CHAPTER 6: CONCLUSIONS

The LCA approach has been used in this study for measuring environmental impacts of imported coal (with and without FGD system) and NGCC thermal power plants using CML 2001 and Eco-Indicator 99-H methods in India.

6.1 CONCLUSIONS

The study reveals that imported coal has approximately 1.9 times more impacts as compared to natural gas in terms of GWP and CCP due to various emissions such as CO₂, CH₄ and N₂O. It has also been observed that electricity generation using natural gas is a good substitute in terms of GHG emissions as compared to coal and oil in developing countries like India. In case of acidification potential, NGCC thermal power plants contributes only 3% and 20% impacts as compare to imported coal thermal power plant with and without FGD technology, respectively. The NGCC thermal power plant causes only 6% of eutrophication problem as compare to imported coal thermal power plant. Imported coal thermal power plant has almost double human health impact as compare to NGCC thermal power plant based on CML 2001 midpoint impact. In overall, NGCC is better option as compare to imported coal thermal power plant in terms of overall impacts on human health and ecosystem quality with both methods CML 2001 and Eco-indicator 99(H) methods. However, if we compare impacts using endpoint method (Eco-indicator-
99-H), then NGCC thermal power plant causes only 3% and 10% damage on ecosystem quality as well as human health in comparison to imported coal thermal power plants, respectively.

Economic analysis discussed in chapter 5 shows that IGCC and NGCC are superior technologies in terms of cost reduction due to negative environmental externalities by 81% with an additional cost of `1.62/kWh and `0.97/kWh, respectively, in comparison to PC. Second choice would be PC + CCS + FGD, but CCS technology has its own limitations due to increase in human health and eutrophication potential. Third option is PC + FGD, which is a better choice for reducing health damages by 61% in comparison to PC due to SO₂, NOₓ and PM₁₀ with an additional cost of `0.14/kWh. It is important to note that additional cost implication of `0.14/kWh due to installation of FGD technology results into reduction of 61% hidden damage cost, which is a very good option in terms of socio-economic cost-benefits in Indian scenario.

6.2 RECOMMENDATIONS

This study reveals that certainly natural gas is a better option in terms of overall environmental aspects as compared to imported coal without implementation of clean coal technologies. It emerged from this study that by installation of FGD technology in Indian condition results into reduction of very significant environmental and health impacts. In case of imported coal, sulphur content is high; therefore, FGD installation is highly recommended as one of the low cost clean technology option for Indian scenario.
Further, demand of power is increasing and domestic coal is in short supply and option available for coastal thermal power plants is either natural gas or imported coal.

6.3 LIMITATIONS OF THE STUDY

There are two noteworthy limitations of this study: generalizability and longitudinal effects. The generalizability of these research findings is limited because the LCA & LCC approaches are limited to two numbers of thermal power plants due to the unavailability of primary data. Second, time and budget limitations made it impractical to assess as collecting such data from foreign countries was beyond the scope of the current study. Future studies might consider narrative-based experiential learning interventions which are followed up with longitudinal check-ups for years or longer to explore if and how long-term after-effects actually occur. In view of the above constraints, the study focuses on LCA of imported coal and natural gas based thermal power plants to narrow down the objective of the research work. The study has following limitations:

- Life cycle analysis was carried out from ‘cradle to gate’ and not from ‘cradle to grave’ due to non-availability of data.
- Transport emissions have not been included in upstream processes for both cases i.e., imported coal and natural gas TPPs due to non-availability of data.
- Resource analysis has not been carried out due to non-availability of indigenous data related to mining and extraction of natural gas.
- In economic analysis, unit damage cost has been taken from other studies conducted in other countries, which might not give a true picture for Indian scenario and could have variable uncertainties.
6.4 FUTURE SCOPE

One can further study environmental and economic impacts in more detail where it could be investigated by collecting indigenous data for alternative technologies such as IGCC, SC and CCS in thermal power plants. Further, study could be analyzed from ‘cradle to grave’ including resource analysis with indigenous data, which can help decision makers for future policy planning for power sector taking into consideration climate change and human health. For economic analysis, social and environmental components could be explored in more detail by including willingness to pay and emission modelling for realistic assessment of exposure on local population.