----------------|
| 1     | <i>Mangifera indica</i> L.                 | 40.5          | 7           | 35         | 0.416           |
| 2     | <i>Borassus flabellifer</i> L.             | 40            | 6           | 44         | 0.437           |
| 3     | <i>Cocos nucifera</i> L.                   | 31            | 9           | 7          | 0.063           |
| 4     | <i>Wodyetia bifurcate</i> A.K. Irvine)     | 38            | 9           | 80         | 1.076           |
| 5     | <i>Conocarpus erectus</i> L.               | 27            | 5           | 12         | 0.045           |
| 6     | <i>Terminalia catappa</i> L.               | 43            | 8           | 14         | 0.092           |
| 7     | <i>Acacia leucophloea</i> (Roxb.) Willd.   | 28            | 6           | 3          | 0.015           |
| 8     | <i>Caesalpinia pulcherrima</i> (L.) SW.    | 36            | 9           | 10         | 0.121           |
| 9     | <i>Tamarindus indica</i> L.                | 40            | 7           | 3          | 0.035           |
| 10    | <i>Tectona grandis</i> L. f                | 30.5          | 7           | 47         | 0.317           |
| 11    | <i>Azadirachta indica</i> A. Juss          | 27            | 6           | 4          | 0.018           |
| 12    | <i>Ficus religiosa</i> L.                  | 25            | 8           | 4          | 0.021           |
| 13    | <i>Syzygium cumini</i> L. Skeels           | 59            | 9           | 12         | 0.389           |
| 14    | <i>Neolamarckia cadamba</i> (Roxb.) Bosser | 53            | 9           | 7          | 0.183           |

**E. CARBON STOCKS:**

The Carbon stocks also will be the same with that of 2021-2022. The general default value of 46% of the Dry weight recommended for tropical trees was adopted and thus the C stocks from the trees was arrived at 330 tons. Added to this, another 173 tons of C was present in the soils. Thus, the total C stock in the REC Campus was estimated at 503 tons.

**F. FAUNA:**

The campus vegetation attracts a diverse range of animal species, with a sporadic inventory conducted over one day (during the year 2021-2022) revealing over 21 species, as listed in Table 4. The most predominant bird species observed on campus is the Common Myna, while numerous butterfly species also add to the attraction. In addition to these natural faunal members, the college maintains an ornamental pond where a few catfish are cultured. Furthermore, as part of its commendable practices, the college engages in the rearing of 22 cows and 14 bulls.

**Table 4. List of major faunal species recorded in REC Campus**

| S.no            | Common name          | Scientific Name              | Type          |
|-----------------|----------------------|------------------------------|---------------|
| <b>REPTILES</b> |                      |                              |               |
| 1               | Tree Gecko           | <i>Hemidactylus sp</i>       | Lizard        |
| 2               | Wall lizard          | <i>Hemidactylus prashadi</i> | Lizard        |
| 3               | Garden Lizard        | <i>Calotes versicolor</i>    | Lizard        |
| <b>BIRDS</b>    |                      |                              |               |
| 1               | Red-vented bulbul    | <i>Pycnonotus cafer</i>      | Diurnal Birds |
| 2               | House Sparrow        | <i>Passer domesticus</i>     | Diurnal Birds |
| 3               | Common Myna          | <i>Acridotheres tristis</i>  | Diurnal Birds |
| 4               | Crow                 | <i>Corvus corvidae</i>       | Diurnal Birds |
| 5               | Common Cuckoo        | <i>Cuculuc canorus</i>       | Diurnal Birds |
| 6               | Cattle Egret         | <i>Bubulcus ibis</i>         | Diurnal Birds |
| 7               | Rose ringed Parakeet | <i>Psittacula krameri</i>    | Diurnal Birds |
| 8               | Black Drongo         | <i>Dicrurus macrocerucus</i> | Diurnal Birds |
| 9               | King fisher          | <i>Alcedinidae sp</i>        | Diurnal Birds |
| 10              | Eagle                | <i>Accipitridae sp</i>       | Diurnal Birds |
| <b>MAMMALS</b>  |                      |                              |               |
| 1               | Squirrel             | <i>Funambulus palmarum</i>   | Palm Squirrel |
| 2               | House Rat            | <i>Rattus rattus</i>         | Rat           |

