EXECUTIVE SUMMARY

Energy costs account a significant part of telecom operators’ operating expenses, the energy conservation measures are not only good for the environment; they also make commercial sense for operators and support sustainable, profitable business. In view of frequent rise in power tariff and diesel price, controlling the energy cost is a major concern of the telecom operators. In general, adoption of energy efficiency measures result in reduction of carbon footprint and cost saving. Indian telecom sector is growing at an exponential rate. With expansion of the telecom networks in no or poor grid areas, the industry has to use the diesel generators to power the networks. The carbon emission associated with energy use in Indian telecom sector is reported to be high as compared with world. Energy efficiency researches in India are confined to energy intensive industries like Cement, Steel and Fertilizers etc. Researchers did not take notice of the increasing energy requirement of the telecom networks. Research studies have been carried out in various countries to find out the share of telecom networks in national electricity consumption. In India, there is no estimate of electricity demand of telecom networks. In spite of consumption of billions of liters of diesel by the Indian telecom operators, there is no authentic estimation for the same. Moreover, use of diesel by Indian telecom industry is contributing to India’s GHG inventory. There is lack of understanding of suitable fuel switching option for telecom sector.

Although the telecom companies are making the efforts to implement energy efficiency measures and using renewable energy, the policy interventions are needed to motivate them.

This study has been conducted to estimate energy requirement of Indian telecom sector. It also develops insight in the energy consumption pattern of telecom operators. This study analyzes existing and potential energy conservation measures in Indian telecom sector. It identifies the critical factors affecting the energy conservation measures in Indian telecom sector.
The whole study is covered under seven chapters which are broadly covering business context, outline of the thesis, overview of Indian telecom sector, research methodology, analysis, findings, conclusion theoretical contribution and references of the study. The brief detail of the chapters is given below:

**Chapter One**- This chapter outline the background of the study. It explain the availability of grid electricity, forced outage and un-electrified villages in various telecom service areas based on ministry of power, central electricity authority and department of telecommunications data. The business case of the study is discussed with supporting data. The need of the study is outlined in this chapter. A brief structure of the thesis has been provided along with the construct of the research.

**Chapter two**- Discusses the overview of Indian telecom sector. The chapter provides a snap shot of the Indian telecom sector. The growth of Wireline and wireless telecom subscriber base in India is demonstrated and compound annual growth rate of various telecom services in India has been discussed. It provides the detail about telecom service areas in India and shows telecom service area map.

The roles and responsibilities of key decision making bodies Department of Telecommunications, Telecom Commissions, Statutory Bodies, such as TRAI, TDSAT have been discussed. It also covers important offices, departments like TEC, TERM Cell and public sector undertakings BSNL, MTNL, BBNL etc.

This chapter provides introduction to major telecom service providers in India and their market share. It also traces the role of telecom tower industry with its major players.

This chapter portrays key themes of National Telecom Policy 2012 and explains green telecom, use of renewable energy technologies to reduce carbon foot prints.
Chapter three - Reviews the various literatures available to understand the research area. This chapter gives a back drop of on the energy conservation and has tried to define the term energy conservation and energy efficiency. This chapter discusses the methods of energy conservation and also identifies drivers and barriers to energy conservation. It explains the energy consumption and carbon emission of ICT and telecom networks and identifies the energy conservation and regulatory drivers for the sustainable growth of the telecom sectors. It has also portrayed the energy conservation measures in telecom sector.

Chapter four - Covers the research need, research gap, research problem research questions and research objectives. Discusses the theoretical premise of the study and research methodology adopted in the study. A model for estimation of electricity demand and to estimate the diesel and electricity consumption of Indian telecom sector is developed in the study. Another energy model has been developed of telecom towers in India. To compare the energy cost of Indian telecom operators, two benchmarks “energy cost per subscriber” and “energy cost as percentage of revenue of telecom service providers” have been identified. The study also has identified methodology to calculate the carbon emission of telecom towers. This chapter discusses energy conservation measures adopted by Indian telecom operators and calculation of payback period for fuel switching option based on NPV method. This work has used a questionnaire as research tool to identify the driving forces and barriers to adoption of energy conservation measures in Indian telecom sector.

Chapter five - Showcases the analysis and findings of the study. The estimated annual electricity consumption of Indian telecom networks comes out to be around 35000 million units. This includes the necessary air-conditioning and general lighting requirement of telecom networks. This estimation assumes that there is round the clock availability of the grid electricity to all telecom networks. The share of electricity consumption of Base Transceiver stations (BTS) is about 83.69% in total electricity consumption of the telecom network in India. The annual grid electricity
consumption of telecom towers has been estimated as 22194.12 kWh considering daily 4 and 8 hours power breakdown in urban and rural areas respectively. The annual diesel consumption by telecom towers is estimated as 3.3 billion liters.

The chapter portrays the analysis of energy expenditure of five major Indian telecom service providers during last decade. It is evident from the analysis that there is wide difference among the energy cost per subscriber of telecom companies. The energy cost of MTNL for year 2015 is just double of the energy cost of private telecom operators that is below Rs. 200 per subscriber per annum. It demonstrates that energy expenditure has been rising and telecom operators spend a significant percentage of their revenue (5-10%) on energy.

In this chapter, the estimated total annual carbon emission by telecom towers due to energy consumption is 31.69 million ton. Annual carbon emission per subscriber is estimated as 32.67 Kg which is on higher side with TRAI estimation 21 Kg and world average 8 Kg. (TRAI 2011)

There is detailed analysis of existing and potential energy conservation measures including fuel switching options. Payback period for fuel switching at a typical Indian BTS site has been portrayed. Scenario analysis demonstrates that by use of fuel switching option i.e. replacing diesel with hybrid (Renewable Energy + Grid) energy the expected saving in diesel is 1414.05 and 3313.30 million liters respectively for the years 2015 and 2020. The resultant reduction in carbon emission due to fuel switching (diesel to renewable energy) will be 3.81 and 8.95 Mt of CO2 respectively for the year 2015 and 2020.

Based on factor analysis six drivers has been identified that affect energy conservation in telecommunication sector- Regulation and Competition Oriented Drivers, Organizational Policy Oriented Drivers, Incentive oriented Drivers, Customer Oriented & Financial Benefits Oriented Drivers and Sustainable Benefit Oriented Drivers
Based on factor analysis, eight barriers have been identified that affect energy conservation in the Indian telecommunications sector - Lack of Benchmarks / Targets and Reporting Barriers, Bounded Rationality Barriers, Customer Awareness Barriers, Precedence and Lack of financial incentives Barriers, Hiding diesel use information Barriers, Lack of Standards of Energy Efficient Products Barriers, Regulatory & Organizational Policy Barriers, and Technical Barriers.

Chapter Six discusses the recommendations of this study. The major recommendations are: Inclusion of Telecommunication Industry under EC Act, Financial Incentives and Subsidy etc. The chapter suggests Layout for Sustainability (Quarterly Energy consumption and resultant CO₂ emissions) Report and for Quarterly Diesel Consumption and Carbon Emission Saving Report for off-grid Telecom Tower Sites.

This chapter also covers the further scope of this study and contribution to theory/literature. The limitation of the study also has been discussed.