Tata ISES 2012

Tata Capital

-

Green Office Project – Bangalore

02.07.12 – 02.09.12

Tobias Kruse

1. Acknowledgements:

Over the two months of July and August 2012, I had the chance to work for Tata Capital's Corporate Sustainability Team on a pilot project to assess the opportunities for its Bangalore office to become more energy efficient and environmentally friendly. Over the course of this project, I have received invaluable support from the Tata Capital Corporate Sustainability Team, namely Ms. Radha Sule and Mr. Harish Dash. In addition, I am extremely thankful for all the advice, support and encouragement given to me by the NGO CERE (Centre for Environmental Research and Education) and in particular Ms. Katy Rustom. Their support has made my stay a truly fascinating, enjoyable and enriching experience with many unique impressions and memories, which I am taking home with me. I strongly hope that this report will have the necessary impact on the Tata Capital Management Team so that the suggested measures will be implemented and that it encourages further 'green initiatives' within the company and creates further awareness among the employees.

2. Background Information on Climate Change and India:

India is highly prone to the impacts of Climate Change due to its dependency on the Himalayan glaciers and the monsoon patterns for water supply and its large population in coastal areas (Stern et *al.,* 2012). In addition, about 70% of the rural Indian population derive their living from agriculture, whereby their main income source is highly dependent on stable and predictable climatic conditions (World Bank, 2011). Climate Change however, is expected to destabilize weather patterns and can have a substantial impact on monsoon rains and the El Niño phenomenon with severe consequences for entire South Asia (Stern, 2006). Already now about 60% of the country is prone to droughts, of which about half is critically prone with less than 750 mm of precipitation annually (CSM, 2011). Due to its long coastline with some major cities like Mumbai or Chennai, India is prone to the increased risk of tropical storms and a rise in sea level, which can lead to inundations in major populated areas (Stern et *al*., 2012.).

In addition to its physical proneness, India also faces a high vulnerability, as about 75% of its population is living on less than $2 a day. In particular poor people are highly vulnerable to climate-related problems like drought, water scarcity, floods and storms and have low capacity to adapt to these changes (Stern et *al.,* 2012). Its high proneness to physical hazards combined with its high vulnerability, bears a large potential for climate change related disasters to occur with dramatic consequences for humans and the economy.

The most vulnerable members of society are the "poor, marginalized, women, children, disabled and the aged" (CSM, 2011 p.15) who bear a particularly high risk of being negatively impacted from geophysical events. World Bank (2011) has estimated that after 30 years of rising temperatures, poverty in India will be 3-4 percentage points higher (approximately 50 million people more) than without the warming. Thus, climate change is likely to exacerbate the existing divide between rich and poor members of society and should therefore be seen as an issue of intra-generational equity. The impact of climate change will not be homogeneous across India, but will primarily affect the urban poor due to higher cereal prices. It remains uncertain how the rural poor will be affected from climate change. Productivity of their land will be reduced, which could however be balanced out by higher cereal prices if passed on directly to the farmers (World Bank, 2011).

The Stern Review on The Economics of Climate Change (2006) has shown that on a global scale climate change mitigation will be more cost-effective than climate change adaptation. Under a BAU emission-scenario at least 5-20% of global GDP will be lost each year due to

climate change adaptation measures. In contrast, the costs to mitigate climate change are only about 1% of global GDP per year. Thus, economic development and climate change mitigation should not be seen as opposing principles. Stern et *al.* (2012) show that a low-carbon growth strategy is necessary for the next 30 years in developing countries in order to overcome the two prevailing challenges of poverty alleviation and climate change management. Furthermore, it is stated that both challenges are complementary and failure to overcome one challenge implies failure to overcome the other. Failure to manage climate change will lead to irreversible damage to development (Stern et *al.,* 2012). For India in particular, the low-carbon growth path and investment in solar power holds great opportunity, as it creates a reliable power source and independence from the grid providers. Therefore, decentralized power-generating systems have a large potential on the Indian sub-continent. In 2010, renewable energy investments in India have already been around $3.8 billion, which is an increase of 25% compared to 2009, but however significantly lacking behind China with $49 billion (Stern et *al.,* 2012). Thus, there is still considerable scope for decentralized solar power generation on a nation-wide scale.

3. Tata Capital on the Carbon Map and Cap Path:

Tata Capital has committed itself to an environmentally friendly development path. In order to achieve this path, The Centre for Environmental Research and Education (CERE) has started in 2009 with the mapping of carbon emissions for Tata Capital. This is the first essential step to identify the most effective reduction measures. However, determined action including financial investment needs to follow to truly pursue this sustainable development path.

In the Carbon Footprint Report 2010-2011, CERE has identified that purchased electricity (51%) and Air Travel (33%) are responsible for the largest proportions of Tata Capital's total emissions of 4808.147 MT of CO_2e (CERE, 2011). Averaged over its 1883 employees, Tata Capital has a carbon intensity of 1.39 MT of CO_2e per full-time employee. The carbon intensity is relatively low, when compared to other financial institutions e.g. IDBI India (11.3), Lloyds Bank UK (4.1), HSBC UK (3) (CERE, 2011). Despite this already low carbon intensity Tata Capital has committed itself to further reductions of its carbon footprint, which is an ambitious and remarkable target given that Tata Capital is a relatively young company and has just been established in the year 2007.

