ASSESSMENT OF CARBON FOOTPRINT GENERATION THROUGH ELECTRICAL APPLIANCES IN RESIDENTIAL COLONY OF CSIR-INDIAN INSTITUTE OF PETROLEUM
(Phase-II Survey; Summer Season)

Submitted as a part of the requirement for the partial fulfillment of the course work of CSIR-Harnessing Appropriate Rural Interventions and Technologies (CSIR-HARIT) for the award of degree of PhD

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Declaration – I Megha Sailwal hereby certify that the work presented in this Report entitled "Assessment Of Carbon Footprint Generation Through Electrical Appliances In Residential Colony Of CSIR-INDIAN INSTITUTE OF PETROLEUM (Phase-II Survey; Summer Season)" in partial fulfillment of the course requirement for award of the Degree of PhD, being submitted to CSIR-HARIT Unit, CSIR-Indian Institute of Petroleum, Dehradun, is an authentic record of Project Research work carried out by me at CSIR-Indian Institute Of Petroleum during the period March – May 2018 and under the supervision of Dr. Debashish Ghosh.

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1. INTRODUCTION

A **carbon footprint** is defined as "the total set of carbon emissions caused by an individual, organization, product expressed as carbon dioxide equivalent."

OR

A **carbon footprint** can broadly be defined as a measure of the carbon emissions that are directly and indirectly caused by an activity or are accumulated over the life stages of a product or service, expressed in carbon dioxide equivalents CO_2e.

For easiness of writing, it is often expressed in terms of Carbon footprint, a way of showing your carbon emissions. Human's individual emissions are built up from the energy we use personally for electricity, as well as the energy that's required to produce our food. The total carbon footprint cannot be calculated because of the large amount of data required and the fact that carbon dioxide can be produced by natural occurrences. Our footprint value is in "tonnes of carbon dioxide equivalent". The result is an individual footprint, although household information is used to calculate home energy impacts. The impact of heating and powering the home is divided by the number of adult residents. Generally, carbon emissions, which are closely, related to direct and indirect energy requirements of households. The following definitions are used:

Direct GHG emissions: **Scope 1:** sources that release emissions straight into the atmosphere.

Indirect GHG emissions: **Scope 2:** Indirect emissions from purchased electricity,

Scope 3: Other Indirect emissions, is an optional reporting category that allows for the measurement of all other indirect emissions.

For this report, an independent study was conducted by the student, as part of a CSIR HARIT project. This is planned to be an ongoing part of the CSIR HARIT, giving the student direct exposure to challenging problems of the real-world, in this case, sustainability and in particular measuring and mitigating carbon footprint.

2. BACKGROUND AND MOTIVATION

An initiative to develop an eco-campus with in CSIR-IIP's colony premises was made. We combine energy analysis with household demand structure to estimate the carbon footprint for IIP colony households limited to C, D, E, S type. Therewith, we can trace the carbon content of each final consumption items. This survey can be used to propose ideas for maintaining the generation of total carbon footprints generated. The basic understanding, ability and motivation for reducing carbon emissions is known as CARBON CAPABILITY. It captures the contextual meanings associated with carbon, whilst also referring to an individual's ability and motivation to reduce emissions within the broader institutional and social context. Managing finance and managing carbon are also similar in the way that they have intangible aspects. Similarly, the negative impacts of increasing carbon emissions are easily ignored because of their intangibility. One of the challenges therefore for promoting carbon capability is to increase the visibility of carbon and re-materialize energy use in day-to-day activities and choices. Carbon capability is about transforming understandings of carbon from an inevitable waste product of modern lifestyles, to a scarce and potent resource to be carefully managed.

Being carbon capable implies knowledge of:

- the causes and consequences of carbon emissions;
- the role individuals - and particular activities - play in producing carbon emissions;
- the scope for (and benefits of) adopting a low-carbon lifestyle;
- what is possible through individual action;
- carbon-reduction activities which require collective action and infrastructural change;
- managing a carbon budget;
- information sources - and the reliability (bias, agenda, uncertainty, etc.) of different information sources; and
- the broader structural limits to and opportunities for sustainable consumption.

The purpose of this exercise is to demonstrate that individual action is only one part of the carbon-management picture, and there is a limit to what can be achieved by individuals acting independently. To achieve the necessary cuts in carbon emissions, collective action and action by business and government are essential to shift fundamental infrastructures of society.

(a) Investigate your carbon footprint using the following web sources:

1. www.carbontrust.co.uk/solutions/CarbonFootprinting/
2. wi.footprint.wwf.org.uk
3. actonCO_2.direct.gov.uk/index.html
    - who is providing these calculators?
    - what do you think their aims are in providing the calculator? - what are your scores for each of the footprint calculators?
    - what assumptions are made in each of the footprint calculators?
    - how useful do you think calculators like this are for contributing to a low carbon future?

(b) How could you, acting on your own, reduce your carbon footprint?

(c) How could the following people or organizations help to create an environment which would make it easier for you to reduce your footprint?

- your fellow household members
- your community
- organizations?

In 2016, Mr. Abhilek Kumar Nautiyal, SRF, BCA, BFD carried out the same study for winter season. This year, I have repeated the same study limited to same reference frame, for summer season (March – May 2018). I have surveyed all the occupied quarters in C, D, E, S1, and S2 as, previously done by Mr. Abhilek and also co-related with total electrical meter reading (individual house-hold basis), as supplied by Ms. Sandhya Garg, ESD, CSIR-IIP to calculated carbon foot print generated during summer season due to electrical appliances.

3. SURVEY

The survey was restricted to C, D, E, S1 and S2 type quarters in CSIR-IIP Colony during summer season (March-May 2018) and calculations have been shown on average output per month basis.

Figure 1: Google map image of CSIR-IIP Residential campus showing S1, S2, D , E & C type quarters

4. ANALYSIS

4.1 Methodology

To calculate the CO_2 emissions inventory, we identified all relevant emissions sources and collected activity data from the site then, using emission factors, calculated emissions from each source. This was aggregated to total carbon footprint.

Emission sources and activity data: Activity data is a quantitative measure of activity that results in CO_2 emissions. It is mainly primary data e.g. the amount of electricity used for heating. The activity data is also used as environmental impact indicators.

Emission factors: Emission factors are calculated ratios relating CO_2 emissions to a measure of activity at an emissions source. They are used to convert activity data to carbon emissions. Emission factors represent **carbon dioxide equivalent (CO_2)**.

To calculate your housing footprint, you need to work out your personal share of home energy use. Having gathered this information, we then multiplied our personal usage by an emissions factor (EF) to calculate home footprint based on the following equation.

USE (kWh/month) × **EMISSIONS FACTOR** (kg CO_2e/kWh) = **EMISSIONS** (Kg CO_2e/ month)

4.2 Activity data

Table 1: Carbon foot print generated through various electrical appliances

Appliances	Emission Source	Load (Avg.)	Units	Carbon footprints (considering usage of 1 h / day)
		Wh	**KWh**	**kg CO_2eq. / h**
Electrical	Fan	60	0.06	0.03
	Incandescent bulb	100	0.1	0.05
	CFL bulb	20	0.02	0.01
	LED bulb	9	0.009	0.00
	Tube light	40	0.04	0.02
Kitchen	Microwave	1200	1.2	0.60
	Refrigerator	200	0.2	0.10
	Water purifier	30	0.03	0.02
	Mixer Grinder	450	0.45	0.23
House hold	Geyser	2000	2	1.00
	Room heater	2000	2	1.00
	Air conditioner	2000	2	1.00
	Television	90	0.09	0.05
	Washing Machine	900	0.9	0.45
	Iron Press	750	0.75	0.38
	Immersion Rod	1500	1.5	0.75
	PC Desktop	280	0.28	0.14
	Laptop	90	0.09	0.05
	Printer	350	0.35	0.18
	Tablet PC	5	0.005	Negligible
	Phone	5	0.005	Negligible

Based on above mentioned table, during survey all the appliances were divided into three heads; (1) electrical appliances, (2) kitchen appliances, (3) house hold appliances and the calculations were based on their Avg. load and usage as per survey of individual household.

