A NOVEL FRAMEWORK TO ASSESS THE LEVEL OF ENERGY CULTURE MATURITY: THE CASE OF TEXTILE AND APPAREL INDUSTRIAL ORGANISATIONS

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Thesis submitted in partial fulfilment of the requirements for the degree

Doctor of Philosophy

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September 2022

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The supervisor/s should certify the thesis with the following declaration. The above candidate has carried out research for the PhD thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of the supervisor: Prof. Udayangani Kulatunga

Signature of the supervisor: UOM Verified Signature Date: 12/09//2022

DEDICATION

I dedicate this piece of work to my loving wife Mahesha and son Vinuth in return for the departed time and unconditional love.

ACKNOWLEDGEMENT

There were many people who were of great importance and influence on me during my period of pursuing a PhD, whom I would like and most gratefully acknowledge.

First and foremost, I would like to acknowledge my gratitude to Professor Udayangani Kulatunga, Dr Gayani Karunasena, Professor Lalith de Silva, and Dr Nateque Mahmood for their enormous support and continuous guidance given as my supervisors, especially for their patience and efforts in encouraging me throughout the study. Further, I highly appreciate the invaluable feedback received from Associate Professor Thayaparan Gajendran from the University of Newcastle, Australia as the external expert in the progress review panel, which shaped the study's direction from the beginning.

I must express my gratitude to renowned scholar Professor David L. Morgan at Portland State University in the United States for his generous guidance provided for various matters relating to development of the research methodology of the study. Further, I would like to acknowledge the guidance received from Professor Janet Stephenson, Managing Director of the Centre for Sustainability, University of Otago, New Zealand as the leading scholar who developed the energy cultures framework that is the foundation for this study.

My sincere thanks also go to staff from Deakin University and the University of Moratuwa. I would like to thank the staff of the School of Architecture and Built Environment at Deakin University, including Head of the School Professor Sarah McGann, former Head of the School, Professor Anthony Mills; Professor Chunlu Liu; Associate Head of School (Research), Dr M. Reza Hosseini; HDR Coordinators, Dr Dominic Ahiaga-Dagbui and Dr Akari Nakai Kidd; and School Administrative Officer, Ms Bronwyn Burrell. Further, I convey my gratitude to the staff of the University of Moratuwa, including the Dean of the Faculty of Graduate Studies, Professor Ajith De Alwis; Former Dean of the Faculty of Graduate Studies, Professor Dileeka Dias; Dean of the Faculty of Architecture, Dr D.P. Chandrasekara; Head of the Department of Building Economics, Ch Qs Suranga Jayasena; former Head of the Department, Professor Yasangika Sandanayake; and Director Post Graduate Studies of the Faculty of Architecture, Dr Sachie Gunathilake.

My special thanks go to Dr Chandanie Hadiwattage, Dr Aparna Samaraweera, Ms Indrani Wimalaratne and Mr Nandun Madushanka for their invaluable support and motivation that had a highly positive influence on my journey. Further, I want to acknowledge the members of the Deakin University Thesis Writing Group, led by Dr Terrie Fraser, for their support and constructive feedback. Moreover, I would like to acknowledge the invaluable knowledge gained through "Thesis Whisperer" and "Patter" blogs about various aspects of the PhD journey. Therefore, I would like to thank Professor Inger Mewburn and Professor Pat Thomson for maintaining such resourceful blogs for the betterment of the academic community. Further, I wish to thank Dr Blue Mahy for editing services, including correcting errors in grammar,

punctuation, and spelling; improving the clarity of expression; and ensuring consistency of this thesis.

Last but not the least, I would like to thank my family members for their unconditional love, emotional sacrifices, constant help, and encouragement throughout my challenging journey of completing a PhD.

ABSTRACT

Global progress of energy-related improvements is considerably behind the curve due to the slow progress of existing initiatives. Hence, there is a pressing need for alternative approaches. Emerging energy culture research area has been identified as a promising approach to look at the lower progress of energy-related improvements. However, energy culture maturity frameworks have not been established yet despite the ability for performance improvement proved by other culture maturity frameworks, like safety culture maturity. Hence, this study aimed to develop a mechanism to assess the level of energy culture maturity focused on the textile and apparel industrial organisations in Sri Lanka, which is the major energy-consuming industry in the country with considerable energy issues. This study was conducted in two (02) phases to develop and evaluate an energy culture maturity assessment framework. Phase I developed the energy culture maturity framework using three (03) steps. Accordingly, Steps 1 and 2 developed a draft energy culture maturity framework using 10 and 15 semi-structured interviews respectively. Then, Step 3 refined the draft framework using three (03) focus groups with four (04) participants each. Phase II of the study evaluated the applicability of Phase I's framework using three (03) case studies of large-scale textile and apparel industrial organisations in Sri Lanka. The findings of the study revealed a novel energy culture maturity assessment framework and its applicability for assessing the energy culture maturity of large-scale textile and apparel industrial organisations in Sri Lanka. This study not only took the innovative step of developing the first energy culture maturity conceptual framework and energy culture maturity framework for textile and apparel industrial organisations but also provides a robust mechanism for policymakers and practitioners to assess the level of energy culture maturity in textile and apparel industrial organisations.

Keywords: energy culture; energy culture maturity; textile and apparel industrial organisations

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

Abbreviation	Description
BMS	Building Management Systems
CAQDAS	Computer Assisted Qualitative Data Analysis Software
CMM	Capability Maturity Model
ETI	Ethical Trading Initiative
GOTS	Global Organic Textile Standard
GRS	Global Recycled Standard
IEA	International Energy Agency
ISO	International Organisation for Standardisation
JASTECA	Japan Sri Lanka Technical and Cultural Association
KPI	Key Performance Indicator
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
PDCA	Plan, Do, Check, Act
SBTI	Science Based Targets Initiative
SLSEA	Sri Lanka Sustainable Energy Authority
WRAP	Worldwide Responsible Accredited Production

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research background

The Paris Agreement targets limiting global warming to 1.5^{o}C compared to the pre-industrial temperature level (United Nations Framework Convention on Climate Change, 2021). Hence, reducing global Carbon Dioxide emissions, which are mainly caused by energy-related emissions, has become necessary (International Energy Agency (IEA), 2021; IEA, 2018). Sustainable Development Goal (SDG) 7 provides guidelines to increase energy efficiency and renewable energy as two promising avenues to mitigate energy-related emissions (Taylor, 2019). However, the global progress of energy efficiency and renewable energy implementation is considerably behind the curve from the 2030 SDG 7 and 2050 net zero emissions targets. For instance, the targeted annual rate of energy efficiency improvement should have been at least 2.6% until 2030, according to SDG 7. However, the actual rate of energy efficiency improvement was 1.3% in 2018 (United Nations, 2019), and due to the lower progress, the annual target has increased now to 3% to achieve the 2030 goal. On the other hand, despite the considerable progress in renewable energy sources globally, the contribution of those to the global total final energy consumption has remained steady over the same time (IEA, International Renewable Energy Agency (IRENA), United Nations Statistics Division (UNSD), World Bank, & World Health Organization (WHO), 2021). Renewable energy sources' steady contribution to the global energy mix confirms the failure to replace fossil fuels with renewable energy additions. Instead, renewable energy and fossil fuel sources have been increasing without an absolute emission reduction globally (York & Bell, 2019). Overall, the current approaches have been considerably unsuccessful in limiting energy-related impacts on climate change. Hence, massive and immediate alternative actions that completely transform the current ways of producing and consuming energy are necessary to achieve net-zero emissions by 2050 (IEA, 2019; IEA, 2021: Hickel & Kallis, 2020).