4. Office Assessment:

In order to assess how Tata Capital can become a more energy-efficient and environmentally responsible company, its corporate office in Bangalore has been selected as a pilot project. The areas **Energy, Waste, Water** and **Biodiversity** are analysed and complemented by suggestions for an intermediary approach to offset carbon emissions, which cannot be avoided in the short run. Furthermore, behavioural changes and employee-awareness programs are advocated, which can significantly reduce the carbon footprint if incorporated correctly. Firstly, this report will explain the importance of each area, which is followed by an assessment how the existing conditions can be improved in the Bangalore office. Some measures are not suitable for this particular office due to its relatively small scale of approximately 60 employees. The recommendations are nevertheless included in this report, as they might be suitable for larger offices e.g. the Thane office with approximately 800 employees. Prior to this report, CERE has compiled a qualitative analysis of the Bangalore office and has made suggestions how electricity consumption and carbon emissions could be reduced. Their suggestions have been used as guidelines for this report's analysis.

4.1.Energy:

As the Carbon Footprint Report by CERE (2011) has revealed that the majority (51%) of Tata Capital's carbon emissions is generated by its electricity consumption, the primary focus of this assessment lies on how the grid-energy consumption of the office can be reduced. As approximately 66% of India's electricity is gained from fossil fuels (coal, gas), reducing electricity consumption from the grid is crucial for reducing carbon emissions (CEA, 2012). This can be achieved in two complimentary ways. Firstly, the total energy consumption from lighting, AC, IT etc. can be lowered. Secondly, generating energy from renewable resources can reduce the purchase from the grid or the use of a Diesel Generator, which reduces the carbon footprint.

4.1.1. LED lighting:

For LED lighting solutions, the two companies *Anu Solar* and *Urja Solutions* have been consulted. Each company submitted a project proposal, after having visited the office. Both companies suggested changing the existing CFL and tube lights to LED lights in order to reduce electricity consumption, while maintaining the same brightness. The up-front investment to change all lights to LED is Rs. 329,300 (*Anu Solar*) and Rs. 382,000 (*Urja Solutions* respectively (VAT 5% extra for both providers) (Appendix 1 + Appendix 2). Both companies stated the break-even at approximately 3 years. A technician from *Anu Solar* has visited the office and made an exact count of the lightings and their wattages and has examined the existing fixtures. Thus, it could be assumed that *Anu Solar*'s proposal is more precise than the offer submitted by *Urja Solutions*, since their figures are based on estimates from only one site-visit without technician. As stated by *Anu Solar*, LED lights have a lifespan of 50,000 hrs, which equals approximately 14 years with 10 hours per day and 350 days a year usage. This needs to be compared to 5000 hrs. for CFL and 1200 hrs. for Incandescent light bulbs. Although the upfront cost per light bulb is for LED (Rs. 1170) significantly higher than for CFL (Rs. 210) and Incandescent (Rs. 25), the total cost over 50,000 hrs. is significantly lower with LED (Rs. 2670) compared to Rs. 5600 for CFL and Rs. 16050 for Incandescent. *Anu Solar* states that per year Rs. 107,461 will be saved, which equals 60% savings in comparison to the existing lights (Appendix 1: *Anu Solar*).

4.1.2. Air-Conditioning:

Air-conditioning consumes a substantial proportion of the total electricity use in Mumbai. The Maharashtra Electricity Regulatory Commission (MERC) has stated that air-conditioners consume about 40% of Mumbai's total power consumption of 2700 MW (Tembhekar, 2009). Therefore, the daytime load during peak-hours is very high, which has led to rises in power bills. MERC has suggested that large power consumers should switch to water-based cooling solutions. Thereby, water is chilled during night and subsequently used during the day to keep temperatures down (Tembhekar, 2009).

It needs to be distinguished between central AC and individual AC-units. In the Bangalore office there are overall six 1.5 ton AC units, of which 2 units are in the Server- and UPS-room respectively and 2 are located in the kitchen. The central AC is controlled by the building administrator, which can therefore not be controlled by Tata Capital directly. For the individual AC-units there are different technologies available to reduce their energy consumption. CERE has analyzed the Arctic Master Technology, which can potentially reduce energy consumption from AC by about 20%. The downside of the technology is however that the guarantee on the existing AC units would cease to exist with the Arctic Master installed.

Urja Solutions offers a device called *Aircosaver*, which would according to the provider not affect the guarantee of the installed AC-unit. However, it has not been possible yet to receive confirmation about the guarantee from the AC-provider, Blue Star. The *Aircosaver* can save up to 15-20% of energy from the AC units. The Unit price for *Aircosaver* including installation costs is Rs. 10150 + tax. The installation is quick and can be undertaken by any AC-trained technician. If on average 40% of energy used is for AC (Tembhekar, 2009) the savings in energy consumption for the Bangalore office are approximately Rs. 5600[1] (without DG) per month, which would equal a break-even point of 2 months.

