

**Citigroup Global Services Limited (CGSL),
Spencer Plaza, Anna Salai, Chennai, (Tamil Nadu)**

Company and Building Profile

Citigroup Global Services Ltd (CGSL) is from the family of Citi group and handles all its international back office transactions of the Citi Bank.

CGSL operates 24x7 x365 days as it caters to the international clientele. CGSL is located in the heart of Chennai, Anna Salai (Mount Road) in a huge shopping mall called 'Spencer Plaza'. CGSL occupies Ground floor, and floors 5,6,7,8 & 9 of Phase III, with a total area of 278,404 square feet of super built up space.

In Phases 1 & 2, the first two floors are exclusively earmarked for shopping arcade and the entire 3rd floor has been dedicated for parking.

Power Supply: At Spencer Plaza, Tamil Nadu Electricity Board (TNEB) has provided a dedicated 33/11 kV Sub Station in the premises. The entire Phase III is fed by 11kV power supply and stepped down to 415V through 1600 kVA & 2500 kVA Indoor dry type transformers.

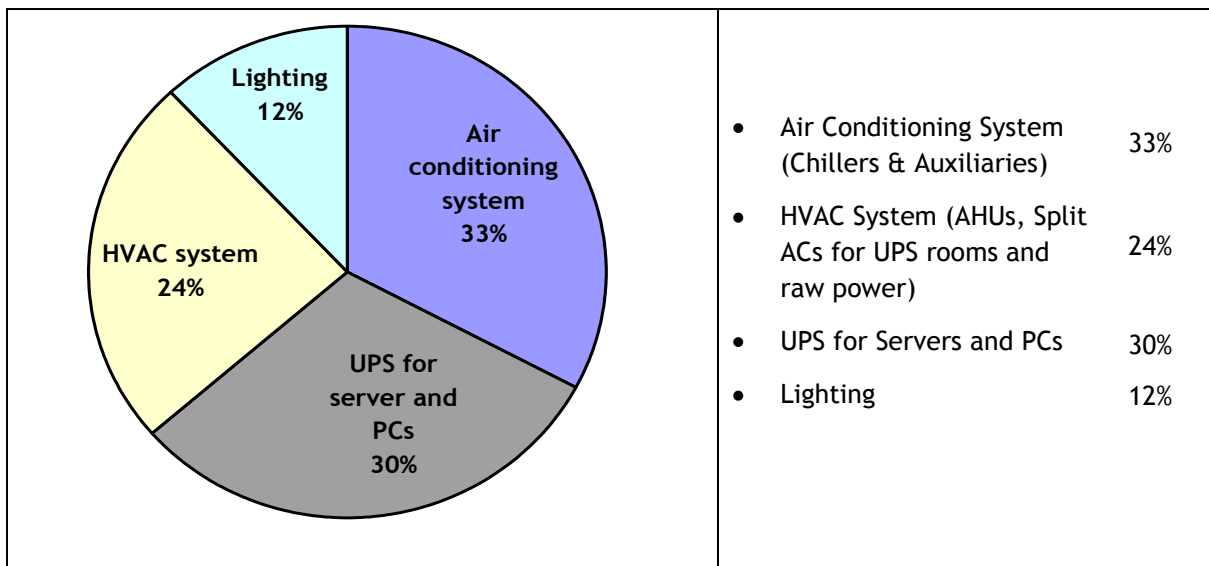
100% back up power is provided by the building owners (landlords), with four 990kVA Diesel Generator Sets (DG) that are entirely managed by the landlords.

CGSL started its operations at Spencer Plaza, Chennai during January 2005, initially with five floors (Ground, 6,7,8 & 9th floors), and made efforts to incorporate several energy efficiency measures, to reduce the energy and demand requirement, as detailed below. Office interiors consist of wooden partition, carpeted floor and Modular furniture, with gyp board false ceiling and technical room false floorings.

The connected electrical load and contract demand from Tamil Nadu Electricity Board (TNEB) is 3056 kW and 1800 kVA. The power factor (pf) was maintained close to unity and CGSL received pf incentive from TNEB.

An additional floor (5th floor) was taken up in January 2007 and the present connected electrical load and contracted demand (with increased carpet area) is 3938 kW and 2,300 kVA.