Deployment of energy-related improvements, such as energy efficiency and renewable energy, has been slowed due to the predominance of traditional techno-economic thinking that does not consider the cultural dimension (Sovacool & Griffiths, 2020). There are instances where well-developed and economic energy-related improvements with financial incentives have failed due to cultural incompatibility as one of the major reasons. Hence, culture plays a significant role in deploying energy-related improvements similar to regulations and national programs (Sovacool & Griffiths, 2020). Further, the cultural adoption of the energy-related improvements should be carefully considered to ensure the world is on track with energy-related emission reduction (Sovacool & Griffiths, 2020*;* Stephenson et al., 2021). Many authors have highlighted the potential of overcoming the traditional techno-economic focus on

energy-related improvements using the energy culture approach (Dew et al., 2017; Dunlop, 2019; Fowler et al., 2017; Lutzenhiser, 1992; Rotzek et al., 2018; Schubert and Stadelmann, 2015; Sovacool, 2014; Sovacool & Griffiths, 2020; Stephenson et al., 2010; Stephenson et al., 2015; Stephenson, 2018; Stephenson, et al., 2021) that has the potential to subsume other energy-related research areas, including technology and economics (Lutzenhiser, 1992).

There have been studies that relate culture maturity and respective performance. For instance, Jääskeläinen et al. (2020) and Stemn et al. (2019) established a safety culture maturity's positive relationship with the safety performance in organisations. Further, culture maturity frameworks provide the benchmarking ability that supports the performance improvements of the respective area (Jääskeläinen et al., 2020). Moreover, Stephenson et al. (2015) and Stephenson et al. (2010) stressed the importance of identifying different clusters of energy cultures to bring tailor-made interventions for energy culture improvements. Energy culture maturity can facilitate the improvement of energy cultures. The energy culture maturity can be defined as the journey that shows the progressive steps towards energy culture excellence. Accordingly, energy culture maturity can establish different clusters of energy cultures using the different energy culture maturity levels as expected by Stephenson et al. (2015). Thus, energy culture maturity can bring tailor-made interventions to change energy cultures for better energy performance. Hence, establishing energy culture maturity research under the energy culture research domain can be identified as a significant area for research.

1.2 Justification of the research problem

There have been various studies on the energy culture representing various areas, such as energy efficiency improvement (Bell et al., 2014; Dew et al., 2017; Gill et al., 2015; Stephenson et al., 2010; Walton et al., 2020), renewable energy transitions (Ambrosio-Albalá et al., 2019; Bach et al., 2020; Ford et al., 2017; Johnson et al., 2019; Khan, 2020) and energy consumption and conservation (Bardazzi, & Pazienza, 2017; Bardazzi, & Pazienza 2020; Rau et al., 2018; Tesfamichael et al., 2020). However, one of the significant limitations of the existing energy culture studies is that they only examine the details of the existing energy cultures, such as drivers and barriers, without identifying and assessing the level of energy culture maturity. Further recent energy culture studies like Oksman et al. (2021) have discussed the term *energy culture maturity* without providing an energy culture maturity framework.

At the same time, culture maturity assessment has been already established in other culture research areas, such as safety culture maturity (Jean and Zaleschuk, 2018; Lee, 2019; Musonda, 2018; Stiles, 2018; Zwetsloot et al., 2020), health safety and environment culture maturity (Bordage et al., 2012) and organisation culture maturity (Chaitanya & Madala, 2008) that facilitates assessment of cultural maturity. In addition, there are a few energy maturity studies limited to areas such as energy management (Finnerty et al., 2017b; Introna et al., 2014; Ngai et al., 2013; Prashar,

2017) and the ISO 50001 energy management system (EnMS) (Antunes et al., 2014; Jin, 2021; Jovanović et al., 2016) without focussing on energy culture maturity assessment. Overall, the existing energy culture and energy maturity studies have not facilitated the energy culture maturity assessment that provides the level of the maturity of an energy culture and a road map for cultural excellence.

According to Lutzenhizer (1992), who was the founder of the energy culture model, energy culture varies among different contexts such as different industries. Stephenson et al. (2015) and Bell et al. (2014) also confirmed the existence of a distinctive energy culture at the industry level. Therefore, energy culture maturity assessments should be focused on a specific industry or a sector. Thus, it is vital to identify a suitable industry based on the significance of energy use and energy-related issues. Globally, the industrial sector has been the leading energy consumer, using more than 50% of the total delivered energy (Conti et al., 2016; Henriques & Catarino, 2016; Muthukumarana et al., 2018; Valavanidis., 2018).

Within the context of Sri Lanka, the non-domestic sector's energy consumption, including industrial and commercial sectors, is higher than the domestic sector's energy consumption (Singh et al., 2017). Equally, the textile and apparel industry is the major energy-consuming industry in the non-domestic sector in Sri Lanka, with around 14% of energy consumption (Sri Lanka Sustainable Energy Authority (SLSEA), n.d.). At the same time, there is a considerable energy saving potential within the textile and apparel industrial organisations. Textile manufacturing accounts for an energy-saving potential of 10–45% from thermal energy and 10–15% from electrical energy. Similarly, apparel manufacturing accounts for an energy-saving potential of 15–40% from thermal energy and 25–40% from electrical energy in Sri Lanka (Namal, 2020). SLSEA (n.d.) also confirms considerable energy efficiency gaps in textile and apparel organisations. The energy efficiency benchmark of the industry is 6.46 MJ/Clock hour and, conversely, a considerable number of factories have been reported with poor energy efficiency rates that range from 9.99 to 15 MJ/Clock hour. Furthermore, being the major source of export revenue for Sri Lanka, the textile and apparel industry contributes around 40% share of total exports (Edirisinghe & De Alwis, 2021; Embuldeniya, 2015; Mirza & Ensign, 2021; Muthukumarana et al., 2018; Pathirana & Yarime, 2018; Sri Lanka Export Development Board (SLEDB), 2021). However, the high energy cost and consumption have contributed to reducing the competitive advantage of the Sri Lankan textile and apparel industry among the competitors in the global market (Muthukumarana et al., 2018; Pathirana & Yarime, 2018; SLEDB, 2021). Overall, the energy-related improvements in the textile and apparel industry in Sri Lanka have become significant due to the size of the energy consumption and related issues. Therefore, it is vital to study the energy culture maturity assessment of the textile and apparel industrial organisations in Sri Lanka. Hence the research problem is identified as

"How can the energy culture maturity be assessed in textile and apparel industrial organisations in Sri Lanka?"

Accordingly, the following research aim and objectives are formed for this investigation.

1.3 Aim and objectives

This study aims to develop a mechanism to assess the level of energy culture maturity of textile and apparel industrial organisations in Sri Lanka.