4.3 Mean data table

Table 2: Total electricity consumption over a period of 3 months by the individual quarter rows S2, S1, E, D and C

SUMMARY					
Groups	*Count*	*Sum (KWH)*	*Average*	*Variance*	SD
S_2 type	13	5892	184.125	21604.56452	146.9849125
S_1 type	14	5229	163.40625	20041.8619	141.569283
E type	19	9086	378.5833333	57404.42754	239.5922109
D type	12	7461	532.9285714	135100.8407	367.5606626
C type	5	5816	969.3333333	308634.6667	555.5489777
Mean			**445.675297619047**		

The data table shows the total electricity consumption over a period of 3 months by the individual quarter rows S_2, S_1, E, D and C. The maximum electricity consumption was observed in case of C type quarter with high SD which comprises of ~43.49% of the entire load.

4.4 Anova Analysis

The variation among the groups was studied with ANOVA with a α value of 0.05. The null hypothesis was assumed that the population means are equal. Hence, we may write the null hypothesis as:

H_0: $\mu_1 = \mu_2 = \mu_3$ - The mean electrical consumption across the blocks are similar.

Since the null hypothesis assumes all the means are equal, we could reject the null hypothesis if only mean is not equal. Thus, the alternative hypothesis is:

H_a: At least one mean pressure is not statistically equal.

Table 3: ANOVA among the groups

ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	4611667	4	1152916.634	20.09032699	2.97266E-12	2.45992
Within Groups	5910825	103	57386.65353			
Total	10522492	107				

From the data table, we see that the observed F value is 20.09 which is significantly higher than the critical value Fcrit (2.45) at 95% level of confidence. So, we reject the null hypothesis that the observed means are statistically different and the blocks contribute differently to the mean electricity consumption.

4.5 Box plot

A box plot for electricity consumption as estimated by the survey and based on the meter reading data for the peak month of summer (May) was carried out to estimate the regression coefficient between the two. It was observed from the box plot that the survey data for quarters C, D, E, S_1 and S_2 were close to the actual meter readings for the total consumption corresponding to the quarter blocks. It can be inferred that the survey data was an accurate representation of the electricity consumption corresponding to these block. Based on the regression statistic, it could be inferred that the survey could only represent 90% of the actual meter readings accurately.

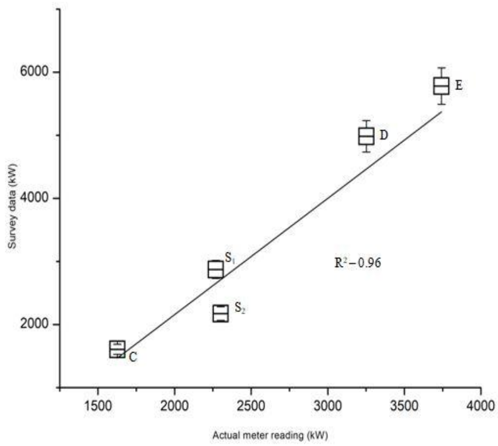


Figure 2: Box plot for electricity consumption as estimated by the survey and based on the meter reading data for the peak month of summer.

4.6 Mean Electricity Consumption of different apartment types

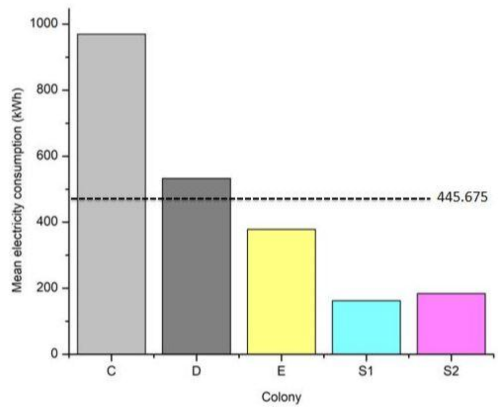
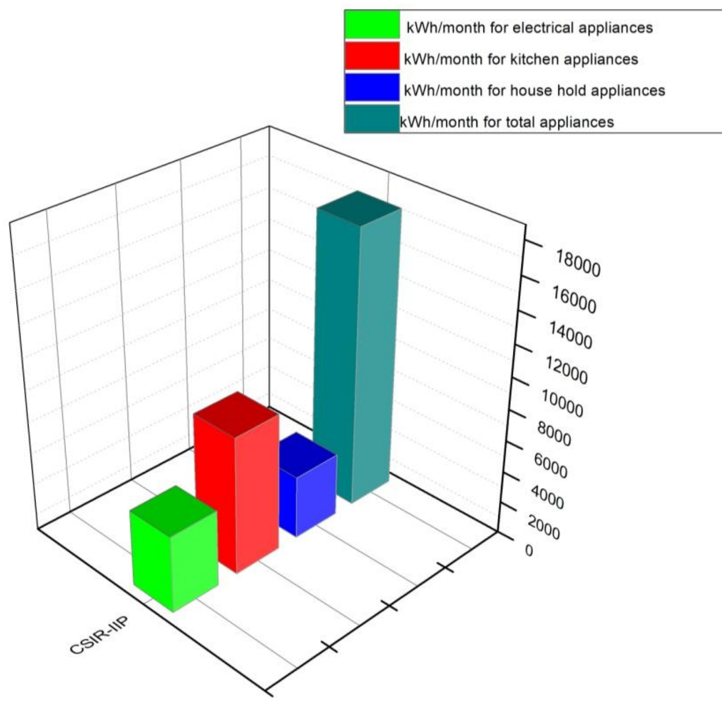
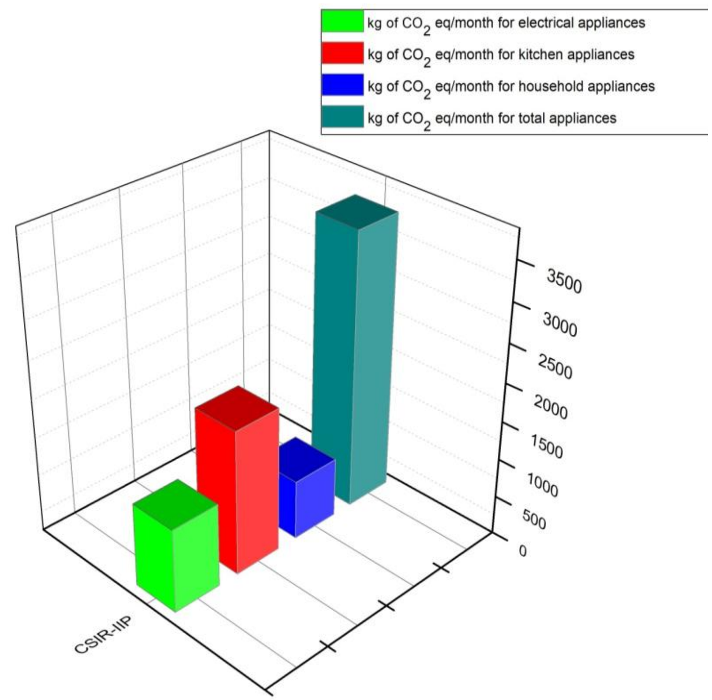


