



## GOVERNMENT COLLEGE OF ENGINEERING

Station Road, Osmanpura,  
AURANGABAD-431 005 (M.S.)

"In Pursuit of Global Competitiveness"

☎: (0240) 2332635, 2358333, 2366150 Fax: (0240) 2332835

E-mail: [principalgeca@yahoo.com](mailto:principalgeca@yahoo.com) Website: <http://www.geca.ac.in>

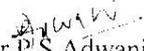
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### NOTICE

#### Subject : Saving of Papers, Water and Energy

As a part of curriculum engineering students have to submit write up or print outs of submission works for practical, assignments, seminar works or project works. It is observed that most of the students write/print the submission works on single side of paper. The other plain side of paper gets wasted. In this regard a batch of civil engineering students have worked out the consumption of papers and the quantity of wastewater generated, energy required and CO<sub>2</sub> emissions for the manufacture of papers. The study reveals that if both sides of papers are used for submission works, that will save considerable amount of papers, energy and water. Therefore all the students are directed to preferably use both sides of papers for their submission works. The printed copies of seminar, project and dissertation works submitted to institute shall be preferably printed on both sides of papers. If student desires his/her own one copy may be printed on single side of paper.

  
(Dr. P. S. Adwani)  
Principal

Copy to all Heads of the Departments for information and necessary action.



# SAVING OF WATER AND ENERGY THROUGH OPTIMUM UTILISATION OF JOURNAL PAPERS FOR UNDERGRADUATE COURSES IN ENGINEERING

- 1) Dr. U.J.Kahalekar  
(Professor in Civil Engineering, Government College of Engineering, Aurangabad (GECA))
- 2) Mr. Rushabh S.Thole (BE CIVIL Student, GECA)
- 3) Mr. Nikhil S. Mahale (BE CIVIL Student, GECA)
- 4) Mr. Shreyans J. Mutha (BE CIVIL Student, GECA)
- 5) Ms. Swarrasha S. Bedmutha (BE CIVIL Student, GECA)
- 6) Mr. Amol A. Chaudhari (BE CIVIL Student, GECA)
- 7) Ms. Rajashri K. Sarode (BE CIVIL Student, GECA)
- 8) Ms, Seema P. Kolte (BE CIVIL Student, GECA)
- 9) Ms. Kiran M. Ahire (BE CIVIL Student, GECA)
- 10) Ms. AshwiniS. Gapat (BE CIVIL Student, GECA)

## 1. INTRODUCTION

As a part of curriculum, engineering students have to submit write up or print outs of submission works for practical, assignments, seminar works or project works. It is a common practice of students to write the submissions of practical and assignments on single side of journal paper. Similarly, it is a common practice to print seminar, project works on single side of papers. The size of paper which is used by students is A 4 (21 cm x 29.5 cm). It observes that the other side of paper used for submission works, which is plain, gets wasted. If students are directed to write on both sides of paper, it will save substantial number of papers and thus water and energy will also be saved. Using less number of papers will also reduce pollution. Writing or printing of submission works on both sides of journal papers will have no adverse effect on quality of academics as well as on knowledge inputs of students.

## 2. WATER AND ENERGY CONSUMPTION FOR PRODUCTION OF PAPER

Pulp and paper industry consumes large quantities of fresh water. It consumes fresh water more than 120 m<sup>3</sup>/t of paper depending on the type of raw material being used. Disposal of wastewater from paper and pulp industries, containing various chemicals is the greatest environmental concern. Few of the large paper mills have upgraded their Effluent Treatment Plant (ETP) with installation of tertiary treatment system for better effluent quality. Few agro-based paper mills have installed the non-conventional chemical recovery system, to incinerate the black liquor, which is one of the major causes of pollution, coupled with a system for tertiary treatment.

For mill producing writing printing paper and newsprint average power consumption is 1500 to 1700 kWh/ton and wastewater generation is about 150 m<sup>3</sup>/ton.