| <b>BUTTERFLIES</b>  |                      |                           |              |
|---------------------|----------------------|---------------------------|--------------|
| 1                   | Plain Tiger          | <i>Danaus chrysippus</i>  | Insects      |
| 2                   | The Gram Blue        | <i>Euchrysops cnejus</i>  | Insects      |
| 3                   | Common Baron         | <i>Euthalia garuda</i>    | Moth         |
| 4                   |                      | <i>Jamides celeno</i>     |              |
| 5                   |                      | <i>Neptis hylas</i>       |              |
| 6                   |                      | <i>Tirumala limniace</i>  |              |
| <b>DOMESTICATED</b> |                      |                           |              |
| 1                   | Cat fishes           | <i>Clarias gariepinus</i> |              |
| 2                   | Cows ( 22 in number) | <i>Bos indicus</i>        | Domesticated |
| 3                   | Bulls 14 (number)    |                           |              |

### 5.3. WATER RESOURCES MANAGEMENT:

In the current year, REC, with its residential population of 854 and over 4095 day scholars, continues to have a demand for approximately 90 KLD (Kilo Liters per Day) of water, primarily sourced from groundwater. The college operates six borewells connected to various overhead tanks across academic, administrative, and residential buildings. The total installed capacity for water storage stands at 93 KLD. During holidays and vacation periods, the water demand decreases by more than 50%.

Water quality analysis was conducted for four out of the six borewells. Results revealed that the water quality of one borewell closely aligns with standards suitable for drinking water use as per IS 10500 (except for Total Dissolved Solids

**Table 5. Water Quality of the Groundwaters of REC – 2023.**

| No. | Parameter                       | BW-1 | BW-2 | BW-3 | BW-4 | IS 10500 |
|-----|---------------------------------|------|------|------|------|----------|
| 1   | pH                              | 7.1  | 7.5  | 7.2  | 7.4  | 6.5-8.5  |
| 2   | EC ( $\mu$ S/cm)                | 250  | 250  | 275  | 275  | 500      |
| 3   | TDS (mg/l)                      | 490  | 465  | 510  | 530  | 500      |
| 4   | TH (mg/l as CaCO <sub>3</sub> ) | 300  | 215  | 225  | 220  | 300      |
| 5   | Ca (mg/l)                       | 80   | 60   | 100  | 80   | 75       |
| 6   | Mg (mg/l)                       | 24   | 24   | 36   | 24   | 30       |
| 7   | Na (mg/l)                       | 15   | 50   | 75   | 62   | 200      |
| 8   | K (mg/l)                        | 2    | 10   | 20   | 2    | 10       |
| 9   | Fe (mg/l)                       | 0.05 | 0.1  | 0.1  | 0.1  | 0.3      |

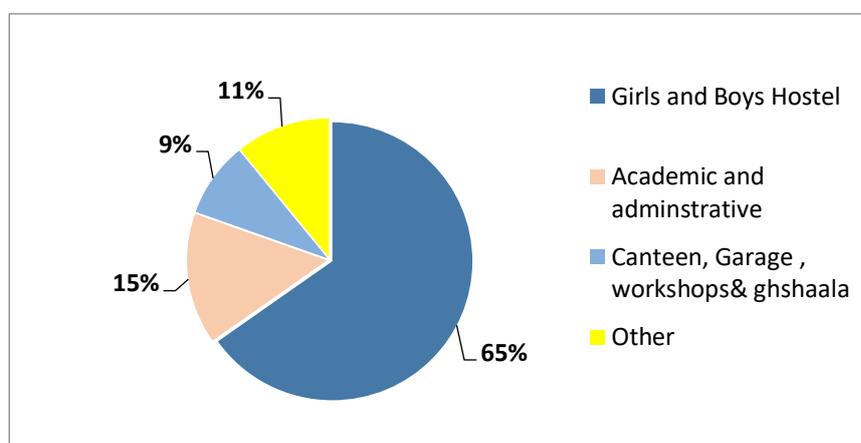
|    |                         |     |      |      |      |     |
|----|-------------------------|-----|------|------|------|-----|
| 10 | Cl (mg/l)               | 95  | 100  | 100  | 100  | 250 |
| 11 | PO <sub>4</sub> (mg/l)  | 11  | 0.8  | 0.9  | 0.9  | 10  |
| 12 | NO <sub>2</sub> (mg/l)  | 0.3 | 0.03 | 0.03 | 0.03 | 1.0 |
| 13 | F (mg/l)                | 0.4 | 0.4  | 0.5  | 0.4  | 1.2 |
| 14 | TA (mg/l)               | 160 | 150  | 165  | 160  | 200 |
| 15 | CO <sub>3</sub> (mg/l)  | 36  | 38   | 40   | 38   | --- |
| 16 | HCO <sub>3</sub> (mg/l) | 222 | 225  | 228  | 226  | --- |
| 17 | DO (mg/l)               | 7.2 | 7.4  | 7.8  | 7.5  | 4.8 |