The following objectives are recognised to achieve the above aim:

1. Review attributes, descriptors, and stages of energy culture maturity
2. Design an energy culture maturity conceptual framework
3. Develop an energy culture maturity assessment framework for textile and apparel industrial organisations in Sri Lanka
    a. Develop energy culture maturity attributes for textile and apparel industrial organisations in Sri Lanka
    b. Develop energy culture maturity descriptors under maturity levels for textile and apparel industrial organisations in Sri Lanka
4. Evaluate the applicability of the developed energy culture maturity assessment framework in textile and apparel industrial organisations in Sri Lanka

1.4 Research methodology

First, Objective 1 and Objective 2 of the study were achieved using a systematic literature review conducted based on the Web of Science database. Accordingly, Objective 1 developed the components of conceptual energy culture maturity framework, and the conceptual framework was designed thereafter in Objective 2. Moreover, this study utilised the concept by Saunders et al. (2019) of a *research onion* to outline the research methodology. Accordingly, interpretivism was identified as the appropriate research philosophy for this research, and under that, the abductive research approach was adopted. The research strategies employed were the qualitative survey and case studies. Further, the methodological choice of the research was multi-method qualitative since it employed multiple qualitative data collection techniques. Considering the time horizon, this study can be categorised as a cross-sectional study due to examining the energy culture maturity at a given time.

Data collection and analysis were carried out in two (02) phases. The purpose of Phase I was the development of an energy culture maturity assessment framework for the textile and apparel industrial organisations in the Sri Lanka as Objective 3 of the study. Qualitative survey was the research strategy employed in the Phase I. Under qualitative survey, Phase I employed three (03) steps of data collection. Steps 1 and 2 were conducted using semi-structured expert interviews from a pool of 21 energy experts employed in textile and apparel industrial organisations. Accordingly, Step 1 involved developing energy culture maturity attributes using 10 energy experts and Step 2

carried out the development of the energy culture maturity descriptors for five (05) maturity levels and refined attributes developed from Step1, using 15 semi-structured expert interviews. Then, in Step 3, three (03) focus groups with four (04) members in each were conducted to refine the drafted energy culture maturity framework from Step 2 findings. Thereafter, Phase II evaluated the applicability of the Phase I's final framework using the case study research strategy. Accordingly, three (03) case studies were conducted using three (03) textile and apparel industrial organisations in Sri Lanka. Focus groups, document reviews and observations were used as the data collection techniques of Phase II case studies. Phase I data were analysed using code-based content analysis using QSR NVivo 12 software and manual content analysis. Further, Phase II case studies used pattern matching and cross-case synthesis and as the data analysis techniques. Figure 3.2 in Chapter 3 provides a detailed illustration of the Phase I and Phase II data collection and analysis processes.

1.5 Scope and limitations of the research

The study was limited to textile and apparel industrial organisations in Sri Lanka since the energy cultures are distinctive at the industry levels (Bell et al., 2014; Lutzenhizer, 1992; Stephenson et al., 2015). Further, the textile and apparel industry in Sri Lanka consists of a large number of large-scale organisations (Embuldeniya, 2015). Therefore, this study focussed on large-scale textile and apparel industrial organisations considering the significance of energy consumption, energy-saving potential and the number of organisations. Further, this study's proposed framework only facilitates assessment of the level of energy culture maturity which was the focus of this study. However, the framework does not guide on "how to change" energy cultures to reach higher maturity levels which can be identified as a limitation.

1.6 Contributions of the research

The study's contribution is in three (03) forms: contribution to knowledge, to research methods and to practice. There are other frameworks available to represent the culture maturity in different research areas, such as the safety culture maturity and organisation culture maturity. However, there were no energy culture maturity frameworks available. Hence, this study undertook the innovative step to develop the first energy culture maturity framework, and thereby provide a significant contribution to knowledge as given in Section 6.3. This study's mixed focus group design claims for the contribution to research methods by fulfilling Morgan's (2019) call for more studies to conducting mixed focus group designs as explained in Section 6.4. The contribution to practice can be explained in several ways. The proposed energy culture maturity framework can be utilised as a baselining and benchmarking tool by the textile and apparel industrial organisations and the energy-related regulatory bodies, such as the Sri Lanka Sustainable Energy Authority (SLSEA), to assess and improve the energy culture maturity of the organisations in the textile and apparel industry as explained in Section 6.5. The framework supports increasing the energy performance

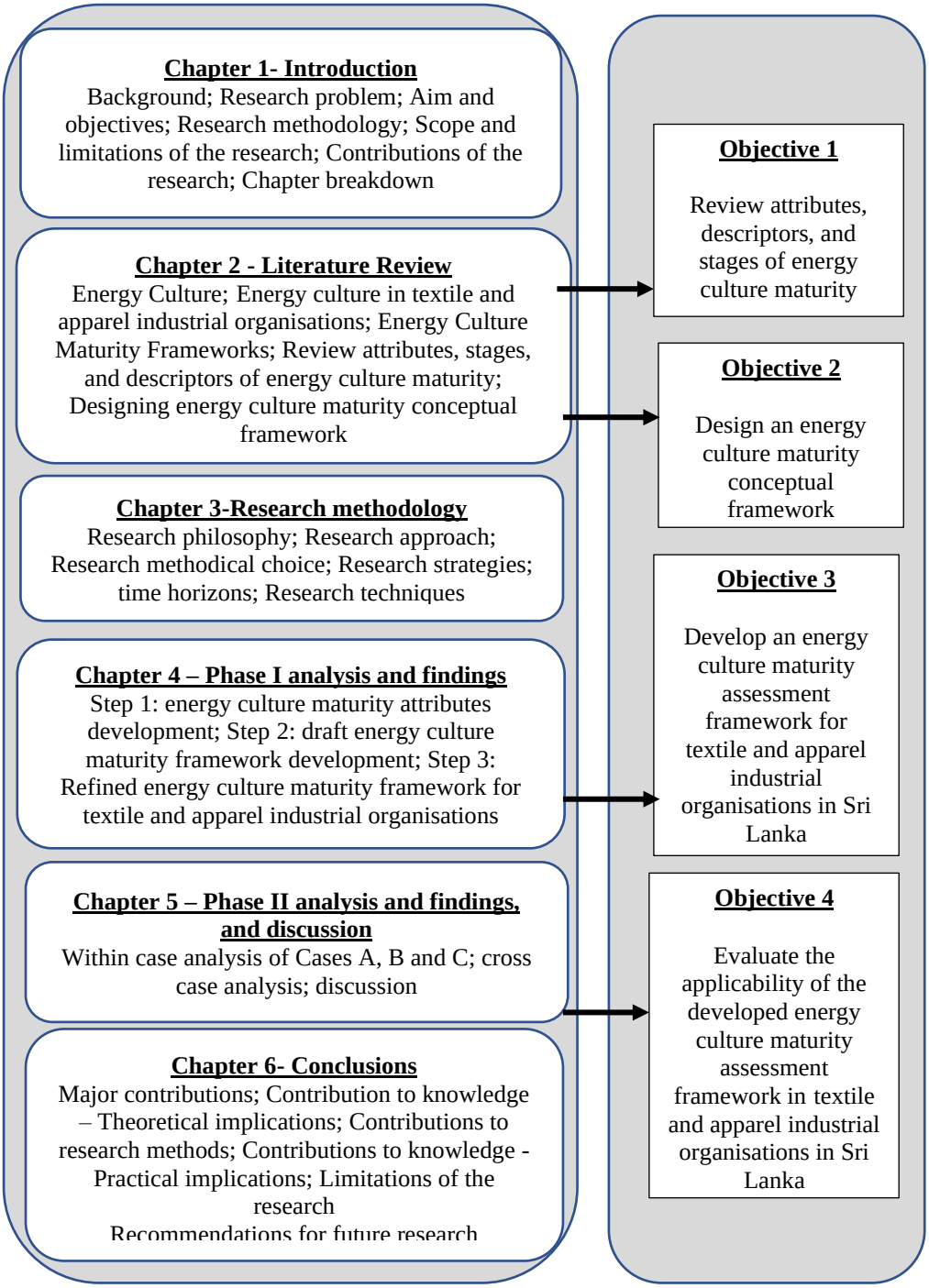
of the organisations and industry and reducing energy consumption and related carbon emissions at large.