As medium- and long-term solutions and in particular when new offices are built Tata Capital should seriously consider switching from Air-conditioning to Air-cooling systems like the ones offered by *Symphony*. Air-cooling systems do not emit environmentally damaging CFCs, as air-conditioners do, but simply use water and consume 90 – 95% less electricity than Air-conditioners. In addition, air coolers do not simply circulate the air, but instead draw and filter fresh air from outside. Air coolers can be installed in all different office-sizes and can also be retrofit (*Symphony*, 2011).

4.1.3. *InfraSecure* Software:

InfraSecure is a software solution provided by *See Beyond Technology*, which reduces energy consumption from computers and laptops by putting them into a hibernated mode when not in use. A trial has been conducted with 28 computers in the Thane office, which showed cost-savings of approximately 33% in comparison to no software installed. A preliminary estimate from *See Beyond Technology* for the Bangalore office shows that up-front costs of the software for all 55 computers would be Rs. 77,000, which could lead to a reduction of 20,000 electricity units per annum, which equals approximately Rs. 1.6 lakhs cost reduction per annum and a reduction of 16 tons of CO2 emissions. The break-even period for the investment in *InfraSecure* was stated to be 6 months. The effectiveness of the *InfraSecure* software depends however on current employee behaviour. If employees already shut down their computers over night, the impact of *InfraSecure* would be minimal. Thus, employee behaviour should be monitored prior to installing the software.

4.1.4. Photovoltaic (PV) installations on the rooftop:

The roof-area of the Bangalore office (approx. 100 sq. mt.) has been visited and assessed by representatives of *SELCO*, *Orb Energy, Urja Solutions* and *Tata BP Solar*. *SELCO*, *Orb Energy* and *Tata BP Solar* have submitted their proposals for a 10KW installation. *Urja Solutions* has submitted their proposal for a 15KW installation. The installation of small windmills on the roof has not been considered, since wind speed in Bangalore even in the monsoon season is not sufficient to operate windmills profitably. Bangalore enjoys however, for at least 8 months in a year 200 to 300 sunshine hours per month, whereby PV installations have become a popular way to generate electricity in Bangalore (World Weather and Climate Information, 2012), Generally, three alternative solar photovoltaic systems are possible, namely grid-based, battery-based or hybrid.

Grid-based systems, which feed in electricity from the PV installation into the normal grid are subject to many regulatory hurdles and a substantial amount of administration work. Furthermore, they are used when the electricity demand of the office is lower than the energy

[1] ((70,000*0.4)*0.2)

generated at the site. Thereby, it is only considered feasible for large-scale installations, which is not the case for the Bangalore office (Rajashekar, *Urja Solution*, pers. comm. 19.07.2012).

Battery-based systems store the energy generated by the PV installation and release the energy on demand e.g. during power cuts. Thereby battery-based systems have the potential to replace the Diesel-Generator (DG) to a large extend. However, a DG unit will always remain necessary for long lasting power cuts or during the monsoon, when the efficiency of PV units is reduced due to rainfall and cloud cover (Nikhil Nair, *SELCO*, pers. comm., 18.07.2012). Battery-based systems are considered controversial, since the batteries contain highly toxic substances such as lead and are therefore problematic from an environmental point of view. There are two types of batteries, namely Tubular and Sealed Maintenance Free Batteries. Tubular Batteries have constant lead emissions while operating and can therefore be harmful to humans and the environment if used improperly. Sealed Maintenance Free Batteries do not have lead emission; however also contain large amounts of toxic and environmentally damaging substances (Nikhil Nair, *SELCO*, pers. comm., 18.07.2012). When using either battery-based systems, professional disposal of the batteries is pivotal. However, due to the high quantities of toxics and environmentally harmful substances within the batteries, it remains disputable whether battery-based systems can be considered an environmentally friendly solution. According to Nikhil Nair from *SELCO* these environmentally damaging characteristics have been the reason why Infosys has banned all battery-based solar systems from its CSR activities (pers.comm., 18.07.2012). In addition to these detrimental characteristics, batteries have a limited life span and need to be replaced, whereby the costs for battery-based systems is often higher than for non-battery-based system (Muthanna, GRID (*Tata BP Solar*), pers. comm., 23.07.2012).

Hybrid systems are the preferred choice for the dimensions given in the Bangalore office. PV installations on the roof area can at least generate 10KW and thereby cover 20% of the office energy use. The remaining electricity demand needs to be covered from the grid. The 20% electricity from the PV units is included into one office sub system e.g. lighting or IT. This sub system should have a larger electricity demand than the maximum capacity of the PV-units, as energy could otherwise remain unused during strong sunshine seasons. In addition to the electricity from the roof the grid is used for the remaining demand. However, preference is always given to the electricity from the PV-units, which ensures that all of its electricity is used.