\* = All parameters are in mg/l , with the exception of pH

The total water consumption of the REC can be classified into four use types: (1) Residential; (2) Academic and administration; (3) Transportation and Other utilities, and (4) Greenery.

Both the Hostels (Boys and Girls Hostels) together consume 60 KLD of water; academic and administration had a daily consumption of 14 KLD, while canteen, garage, workshops, and Goshala consume another 8 KLD of water. Gardens and other green zones require nearly 10 KLD of water of which 8 KLD is met from RO reject waters (Fig. 4). Thus, REC on all working days uses 85 to 90 KLD of water from its groundwater.

**Fig.4. Water Consumption sectors of REC and their status in AY 2022-2023.**



REC currently operates two RO water plants: one at the Boys Hostel with a capacity of 2000 liters per hour (lph) and another at the Academic Block, which also serves the Girls Hostel, with a capacity of 1000 lph. Both RO plants produce 3 liters of waste water for every liter of treated water, resulting in the rejection of approximately 8 KLD of water from both plants on working days. The rejected water is collected in tanks and utilized for gardens and green areas on campus.

In addition, sewage from all blocks is channelled to soak pits and septic tanks, as REC activities do not generate toxic waste. However, in the Wet Laboratory where chemicals are utilized, laboratory sinks are directly connected to effluent collecting cans, each with a capacity of 250 liters. Effluent water is disposed of through authorized collectors every two months.

The rise of nearly 30 KLD over previous year was due to rise in the residential students and also substantial water is used for construction purpose. It is commendable that the waste water generation was reduced by one KLD, is a significant achievement.

## **5.4. ENERGY MANAGEMENT**

REC maintains a focused policy on Energy Management and strives to establish itself as a Model Institution for Energy efficiency. Over the past four years, the college has conducted Energy Audits to gauge its energy management practices and achieved efficiency. The details of energy efficiency are documented in the energy audit reports conducted by accredited consultants.

This report highlights the Energy utilization and management within an environmental context, serving as a significant component of the Institution's Environmental Management. REC sources its electric energy needs from three primary sources: HT supply from the Public Distribution Company, HSD Generation, and Solar Power. Additionally, substantial quantities of LPG are utilized, primarily in hostel kitchens, the canteen, and some laboratories. Similarly, significant quantities of HSD are used for transportation purposes.

### **A. ELECTRICITY FROM HT GRID:**

In terms of Electricity consumption, the Institute utilized 615177 KVAh from the metered connection during the audit year, with a monthly mean of 50,972 KVAh. Monthly variations exhibited notable fluctuations, ranging from a low of 32790 in February 2023 to a high of 72582 KVAh in May 2023. Despite fluctuations, there was a significant increase in consumption compared to the previous year.

The College's Electricity usage is categorized into four major Load Sectors: Illumination, Fans and Ventilations, Air Conditioning, and Computers, labs, and Machinery. During the audit year, the Air-conditioning sector accounted for the highest load percentage, followed by the Computers and Machinery sector, each contributing significantly to the total load.

**B. ELECTRICITY FROM SOLAR POWER SYSTEMS:**

REC continued its commitment to renewable energy with an installed capacity of 500 KW power generation across five Rooftop installations, each generating 50 KW. Throughout the audit year, these installations collectively generated a total of 98,454 units of electricity. This amount accounted for approximately 16% of the consumption from the metered supply. It's worth noting that the mean generation from each of the 50 KW installations varied significantly, as indicated by the monthly data. Further, there was a decline of more than 200,000 KW of solar power generation during the year, compared to that of 2021-2022.