1.7 Chapter breakdown

The structure of the thesis consists of six (06) chapters. Figure 1.1 depicts the content of each chapter and objectives achieved in different chapters.

Figure 1. 1

Chapter Breakdown



1.8 Chapter summary

This chapter has introduced and discussed the background of the of the study. Significance of studying on energy culture maturity for addressing current energy-related issues was discussed that lead to identify the research problem of the study. Hence, the research aim was established together with the objectives to resolve the identified research problem. The Chapter further presents the overview of the research design. Furthermore, the scope and limitations, and contributions of the study are briefly presented. Finally, the structure of the thesis in brief was presented using the chapter breakdown. The following chapter presents the literature review of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature on energy culture and the development of an energy culture maturity conceptual framework and its components. Initially, the chapter discusses energy culture, its components and status of the energy culture research in textile and apparel industrial organisations. Then, the details of the systematic literature review, including the systematic literature review procedure and the findings of the systematic literature review are explained. Under findings of the systematic literature review, first, this study developed energy culture maturity attributes, descriptors, stages based on the screen energy culture research studies. Subsequently, the energy culture maturity conceptual framework was developed by integrating the identified energy culture maturity components as the ultimate outcome of the literature review.

2.2 Energy culture in textile and apparel industrial organisations

This section initially provides understanding of the concept of energy culture. Then, the results of the literature review are presented regarding the status of the energy culture research in textile and apparel industrial organisations.

2.2.1 Energy culture

Ishak (2017) identified the model developed by Lutzenhiser (1992) as the first attempt to unveil energy culture as a concept. Stephenson et al. (2010) also concurred that the same work was an innovative study. Lutzenhiser (1992) highlighted energy culture's possibility of subsuming the technology and economic aspects of energy use. Energy culture not only considers the individual's behaviour on energy consumption but goes beyond the that to identity the impact of the group's behaviours on energy use. Further, Lutzenhiser (1992) identified the potential applicability of the energy culture approach for energy consumption analysis under three levels as predictive, explanatory, and descriptive forms of analysis of energy use. However, Stephenson et al. (2010) and Stephenson (2018) recognised a significant limitation of the development made by Lutzenhiser (1992); it is not a developed theoretical model since it only describes the energy culture concept without providing a clearly defined model. Considering the further advancements of the energy culture research area, Ishak (2017) highlighted the development by Stephenson et al. (2010) as the first framework that comprehensively explains the energy culture.

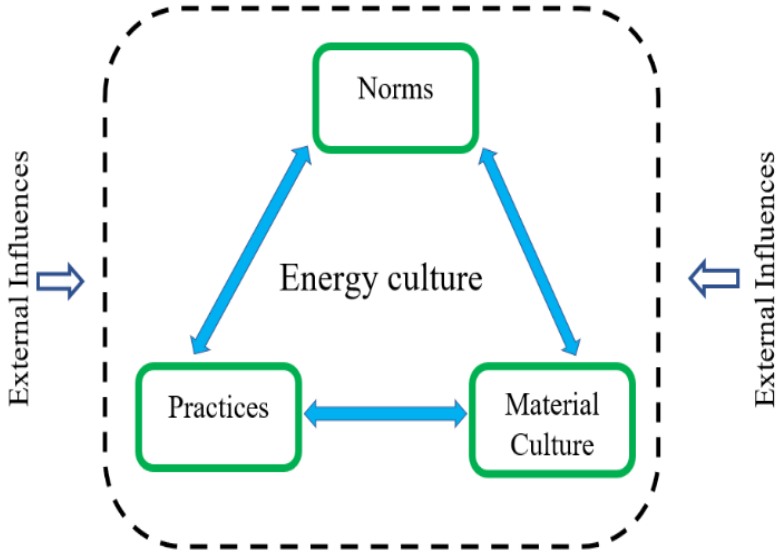
The energy cultures framework (Stephenson et al., 2010) plays a unique role among the existing theoretical frameworks relating to energy behaviour research. The well-

known socio-technical system model (Geels, 2004) is mainly focused on technologies from production to end use of those. However, there is comparatively less focus on the individual's energy behaviour. Conversely, the energy cultures framework brings an individual's or group's energy behaviour as the central element (Stephenson et al., 2010). Furthermore, practice theory as another established theoretical framework focuses on practices as the way to understand energy behaviour whereas the energy cultures framework is focused on energy behaviour of the actors. Further, the energy cultures framework aims to drive the change whereas the practice theory focuses on observing a system's stability or uniformity (Stephenson et al., 2010). Overall, the energy culture framework's suitability for examining the energy behaviour of actors in a context can be identified as unique from the other established theories. Hence, the energy cultures framework is suitable for the aim of this research over other theories.

According to Stephenson et al. (2010) the framework was comprehensively developed based on systems and behavioural theories. Therefore, the energy cultures approach can resolve considerable gaps in the existing energy behaviour literature since it provides a broader cultural identity, which is lacking in the traditional techno-economic scholarship. Jürisoo et al. (2019) also agreed on the inadequacy of existing energy-related models to explain real-life energy behaviours and the potential of an energy cultures framework to be utilised in the multidimensional and interrelated examination of complex and multifactor energy behaviour. Furthermore, the energy cultures framework has proven its ability to examine energy behaviours in different contexts, from domestic buildings to firms and industries (Raggio et al., 2020). The energy cultures framework developed by Stephenson et al. (2015) is given in Figure 2.1 below.

Figure 2. 1

Energy Cultures Framework



Note. Source: Adapted from Stephenson et al., (2015)

Stephenson et al. (2015) identified the three (03) core components of the energy culture as norms, practices, and material culture. Norms are defined as the shared beliefs regarding the behaviour of persons in a given context; practices represent the usual activities that consume energy; and, finally, material culture refers to the energy-consuming physical elements, such as machinery. Hence, energy culture can be broadly defined as the interactive energy behaviour between a given subject's norms, practices, and material culture (Stephenson et al., 2015). The energy behaviour of different subjects, such as individuals, households, businesses, or countries, can be studied by examining the interaction between the three (03) components (Axon, 2018; Nie, 2019).