After having met with 4 different Solar PV providers, namely *SELCO*, *Orb Energy, Urja Solutions* and *Tata BP Solar*, the offer for a hybrid-system submitted by the latter seems most cost-effective. Up-front costs are at Rs. 1,510,000 with a break-even of 4 years. *Tata Capital* would be eligible for a 30% subsidy from the Indian government and could depreciate 80% of the costs in the 1st year in its books of account. *Tata BP Solar* also gives Performance warranty for solar modules of 25 years and workmanship warranty for 5 years for the complete system. *Tata Capital* would only have to submit a Letter of Intent (LOI) to *Tata BP Solar*. Thereafter, *Tata BP Solar* would take on all the administrative work (Appendix 3: *Tata BP Solar*).

SELCO has stated in a personal communication (Nikhil Nair, 18.07.2012) that they only have very little experience with installations as big as 10KW. Up-front costs would be at approximately Rs. 18 lakhs and the break-even of a similar project they conducted for KREDL (Karnataka Renewable Energy Development Limited) was around 15 years. Thus, *SELCO* does not seem being the ideal partner for an installation of 10KW, but for rather smaller-scale projects.

Orb Energy suggests a battery-based system with an initial cost of 1,736,500 (Rs. 17 lakh). *Orb Energy* can only provide 1 year total system warranty, compared to *Tata BP Solar* with 5 years total system guarantee. (Appendix 3: *Orb Energy*). *Urja Solutions* suggests a battery-based system for 15KW installation at a total cost of Rs. 2,743,000. It is however unclear whether the roof area provides sufficient space for a 15KW PV installation. Therefore, the other providers have submitted conservative estimates for a 10KW installation, for which the necessary space is certainly available. Both, *Orb Energy* and *Tata BP Solar* would also be able to simply expand their installation to use the maximum roof area, if sufficient space is available. Thus, this report suggests to take on the offer made by *Tata BP Solar* as the upfront costs are lowest and the complete-system warrantee and guarantee is longest and actually exceeds the break-even point. Hence, *Tata Capital* would not face any risks of high repair or maintenance costs within the first 5 years and would start making a profit from the PV-units after the fourth year.

4.1.5. Purchase of renewable energy from wind or solar farms:

As part of Tata Capital's long-term strategy to become carbon neutral it has already been estimated which investment in wind energy would be necessary to generate the amount of power, which equals the current power consumption. For this purpose the wind farm provider *Suzlon* has estimated that Tata Capital would have to invest approximately Rs. 27 crores in order to build a 4.5 MW wind farm, which would make Tata Capital carbon neutral by 2015 considering its current growth (Sindhwani, pers. comm., 20.08.2012). This proposal has been submitted to the Senior Management Team, but has not yet received approval. Projects before December 2012 are eligible for Certified Emission Reductions (CERs) which could be traded under the Clean Development Mechanism (CDM) in the European Union Emission Trading Scheme (EU ETS). However, due to the time lag of the approval and construction, a wind farm would not be finished before December 2012 any more. There is considerable insecurity at the moment about how international protocols on carbon trading are going to develop post Kyoto. It has also been stated by the EU ETS that wind farm projects in India would not be accepted as CDM projects any more after December 2012 (Sindhwani, pers. comm., 20.08.2012). Thus, there is considerable uncertainty about the legal and regulatory aspects. Tata Capital could still use Voluntary Emission Reductions (VERs), which can be traded at a lower price than CERs and are not conditioned to any international protocol. However, due to the lower price it would not be a profitable investment, but rather a CS initiative (Sindhwani, pers. comm., 20.08.2012). Solar energy has not been considered, as the efficiency of PV is generally lower than that of wind turbines, which would result in higher up-front costs (Sindhwani, pers. comm., 20.08.2012).

4.1.6. Transport of employees:

As stated by the CERE Summary Note on the Bangalore Office (2012) there is scope for improvement regarding carpooling, bus service from the metro station to the office and converting office cars into CNG-cars. As stated by CERE (2012), most employees either use their own vehicles (2- or 4-wheelers) or use rickshaws when commuting to work. Tata Capital has 4 company cars in Bangalore and 6 car parking spaces, which are however hardly ever filled. In contrast, the car parking space for two-wheelers is always crowded. Currently, only 5 employees from the office commute to work by railway. The senior management team could encourage the choice of fuel-efficient company cars with financial incentives. Employees who choose a more fuel-efficient car could be made eligible for further benefits from the company. Thereby, the carbon footprint of employees in higher positions who are entitled to a company car could be reduced notably, which could also increase awareness among employees.

4.1.7. Video-Conferencing:

It has been observed that physical presence of employees is often expected for meetings, even if long journeys need to be undertaken. This report underlines that a mindset change is needed, which puts more emphasis on video conferencing instead of physical presence. From qualitative analysis of conversations with employees, it has become clear that it is common practice to travel even for only short meetings to different office locations. This has been observed especially in the Thane office where employees often travel to the different offices in Mumbai. It has also been stated by employees that travelling to different locations is often considered as stressful and seen as inefficient. Working time could potentially be used more efficiently by switching to more video conferencing instead of physical presence in meetings and the company's carbon footprint would also be reduced considerably. Since the person higher in the hierarchy often schedules meetings, this mindset change needs to be implemented as a 'top-down' approach.