## 3. CASE STUDY

### 3.1 Intake Capacity:

Govt. College of Engineering, Aurangabad is a prime institute in Marathwada region in Maharashtra State. The institute is established in the year 1960 and institute runs 6 undergraduate engineering courses viz. Civil, Mechanical, Electrical, E & TC, Computer and Information Technology. Along with undergraduate courses, institute also runs MCA course with intake of 60 and seven PG courses in engineering with 18 intakes each. In this study, six

undergraduate courses are considered. The number of undergraduate students in the institute is as below:

**Table Number 1**  
Number of Undergraduate Students in GECA

Course	Number of first year students	Number of second year, third year , fourth year students	Total Number of students
Civil Engineering	60	75x3=225	285
Mechanical Engineering	60	75x3=225	285
Electrical Engineering	60	75x3=225	285
Electronics And Telecommunication	60	75x3=225	285
Computer Science Engineering	60	75x3=225	285
Information Technology	60	75x3=225	285
TOTAL			1710

### 3.2 Paper Requirement:

It observes that there are minimum 6 practical and 10 assignments which require 450 pages per year per student. Along with submission works of practical and assignments, students from higher classes have to submit print outs of the seminar and project works. Commonly students use A 4 size papers, which are available in market. One set of paper consists of 100 pages and has weight of 0.400 Kg per set. The tentative requirement of papers and weight thereof is as below:

**Table Number 2**  
Number and Weight of Papers Required for Undergraduate Engineering Students in GECA per Year  
(Total Number of Students 1710)

Item	Minimum Number of Pages required per student	Weight (kg) of paper per student	Total number of pages required for 1710 students	Weight of paper for 1710 students (Kg)
Submission works of practical and Laboratory works	300	1.2	513000	2052
Assignments	150	0.600	256500	1026
Seminar and Project	150	0.600	256500	1026
Total	600	2.4	1026000	4104

### 3.3 Energy, Water and Other Requirements:

During manufacturing process of papers in agro based mills, water and energy is required for production of papers. Major raw materials used in Indian paper industries are hard wood and Bamboo. For production of papers chemicals are also required, which further contribute in pollution of air, ground water and surface water. The CO<sub>2</sub> emissions and wastewater

generated during manufacturing of paper are also significant. Table Number 3 gives the requirement of trees, and energy for manufacture of papers. The table also gives statistics of CO<sub>2</sub> emissions and wastewater generated during manufacture of papers

**Table Number 3**  
Important Aspects Related With Energy and Environment

Item	Magnitude for Production of One Ton of Paper	Magnitude for GECA (4.104 ton paper, 1710 students)	Magnitude Per Student
Energy	1000 kWh [1]	4104 kWh	2.4 kWh
CO <sub>2</sub> Emission	2.20 ton [3]	9.0288 ton	0.00528 ton
Waste Water Generation	120 m <sup>3</sup> [1],[2]	492.48 m <sup>3</sup>	0.288 m <sup>3</sup>
Trees	17 [4]	69.7	0.04

### 3.4 State Level Statistics for Water, Energy and other Environmental Parameters:

The intake capacity of undergraduate engineering courses in Maharashtra is about 150000. For finding the requirement of papers and other environmental parameters, it is assumed that 60% of intake capacity i.e. about 90000 students seeks the admission for first year Under graduate Engineering Courses. Considering 20 % additional admissions of Diploma completed candidates to direct second year engineering courses, total number of candidates in Maharashtra who are pursuing the undergraduate engineering courses works out to 414000. Table Number 4 gives statistics of energy, water requirements for manufacturing of papers and other important parameters thereof for undergraduate students in Maharashtra.

**Table Number 4**  
Total Consumption of Energy & Other Aspects  
(In Maharashtra)

Item	Magnitude Per Student	Magnitude for Undergraduate Engineering students in Maharashtra (414000 students)
Weight of Papers Required	0.0024 ton	993.60 ton
Consumption of Energy to Produce Papers	2.4 kWh	993600 kWh
Emission of CO <sub>2</sub>	0.00528 ton	2185.92 ton
Generation of Waste Water	0.288 m <sup>3</sup>	119232 m <sup>3</sup>
Trees Required	0.04	16560

## 4. PROPOSED CHANGE OF PRACTICE OF SUBMISSION WORKS AND ITS IMPACT ON ENVIRONMENT

The quantity of papers used per year in the institute GECA with 1700 students for undergraduate engineering courses is about 4.08 ton. If the policy of write up of submission of laboratory works, seminar, assignment and taking print outs of project and seminar works is changed and directives are issued to use both sides of papers, that will save papers, water and energy. Papers required for write up/print out of submission works are about 600. It is estimated that 40 % papers (i.e.240pages) can be saved by directing the students to write or take print outs on both sides of papers for submitting the submission works.