Figure 3: Mean Electricity Consumption of different apartment



(a) Total consumption in kWh/month for different appliances



(b) Total foot print generation of Kg CO_2eq /month for different appliances

Figure 4: Mean Electricity Consumption of CSIR-IIP residential complex (summer season)

5. APPLIANCE BASED LOAD DISTRIBUTION AND CARBON FOOT PRINT EVALUATION

5.1 C Type quarters

Quarter Type and No	Electrical appliances			Kitchen appliances			House hold appliances			Total electrical load	Total Carbon Footprint
	Load		Carbon Footprint	Load		Carbon Footprint	Load		Carbon Footprint		
	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/month	Kg of CO_2eq/month
C2	2.860	85.8	10	6.784	203.52	30	7.379	221.37	40	510.69	90
C3	3.630	108.9	10	5.670	170.1	20	4.884	146.52	20	425.52	40
C4	1.176	35.28	10	5.620	168.6	40	0.847	25.41	10	229.29	60
C5	1.176	35.28	10	5.620	168.6	40	0.847	25.41	10	229.29	60
C6	1.620	48.6	10	5.070	152.1	40	0.365	10.95	0.00	211.65	50
Total C	**10.462**	**313.86**	**50**	**28.76**	**862.92**	**170**	**14.32**	**429.66**	**80**	**1606.44**	**300**

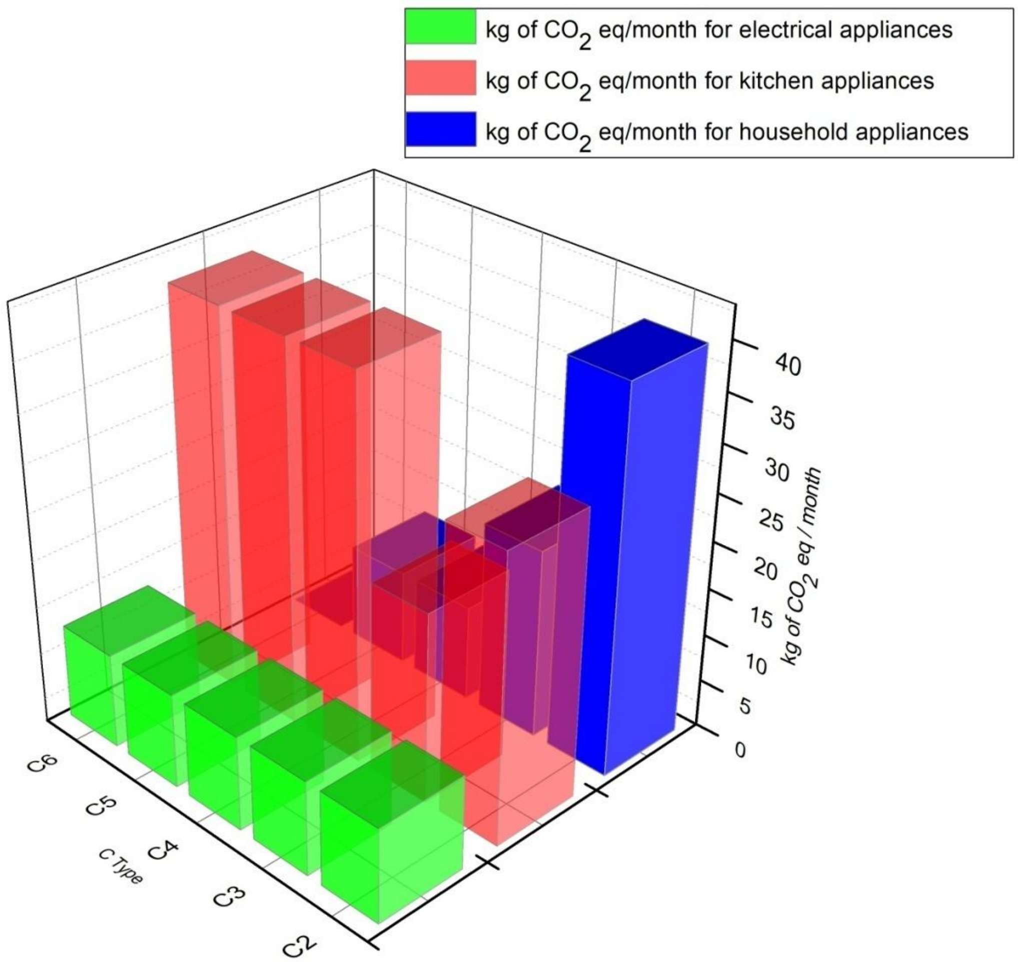


Figure 5: C type appliance-based carbon foot print generation (summer season)

5.2 D Type quarters

Quarter Type and No	Electrical appliances			Kitchen appliances			House hold appliances			Total electrical load	Total Carbon Footprint
	Load		Carbon Footprint	Load		Carbon Footprint	Load		Carbon Footprint		
	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/month	Kg of CO_2eq/month
D1	3.840	115.2	30	5.242	157.26	40	6.077	182.31	50	454.5	110
D2	3.280	98.4	10	4.870	146.1	20	5.366	160.98	20	405.48	50
D4	2.128	63.84	10	6.046	181.38	20	2.750	82.5	10	327.72	40
D5	0.450	13.5	0.00	11.372	341.16	90	5.010	150.3	40	504.96	130
D6	3.920	117.6	10	6.945	208.35	20	9.947	298.41	30	624.36	60
D7	1.164	34.92	10	5.520	165.6	30	1.258	37.74	10	238.26	40
D8	4.655	139.65	20	5.537	166.11	20	3.071	92.13	10	397.89	50
D9	2.586	77.58	10	4.815	144.45	20	0.780	23.4	0.00	245.43	30
D10	11.920	357.6	60	10.940	328.2	60	9.452	283.56	50	969.36	160
D11	1.944	58.32	10	5.452	163.56	30	1.386	41.58	10	263.46	40
D13	2.052	61.56	10	4.867	146.01	20	1.780	53.4	10	260.97	40
D14	3.292	98.76	10	5.045	151.35	20	1.345	40.35	0.00	290.46	30
Total D	**41.23**	**1236.93**	**190**	**76.65**	**2299.53**	**390**	**48.22**	**1446.66**	**240**	**4982.85**	**780**

D-3 & 12 (A total of 2 quarters were unoccupied during the time of survey)