4.2. Waste and E-Waste:

Waste management is crucial for achieving a 'green' office, since non-biodegradable waste is a huge burden for the environment. In particular E-waste needs to be managed properly, as it often contains hazardous chemicals, which can be released when the device is not disposed correctly. Tata Capital returns all of its used computers to Tata Consultancy Services, which has its own E-waste disposal scheme.

The Bangalore office does not have a cafeteria, but only a pantry, which is used for making tea or heating up food. Employees either bring their own food from home or go out for lunch. Since there is only a small quantity of wet waste at the office a *Daily Dump* wet waste digester could be installed. *Daily Dump* is a hygienic composting technique, which emits no smell even as it composts the wet waste. Thereby, the wet waste would be composted at site and the compost could be used for indoor plants.

As stated by CERE (2012), no disposable cups or plates are used in the office, which is a good practice. Furthermore, no bottled water is used, but a Blue Star water dispenser, which reduces plastic waste substantially. Further improvement could however be achieved by installing a water filter to replace the water dispenser. This would be a permanent solution and would thereby reduce emissions from the production of the canisters and from their transportation from the production site to the office.

4.3. Water:

For Rainwater Harvesting two different systems are possible, which use the harvested water in distinct ways. Firstly, the rainwater could be collected in an in-house water tank and be used for internal washroom facilities. Secondly, the rainwater, which is collected from the roof area could be collected and injected into the ground in order to support ground water, which is crucial in many regions to cover drinking water needs for people. Mr. Rajaram has assured that rainwater harvesting is in place. However, no further details have been provided and the facilities have not been visited during the site visit. Providers for rainwater harvesting installations are: *Biome Environmental Solutions, Greentech India, Nesara Constructions, Hindustan Renewable Energy Systems.*

Tata Capital should also consider installing grey water recycling facilities in its offices. Only the water from basins, showers and dishwashing can be recycled on-site and be re-used for

toilet water or the watering of plants. Grey water recycling often requires adjustments in the pipe systems in order to separate the water used in basins from the water used in toilets. Thus, it could be installed in offices where *Tata Capital* is planning a long-term commitment or where it is owning the building.

4.4. Biodiversity:

Biodiversity and in particular office plants can play an important role in improving work-place environment and air quality inside the office. The company *ELT India* has specialized in this field and provides different indoor and outdoor office plant solutions. For the Bangalore office *ELT India* suggests a set of indoor plants fixed on a green curtain structure. The plants have been selected for their proven capacity to improve indoor air quality. These green curtains could be installed as a pilot in either the large conference room at a cost of Rs. 18,000, in the entrance area at a cost of Rs. 27,000, or in all three conference rooms and the entrance area at approximately Rs. 84,600.

Plants along walls and windows can also contribute to reduce indoor temperature and thereby reduce the need for AC, which consumes a substantial amount of electricity. As Alexandri and Jones (2006) have shown for Mumbai, wall and roof gardening combined can lead to a 72% reduction in the cooling load due to the additional isolation, which reduces the cooling energy demand from 11h to 6h per day. Since, air conditioning is very energy intensive, green walls and roofs can have a significant impact on electricity consumption. This effect is however reduced, when only either green walls or roofs are installed. Since, the Bangalore office is not on the top floor of the building, roof gardening would not result in a reduced indoor temperature. Since high-rise buildings also surround the building, wall gardening would be unlikely to lead to a reduction in indoor temperature for this particular office. However, roof and wall gardening should always be considered when assessing Tata Capital offices due to its potentially large reductions in indoor temperature, which could reduce electricity consumption from AC substantially.

4.5. Offsetting of emissions:

Until no decision to invest in a large-scale wind or solar park is taken, Tata Capital should consider a transitional solution to reduce its carbon footprint. Offsetting of carbon emissions could be used as such an intermediary solution. It should not be pursued as a permanent solution, as firstly re-occurring investments are necessary to maintain the status quo (purchasing of trees every 40 years). Secondly, environmentalists such as George Monbiot (2006) oppose offsetting of carbon emissions, as they do not address the root of the problem and delay necessary behavioural change to reduce carbon emissions. By purchasing carbon offsets Tata Capital could however reduce its environmental impact very rapidly and does not need to wait until large-scale wind parks would become approved. Based on its carbon emissions of approximately 2439.926 metric tonnes of CO2e, Tata Capital would have to purchase 122,000 trees every 40 years, given that each tree captures about 20kg CO2 per year over its lifetime (Grow Trees, 2012). Providers such as *Grow Trees*, which offer a tree at Rs.50, the cost could be estimated at approximately Rs. 6,099,815.

Since, some travelling is necessary for employees of Tata Capital a company-wide offsetting mechanism should be implemented. Tata Capital should make its employees aware of their emissions and the costs incurred by the offsetting, which is the first step to achieve behavioural changes. The emissions could e.g. be stated on the monthly pay check, as it has been established by McKinsey & Company. However, it would have to be backed-up by a

sophisticated IT system, which would monitor all employees' travels including distance and mode of transport.