Table Number 5 gives the statistics of savings of paper, water and energy with the change in policy of writing or printing the submission works on both sides of papers. The table also give statistics of reduction in CO<sub>2</sub> emissions, generation of wastewater.

**Table Number 5**

Annual Savings of Papers, Water, Energy & Other Important Aspects in GECA and All Over the Maharashtra

Description	Saving (per student)	Saving in GECA (1710students)	Saving for all over Maharashtra (414000 students)
Saving in Number of papers	240	410400	99360000
Saving in weight of papers	0.000960 ton	1.6416 ton	397.440 ton
Energy Saved	0.960 kWh	1641.6 kWh	397440 kWh
Reduction in CO <sub>2</sub> emission	0.002112 ton	3.6115 ton	874.368 ton
Reduction in waste water generation	0.1152 m <sup>3</sup>	196.992 m <sup>3</sup>	47692.80 m <sup>3</sup>
Trees Saved	0.016	27.36	6624

## 5. CONCLUSION

As a part of curriculum the undergraduate engineering students have to submit write up or print out of submission works for laboratory works, seminar, assignment, projects and seminars. Students use A-4 size papers for their submission works. It is a practice to write/print the submission works on single side of paper. The other plain side of paper gets wasted. If the students are directed to use both sides of papers for their submission works that will reduce substantial number of papers.

The studies are carried out regarding savings in paper use and subsequently savings in water consumption and energy if the policy of writing the submission works on both sides of papers is implemented. The total number of students studying for Undergraduate Engineering courses in Govt. Engineering College, Aurangabad is about 1710 and students consume about 1026,000 papers. It is estimated that with the change in policy of using papers on both sides, annually 410,400 number of pages can be saved and thus 1641.60 kWh energy per year can be saved. Annual saving in energy and papers at Maharashtra State level could be 397440 kWh and 99.36 million papers. Reduction in use of papers can reduce CO<sub>2</sub> Greenhouse gas emission, pollution of air and wastewater generation. Reduction in use of papers will also reduce generation of solid waste.

A survey in Government College of Engineering, Aurangabad and other technical institutions at Aurangabad is carried out about consumption of papers and saving in the papers after use of both sides of papers. About implementation of concept of write up/ print out of submission works on both sides of paper, the concept is welcomed almost by all students, faculty and head of the institutions. In this paper, saving in papers for undergraduate engineering courses is discussed. If the concept of utilization of both sides of papers for submission works for all undergraduate as well as postgraduate courses is implemented, that will save substantial number of papers, energy and water. It is recommended that appropriate authority shall issue directives to students and concerns to submit or accept write up/print outs of submission works on both sides of paper to conserve nature and environment.

## 6. ACKNOWLEDGEMENT

Authors are grateful to Mr. Prasad Kokil (Managing Director, Sanjay Techno Products Pvt. Ltd., Aurangabad, and Maharashtra) for motivating us to conserve water and energy.

## 7. REFERENCES

- 1) Central Pulp and Paper Research Institute, (2002) Final Report Draft on 'Global Competitiveness of the Indian Paper Industry': 44-45
- 2) The Environment (Protection) Act, 1986
- 3) [www.cseindia.org/userfiles/91-104%20Paper\(1\).pdf](http://www.cseindia.org/userfiles/91-104%20Paper(1).pdf): 96(Center for Science & Environment)
- 4) <https://engineering.dartmouth.edu/~d30345d/courses/engs171/Paper.pdf> : 7