According to Ford et al. (2017), energy cultures are distinctive in different settings, such as domestic and industrial; therefore, they impact the occupants differently. Norms impact energy technology choices (material cultures) and energy-consuming activities (practices). Material culture shapes energy technology utilisation, practices and norms. Furthermore, practices control the use of energy technologies (material cultures) and partly influences attitudes, values, and belief systems (norms) (Stephenson et al., 2010). Occupants' energy behaviour in buildings is a combined effect of these three (03) principals components that create a self-reinforcing system (Ishak, 2017). In addition, energy culture is shaped by external influences, which are typically beyond the control of internal actors (Ambrosio-Albalá, 2018). External influences, illustrated outside the dashed line of Figure 2.1, generally include policies, regulations, energy prices, subsidies, information and promotion campaigns, and broader social norms (Stephenson et al., 2015).

It is important to identify the components of the energy culture in detail to gain sound understanding of an energy culture. Table 2.1 depicts the interpretations given for the energy culture components in several studies. Under that, Stephenson et al. (2010), Ford et al. (2017) and Ambrosio-Albalá, et al. (2019) represent research on domestic energy cultures. Dew et al. (2017) and Bell et al. (2014) outline non-domestic environments.

Table 2. 1

Interpretations for the Components of Energy Culture

Study	Norms	Material Culture	Practices
Stephenson et al. (2010)	Attitudes, values, belief system, understandings	A technical system	Activities, processes
Bell et al. (2014)	Mental models of what is normal or appropriate	Physical technologies and infrastructure	Energy-using activities
Dew et al. (2017)	Specific professional norms	Organisation specific material culture	Long-institutionalised practices
Ford et al. (2017)	Expectations and aspirations	Physical artefacts including buildings, infrastructure, appliances, and other technologies	Everyday actions, acquisition of material objects

Ambrosio-Albala et al. (2019)	Attitudes, values, and beliefs	Energy objects, technologies, and physical aspects	Everyday actions (both routinised and less frequent)

It was observed that the interpretations of the three (03) components in different studies are not contradictory as these share the same overall meaning. However, the formation of norms, practices and material culture is shaped as per the context, such as domestic buildings or complex non-domestic buildings.

2.2.2 Energy culture in textile and apparel industrial organisations

Textile and apparel industry is a major strength in Sri Lankan economy. The export income generated by textile and apparel products was 44% of the total export income in 2020 and 2021. Comparatively, the next highest income received from tea which was only 11 % of the export income. Therefore, the textile and apparel industry has been the main player in Sri Lankan exports profile (Central Bank of Sri Lanka, 2022). Equally, the textile and apparel industry is the leading energy-consuming industry in Sri Lanka which is approximately 14 % of the total industrial energy consumption. (SLSEA., n.d.).

Textile manufacturing and apparel manufacturing are the two major processes of the textile and apparel industry. Energy consumption in the textile manufacturing process is significant compared to the apparel manufacturing processes. Yarn and fabric manufacturing consumes 40% to 45% of energy and wet processing consumes around 60% of energy in the textile manufacturing process under wet processing (Shah & Shah, 2013). Various studies have reported different percentages of energy consumption in apparel manufacturing process. Cay (2018) identified 86% for production related technologies (47% for production machinery, 24% for steam generation and 15% for compressors) and 14% for factory lighting. Conversely, Mendis and Perera (2006) stated that air conditioning, sewing machines, lighting, compressors, pumps, and other machines consume 42%, 24%, 17%, 9%, 3% and 4% respectively. The main difference between the energy consumption in two studies is the energy consumption by the air conditioning system which is absent in Cay's (2018) study.

There are various forces in that pushes the sustainability in the textile and apparel industry such as the organization's drive itself, requirements of buyers, external auditors, and regulatory requirements (Nath, 2019). In accordance with that, there are number of standards and certifications implemented in the textile and apparel manufacturing organisations to uplift the sustainability aspects. The standards and certifications such as Life Cycle Assessment (LCA), carbon footprint and Higg Index (Luo, 2021); ISO 14001 and ISO 9001 (Zimon, 2020); Worldwide Responsible Accredited Production (WRAP), Global Organic Textile Standard (GOT) (Warasthe, 2020) and green building standards like Leadership in Energy and Environmental Design (LEED) (Fontana, 2019) can be highlighted among the number of standards

and certifications available. Further, specific standards are promoted by buyers in such as Nike, GAP, and Adidas (Luo, 2021) throughout their supply chains.

This study's focus is on the energy culture maturity of textile and apparel industrial organisations. Therefore, initially, the study explored for existing energy culture research on textile and apparel organisations, since the energy cultures have an industry distinctive nature (Bell et al., 2014; Stephenson et al., 2010). However, with the energy culture research area being an emerging research domain, there were no energy culture studies specific to textile and apparel industrial organisations. Further, it was noted that most of the energy culture research was domestic buildings dominant, which is different from the energy culture of organisations. There were also only limited studies that could be found based on the energy culture relating to organisations. Those studies were Walton et al. (2020), Dew et al. (2017), Bell et al. (2014) Ishak (2017), Ishak et al. (2016), Ishak et al. (2015) and Rotzek et al. (2018). Table 2.2 presents the focus areas of each study.

Table 2. 2

Current Energy Culture Research in Organisations

Energy Culture Study	Focus Area
Bell et al. (2014)	Adoption of heat pump dryers in New Zealand's timber industry.
Ishak et al. (2015)	Energy consumption behaviour in Malaysian higher education institutions.
Ishak et al. (2016)	Energy consumption behaviour in Malaysian higher education institutions.
Dew et al. (2017)	Adoption of Light Emitting Diodes (LED) in the United States Navy ships.
Ishak (2017)	Energy consumption behaviour in student accommodations in Malaysian public universities.
Rotzek et al. (2018)	Industrial energy behaviour (a systematic literature review).
Walton et al. (2020)	Energy eco innovations in business organisations located in New Zealand.

The unavailability of studies based on the energy culture of textile and apparel organisations itself demonstrate the importance of studying this area due to the significant energy issues in the textile and apparel industry.

Having explained the energy cultures framework and the status of energy culture research on large scale textile and apparel industrial organisations, the next section presents development of the conceptual energy culture maturity framework and its components.

2.3 Development of energy culture maturity conceptual framework and its components

This section explains the development of the energy culture maturity framework under several steps. First, Section 2.3.1 presents the status of energy culture maturity research considering existing culture maturity frameworks and energy maturity frameworks.

Further, adoption of a suitable framework as the foundation framework to develop this study's energy culture maturity conceptual framework is explained. Then, Section 2.3.2 presents the procedure followed in conducting the systematic literature review to identify relevant studies to develop the energy culture maturity conceptual framework and its components. Subsequently, Section 2.3.3 presents the developments of energy culture maturity attributes, stages, and descriptors as the findings of Objective 1. Ultimately, Section 2.3.4 contains the developed energy culture maturity conceptual framework as the Objective 2 of the study.