Tata Capital could also combine tree planting with team-building activities for its employees. Organizing trips to tree-plantations and encouraging employees to plant their own trees on these plantations will raise awareness to environmental protection. This could be combined with presentations about India's high dependency on stable climatic conditions and its proneness to global warming (e.g. Himalayan glaciers, El Niño events etc.).

Conclusion:

Overall, this report concludes that Tata Capital could begin its long-term initiative to become a carbon neutral company by making the Bangalore office its first carbon neutral branch. In order to achieve carbon neutrality for this office, Tata Capital could replace the existing lights with LEDs, generate renewable energy on the rooftop, retrofit the AC-units with *Aircosaver* and apply *infraSecure* computer software. When using all these measures the initial investment would be Rs. 1,977,200[2]. The break-even points for the respective measures are reached after 3 years (LED lighting), 4 years (Solar PV units), 2 months (*Aircosaver)* and 6 months (*infraSecure)*.

When installing the Solar PV panels, the annual carbon emissions of the office would be reduced from approximately 71,400 kg CO_2e[3] to 57,120 kg CO_2e[4] (excluding DG) (CEA, 2011). Assuming that the solar panels would also lead to a 20% reduction in use of the DG, the annual carbon emissions would fall from 76,244 kg CO_2e[5] to 60,979.2 kg CO_2e [6] (DEFRA, 2012). Since information on the individual loads of the office for AC and lighting are not available, the exact impact on total carbon reductions from LED lighting interventions and AC-retrofitting cannot be estimated. Assuming that only the Solar PV installation is being built, the Bangalore office could become carbon neutral by additionally purchasing 3050 (61000/20) trees at a total cost of Rs. 152,500 (Grow Trees, 2012). The total emissions and therefore the cost for purchasing trees is however likely to be reduced considerably with the installation of LEDs, *Aircosaver* and *infraSecure*.

Since the Bangalore office is meant to become a pilot project, this report suggests that all four main suggestions (LEDs, PV-panels on rooftop, *Aircosaver, infraSecure*) should be implemented on this relatively small scale in order to measure the impact of each intervention. The most effective interventions could then be replicated at other Tata Capital offices. For this purpose the electricity consumption prior and post each intervention should be monitored in order to verify the assumed savings from the providers and test the reliability of their data. Secondly, it is important to successfully communicate the savings in carbon emissions to the employees and the public in order to create more awareness for the necessity and feasibility of carbon reductions in the

[2] [329,300 + 1,510,000 + (6*10,150) + 77,000]

[3] (Electricity units (KWH) consumed per month*12 months* GHG Conversion Factor for grid electricity in south India) = (7000*12*0.85)

[4] (80% of total electricity units (KWH) consumed per month*12 months* GHG Conversion Factor for grid electricity in south India) = (5600*12*0.85)

[5] [CO_2e emissions without DG + (Litres of Diesel used per month*12 months*Diesel GHG Conversion Factor)] = [71400 + (150*12*2.68)]

[6] [80% of CO_2e emissions without DG + (80% of total litres of Diesel used per month*12 months*Diesel GHG Conversion Factor)] = [57120 + (120*12*2.68)]

corporate sector. In addition to these office specific recommendations, this report has also made more generic suggestions, which should be considered for the assessment of other offices. These recommendations should however not remain only within Tata Capital, but should be communicated to other companies and their clients.

Tata Capital has already taken notable efforts to monitor its carbon emissions, which is an excellent practice that should be continued. The next step is however to take action and invest in reducing electricity consumption and carbon emissions. India is highly prone and vulnerable to climate related hazards, which makes it necessary that all parts of society contribute to reducing carbon emissions and mitigate climate change as much as possible. Thus, Tata Capital should aim to become a carbon neutral company in the long run.

References

Alexandri, E and Jones, P., 2006: Temperature Decreases in an Urban Canyon due to Green Walls and Green Roofs in Diverse Climates, *Building and Environment,* 43 (2008), 480-493

Central Electricity Authority (CEA), 2012: *All India Regionwise Generating Installed Capacity (MW) of Power Utilities Including Allocated Shares in Joint and Central Sector Utilities (As on 30.06.2012),* accessed from: http://cea.nic.in/welcome.htm, on 16.08.2012

Central Electricity Authority (CEA), 2011: CO_2 Baseline Database for the Indian Power Sector – User Guide, Verson 6.0, March 2011, New Delhi

Centre for Environmental Research and Education (CERE), 2012: *Summary Note of Site Visit – Tata Capital – Bangalore Office.*

Centre for Environmental Research and Education (CERE), 2011: *Tata Capital – Carbon Footprint Report 2010-2011,*

Centre for Social Markets (CSM), 2011: *Disaster Management & Climate Change – Indian Policy Frameworks and key challenges*

DEFRA, 2012: *2012 Guidelines to DEFRA / DECC's GHG Conversion Factors for Company Reporting*