## PROPOSAL FOR SAVING OF PAPERS, WATER AND ENERGY

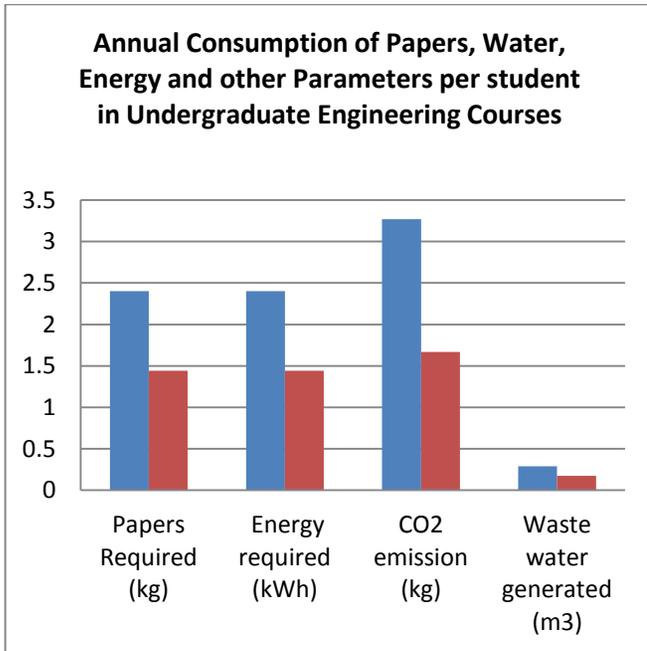


Figure 1

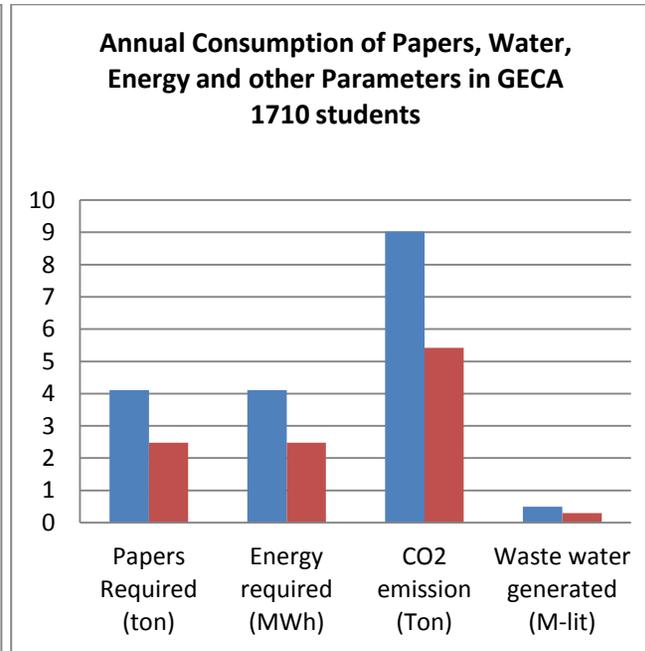


Figure 2

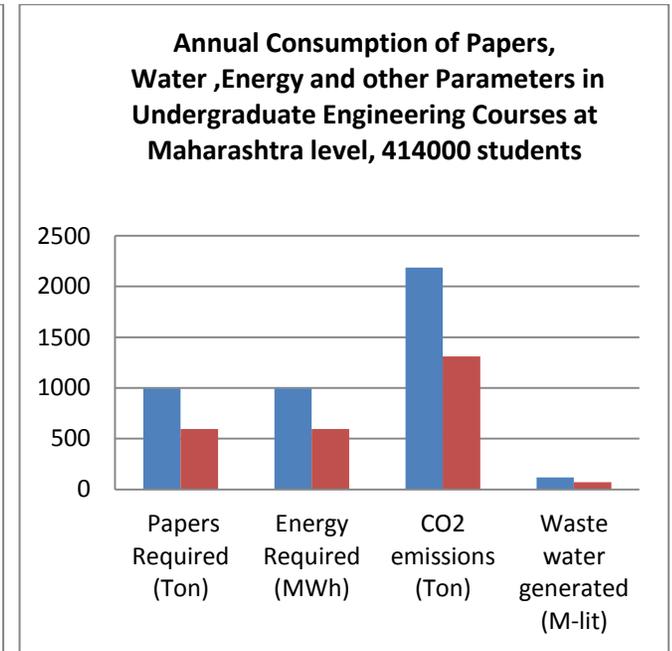


Figure 3

■ Submission on One side of papers  
■ Submission on both sides of papers

	Papers Required (Number)			Weight of Papers			Consumption of Energy			CO <sub>2</sub> Emission			Wastewater Generation		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<b>Per Student</b>	600	360	240	2.4 kg	1.44 kg	0.96 kg	2.4 kWh	1.44 kWh	0.96 kWh	5.28 kg	3.168 kg	2.112 kg	0.288 m <sup>3</sup>	0.173 m <sup>3</sup>	0.115 m <sup>3</sup>
<b>For GECA</b>	1.026 million	0.616 million	0.410 million	4.104 ton	2.462 ton	1.642 ton	4104 kWh	2462 kWh	1642 kWh	9029 kg	5417 kg	3612 kg	0.4924 M lit	0.2958 M lit	0.1966 M lit
<b>For Maharashtra</b>	24.84 crore	14.904 crore	9.936 crore	993.6 ton	596.2 ton	397.4 ton	993.6 MWh	596.2 MWh	397.4 MWh	2186 ton	1312 ton	874 ton	119.23 M lit	71.62 M lit	47.61 M lit

**Note - A: Submission works on single side of papers    B: Submission works on both sides of papers    C: [A-B ] Savings (40%)**



# **SAVING OF WATER AND ENERGY THROUGH OPTIMUM UTILIZATION OF PAPERS FOR POSTGRADUATE COURSES IN ENGINEERING**

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## **1. INTRODUCTION**

As a part of curriculum, post graduate engineering students have to submit write up or print outs of dissertation work, laboratory works, seminar and assignments. There is a practice of students to write or print the submission works on single side of papers. It is observed that the other side of paper which is plain gets wasted. If students are given directives to write/print the submission works on both sides of paper, it will save substantial number of papers and thus will also save water and energy. Using less number of papers will also reduce pollution.. Printing or writing of submission works on both sides of paper will not have any adverse effect on academics as well as knowledge inputs to students.