Energy Consumption at CGSL - Section wise :



Energy Savings Measures in place at CGSL, Spencer Plaza

- Low loss energy efficient transformers
- Capacitors banks with Automatic Power Factor Controller to maintain the power factor close to unity.
- Four 195 TR Energy Efficient Screw Chillers
- Primary and secondary circuits for chilled water system
- Energy efficient pumps for primary and secondary chilled water pumping system.
- Variable speed drive (VSD) for primary chilled water pump with feedback signal from chilled water flow meter installed at chiller outlet.
- VSD for secondary chilled water pump with a feedback signal from pressure transducer installed at tail end of the AHUs.
- Energy efficient fans for Air Handling Units (AHUs)
- VSD for blower in all AHUs with feedback signal from temperature sensor.
- Two way valve for all AHUs with temperature feedback to control the chilled water flow rate.
- Chiller load optimization through chiller software (chillers and its auxiliaries requirement will be monitored through this software to control the chillers requirement).
- Building management system (BMS) to control the requirements on individual chillers, AHUs, Server and UPS room ACs, lighting, etc.
- Occupancy sensor for some individual rooms to control the lighting requirement.
- Energy efficient Compact Fluorescent Lamps.
- Area wise switch control for lighting distribution system.
- Energy efficient flat TFT monitors for PCs.
- UPS with harmonic filters to suppress harmonics and improve power quality.
- On line energy monitoring system to monitor and control the sections wise energy consumption.
- Other areas covered by CGSL to optimize energy usage, such as
 - Chilled water pipeline and AHUs ducts insulation
 - Double glazed glass and Sun control film for windows
 - Automatic power change over facility for transferring power from one raising main to other for raw power and lighting
 - DG sets with synchronization panel and Acoustic cover for noise level reduction.

Data of Energy Consumption from TNEB, total energy cost for the past three years is given below.

Year	Total Energy consumption	Carpet area	Total cost	Average pf	Specific Energy Consumption (SEC),
	Lac kWh	lac sq ft	Rs.lacs		kWh/sqft
2005-06	43.5	1.45	317	.98	2.50
2006-07	68.5 *	2.12	455	.98	2.69
2007-08	87.4	2.78	556	.98	2.61

*- increased energy consumption due to increased carpet area, taken up during middle of the year 2006-07

ENERGY CONSERVATION AT CGSL : FOCUSED ATTENTION

CGSL is fully aware of the benefits of energy efficiency and installed energy efficient equipment as detailed earlier. CGSL recognized the potential for improved efficiency due to close monitoring of the 'design vs. actual' performance of the equipment in use - more so in the context of changing technology and increasing energy costs.

CGSL efforts at energy conservation involved four phases:

- **Internal Knowledge Gain:** A 'Six Sigma' principle of quality and efficiency improvement was applied for 'Energy Efficiency' and a Senior Manager - a 'Six Sigma Black Belt' was involved in the implementation process of the 'energy saving projects'.

The 'Six Sigma' methodology involved 20 days of training spread over 4 months (5 days a month) followed by 3 rounds of tests and a case study.

A project was of high 'complexity' - with a strong business case/ customer impact was taken up, and the DMAIC framework and Six Sigma tools utilised.

(Six Sigma Case Study - Design of experiments, IMR Charts attached - Annexure)

Energy consumption patterns were analysed by CGSL, by :

- Using In House resource by creating a core team, Brain Storming Sessions, Site visit, Identification of steps
 - Identification & implementation of short term measures
 - Gathering and Analysing historical data.
- **Technical Know-how: External Energy Consultants:** CGSL was keen to derive the maximum benefit by undertaking a systematic detailed Energy Audit and engaged energy consultants in July 2007, for a detailed energy study to review the entire operations of CGSL facilities at Chennai (two locations) and Mumbai (three locations):
 - to review the energy system and performance of the equipment, with focus on improved energy efficiency
 - To save on power without compromise on ambience with an 'end-to-end' perspective and optimize the electricity consumption by over 10% of the overall electrical energy consumption
- **Outcome of the Energy Study at CGSL, Chennai & Mumbai:**

Executive Summary of the Detailed Energy Study

- Total Energy savings potential of over 18% of Energy bill - over Rs.2 crores annual savings, was identified as a result of the study.
- Summary of the Energy Study is given below:

CGSL - All 5 Locations	CGSL Total	
	lac kWh	Rs. Lacs
Annual Energy Consumption (Before)	215	1320

- **Implementation of Energy Savings Proposals (ESPs) identified:**
Based on the energy consultants' recommendations, the non-capital energy savings proposals (ESP) were implemented on priority. All the implemented ESPs were monitored proposal wise and the Energy savings verified as per the Monitoring & Verification formats prepared.