**C. ELECTRICITY FROM OIL DG SETS:**

As standby to the main power supply, REC maintains two DG (Diesel Generator) sets: one with a capacity of 320 KVA and the other with a lower capacity of 140 KVA. Over the audit year, these sets collectively generated approximately 28,673 KWs of power, consuming 4587 liters of diesel oil. This suggests a cost of around Rs. 15 per KW for DG set power.

Overall, the total electricity consumption from all three sources amounted to 568,049 units. With a per capita consumption of approximately 120.6 units per annum, REC's energy usage remains within reasonable bounds for a technical educational institution.

**D. ENERGY USED FOR TRANSPORTATION:**

The Transportation sector remains the second major energy-consuming sector at the Institute. On all working days, the Institute's fleet of buses and other vehicles serves various parts of the district and surrounding areas. With a total campus population of 4949 individuals, including all categories, approximately 854 individuals reside in the campus hostels, leaving the remaining 4100 to commute daily. Students and staff travel varying distances, with the mean distance being 41 km. Notably, the

college is situated 40 km from Visakhapatnam and 12 km from Vizianagaram, the two major urban centers.

The college maintains its own fleet of 23 buses, which operate from different locations within Visakhapatnam and Vizianagaram districts. Details of the buses can be found in Table 6. It's worth noting that among the 4949 students, 854 are hostellers.

**Table 6. Transport Bus types and numbers of REC.**

|   | Types of buses   | Oil Tank Capacity (liters) | No. of buses |
|---|------------------|----------------------------|--------------|
| 1 | Eicher (type i)  | 70                         | 4            |
| 2 | Eicher (type ii) | 90                         | 12           |
| 3 | SML (type i)     | 70                         | 4            |
| 4 | SML (type ii)    | 90                         | 2            |
| 5 | Ashok Leyland    | 140                        | 1            |

As mentioned previous year, the buses cover approximately 2300 km daily, transporting 801 individuals and consuming around 451 liters of HSD (High Speed Diesel) per day. Throughout the audit year, the College buses consumed a total of 97,002 liters of oil, resulting in a per capita consumption of approximately 121 liters per annum.

Additionally, approximately 3400 individuals utilize various other modes of transportation. Of these, a majority opt for APSRTC bus services. By maximizing the entropy, the total consumption of oil by all modes of travel was estimated at 479 KL/annum and this results in a per capita consumption of 97 l/annum.

#### **E. USE OF LPG:**

REC also utilizes LPG fuel for its hostel messes, canteens, and some laboratories. Records indicate that the annual consumption of LPG across all facilities for the year 2022-2023 totalled 16420 kg, with the majority (94%) allocated for hostel usage.

In summary, the total annual consumption of various energy sources by REC during the specified period is as follows:

Electricity: 568,049 units

Diesel Oil: 484 KLD

LPG: 16.42 tons

#### **The Carbon Foot Print for Energy Use:**

In the fiscal year 2022-2023, REC emitted 534 tons of CO<sub>2</sub>e from electricity consumption, 1298 tons from HSD oil consumption, and 37 tons from LPG use. This amounted to an estimated total of approximately 1869 tons of CO<sub>2</sub>e emissions from these three major energy sources (Table 7).

However, through solar power generation, approximately 93 tons of CO<sub>2</sub>e equivalents were saved or mitigated. As a result, the net emissions totaled 1776 tons, with a per capita emission of 0.359 tons of CO<sub>2</sub>e equivalents per annum.

**Table 7. Carbon emission sources and levels of REC 2022-2023.**

| No.                                 | Emission Source  | Annual Consumption | CO <sub>2</sub> emission Factor (kg/Unit) | Total CO <sub>2</sub> emissions (kg) | Total emissions (t CO <sub>2</sub> e/ann) |
|-------------------------------------|------------------|--------------------|---|--------------------------------------|---|
| 1                                   | Grid Electricity | 568049 KW          | 0.94                                      | 533966                               | 534                                       |
| 2                                   | Diesel Oil       | 484167 liters      | 2.68                                      | 1297568                              | 1298                                      |
| 3                                   | LPG              | 16420 kg           | 2.252                                     | 6891                                 | 37  |
| TOTAL Carbon emissions              |                  |                    |   |                                      | <b>1869</b>                               |
| Emission Offset through Solar Power |                  |                    |   |                                      | <b>93</b>                                 |
| NET Carbon emissions                |                  |                    |   |                                      | <b>1776</b>                               |