Grow Trees, 2012: *Offset,* accessed from: http://www.grow-trees.com/offset.aspx, on 16.08.2012

Monbiot, G., 2006: Selling Indulgences, in *The Guardian,* on 19 October 2006, accessed from: http://www.monbiot.com/2006/10/19/selling-indulgences/, on: 26.08.2012

Muthanna, M.C., Director of GRID (Employed by *Tata BP Solar* for feasibility analysis of PV installations), personal communication, 23.07.2012

Nikhil Nair, Assistant Manager - Projects *SELCO*, personal communication., 18.07.2012

Rajashekar, *Urja Solutions*, personal communication, 19.07.2012

Stern, N. Kattumuri, R. James, R, 2012: Low-carbon Growth and Development. In: Basau, K, and Maertens, A. (eds.): *The New Oxford Companion to Economics in India.* Oxford University Press

Stern, N. (2006): *Stern Review on The Economics of Climate Change.* HM Treasury, London

Sindhwani, P. Head – Green Cluster, Tata Capital, Personal Communication, 20.08.2012

Symphony Limited, 2011: *Annual Report - 2010-11 - STRNGHTS,* accessed from: http://www.*Symphony*limited.com/pdf/report-2010-11/Strengths.pdf, on: 24.08.2012

Tembhekar, C. 2009: ACs eat up 40% of city's total power consumption, *The Times of India,* from: 23.12.2009, accessed from: http://articles.timesofindia.indiatimes.com/2009-12-23/mumbai/28090234_1_power-bills-air-conditioners-conditioners, on: 23.08.2012

The World Bank, 2011: *Distributional Implications of Climate Change in India,* Poverty Reduction and Equity Unit, Policy Research Working Paper 5623

World Weather and Climate Information, 2012: *Average sunshine in Bangalore, India,* accessed from: http://www.weather-and-climate.com/average-monthly-hours-Sunshine,bangalore,India, on: 26.08.2012

Appendix

Appendix 1: *Anu Solar*

	LED	CFL	Incandescent
Projected lifespan of Light bulb	50,000 hours	5,000 hours	1,200 hours
Watts per bulb (equivalent to 60 watts)	6	14	60
Cost per bulb	1170	210	25
KWh of electricity used over 50,000 hours	300	700	3000
Cost of electricity (@ Rs. 5 per KWh)	Rs. 1500	Rs. 3500	Rs. 15000
Bulbs needed for 50,000 hours of use	1 No	10 Nos	42 Nos
Equivalent 50,000 hours bulb expense	Rs. 1170	Rs. 2100	Rs. 1050
Total cost for 50,000 hours	Rs. 2670	Rs. 5600	Rs. 16050

Figure 1.1.: Comparison between LED, CFL and Incandescent light bulbs

Existing lighting expenditure									
Sl no.	**Type of lighting**	**Watts**	**Numbers**	**Hours/Day**	**in W per day**	**in KW per day**	**in KW per month**	**1 month electricity cost in Rs**	**Per year cost**
1	Tube lights	48	61	10	29280	29.28	878.4	4831.2	
2	CFL light	36	29	10	10440	10.44	313.2	1722.6	
3	CFL light	16	8	10	1280	1.28	38.4	211.2	81,180
Diesel spent to run the above lights during power cut costs atleast Rs. 8000 / month								8,000	96,000
Present expenditure on lighting								**14,765**	**177,180**

Figure 1.2. Existing lighting expenditure Bangalore office

Proposed LED Lighting										
No.	**Type of lighting**	**Watts**	**Numbers**	**load**	**Hours/Day**	**In KW /day**	**1 month electricity cost in Rs**	**Per year Electricity cost**	**Cost per light**	**Total**
1	LED Tube lights	20	61	1220	10	12.2	2,013	24156	4000	244000
2	LED	15	29	435	10	4.35	718	8613	2500	72500
3	LED	6	8	48	10	0.48	79	950.4	1600	12800
Diesel spent to run the above lights during power cut costs atleast Rs. 3000 / month							3,000	36000		
Expenditure if LED lights used							**2,810**	**69,719**		**329300**
Total savings per year								**107,461**		

Figure 1.3.: Proposed LED lighting solution by *Anu Solar.*

Appendix 2: *Urja Solutions (LED)*

Proposed LED Lighting *Urja Solutions*								
LED	**Watts**	**Numbers**	**Hours/Day**	**Reduction in connected load**	**Energy saving per day**	**Unit price**	**Total Cost**	**ROI**
2x2 fixture LED	32	70	10	2.94Kw	-	4600 + Tax	322000 + Tax	-
LED down light	10	40	10	480W	-	1500 + Tax	60000 + Tax	-
Total	-	110	10	3.42 Kw	34.6Kw	-	**382000 + Tax**	**3 years**