**Savings from Energy Savings Proposals (ESPs)
implemented/in progress at CGSL -Spencer Plaza, Chennai**

ESP No.	Proposal description	Annual Savings		Investment	Payback
		lac kWh	Rs.lacs	Rs.lacs	Months
1	Optimize Chilled Water leaving temperature in screw chillers	3.11	16.3	Nil	Immediate
2	Reset the return air temperatures of Ductable Split ACs at all UPS rooms	0.77	4.1	Nil	Immediate
3	Energy Savers for identified Air Conditioners (ACs)	0.39	2.0	1.3	8
4	Energy savers in lighting circuits	2.92	15.4	10.7	8
5	Energy Efficient Fluorescent lamps (EEFL) and electronic ballast in place of existing 18 W conventional FLs and copper ballasts	2.50	13.2	24.0	22
6	Electronic ballast in place of copper ballast for 18 W Compact Fluorescent Lamp (CFL) fittings	0.7	3.5	7.9	27
	Total	10	55	44	10

Successful Implementation - Energy Conservation Measures

1. Reset the return air temperature setting of Ductable Split ACs in UPS rooms

- **Background:** UPS room provided with inverter drive and battery to supply back up power to server and PCs when the main power fails.
- UPS batteries are required to be stored in air-conditioned room atmosphere. Recommended temperature range is 20°C - 25°C, optimum temperature for increased battery life is at 24±1°C. If the operating room temperature goes below 20°C, then the battery life reduces significantly.
- Three to four 11 TR rated split ACs were installed and two to three ACs will be in operation 24x7, and 365 days in a year, to meet the AC requirement. Operating temperature maintained between 18°C and 20°C
- **Measures:** Return air temperature setting for all Split ACs in UPS room set at 24°C. UPS Room temperature is being monitored and the same is logged every two hours.

Energy savings achieved: 212 kWh per day - Annual Savings Rs 4.1 lacs

2. Optimise chilled water leaving temperature in the screw chillers

Background:

- Five 195 TR rated capacity air-cooled screw chillers were installed to meet the air conditioning requirement for the building.
- Each chiller is provided with 9.3 kW rated primary water pump with VSD. VSD for primary water pump was considered to vary the chilled water flow to chiller for saving power whenever the chiller load is lower than the rated capacity.
- Three 37 kW rated secondary water pumps with VSD are operated for supplying the chilled water to all the AHU's installed in five floors.
- Each AHU blower is provided with VSD to maintain the constant set temperature in the office. Pressure sensor was installed at the tail end of the user area to control both energy and chilled water flow in secondary water pump.
- Design temperature for air-conditioned area is 21±1°C. Total AC operation was controlled through Building Management System (BMS). Chiller was set to operate at 46°F and three to four chillers were in operation in day time and two to three chillers were in operation during time to meet the AC requirement. With present operating temperature settings, many complaints were raised regarding over cooling.

Measures:

- Increased the chiller leaving chilled water temperature setting from 46°F to 52°F in steps and increased working area temperature to 24±1°C from 21±1°C.
- Stopped one 37kW secondary pump. Running hours for one chiller and one primary water pump got reduced by one third. Complaints due to 'over cooling' - low temperature also reduced substantially.

Energy savings achieved: 850 kWh per day - Annual Savings Rs 16.3 lacs

3. Replace existing Fluorescent lamps (FTLs) with energy efficient (EE) FTLs

- **Background:** Specifications of existing FTLs are: 18 W rating, Light output is 1015 lumens, 5000 hours lamp life, Color Rendering Index (CRI) is 70% and Lumen depreciation up to 40% over time. Consumes higher power for a given lumen output
- **Measure:** Replaced existing conventional FTLs with energy efficient FTLs.
Specifications of the energy efficient FTLs are: 18 W rating, Light output 1300 lumens, 15000 hours lamp Life, CRI 85% and Lumen depreciation only up to 5% over time. Higher light output due to usage of tri phosphor coating. Light output Increased by more than 50% with EE FTL and therefore, the number of lamps required reduced substantially.

Energy savings achieved: 415 kWh per day - Annual Savings Rs 8 lacs

Installed ECONOLIGHT



AHU Room Actuator



Secondary Pump Actuator



Controls