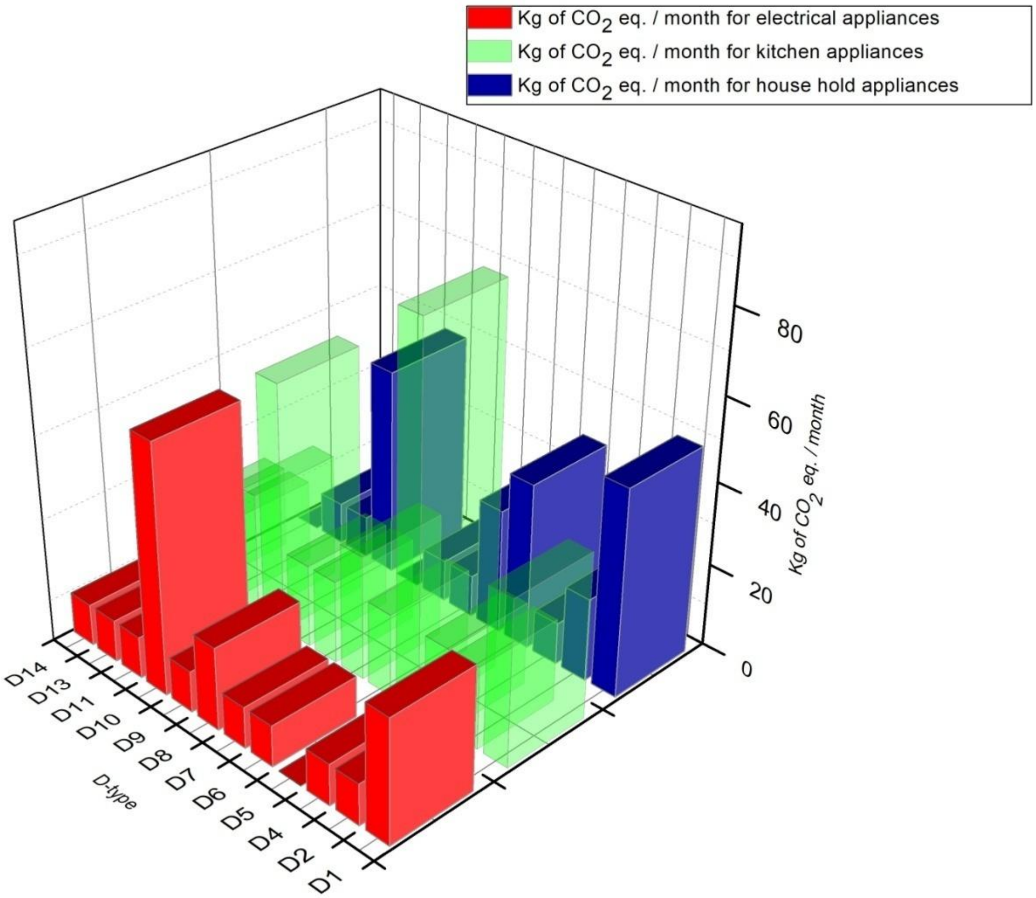


Figure 6: D type appliance-based carbon foot print generation (summer season)

5.3 E Type quarters

Quarter Type and No	Electrical appliances			Kitchen appliances			House hold appliances			Total electrical load	Total Carbon Footprint
	Load		Carbon Footprint	Load		Carbon Footprint	Load		Carbon Footprint		
	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/month	Kg of CO_2eq/month
E1	3.121	93.63	20	5.736	172.08	30	2.797	83.91	10	349.62	60
E3	1.308	39.24	10	5.162	154.86	40	0.354	10.62	0.00	204.72	50
E4	3.825	114.75	20	5.067	152.01	30	0.875	26.25	0.00	293.01	50
E5	3.225	96.75	10	5.052	151.56	20	3.005	90.15	10	338.46	40
E6	3.348	100.44	20	5.315	159.45	30	4.700	141	20	400.89	70
E7	3.600	108	10	4.867	146.01	20	0.326	9.78	0.00	263.79	30
E8	4.656	139.68	70	5.437	163.11	80	1.573	47.19	20	350.58	180
E9	2.680	80.4	10	4.905	147.15	20	1.722	51.66	10	279.21	40
E10	1.140	34.2	10	4.957	148.71	40	0.716	21.48	10	204.39	50
E12	1.848	55.44	10	5.557	166.71	30	1.223	36.69	10	258.84	40
E13	3.475	104.25	20	6.032	180.96	30	0.782	23.46	0.00	308.67	50
E14	2.580	77.4	10	6.037	181.11	30	2.251	67.53	10	326.04	50
E15	1.974	59.22	10	9.137	274.11	30	1.697	50.91	10	384.24	50
E18	2.768	83.04	10	4.852	145.56	20	1.255	37.65	10	266.25	30
E19	2.616	78.48	10	4.897	146.91	20	1.203	36.09	10	261.48	30
E20	2.900	87	20	5.067	152.01	30	0.573	17.19	0.00	256.2	40
E21	2.720	81.6	10	4.867	146.01	20	3.032	90.96	20	318.57	50
E23	4.160	124.8	20	4.805	144.15	20	1.538	46.14	10	315.09	40
E24	5.880	176.4	30	5.047	151.41	30	2.400	72	10	399.81	70
Total E	**57.82**	**1734.72**	**330**	**102.79**	**3083.88**	**570**	**32.022**	**960.66**	**170**	**5779.86**	**1020**

E- 2, 11, 16, 17, & 22 (A total of 5 quarters were unoccupied during the time of survey)

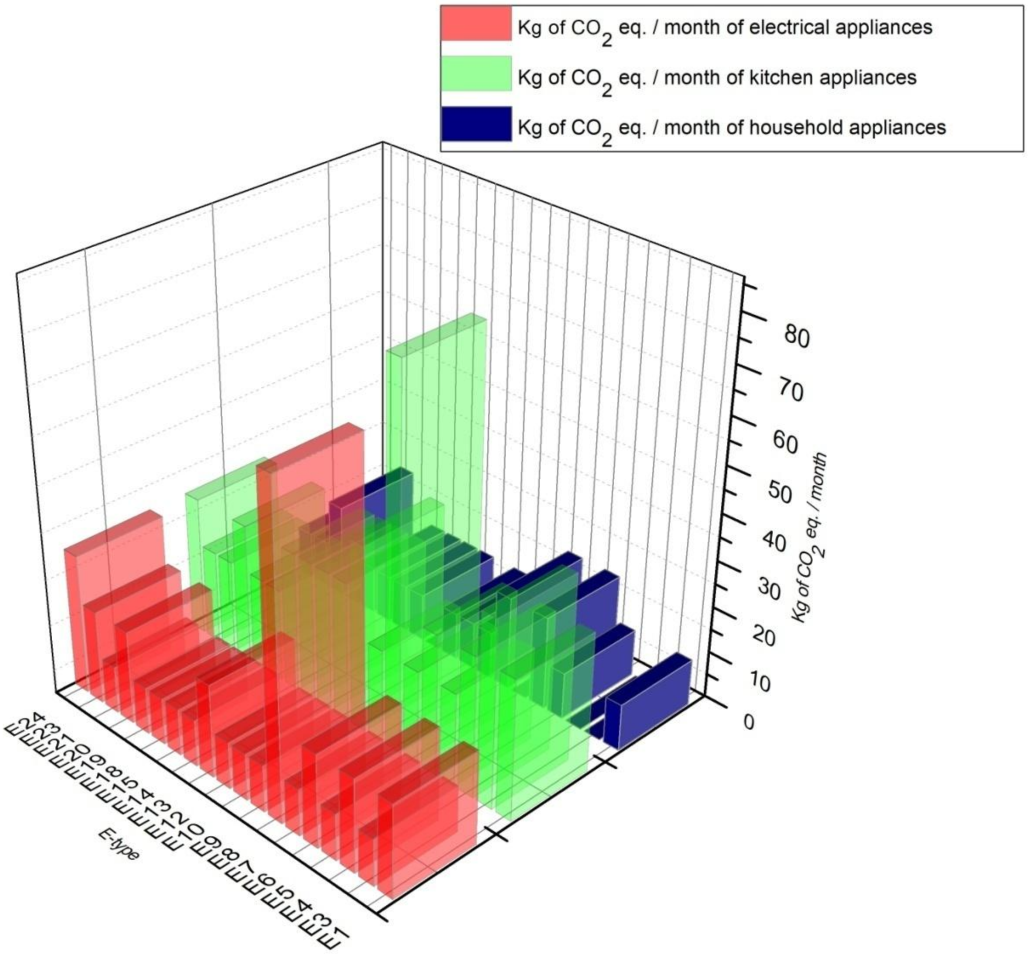


Figure 7: E type appliance-based carbon foot print generation (summer season)

5.4 S-1 Type quarters

Quarter Type and No	Electrical appliances			Kitchen appliances			House hold appliances			Total electrical load	Total Carbon Footprint
	Load		Carbon Footprint	Load		Carbon Footprint	Load		Carbon Footprint		
	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/month	kW/month	Kg of CO_2eq/month
S-1-4	1.836	55.08	10	5.097	152.91	40	0.262	7.86	0.00	215.85	50
S-1-6	0.744	22.32	10	4.867	146.01	40	0.353	10.59	0.00	178.92	50
S-1-8	1.935	58.05	30	2.00	60	30	1.252	37.56	20	155.61	80
S-1-9	2.832	84.96	10	0.00	0	0.00	3.040	91.2	10	176.16	20
S-1-10	1.207	36.21	20	0.031	0.93	0.00	0.659	19.77	10	56.91	30
S-1-12	1.820	54.6	30	6.795	203.85	100	0.961	28.83	10	287.28	140
S-1-14	2.052	61.56	10	0.00	0	0.00	1.900	57	10	118.56	20
S-1-16	2.500	75	40	2.00	60	30	0.935	28.05	10	163.05	80
S-1-18	0.522	15.66	10	6.00	180	90	0.262	7.86	0.00	203.52	100
S-1-20	5.250	157.5	20	8.145	244.35	30	1.662	49.86	10	451.71	60
S-1-24	2.562	76.86	10	4.917	147.51	30	2.845	85.35	10	309.72	50
S-1-30	2.140	64.2	20	5.017	150.51	40	0.462	13.86	0.00	228.57	60
S-1-31	1.824	54.72	30	0.00	0	0.00	0.207	6.21	0.00	60.93	30
S-1-32	1.320	39.6	10	4.954	148.62	30	2.581	77.43	10	265.65	40
Total S-1	**28.54**	**856.32**	**260**	**49.82**	**1494.64**	**460**	**17.38**	**521.43**	**100**	**2872.44**	**770**

S-1-1, 2, 3, 5, 7, 11, 13, 15, 17, 19, 21, 22, 23, 25, 26, 27, 28, & 29 (A total of 18 quarters were unoccupied during the time of survey)

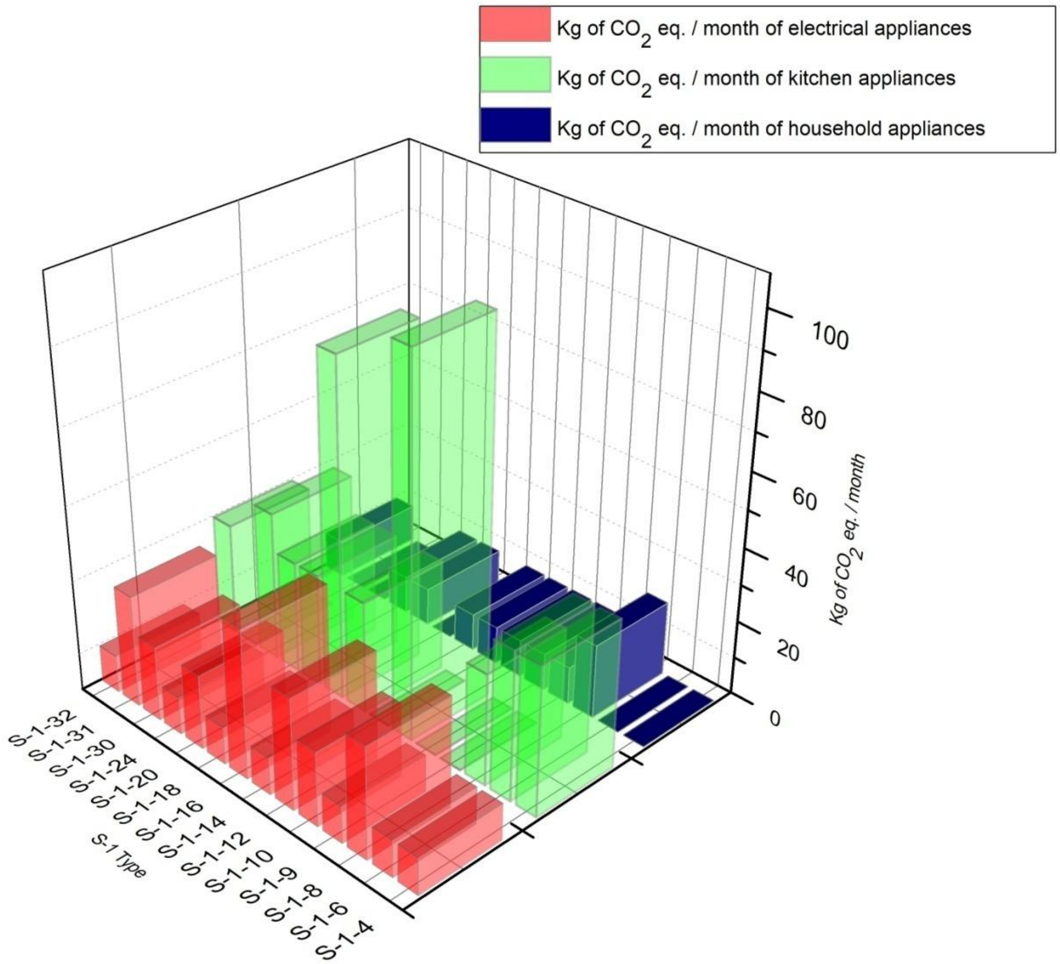


Figure 8: S1 type appliance-based carbon foot print generation (summer season)

5.5 S-2 Type quarters

Quarter Type and No	Electrical appliances			Kitchen appliances			House hold appliances			Total electrical load	Total Carbon Footprint
	Load		Carbon Footprint	Load		Carbon Footprint	Load		Carbon Footprint		
	kW/day	kW/month	Kg of CO_2eq/month	kW/day	kW/month	Kg of CO_2eq/ month	kW/day	kW/month	Kg of CO_2eq/ month	kW/month	Kg of CO_2eq/month
S-2-3	1.512	45.36	10	0.00	0	0.00	0.01	0.3	0.00	45.66	10
S-2-4	1.380	41.4	10	0.00	0	0.00	4.767	143.01	40	184.41	50
S-2-8	0.768	23.04	10	0.00	0	0.00	0.588	17.64	10	40.68	20
S-2-9	2.140	64.2	10	7.745	232.35	30	4.731	141.93	20	438.48	60
S-2-11	0.731	21.93	10	4.831	144.93	40	2.687	80.61	20	247.47	60
S-2-12	1.710	51.3	10	5.632	168.96	30	2.600	78	10	298.26	50
S-2-14	2.080	62.4	30	0.00	0	0.00	0.418	12.54	10	74.94	40
S-2-15	1.832	54.96	10	0.00	0	0.00	0.210	6.3	0.00	61.26	20
S-2-19	1.104	33.12	20	4.800	144	70	0.005	0.15	0.00	177.27	90
S-2-23	1.030	30.9	20	0.3	9	10	0.01	0.3	0.00	40.2	20
S-2-24	2.205	66.15	30	0.030	0.9	0.00	0.503	15.09	10	82.14	40
S-2-28	3.460	103.8	50	4.800	144	70	3.190	95.7	50	343.5	170
S-2-30	1.904	57.12	30	2.00	60	30	0.740	22.2	10	139.32	70
Total S-2	**21.85**	**655.68**	**250**	**30.13**	**904.14**	**280**	**20.45**	**613.77**	**180**	**2173.59**	**700**

S-2-1, 2, 5, 6, 7, 10, 13, 16, 17, 18, 20, 21, 22, 25, 26, 27, 29, 31 & 32 (A total of 19 quarters were unoccupied during the time of survey)

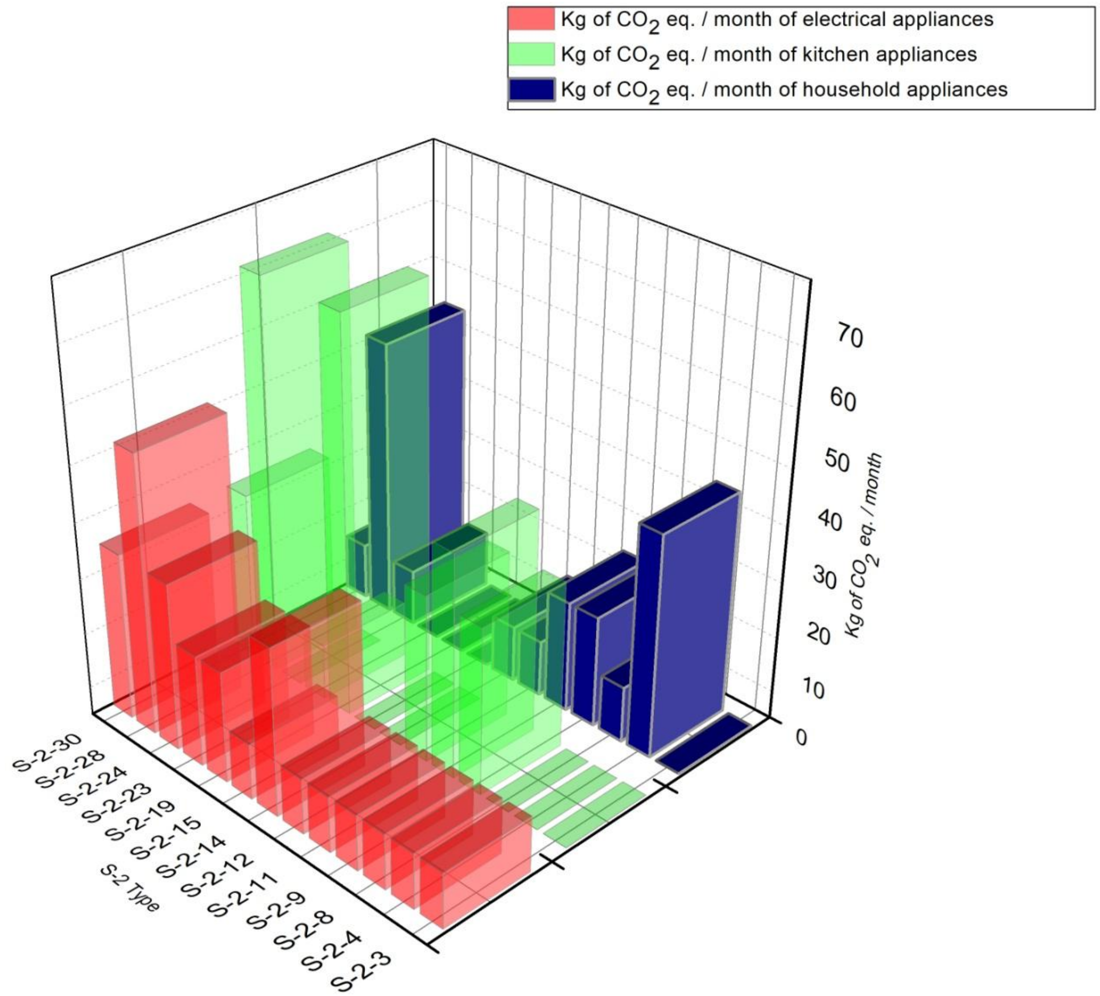


Figure 9: S2 type appliance-based carbon foot print generation (summer season)

5.6 Cumulative electrical load and carbon foot print in Surveyed quarters

Quarter Type	No	Electrical appliances			Kitchen appliances			House hold appliances			Total electrical load	Total Carbon Footprint
		Load		Carbon Footprint	Load		Carbon Footprint	Load		Carbon Footprint		
		kW/ day	kW/ month	**Kg of CO_2eq/ month**	kW/ day	kW/ month	**Kg of CO_2eq/ month**	kW/ day	kW/ month	**Kg of CO_2eq/ month**	kW/ month	**MT of CO_2eq/ month**
C	5	10.462	313.86	50	28.76	862.92	170	14.32	429.66	80	1606.44	0.30
D	12	41.23	1236.93	190	76.65	2299.53	390	48.22	1446.66	240	4982.85	0.780
E	19	57.82	1734.72	330	102.79	3083.88	570	32.022	960.66	170	5779.86	1.020
S1	14	28.54	856.32	260	49.82	1494.64	460	17.38	521.43	100	2872.44	0.770
S2	13	21.85	655.68	250	30.13	904.14	280	20.45	613.77	180	2173.59	0.700
Total	**63**	**159.90**	**4797.51**	**1080**	**288.15**	**8645.11**	**1870**	**132.39**	**3972.18**	**770**	**17415.18**	**3.57**

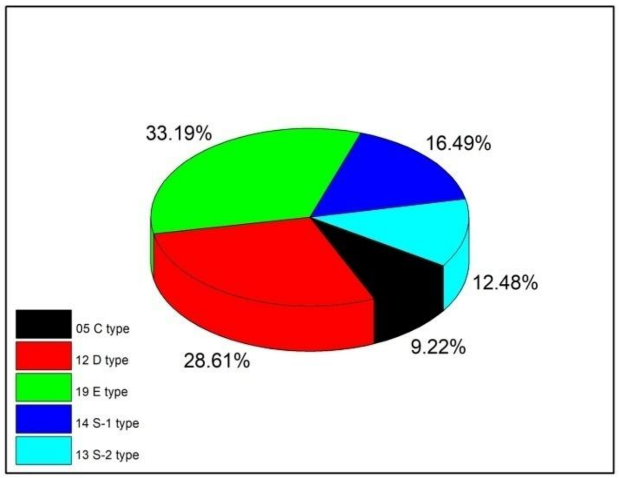


Figure 10: Cumulative electrical load share in surveyed quarters (summer season)

