Abstract
Bioenergy has emerged as a potentially sustainable alternative to the use of fossil fuels for transport and industrial uses. Developing nations, such as Colombia, can seize the advantages of modernizing rural areas by using cleaner energy and having more economic opportunities with bioenergy initiatives, provided the trade-offs between fiber, food, feed and fuel can be managed. This Thesis examines the bioenergy program now under way in Colombia, where comparative advantages (shared with other tropical countries) in production of sugar cane and palm oil are being built on. While the technologies associated with use of these feedstocks are well known, nevertheless their scaling up in a country like Colombia poses considerable environmental, social, economic and business challenges.

The thesis poses two fundamental questions based on current Colombian conditions, namely (1) can the Colombian biofuel industry produce bioethanol and biodiesel under sustainable guidelines; and (2) to what extent is it possible to expand energy crops for biofuels production purposes without jeopardizing sustainability goals? A sustainability approach based on recognized techniques such as Life Cycle Assessment (LCA) allows for a comprehensive social, economic and environmental analysis of the whole cradle-to-grave progress of the bioenergy value chain. An original LCA analysis is conducted for the Colombian bioenergy sector, with results indicating that considerable savings in GHG emissions are achieved while producing sustainable and competitive bioenergy products. Nevertheless expansion of sugarcane and palm oil crops is possible but constrained by biophysical, legal, ecological and socio-economic conditions, established to safeguard sustainable production. Utilising Geographic Information Systems (GIS) some maps were created which clarify the potential for bioenergy expansion in Colombia. The Thesis thereby engages with the bioenergy capabilities of Colombia, and drawing on the literature from other tropical and Latin American countries, provides original estimates of the country’s biopotential as well as needed policy settings to bring Colombia to its full capacity.

To sum up, this document argues that sustainable production and use of biofuels is feasible and would meet expected market demands over time.

**Key-words:** Bio-based energy, Energy, Biofuels, Sugarcane Bioethanol, Palm oil Biodiesel, First Generation Biofuels
Acknowledgments
The writing, designing and final delivery of this document has been possible only with the enormous support of several people.

Firstly, I want to highlight the huge help received by these two institutions, who made possible the completion of this really long and exhausting journey: MGSM and Politécnico Grancolombiano. Staff at the MGSM and Macquarie University were very supportive during my stay in Australia and also in long distance assistance.

The cornerstone of this thesis was the expertise, knowledge and generosity from my supervisor, Professor John Mathews, and despite the short time that we shared, his advice was always precise and accurate.

Also, in Colombia I received special support from the former and current Deans of the School of Management, Economics and Accounting Science, Dr. Jurgen Chiari and Dra. Deisy de la Rosa, and from the Head of Research of the University, Dra. Sandra Rojas.

Of course, this thesis could have not been completed without the special collaboration of several private and public entities that took part directly or indirectly during the research process. In particular, I want to mention FEDEPALMA, ASOCAÑA, FEDEBIOCOMBUSTIBLES, CUE, IGAC, IDEAM, UPME, CENICANA, CENIPALMA, and CORPODIB.

On a personal note, I want to thank my patient wife Diana, my parents, my sister and my family and friends in general. I am fully aware that I have stolen plenty of good time from our lives, but it is my intention to return it in both quality and quantity.

Many more people that were close to me during these last 5 years deserve a special mention for making this burden less heavy. Unfortunately, space is quite limited and I can only say to you all, I cannot thank you enough.