Figure 2.1: Proposed LED lighting solutions by *Urja Solutions.*

Cash Flow Statement

Assumption		Year	Cash Outflow	Cash Inflow				Net Cash Flow
			Initital Investment	Tax Benefit due to depreciation	Capital Subsidy	Gross Energy Savings	Net Energy Savings (Rs.)	
Capacity (KWp)	10.00	1	1510000.00	295960.00	453000.00	14500.00	174000.00	-587040.00
Cost (Rs.)	1510000.00	2	0.00	59192.00		14500.00	174000.00	233192.00
Depreciation Benefit - First year	80%	3	0.00	11838.40		14500.00	174000.00	185838.40
Energy Generation (KWH)	14500	4	0.00	2367.68		14500.00	174000.00	176367.68
Levelised Electricity Tariff (Rs.)	12.00	5	0.00	473.54		14500.00	174000.00	174473.54
		6	0.00	94.71		14500.00	174000.00	174094.71
		7	0.00	18.94		14500.00	174000.00	174018.94
MNRE Capital Subsidy	453000	8	0.00	3.79		14500.00	174000.00	174003.79
Cash Outflow		9	0.00	0.76		14500.00	174000.00	174000.76
Total Expenditure	1057000.00	10	0.00	0.15		14500.00	174000.00	174000.15
Capital Cost	1510000.00	11	0.00	0.03		14500.00	174000.00	174000.03
		12	0.00	0.01		14500.00	174000.00	174000.01
		13	0.00	0.00		14500.00	174000.00	174000.00
		14	0.00	0.00		14500.00	174000.00	174000.00
Cash Inflow		15	0.00	0.00		14500.00	174000.00	174000.00
		16	0.00	0.00		14500.00	174000.00	174000.00
Energy Saving (KWH x Tariff) (Rs.)	174000	17	0.00	0.00		14500.00	174000.00	174000.00
Tax benefit due to depriciation	295960.00	18	0.00	0.00		14500.00	174000.00	174000.00
		19	0.00	0.00		14500.00	174000.00	174000.00
		20	0.00	0.00		14500.00	174000.00	174000.00
		21	0.00	0.00		14500.00	174000.00	174000.00
		22	0.00	0.00		14500.00	174000.00	174000.00
		23	0.00	0.00		14500.00	174000.00	174000.00
		24	0.00	0.00		14500.00	174000.00	174000.00
		25	0.00	0.00		14500.00	174000.00	174000.00
				IRR (Internal Rate of returns) =				33%

Appendix 4: *Orb Energy*

Solectric 30000 – 10 kWp system
The main components of this system include

• 10kWp crystalline PV modules
• 6 kVA high efficiency solar inverter
• Battery bank is designed for 1 day back up – 48V 1020 Ah
• Other accessories

Subsidy and Tax benefits
• As per the announcements of Jawaharlal Nehru Solar Mission, such projects would be entitled to a subsidy of Rs 81 per Wp or 30% of the total price whichever is lower. For this a project report will have to be made and submitted to MNRE for their approval which will be done by us.

Price net of Subsidy
Price of the system = Rs 23,00,000
Vat @ 5.5% = Rs 1,26,500
Total = Rs 24,26,500
Capital Subsidy @ 30% = Rs 6,90,000
Net price = Rs 17,36,500
Price inclusive of Vat net of subsidy is Rs **17,36,500/-** (Rupees Seventeen lakhs thirty six thousand five hundred only)

• The Government of India also offers accelerated depreciation to the extent of 80% per year. This translates to a saving of approximately 30% on the net price after the above subsidy amount.

Delivery, Installation and Commissioning
Delivery: 6 weeks from the date of receipt of order with advance
Installation and Commissioning: 2 weeks from hand-over of site for installation

Warranty and Service
• One year total system warranty against manufacturing defects (from date of invoice)
• One year free after-sales service. The service entails 2 free visits per annum, and callout in event of any issues / trouble-shooting.
• Customer can avail of an Annual Maintenance Contract (AMC) for essential maintenance services from the 2nd year

Terms and Conditions
• Payment terms: 50% advance with order, 50% on delivery of material to site
• Any works contract tax or Octroi if applicable will be at charged at actuals
• Electricity and water supply at site will be provided free of cost during installation
• Any civil / structural works will be for customer's cost
• Support of the roof manufacturer/supplier will be required for fixing of the PV module mounting frames to the roof
• Structure works if any required for mounting the PV panels will be extra and offer will be given only after the site survey / inspection.
• Standard force majure terms apply

Appendix 5: Urja Solutions (PV)

15KWp Solar rooftop solution to generate approximately 50 KW power in a day assuming 3.5 hours of sunny day

1. Solar PV modules: 15KWp
2. Energy Storage Unit: Emerson Liebert make ESU-3 phase 20KW, Qty: 1 no.

This ESU can be used in- i) stand alone ii) Grid sharing (feed in) & iii) Offline –modes

3. Solar Roof top mounting structure
4. Battery bank: 240V / 200Ah (12V / 200AH x 20 nos)
5. Lighting arrestor
6. Junction box

Total system cost: Rs. 27,43,000.00 + Tax

Note: The above price doesn't include cable & wiring cost. The Emerson ESU catalog is attached for your reference which will also provide details of the operation.

Block schematic diagram: