



Dedicated to my parents ...

DECLARATION

I do hereby declare that the Thesis entitled “**IOT BASED BIOGAS MANAGEMENT: TECHNOECONOMIC ANALYSIS FOR RURAL ASSAM (INDIA)**” being submitted to the Department of Energy, Tezpur University, is a record of original research work carried out by me. All sources of assistance have been assigned due acknowledgement. I also declare that neither this work as a whole nor a part of it has been submitted to any other University or Institute for any other degree, diploma, or award.

Place: Tezpur

Trinakshel Sarmah
(TRINAKSHEE SARMAH)

Date: 23.09.2024



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CERTIFICATE OF THE SUPERVISOR

This is to certify that the Thesis entitled “**IOT BASED BIOGAS MANAGEMENT: TECHNOECONOMIC ANALYSIS FOR RURAL ASSAM (INDIA)**”, submitted to the Department of Energy, School of Engineering, Tezpur University in part fulfillment for the award of the degree of Doctor of Philosophy in Energy is a record of research work carried out by Ms. Trinakshee Sarmah under my supervision and guidance.

All help received by her from various sources has been duly acknowledged.

No part of this Thesis has been submitted elsewhere for award of any other degree/diploma.

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ACKNOWLEDGEMENT

I am honored to avail this opportunity to extend my sincere gratitude to Tezpur University and all those individuals whose invaluable contributions have made it possible to bring this Thesis to light.

I extend my gratitude to Professor Debendra Chandra Baruah, my esteemed advisor who has guided me in all the steps of this journey. I also extend my appreciation to the respected members of my Doctoral Committee: Professor Rupam Kataki, Dr. Vikas Verma, and Professor Manuj Kumar Hazarika. Additionally, I would like to express my gratitude to the Head of the Department of Energy, Professor Sadhan Mahapatra. I also appreciate the support from Dr. Rupam Goswami of the Department of Electronics and Communication, Tezpur University, and Dr. Dipal Baruah, Director (R&D and Innovation), TRCATS LLP.

I would also like to acknowledge the financial support received from Tezpur University in the form of Institutional Fellowship. I also take this opportunity to thank Tezpur University for providing financial assistance under the scheme “Research and Innovation Grant”. I am also grateful for the support from the project titled “Multi crop Residue Processing Technology Package for Production of Fuel and Fertilizer” funded by the Science and Engineering Research Board (SERB) from IMPRINT-2(PAC Energy) scheme, Sanction order no. IMP/2019/000247, Government of India.

I am grateful to Mr. Tapan Borah and Mr. Troilokya Lahon of the Department of Energy for providing me with technical support for my research work. I would additionally like to acknowledge the support received from the villagers of Napaam, Amolapam, and Amlighat in carrying out the research work. I am also grateful to the team involved in developing the IoT-based biogas management system. I would like to express my heartfelt gratitude to my family, friends (Dr.Minakshi, Dr. Honey, Dr. Barkhang, Panchali, Adity, Isfakur, Niva, Aliya, Bharat, Dipjyoti), and all well-wishers whose unwavering support and encouragement have been influential in completing this Thesis.

(Trinakshee Sarmah)

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LIST OF ABBREVIATIONS

Abbreviation	Full form
ABHA	Ayushman Bharat Health Account
AD	Anaerobic Digestion
AICRP	All India Coordinate Research Project
BAU	Business as Usual
BDTC	Biogas Development and Training Centre
BHIM	Bharat Interface for Money
BMP	Biomethane Potential
BPGTP	Biogas Power Generation (off-grid) and Thermal Energy Application Program
C: N	Carbon: Nitrogen
CDM	Clean Development Mechanism
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CSC	Common Service Centres
DIKSHA	Digital Infrastructure for Knowledge Sharing and Sharing) and SWAYAM (Study Webs of Active Learning for Young Aspiring Minds
DILRMP	Digital India Land Records Modernisation Programme
DRDO	Defence Research and Development Organization, India
FC	Fixed cost
GHG	Greenhouse gas
GOBARDHAN	Galvanizing Organic Bio-Agro Resources Dhan
HBS	Household Biogas System
HBS_IoT	HBS with the installed IoT system
HRT	Hydraulic Retention Time
ICAR	Indian Council of Agricultural Research
IEA	International Energy Agency
IoT	Internet of Things

Abbreviation	Full form
IREDA	Indian Renewable Energy Development Agency
IREP	Integrated Rural Energy Programme
IS	Indian Standard
KVIC	Khadi and Village Industries Commission
LACFE	Levelized annual cost of fixed expenditure
LPG	Liquefied Petroleum Gas
MDM	Mid-day meal
MoSPI	Ministry of Statistics and Programme Implementation
MOVCDNER	Mission Organic Value Chain Development in North East Region
NBDB	National Biogas Development Board
NBMMP	National Biogas and Manure Management Project
NDDB	National Dairy Development Board
NDUW	National Database of Unorganized Workers
NeGPA	National e-Governance Plan – Agriculture
NFSA	National Food Security Act
NMSA	National Mission on Sustainable Agriculture
NNBOMP	New National Biogas and Organic Manure Programme
NPBD	National Project for Biogas Development
NPV	Net Present Value
NPV	Net Present Value
OLR	Organic Loading Rate
ORP	Oxidation Reduction Potential
PIA	Programme Implementation Agency
PKVY	Paramparagat Krishi Vikas Yojana
PLC	Programmable Logic Controller
PM	Particulate Matter
PM-PRANAM	Programme for Restoration, Awareness, Nourishment, and Amelioration of Mother Earth
PM-PRANAM	PM Programme for Restoration, Awareness, Nourishment and Amelioration of Mother Earth
PMUY	Pradhan Mantri Ujjwala Yojana
RBI	Reserve Bank of India

Abbreviation	Full form
RC	Annual running cost
RET	Rural Energy Technicians
RSE	Renewable Sources of Energy
SATAT	Sustainable Alternative towards Affordable Transportation
SDG	Sustainable Development Goals
SHM	Soil Health Management
STOAT	Sewage Treatment Operation Analysis over Time
VFA	Volatile Fatty Acids
WEST	Worldwide Engine for Simulation, Training and Automation