2.3.1 Energy culture maturity frameworks

According to Schein and Schein (2016), organisational culture matures through stages such as founding and early growth, midlife, and maturity, which also applies to energy culture. Energy culture maturity can be identified as the maturation journey that shows the progressive steps towards energy culture excellence. Therefore, energy culture maturity shows different levels in the evolution of the norms, practices, and material culture. It is essential to note up to which extent the knowledge on energy culture maturity has been established in developing an energy culture maturity framework in this study. Considering the history of maturity models, the Capability Maturity Model (CMM) developed by Paulk et al. (1993) was the first recognised maturity model that has been widely used in the software industry (Antunes et al., 2014). Paulk et al. (1993) introduced CMM for software organisations to carry out process improvements. The CMM consists of five maturity levels as initial, repeatable, defined, managed, and optimising to guide software process maturity. Initial as the lowest maturity level represents ad-hoc software processes. Then, the basic software project management processes are available in the "repeatable" as the next level. "Defined" as the third maturity level represents software organisations with standardised and documented software processes. Then, software processes and the outputs are quantitatively measured and are controlled for quality in the "managed" level. Finally, Software process is continuously improved based on quantitatively gathered feedback from the process itself, technologies, and innovative ideas in the "optimising" level as the fifth and final level. The CMM was later propagated in various fields, such as engineering and construction, manufacturing, work management, healthcare, eco-design, mining and various other fields due to its success in the software industry (Jovanović & Filipović, 2016).

Furthermore, CMM has been adapted to develop culture maturity frameworks and energy maturity frameworks. According to Paulk et al. (1993), CMM guides to establish cultural excellence within an organisation. Therefore, the culture enhancement ability of CMM itself confirms the adaptability for various culture maturity studies. Accordingly, there are various applications of CMM in culture research that are already available, such as safety culture maturity framework (Jean & Zaleschuk, 2018; Lee, 2019; Musonda et al., 2018; Stiles et al., 2018) health safety environment culture maturity framework (Bordage et al., 2012), organisational culture maturity framework (Chaitanya & Madala, 2008) and food safety culture maturity framework (Jespersen et al., 2016). Thus, literature on culture maturity frameworks confirms its suitability for energy culture maturity studies like this study. Furthermore, existing literature also confirms the unavailability of energy culture maturity studies.

Apart from the culture maturity studies, there are energy maturity models developed based on the CMM. However, the energy maturity models are in their infancy

(Antunes, 2014) due to a lack of research and practical advice on implementation (Finnerty et al., 2017b). Table 2.3 shows a review of the available energy maturity frameworks.

Table 2. 3

Review of Energy Maturity Frameworks

Study	Details	
Ngai et al. (2013)	Focus	To measure and manage both energy and environmental performance.
	Energy culture	Not focused.
Antunes et al. (2014)	Focus	Supporting the compliance with ISO 50001 EnMS standard.
	Energy culture	Not focused.
Introna et al. (2014)	Focus	Maturity assessment of the organisation's overall energy management.
	Energy culture	Not focused.
Jovanović and Filipović (2016)	Focus	An ISO 50001 EnMS based implementation framework.
	Energy culture	Not focused.
Finnerty et al. (2017a)	Focus	Development of a new energy management program for multi-site organisations to achieve optimum efficiency within the network.
	Energy culture	Not focused.
Finnerty et al. (2017b)	Focus	A novel energy management methodology.
	Energy culture	Not focused.
Prashar (2018)	Focus	Pre-assessment of the maturity profile of organisations and a personalised improvement plan for small and medium enterprises.
	Energy culture	Not focused.
Jin et al. (2021)	Focus	ISO 50001 energy management system EnMS based maturity framework with a specific focus on China.
	Energy culture	Not focused.

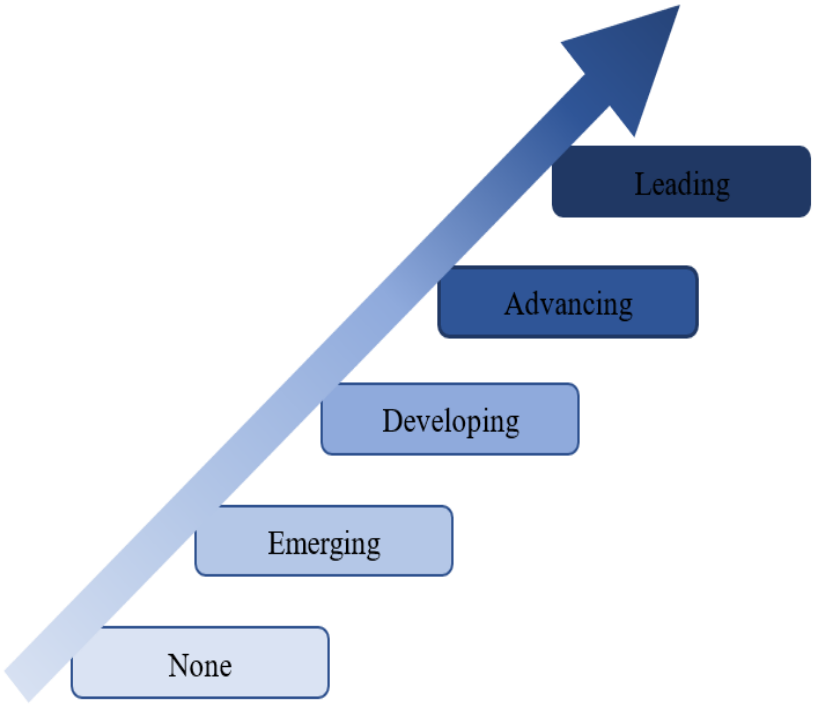
The studies on energy maturity models were limited to Ngai et al. (2013), Antunes et al. (2014), Introna et al. (2014), Jovanović and Filipović (2016), Finnerty et al. (2017a), Finnerty et al. (2017b), Prashar (2018), and Jin (2021), as given in Table 2.3. Further, the energy maturity models given in Table 2.3 were focused on areas such as energy management in organisations (Finnerty et al., 2017b; Introna et al., 2014; Ngai et al., 2013; Prashar, 2018), ISO 50001 energy management system (EnMS) (Antunes et al., 2014; Jin et al., 2021; Jovanović & Filipović, 2016) and energy performance monitoring of multi-site organisations (Finnerty et al., 2017a). Furthermore, literature on energy maturity models also confirmed that none of the existing models focused on energy culture.

Overall, the suitability of the maturity models to examine energy culture maturity can be confirmed through the existing applications by culture maturity and energy maturity frameworks, as discussed above. Therefore, there is potential to develop an energy culture maturity framework based on these developments. Thus, the energy maturity

model developed by Finnerty et al. (2017a) shown in Figure 2.2, was adopted as the foundation framework to develop the energy culture maturity framework in this study.