## **2. WATER AND ENERGY CONSUMPTION FOR PRODUCTION OF PAPER**

Pulp and paper industry consumes large quantities of fresh water. It consumes fresh water more than 120 m<sup>3</sup>/t of paper depending on the type of raw material being used. Disposal of wastewater from paper and pulp industries, containing various chemicals is the greatest environmental concern. For mill producing writing printing paper and newsprint average power consumption is 1500 to 1700 kWh/ton and wastewater generation is about 150 m<sup>3</sup>/ton.

## **3. CASE STUDY**

### **3.1 Intake Capacity:**

Govt. College of Engineering, Aurangabad (GECA) is the prime institute in Marathwada region of Maharashtra State. The institute is established in the year 1960 and right now there are 7 postgraduate engineering courses viz. Water Resource Engineering, Structural Engineering, Computer Science and Engineering, Electrical Machine and Drive, Electrical Power System, Electronics Engineering and Production Engineering. The number of postgraduate students in the institute is as below:

**Table Number 1**  
Number of Postgraduate Students In GECA

Course	Number of first year students	Number of second year students
Water Resource Engineering	18	18
Structural Engineering	18	18
Computer Science and Engineering	18	18
Electrical Machine and Drive	18	18
Electrical Power System	18	18
Electronics Engineering	18	18
Production Engineering	18	18
TOTAL	126	126

### 3.2 Paper Requirement:

It observes that each post graduate student has to submit submission works for seminar, laboratory works, assignments and dissertation. Each student submits 5 copies of dissertation works at the end of second year. The tentative requirement of A-4 size papers in two years of duration of course is as below:

**Table Number 2**  
Number of Papers required per Student and All Postgraduate Engineering Students in GECA (Intake of students 126 per year)