## **5.5. WASTES MANAGEMENT**

All types of waste generated from Raghu Engineering College's units and facilities are categorized under the Environmental (Protection) Act, 1986. These wastes are broadly classified into four categories:

## A. Solid Waste (MSW):

- I. Wet Waste
- II. Dry Waste
- III. Sanitary Waste

## B. Plastic Wastes (PW)

## C. Hazardous Waste (HW):

- I. Battery Wastes
- II. Chemicals and Other Hazardous Wastes

## D. E-wastes

Different wastes generated from various units of the college were quantified on 7 random days. Each representing a day of the week and the sampling was done for two consecutive weeks and the results are presented in Table 8 below:

**Table 8. Types of Wastes and waste generation levels at REC 2021-2022.**

| # | Waste Type     | Sources                        | Qty         | Disposal                 |
|---|----------------|--------------------------------|-------------|--------------------------|
| 1 | Wet Waste      | Dining Halls, Messes & Canteen | 30 kg/day   | To Compost               |
| 2 | Paper & Board  | Administrative & Academic      | 4 kg/day    | Authorized Collectors    |
| 3 | Metallic       | All                            | negligible  | IC/Authorized Collectors |
| 4 | Plastic        | All                            | 0.24 kg/day | IC/Authorized Collectors |
| 5 | Sanitary Waste | Girls Hostel                   | 0.2 kg/day  | Incinerated              |

Additionally, with the commencement of new construction activity, construction waste has been generated at a rate of 1050.33 sqm. It's worth mentioning that oil waste from chemical labs is being utilized for construction as a reused material, contributing to waste management efforts.

The waste management practices at REC revolve around the application of the "5 R's" principle and are designed to be easily implemented. Each facility is equipped

with bins for different types of waste, such as MSW, PW, and HW, placed at convenient points for segregation at the source.

#### **A. SOLID WASTES:**

REC has initiated various initiatives in solid waste management through its Innovation Centre, focusing on implementing the 5 Rs policy. Waste materials, including metallic, plastics, or e-wastes, are examined by members of the Innovation Club to explore reuse, repair, recovery, and reduction opportunities. This approach minimizes waste and encourages innovative thinking among students.

Wet wastes collected from kitchens, dining halls, canteens, messes, and other areas are directly sent to the compost yard on campus. Additionally, dung and debris collected from the cattle shed are utilized for composting purposes. A large bin placed near the main entrances of buildings facilitates daily clearing of wet wastes, which are then transferred to the composting area.

REC also maintains a demonstrative Goshala with 22 cows and 12 bulls on its premises. The cattle are primarily fed with fodder generated from playfield maintenance and lawn cuts. This unique feature is rare for educational institutions, and some researchers at REC are studying traditional livestock rearing techniques as part of rural development protocols.

Approximately 5 tons of cattle dung is collected from the cattle shed every month, with a significant portion used as manure for campus greenery. The remaining dung is sold to nearby villages in exchange for fodder. In the academic year 2021-2022, approximately 15 tons of compost manure were generated and utilized for maintaining the green belt.

Similar waste management practices are being continued for the current academic year to ensure efficient waste disposal and environmental sustainability.

**B. E-WASTES:**

REC strictly adheres to the E-waste management Rules of 2018, maintaining a separate and secure chamber designated for storing E-waste. The institution has partnered with M/S Electro Pro, an Authorized E-Waste Collector, for the periodic collection of E-waste. Before declaring any item as E-waste, REC's Innovation Centre evaluates it for potential reuse, repair, recovery, or reduction, thereby minimizing E-waste generation. During the current audit year, approximately 0.6 tons of E-waste were generated, consisting mainly of worn-out electrical gadgets and a few digital devices.

**C. PLASTIC WASTES:**

REC has implemented a policy banning the single use of plastic and adheres to government norms regarding plastic usage. Each unit within REC has drop-in bins for recyclable and reusable plastics. All plastic wastes are collected and transferred to transit storage facilities before being disposed of through authorized collectors appointed by the local body. On average, approximately 10 kg of plastic waste is disposed of to authorized collectors every month.

