LIFE-CYCLE ASSESSMENT AND ECONOMIC ANALYSIS OF RENEWABLE ENERGY TECHNOLOGIES

by

M A Parvez Mahmud

Dissertation submitted in fulfilment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

School of Engineering
Faculty of Science and Engineering
Macquarie University
Sydney, Australia

August 2019

STATEMENT OF CANDIDATE

I certify that the work in this thesis entitled **"Life-Cycle Assessment and Economic Analysis of Renewable Energy Technologies"** has not previously been submitted for a degree nor has it been submitted as part of the requirements for a degree to any other university or institution other than Macquarie University.

I also certify that the thesis is an original piece of research and it has been written by me. Any help and assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis.

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M A Parvez Mahmud

Dedicated to my amazing parents, my loving siblings, my dearest wife and son

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all the people of Bangladesh

ACKNOWLEDGMENTS

Reverence to the Almighty for His myriad blessings upon myself. The research outcome reported in this thesis would not have been possible without the cooperation and abetment of a number of individuals, especially my principal supervisor Professor Candace Lang. I would like to express my heartfelt thanks and gratitude to her for the unconditional support, guidance, and encouragement throughout the duration of my candidature. She has always motivated me to continue hard work with her charismatic power of influencing others and making strong interpersonal connections being kind, patient, and considerate. Her countless inspirations and insightful suggestions have helped immensely to accomplish this dissertation regardless of all the obstacles. She has always allocated time for our individual and group meetings despite of her tight work schedule. In polishing the manuscripts, she provides critical comments and technical corrections, which helped a lot to publish at the top-tier journals. I highly appreciate her contribution of invaluable time, creative ideas, and effective discussion. Many thanks also go to her open-mindedness and advices on progressing my research career. She is undoubtedly one of the best scholars, mentors, and persons I have ever met and worked with.

I am fortuitous to have a friendly, cooperative, inspirational, great-hearted, and highly knowledgeable co-supervisor like Dr Nazmul Huda. He is a hardworking and motivational individual and always advices me to spend enough time for research, and on many cases I found his insightful guidance and countless supports have helped a lot with the completion of this long PhD journey smoothly. His high encouragement and strategic attitude have always directed me towards the best possible outcome in a convenient way. His door was always open for me for research discussion to tackle the associated difficulties instantly. I am especially appreciative of his valuable time to discuss the research outcomes and directions, to review my manuscripts, and to formulate unique ideas related to my research project. I am indebted to him for providing very fruitful and timely supports, sharings, and cares to overcome the crucial situations during my research endeavours.

I would like to acknowledge the provided quality research facility, harmonious work environment, and financial support under the scholarship scheme "International Macquarie University Research Training Program (iMQRTP)" from Macquarie University for conducting this research. I thank Macquarie University for providing a Postgraduate Research Fund (PGRF) and HDR travel grants, which allowed me to visit around the world to present the findings of my project in several international conferences: ISGT 2017 (Auckland, New Zealand), ALCAS 2017 (Brisbane, Australia), IELS 2017 (Gold Coast, Australia), GCC 2017 (Auckland, New Zealand), ICPEME 2018 (Barcelona, Spain), ICCGE 2018 (Paris, France), ECRES 2018 (Istanbul, Turkey), ESC 2018 (London, UK), Nanotech 2018 (Paris, France), and EEEIC 2018 (Palermo, Italy). Furthermore, it also allowed to collaborate with Professor Jeroen Guinée through a lab visit at Leiden University, Netherlands. I am very thankful to the School of Engineering, Macquarie University for providing me with the great chance to work as a Tutor/ Casual Academic for five semesters, which has befitted me financially and enriched my interpersonal skills. I would like to give special thanks to fellow MQ staff and postgraduate students: Professor Darren Bagnall, Professor Michael Heimlich, Professor Stuart Jackson, Professor Subhas Mukhopadhyay, Associate Professor Jahangir Hossain, Dr Mohsen Asadnia, Dr Ming li, Dr David Inglis, Dr Nikos Kopidakis, Dr Ruth Oliver, Dr Nicholas Tse, Barry McDonald, Imogen da

Silva, Martina Stiemer, Rachel Kyung, Hannah Woodrow Clark, Sheley Kurniawan, Catherine Tolentino, Amit Shrestha, Nirzhar Saha, Debabrata Karmokar, Selim Hossain, Abdullah-Al Nahid, Khizir Mahmud, Audri Biswas, K M Morshed, Md Tasbirul Islam, Sohrab Nizami, Fida Rafi, Shamiur Rahman, B M Ruhul Amin, Naila Mukhtar, Nasrin Afsari, Khushboo Singh, Chenshuo Ma, Sajjad Mahmoudi, and Muhammad Kashif, who has given me unforgettable experiences, adventures, and a lot of fun.

I express gratitude to Dr Keith Imrie for proof-reading my all research paper drafts throughout the candidature period within a very short period of time. His feedback has facilitated to advance my technical writings. Thanks goes to my amazing parents (MD Mortoza Ali and Jharna Begum) for their unconditional help and love, to all my respected teachers, and of course to my naughty friends who contributed directly/indirectly to this research. I am grateful for the countless support and understanding of my family members in Bangladesh, especially my brothers (Polash, Pavel, Piko, Fahim and Forhad), sisters (Lipi, Popy, Polin and Pinki), mother in law (Fatema Sultana), brother in law (Rohan), aunts (Suraiya Begum and Nazma Aktar), and uncle (Abu Zafar Mohiuddin).

Last, but certainly not least, a big thanks to my beloved wife for being a perfect research partner with whom I published 17 journal articles and 13 peer-reviewed conference papers. I am grateful to her for the enormous family and research supports throughout the journey. She always provided assistance through sharing, caring, and sometimes shopping foods and utensils. She takes care of our loving baby M A Wafiq Mahmud (Aayan) along with her full-time PhD research. She also cook delicious foods for us every day. She always accompanies me in all hard/good times and provides precious supports and suggestions. At this moment, I want to say, “I am so blessed to be your life partner, and I love you”.

ABSTRACT

Renewable Energy Technologies (RETs) offer the potential for low-carbon electricity production. The true potential of RETs can be established by assessing their environmental impact and cost for a region, based on a Life Cycle Assessment (LCA) approach. This Ph.D. thesis presents six contributions which analyse the environmental and economic benefit of RETs in specific regions. The first contribution is the LCA-based environmental effects evaluation of a solar-PV and a solar-thermal system. The second contribution is the environmental hazard estimation of existing hydropower plants in Europe. The third contribution is the comparative environmental impact assessment of three different renewable-power plants, namely solar PV, biomass and pumped storage hydropower plants in the United States. The fourth contribution is the design and development of a new life-cycle inventory for solar PV, wind and hydropower plants in Switzerland to evaluate life-cycle emissions and identify the best plant option. The fifth contribution is the development of an advanced power-routing framework for a solar PV-driven islanded microgrid. The final contribution of this research is the accomplishment of a Net-Present-Cost (NPC)-based optimization analysis and an LCA-based environmental-impact assessment of an off-grid microgrid framework. Overall, this work provides a clear identification of technologies which are environmentally-superior and cost-effective; thus allowing prioritisation of appropriate electricity production.

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