Item	Approximate Number of Pages required per student	Weight (kg) of paper per student	Total number of pages required for 126 students	Weight of paper for 126 students (Kg)
Submission works of Seminars and Laboratory Works Of First Year Course	150	0.60	18900	75.6
Dissertation I (2 Copies)	50x2=100	0.400	12600	50.4
Dissertation II Work (5 Copies) For Second Year Course	100 x 5 = 500	2.00	63000	252
Total	750	3.00	94500	378

### 3.3 Energy, water and other requirements:

During manufacturing process of papers in agro based mills, water and energy is required for production of papers. Major raw materials used in Indian paper industries are hard wood and Bamboo. For production of papers chemicals are also required, which further contribute in pollution of air, ground water and surface water. The CO<sub>2</sub> emissions and wastewater generated during manufacturing of paper are also significant. Table Number 3

gives the requirement of trees and energy for manufacture of papers. The table also gives statistics of CO<sub>2</sub> emissions and wastewater generated during manufacture of papers

**Table Number 3**  
Important Aspects Related With Energy and Environment

Item	Magnitude for Production of One Ton of Paper	Magnitude for GECA (0.378 ton paper, 126 students)	Magnitude Per Student
Energy	1000 kWh [1]	378 kWh	3 kWh
CO <sub>2</sub> Emission	2.20 ton [3]	0.8316 ton	0.0066ton
Waste Water Generation	120 m <sup>3</sup> [1],[2]	45.36 m <sup>3</sup>	0.36 m <sup>3</sup>
Trees	17 [4]	6.4	0.05

### 3.4 State Level Statistics for Water, Energy and other Environmental Parameters:

The intake capacity of postgraduate engineering courses in Maharashtra is 19,338. For finding the requirement of papers and other environmental parameters, it is assumed that 60% of intake capacity i.e. about 11600 students pursues the studies for Post-Graduation Engineering Courses. For these 11600 students papers are required for their submission works in different subjects and dissertation works. Table Number 4 gives statistics of energy, water requirements for manufacturing of papers and other important parameters for manufacture of papers required for post graduate students in Maharashtra.

**Table Number 4**  
Total Annual Consumption of Energy & Other Aspects  
(In Maharashtra)

Item	Magnitude Per Student	Magnitude for Postgraduate Engineering students in Maharashtra (11600 students)
Weight of Papers Required	0.003 ton	34.8 ton
Consumption of Energy to Produce Papers	3 kWh	34800 kWh
Emission of CO <sub>2</sub>	0.0066ton	76.56 ton
Generation of Waste Water	0.36 m <sup>3</sup>	4176 m <sup>3</sup>
Trees Required	0.05	580

## 4. CHANGE OF PRACTICE OF SUBMISSION WORKS AND ITS IMPACT ON ENVIRONMENT

The quantity of papers used per year in the institute GECA with the intake of 126 students per year for post graduate engineering courses is about 0.378 ton. If the policy of write up of submission of laboratory works, assignments and printing of Dissertation works is changed and directives are issued to use both sides of journal papers, that will save papers, water and energy. Papers required to write journals for laboratory works, seminars and assignments are about 150. Similarly, students are submitting two copies of Dissertation I. The pages required for Dissertation I are about 100. Thus total 250 pages are required per student. It is assumed that 40 % papers (i.e.100 pages) can be saved by permitting the students to write/print on both sides for submission works. Right now, M.E. students are submitting 5 copies of dissertation works. Out of 5 copies of dissertation works one copy of student can be permitted for printing on single side. If the policy of printing of Dissertation

If work is changed and the students are directed to make one copy on single side of paper and remaining 4 copies are printed on both sides of papers, that will save about 200 papers per student. Therefore, total papers saved per student will be 300.

Table Number 5 gives the statistics of annual savings of paper, water and energy if the write up/printout of submissions are carried out on both sides of papers. The table also gives statistics of reduction in CO<sub>2</sub> emissions, generation of wastewater and savings of trees.