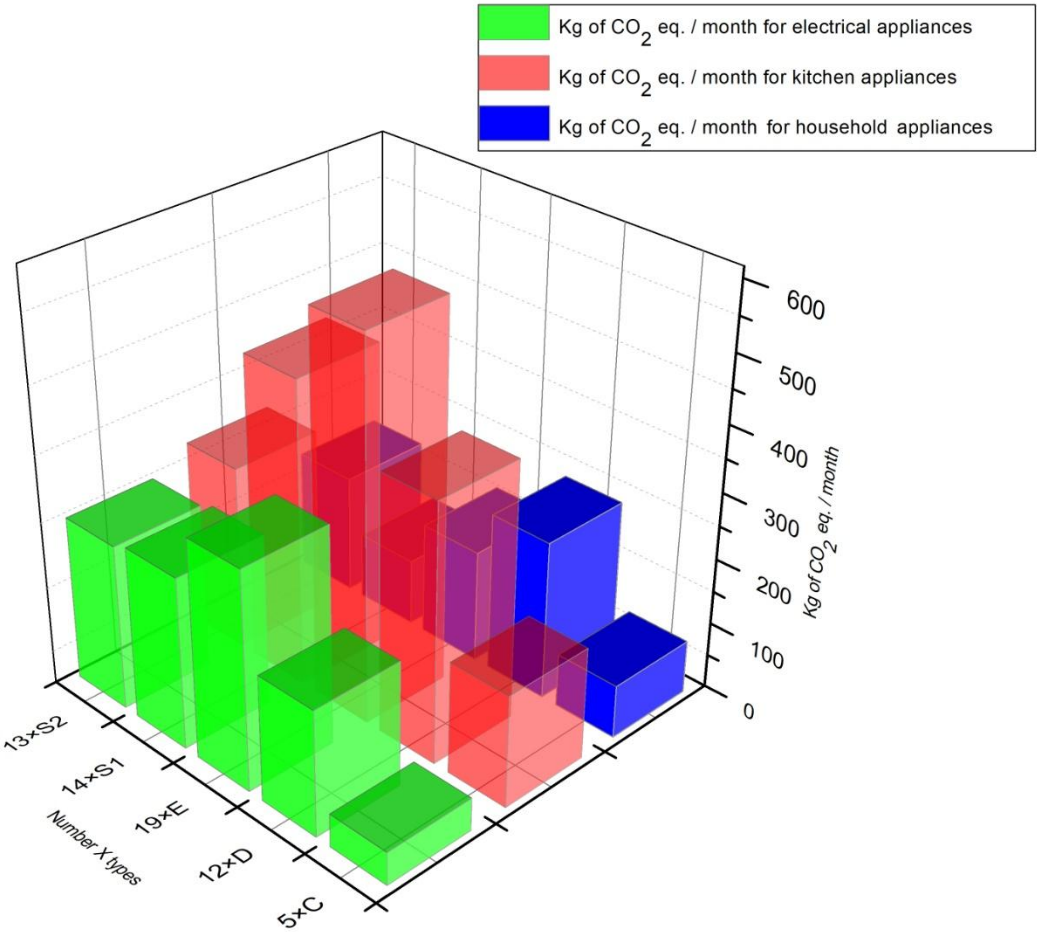


Figure 11: Quarter type wise appliance-based carbon foot print generation (summer season)

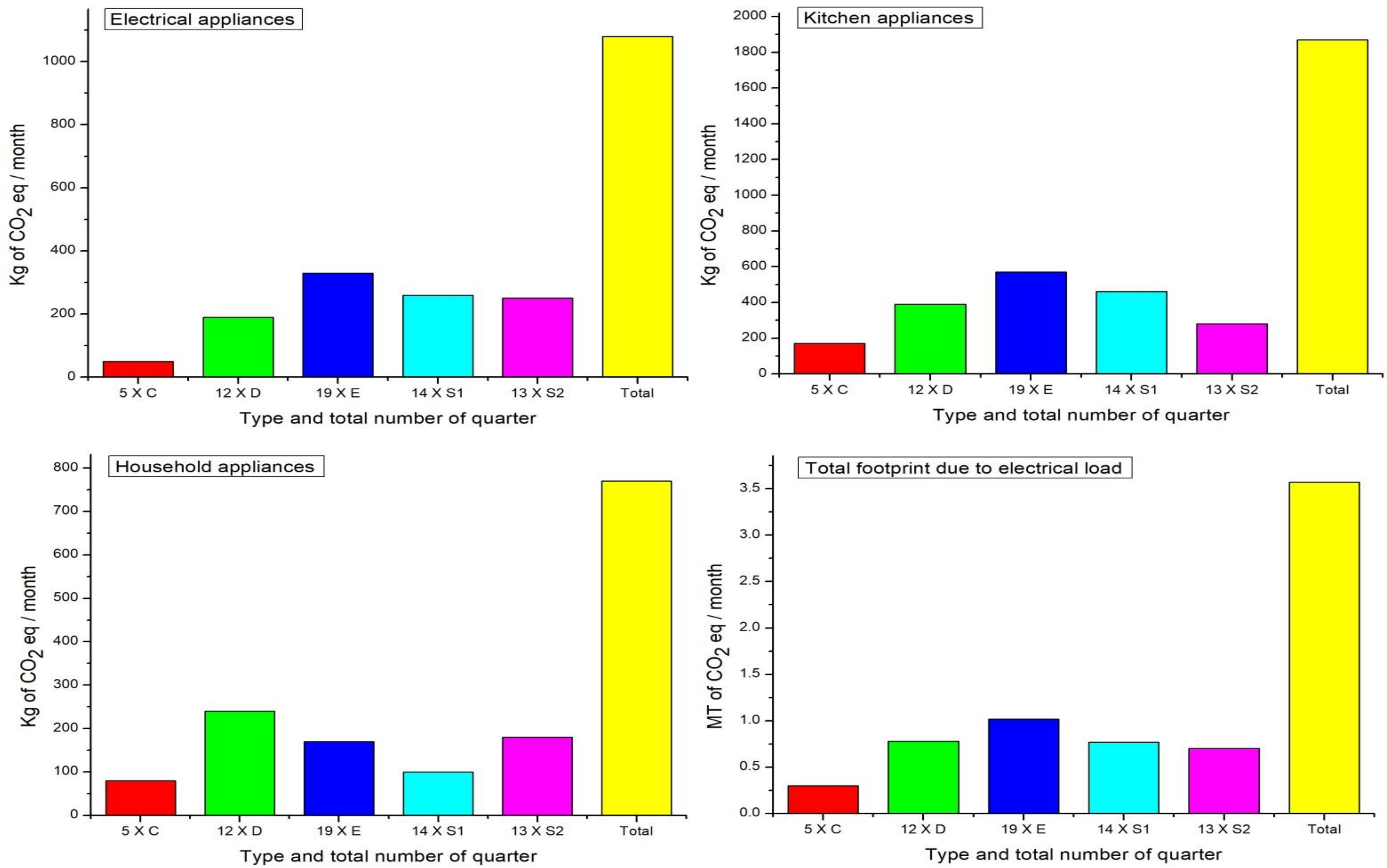


Figure 12: Appliance based and total amount of carbon foot print generation in CSIR-IIP (summer season)

6. CONCLUSION

The intent of this research was to increase awareness among CSIR-IIP colony residents for carbon reduction in urban management. Inferences from this research aimed to demonstrate the usability of GHG inventories within the existing scenario of constraints and its potential benefits to the society to focus on and enforce CO_2 mitigation measures to spearhead sustainability. The use of the survey as a policy tool will also aid to measure and monitor carbon reduction. A better understanding and early awareness of climate change and its impact will allow the person to plan the adaptation measures and be well prepared for any eventualities. Many carbon reduction policies will also have positive socio-economic benefits for the society. For example, creating more carbon sinks within the society by introducing green spaces will create more vibrant and healthy communities; introducing and promoting local renewable generation will promote energy self-sufficiency and reduce energy poverty whilst also providing the citizens with an opportunity to sell the excess energy to the grid, or by planning walkable neighborhoods, apart from reducing transport dependence and associated emissions, the health and safety within the community will also be positively affected. The research adds to the existing body of literature in the field by focusing on the process analysis and adding detail to the understanding of the role of governance structure on policymaking and the adaptation of policy tools. This research identifies that global benchmarking should perhaps not be considered as a key goal in designing inventories.