Overall, waste management practices at REC are commendable, but there is a need for specific documentation concerning E-waste, plastics, and other hazardous wastes. Currently, there are no records for batteries and laboratory wastes, which requires attention. These practices are continued for the current academic year.

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## 6. OBSERVATIONS AND RECOMMENDATIONS

1. In the Land use, the Green area had declined by 2% due to an essential new construction for academic purpose. Yet, 32% of the total area is under greens.
2. The new construction that was started this AY, need to follow "Green Building Norms" so as to make the construction energy efficient and ecofriendly;
3. Although the land use management is commendable, the college can still enhance the scope for maximizing water percolation area in the campus.
4. The species diversity indicators reveal that there is vast scope for enhancing the plants diversity with more number of native species.
5. Biomass and biomass carbon required to be enhanced to at least 1500 tons of carbon. The college may plan to achieve this by 2025.
6. Book keeping for the water resource management is to be improved so that per capita water consumption, particularly in the hostels need to be improved.
7. Enhancing energy efficiency is necessary. Besides the recommendations made in the energy audit (by a separate consultant), the college is advised to instal electricity meters for every building or facility wise, or block wise so as to understand and compare the energy efficiency of different activities.
8. There was a drastic decline in the solar power generation during 2022 - 2023. This need to be immediately addressed. The high variability in the performance of 5 separate solar installations of equal capacity need to be monitored for a systematic maintenance, so as to ensure their efficiency.

9. As a policy, by adopting 24° C as minimum limit for all air conditioners, the load from air conditioning activity can be brought down by 50% and there by substantial saving on power and power generation can be made.
10. This year, the number of resident students have increased contributing to minimizing the transportation and thereby the carbon foot print. The college has to encourage all students coming from more than 25 km of distance to avail residential facilities so that the college can achieve carbon neutral status, as emissions factors of transportation is very high and also cumbersome to the young engineers whose real talents cannot be utilized.
11. The book keeping procedures for waste management, especially for E waste, must be improvised.

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For the following scope of activities:

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|--|------------------|
| Date of Initial Registration           | 23rd August 2022 |
| Date of <b>this</b> Certificate        | 21st August 2023 |
| 2 <sup>nd</sup> Surveillance Audit Due | 22nd August 2024 |
| Certificate Expiry                     | 22nd August 2025 |

*Daniel..*  
Authorised Signatory



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**GREEN AUDIT ASSESSMENT & RANKING CRITERION**

| #              | Audit Components                | WA | Rec. Score |      |      |      |     | Max. Score |
|----------------|---------------------------------|----|------------|------|------|------|-----|------------|
|                |                                 |    | A          | B    | C    | D    | TOT |            |
| 1              | Policy and Program development  | 10 | 3          | 2.5  | 2.5  | 2    | 10  | 10         |
| 2              | Land use and Land Cover Mgmt.   | 15 | 3          | 2    | 2    | 3    | 10  | 15         |
| 3              | Water Management                | 15 | 2          | 3    | 3    | 2    | 10  | 15         |
| 4              | Energy Management               | 15 | 2          | 3    | 3    | 2    | 10  | 15         |
| 5              | Wastes Management               | 15 | 2          | 3    | 3    | 2    | 10  | 15         |
| 6              | Green Initiatives               | 10 | 2          | 3    | 3    | 2    | 10  | 10         |
| 7              | Participation Levels            | 10 | 2.5        | 2.5  | 2.5  | 2.5  | 10  | 10         |
| 8              | BMPs & Green Skills Development | 10 | 2          | 2.5  | 2.5  | 3    | 10  | 10         |
| <b>Summary</b> |                                 | @  | 18.5       | 21.5 | 21.5 | 18.5 | 80  | 100        |

- A. Approved Plans for desired out comes: (18.5)
- B. Book Keeping: (21.5)
- C. Periodical Monitoring (21.5)
- D. Out Put levels (18.5)

| Category          | % Range |
|-------------------|---------|
| <b><u>AA</u></b>  | > 90    |
| <b><u>A++</u></b> | 80 - 89 |
| <b><u>A+</u></b>  | 70 - 79 |
| <b><u>A</u></b>   | 60 - 69 |
| <b><u>B+</u></b>  | 50 - 59 |
| <b><u>B</u></b>   | 40 - 49 |
| <b><u>C</u></b>   | < 40    |