**Table Number 5**

Annual Savings of Papers, Water, Energy & Other Important Aspects in GECA and All Over the Maharashtra

Description	Saving (per student)	Saving in GECA (Intake Capacity 126 students)	Saving for all over Maharashtra (11600 students)
Saving in Number of papers	300	37800	3480000
Saving in weight of papers	0.0012 ton	0.1512 ton	13.92 ton
Energy Saved	1.2 kWh	151.20 kWh	13920 kWh
Reduction in CO <sub>2</sub> emission	0.00264 ton	0.3326 ton	30.624 ton
Reduction in waste water generation	0.144 m <sup>3</sup>	18.144 m <sup>3</sup>	1670.40 m <sup>3</sup>
Trees Saved	0.02	2.57	236.64

## 5. CONCLUSION

As a part of curriculum the Post graduate engineering students have to submit write up/print outs of submission works for laboratory works, assignments, seminars and dissertation works. Students use A 4 size papers for their submission works. Since many years, it is a common practice to write/print the submission works on single side of papers. The other plain side gets wasted. If the students are directed to use both sides of papers for their submission works that will reduce substantial number of papers.

The studies are carried out regarding savings in paper use, water consumption and energy by implementing the policy of writing the submission works on both sides of papers. The intake capacity of Post Graduate Engineering courses for Govt. Engineering College, Aurangabad (GECA) is 126 and presently this number of students requires 94500 papers. It observes that with the change in policy of using papers on both sides, every year total 37800 number of pages can be saved and thus 151.20 kWh energy and 18144 liters of waste water generation can be saved. The annual saving in energy and waste water at Maharashtra State level could be 13920 kWh and 1.67 Million Liters. Indirectly the number of trees can also be saved. Reduction in use of papers can reduce CO<sub>2</sub> Greenhouse gas emission and pollution of air and water.

It is recommended that appropriate authority shall issue guidelines to students to submit the write up or print outs of submission works on both sides of paper to conserve nature and environment.

## 6. REFERENCES

- 1) Central Pulp and Paper Research Institute, (2002) Final Report Draft on 'Global Competitiveness of the Indian Paper Industry': 44-45
- 2) The Environment (Protection) Act, 1986
- 3) [www.cseindia.org/userfiles/91-104%20Paper\(1\).pdf](http://www.cseindia.org/userfiles/91-104%20Paper(1).pdf): 96(Center for Science & Environment)
- 4) <https://engineering.dartmouth.edu/~d30345d/courses/engs171/Paper.pdf> : 7