Figure 2. 2

Energy Maturity Model



Note. Source: Adapted from Finnerty et al., (2017a)

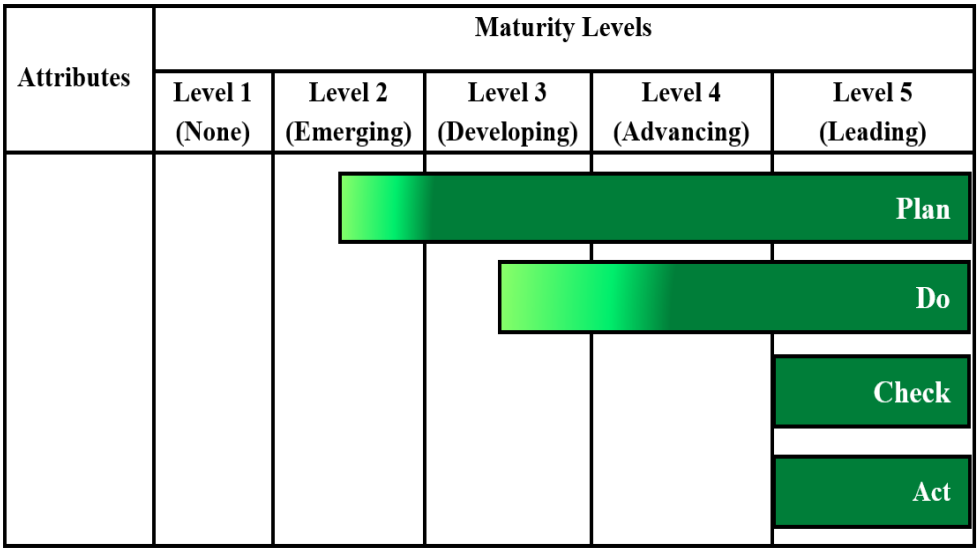
Finnerty et al.'s (2017a) framework was focused on energy maturity assessment of multi-site organisations and providing qualitative characterisation. This study's textile and apparel industrial organisations are also multi-site organisations and energy culture as a subjective research domain requires qualitative characterisation. Therefore, the appropriateness of Finnerty et al.'s (2017a) framework for this study could be determined.

There are five (05) maturity levels in Finnerty et al.'s (2017a) framework: none, emerging, developing, advancing, and leading. The five (05) different levels of maturity represent the status of energy efficiency in different levels. Level 1 (none) represents the lowest level of energy maturity. Then, the maturity gradually increases to reach the highest level as Level 5 (leading). Further, the levels between 1 and 5 represent the intermediate levels that shows gradual development of energy-efficiency enhancement (Finnerty et al., 2017a).

Furthermore, Finnerty et al.'s (2017a) framework followed the Plan, Do, Check and Act (PDCA) structure of continual improvement for establishing the energy maturity. PDCA is a repeating cycle that increases the energy maturity of organisations. Figure 2.3 represents the application of the PDCA structure in five (05) maturity levels. The PDCA structure was considered when developing energy culture maturity descriptors in Phase I's energy culture maturity framework development in this study, as explained in Chapter 4.

Figure 2. 3

PDCA Structure



According to Figure 2.3, Level 1 (none) represents no PDCA elements. Then, PDCA elements are available in next four (04) levels, which gradually increases from level 2 to level 5. Level 5 consists of all PDCA elements as the most matured position. The PDCA structure guides development of maturity descriptors under each maturity level.

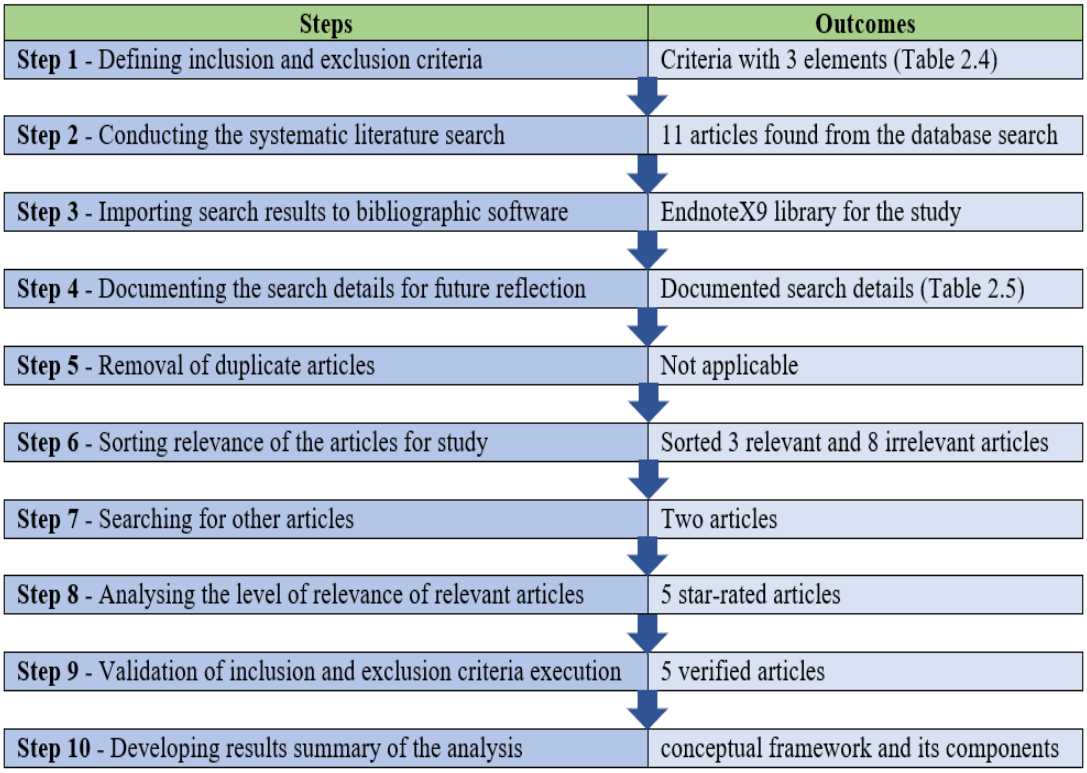
Having explained energy maturity frameworks and the choice of Finnerty et al.'s (2017a) framework as the foundation framework in this study, the next section explains the development of the energy culture maturity conceptual framework and its components based on the systematic literature review.

2.3.2 Implementation of systematic literature review procedure

According to Antunes et al. (2014) maturity frameworks can be developed using the available literature. Accordingly, this study executed a systematic literature review method that is suitable for identifying energy culture maturity descriptors, attributes, and stages to develop an energy culture maturity conceptual framework. The procedure proposed by O'Brien and Guckin (2016) was used to carry out the systematic literature review. This consists of 10 steps based on the established Cochrane collaboration checklist. The steps of the procedure and outcomes of each step are depicted in Figure 2.4.

Figure 2. 4

Adapted Procedure for Systematic Literature Review



Note. Source: Author developed based on O'Brien and Guckin (2016)

Inclusion and exclusion criteria of the systematic literature review are defined as outlined in the first step. One of the major challenges in defining the inclusion and exclusion criteria was lack of relevant literature in the energy culture research domain since it is an emerging research area. Therefore, finding exactly relevant literature on energy culture of textile and apparel organisations was not possible. For instance, based on the previous searches in Web of Science, it was confirmed that there was no energy culture literature relating to textile and apparel industrial organisations or energy culture maturity, which are the focus areas of this study. Hence, the inclusion and exclusion criteria were broadened to ensure more relevant articles were captured. Accordingly, "energy culture" literature was considered since there was no "energy culture maturity" related literature. Further, despite the major energy culture theory development not occurring until 2010 (Stephenson, et al., 2010), the year 1990 was selected as the starting point for the database search, since "energy culture" as a concept emerged in 1992 (Lutzenhiser, 1992). Furthermore, since there was no textile and apparel industry-based energy culture literature, energy culture studies relating to organisations were considered as a broader category. However, the criteria were limited to journal articles to ensure the quality of the documents captured from the database search. The inclusion and exclusion criteria and respective justifications, which guided the relevant articles selection process, are provided in Table 2.4.