6.1 Conclusive remarks

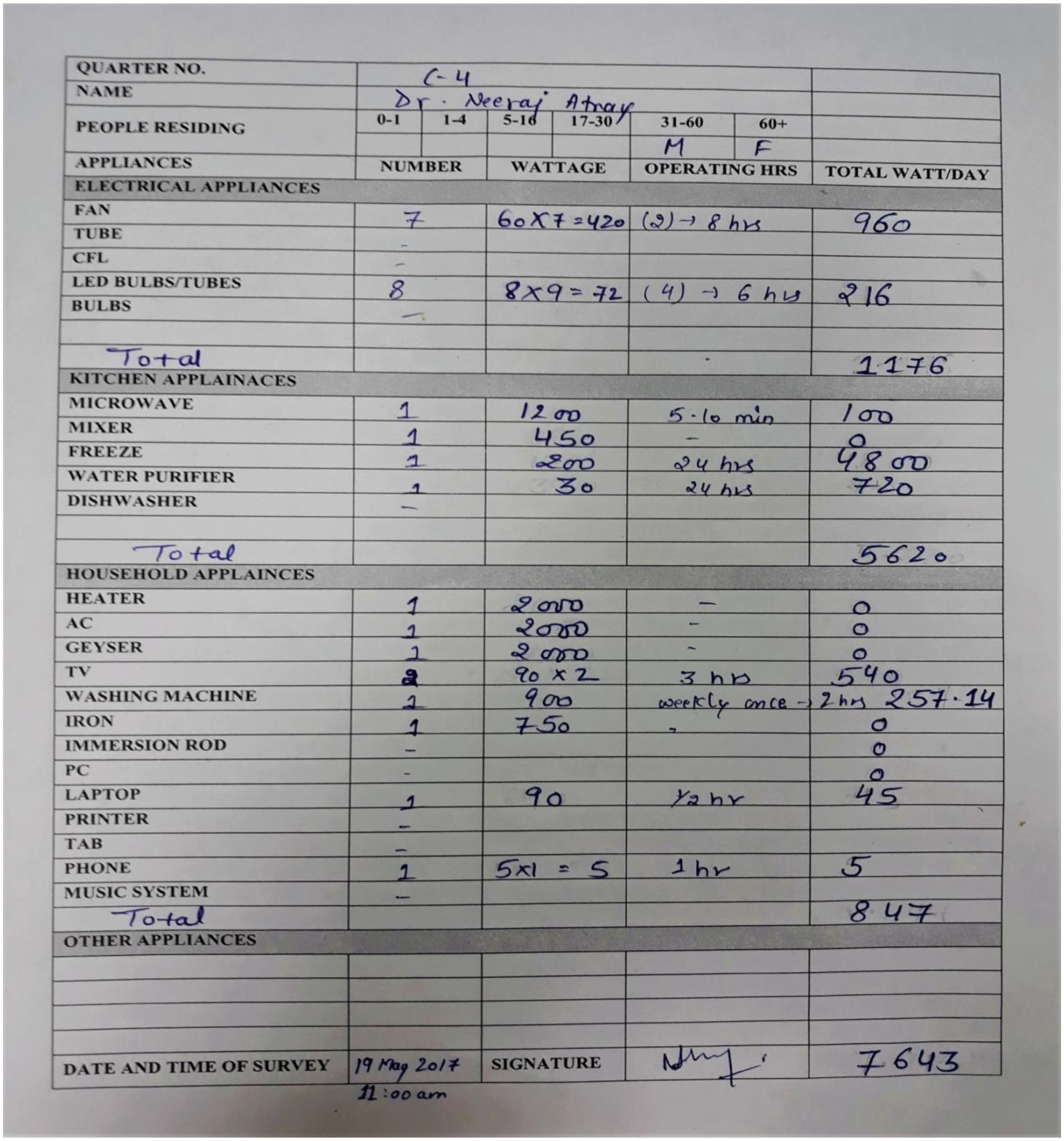
The survey was done unbiasedly to generate data across C, D, E, S1 and S2 type quarters irrespective of considering electrical bills generated by IIP. Hence a more precise survey could be performed to get more specific data.

1. Last year a similar survey was performed by Mr. Abhilek K Nautiyal, SRF, BCA, BFD during winter season and this year (2018), the second phase of the survey was performed.
2. The survey was done during summer season (March, April and May) and average monthly data was presented.
3. **In total 63 occupied residences, a total of 3.57 MT of CO_2 eq. foot print was reported per month basis (During March 2016 to May 2018) from CSIR-IIP Colony.**
4. We recommend a repeat survey during Autumn season (3^{rd} and last phase) to get a complete carbon foot print status of CSIR-IIP Colony due to residential electrical appliances throughout the year.

7. APPENDICES

Appendix-1

SAMPLE SURVEY SHEET



QUARTER NO.	C-4						
NAME	Dr. Neeraj Atray						
PEOPLE RESIDING	0-1	1-4	5-16	17-30	31-60	60+	
					M	F	

APPLIANCES	NUMBER	WATTAGE	OPERATING HRS	TOTAL WATT/DAY
ELECTRICAL APPLIANCES				
FAN	7	60X7=420	(2) → 8 hrs	960
TUBE	-			
CFL	-			
LED BULBS/TUBES	8	8X9=72	(4) → 6 hrs	216
BULBS	-			
Total				1176
KITCHEN APPLAINACES				
MICROWAVE	1	1200	5-10 min	100
MIXER	1	450	-	0
FREEZE	1	200	24 hrs	4800
WATER PURIFIER	1	30	24 hrs	720
DISHWASHER	-			
Total				5620
HOUSEHOLD APPLAINCES				
HEATER	1	2000	-	0
AC	1	2000	-	0
GEYSER	1	2000	-	0
TV	2	90 x 2	3 hrs	540
WASHING MACHINE	1	900	weekly once → 2 hrs	257.14
IRON	1	750	-	0
IMMERSION ROD	-			0
PC	-			0
LAPTOP	1	90	½ hr	45
PRINTER	-			
TAB	-			
PHONE	1	5x1 = 5	1 hr	5
MUSIC SYSTEM	-			
Total				847
OTHER APPLIANCES				
DATE AND TIME OF SURVEY	19 May 2017 11:00 am	SIGNATURE	[signature]	7643

Appendix-2

RECOMMENDED REDUCTION STRATEGIES

The following Carbon Management Principles (developed by EPA Victoria) are considered best practice and are recommended as a model to achieve your ultimate goal of becoming a carbon neutral:

Principle	**Recommended Action**
Measure	This step has been completed with the carbon inventory of your product.
Set objectives	This step has also been completed with short term reduction targets leading to the long-term aim of your product to become carbon neutral.
Avoid	Avoid energy use by reducing the number of lights on in the home and reducing the use of standby power on all electrical appliances and computer equipment. Look at minimizing paper use by instructing user not to print e-mails and adjust photocopiers to ensure double sided printing is the default.
Reduce	Adjust thermostat settings on air conditioning and cooling. Consider replacing current power-hungry lights with energy efficient LEDs and ensure that all draughts and gaps are fixed to avoid heat gain and loss. Also only purchase appliances that have a high energy rating (4 and above).
Switch	Hold discussions to organize switching to green energy for your floor or for the entire building.
Sequester	Organize tree planting projects in partnership with a reputable environment agency to create a natural solution for absorbing carbon.
Assess	Review and compare carbon emissions against the original objectives set. Implement any new strategies to get back on track or continue with progress.
Offset	Once all the above steps have been taken, evaluate the various options available to offset your remaining carbon emissions in order to achieve your carbon neutral objectives.

Sustainable Procurement

It is also recommended that a simple Sustainable Procurement (Purchasing) strategy is implemented by adopting the following three principles:

Principle One – Avoid unnecessary consumption

- Evaluate the absolute need for the new product
- Consider purchasing the product second hand

Principle Two – Select products/services with the lowest environmental impact

- Give preference to products that are reusable, recyclable or contain recycled content.
- Look for products that have been environmentally certified or have credible eco-labels
- Purchase locally produced goods and services. These generally have a lower carbon footprint due to lower “carbon miles” from their distribution.

Appendix-3

Figure 13: Photographs during survey