## PROPOSAL FOR SAVING OF PAPERS, WATER AND ENERGY

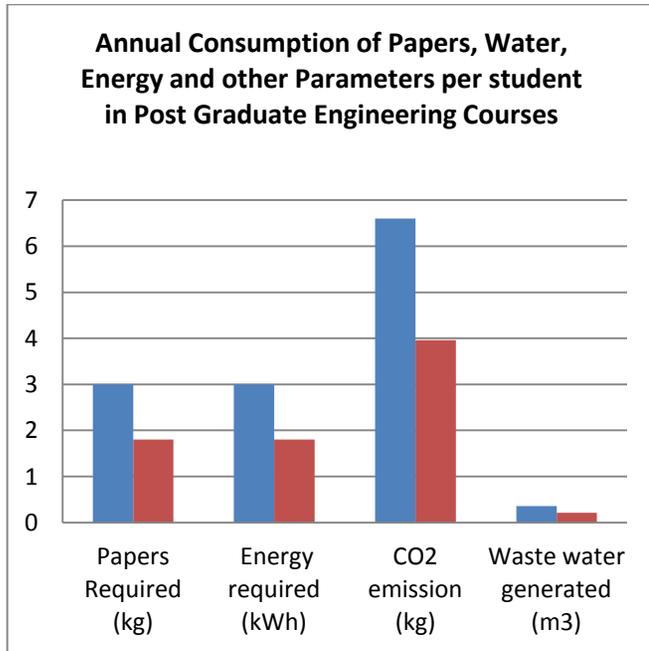


Figure 1

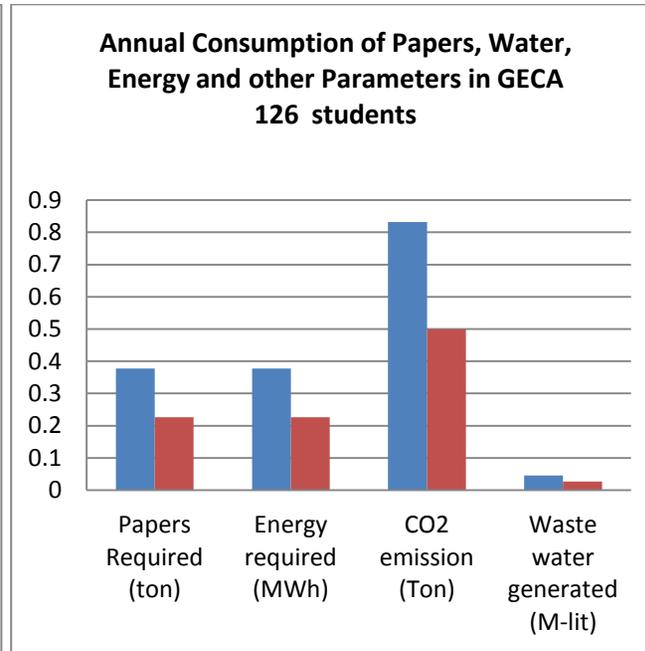


Figure 2

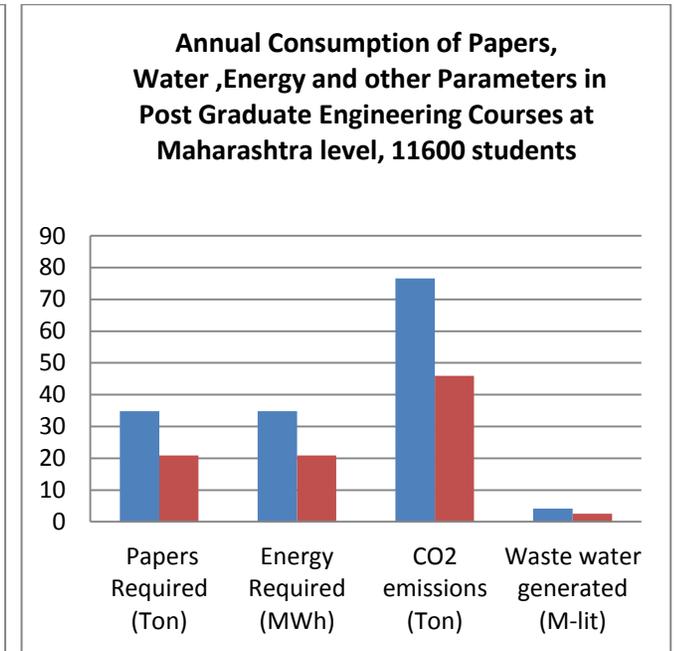


Figure 3

■ Submission on One side of papers  
■ Submission on both sides of papers

	Papers Required (Number)			Weight of Papers			Consumption of Energy			CO <sub>2</sub> Emission			Wastewater Generation		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<b>Per Student</b>	750	450	300	3 kg	1.8 kg	1.2 Kg	3 kWh	1.8 kWh	1.2 kWh	6.6 kg	3.96 kg	2.64 kg	0.36 m <sup>3</sup>	0.216 m <sup>3</sup>	0.144 m <sup>3</sup>
<b>For GECA</b>	0.0945 million	0.0567 million	0.0378 million	0.378 ton	0.226 ton	0.152 ton	378 kWh	226.8 kWh	151.2 kWh	831.6 kg	499 kg	332.6 kg	45.36 m <sup>3</sup>	27.216 m <sup>3</sup>	18.144 m <sup>3</sup>
<b>For Maharashtra</b>	8.70 million	5.22 million	3.48 million	34.8 ton	20.88 ton	13.92 ton	34.8 MWh	20.88 MWh	13.92 MWh	76.56 ton	45.94 ton	30.62 ton	4.176 M lit	2.506 M lit	1.67 M lit

**Note - A: Submission works on single side of papers    B: Submission works on both sides of papers    C: [A-B ] Savings (40%)**