Table 2. 4

Inclusion and Exclusion Criteria

	Inclusion Criteria	Exclusion Criteria	Justification
1	The articles were published between 1990 and 2020, including both years.	The articles outside this time frame were not considered.	According to the scholarship, the innovative study on energy culture was published in 1992. Therefore, 1990 was selected as the starting year to cover all relevant research.
2	Energy culture research on organisations were included.	Other energy culture research that did not focus organisations (e.g.: transport-based energy culture).	This ensured compliance with the research question.
3	The document type was limited only to the journal articles.	All other documents, such as conference papers, were not considered.	Kraus et al. (2020) stressed the significance of limiting to peer-reviewed journal articles without grey literature to ensure quality.

Then, as the **second step**, appropriate keywords were developed with the support of a liaison librarian before searching the Web of Science electronic database. Further, the suitability of the Web of Science database for energy research was recognised by Torreglosa et al. (2020) and Princeton University Library (2020). Then, the systematic literature review search was conducted as a "Title Search", which covers title abstract and keywords of articles. Table 2.5 depicts a summary of the systematic literature review search relating to the use of databases, which includes the keywords developed, timespan considered, and number of articles screened.

Table 2. 5

Systematic Literature Review Searching Summary

Keywords	Timespan	Number of Articles
TITLE-ABS-KEY: "energy culture*" AND TITLE-ABS-KEY: organisation* OR organization* OR industr* OR firm* OR "non-domestic" OR "nondomestic" Refined by: Document types: (Article)	1990–2020 inclusive	11

For the **third step**, the search results from the database were imported to the bibliographic software EndNote X9. Then as the **fourth step**, relevant search details were recorded to facilitate future replications of this research. However, the **fifth step's** removal of duplicate articles from multiple database results was not applicable for this study since the study was limited to the Web of Science database. Then, in the **sixth step**, 11 articles obtained from the database search underwent a rigorous sorting process to identify the relevant and irrelevant articles, utilising the inclusion and exclusion criteria. The sorting process consisted of three (03) sub steps: reading titles of articles, reviewing abstracts, and browsing through the full article. The articles that did not meet the inclusion criteria were recorded as irrelevant in each step. Only three (03) articles met the inclusion criteria to qualify as relevant articles based on the sorting

process. The three (03) articles were: Walton et al. (2020), Dew et al. (2017), and Bell et al. (2014). The **seventh step** was additional searching using the references of the selected studies to identify other articles relevant to this study. However, the additional search could not provide energy culture studies relating to large organisations that were suitable for a conceptual framework development. Further, the identified additional articles, such as Ishak (2017), Ishak et al. (2016), Ishak et al. (2015) and Rotzek et al. (2018), were not energy culture descriptive studies that can facilitate the development of energy culture maturity components. Therefore, those were omitted from the study. Thereafter, the decision was made to include suitable articles relating to domestic buildings due to a lack of suitable studies representing organisations. Accordingly, Gill et al. (2015) and Stephenson et al. (2010) were identified as suitable studies. Then, the **eighth step** included examining the five (05) articles to identify the level of relevancy to the research question and were ascribed with a star rating. The implementation of the inclusion and exclusion criteria in the above steps was validated with the support of another researcher as the **ninth step** of the protocol. The **tenth and final step** of the protocol detailed the findings to develop an energy culture maturity conceptual framework by fulfilling objectives 1 and 2 of the study.

Having explained the procedure of the systematic literature review, the next section provides the findings of the review.

2.3.3 Review attributes, stages, and descriptors of energy culture maturity

Components of the energy culture maturity conceptual framework were developed prior to designing the conceptual framework. Accordingly, the components of Finnerty et al.'s (2017a) energy management maturity framework were examined first. Finnerty et al.'s (2017a) framework consists of five (05) maturity levels, energy maturity descriptors and energy maturity attributes as the components. Accordingly, this study considered adopting the components of Finnerty et al.'s (2017a) framework. Therefore, energy culture studies screened through the systematic literature review were examined to develop the components of the energy culture maturity conceptual framework as Objective 1 of the study.

Accordingly, the five (05) articles identified from the systematic literature review were explored to develop energy culture maturity stages, attributes and descriptors under this section. These components later acted as the elements for designing the energy culture maturity conceptual framework. Table 2.6 summarises details of the selected five (05) articles including contexts, focus, and the types of organisations. When the same study presents two (02) different energy cultures, those different energy cultures were identified as different contexts under the same study. In addition, all studies were assigned with a context to facilitate easy reference in the energy culture maturity conceptual framework development process.

Table 2. 6

Summary of the Selected Studies

Articles	**Context**	**Details**	
		Focus	**Type of Organisation**
Walton et al. (2020)	Context A (CA)	Eco-innovations	Business organisations located in New Zealand
	Context B (CB)	Eco-innovations	Business organisations located in New Zealand

Dew et al. (2017)	Context C (CC)	Light Emitting Diodes (LED) lighting	Ships of the United States Navy
Gill et al. (2015)	Context D (CD)	Solar hot water systems	Domestic buildings in Australia
Bell et al. (2014)	Context E (CE)	Heat pump dryers	Timber factories in New Zealand
Stephenson et al. (2010)	Context F (CF)	Heating technologies	Domestic buildings in New Zealand
	Context G (CG)	Heating technologies	Domestic buildings in New Zealand

Accordingly, there were seven (07) contexts (CA to CG) representing the five (05) studies. Walton et al. (2020) and Stephenson et al. (2010) consisted of two (02) different contexts within each study, while all the other studies are limited to single contexts. Accordingly, CA and CB belong to Walton et al. (2020), representing two (02) different contexts of energy cultures relating to the energy-related eco-innovation in New Zealand business organisations. CC refers to a study adopting LED lighting technologies in the United States Navy (Dew et al., 2017). CD (Gill et al., 2015) is the study conducted on the diffusion of hot water systems in Australian domestic buildings. CE presents the case of adopting energy-efficient heat pump dryers in the timber industry in New Zealand (Bell et al., 2014). Lastly, Stephenson et al. (2010) provide two (02) other contexts, CF and CG, regarding the adoption of heating technologies in New Zealand homes before and after an energy culture change program.

The next section explains the identification of energy culture maturity descriptors from the five (05) studies.

2.3.3.1 Energy culture maturity descriptors

Antunes et al. (2014) proposed developing maturity descriptors for maturity frameworks using best practices found in the literature. When it comes to energy culture maturity, the maturity descriptors are the descriptions of energy culture. Therefore, first, the five (05) studies were examined to identify the available energy culture maturity descriptors. Accordingly, it could be identified that there were drivers and barriers in each study that best describes the maturity status of a given energy culture. For instance, drivers in CB presents best practices of excellent energy cultures, whereas barriers in CC shows energy culture that has heavily obstructed energy-related improvements. Hence, drivers and barriers could be identified as energy culture maturity descriptors of the given energy cultures. Accordingly, this study identified energy culture maturity descriptors from the seven (07) contexts in five (05) studies. Table 2.7 depicts the identified maturity descriptors as drivers and barriers.

The selected five (05) studies given in Table 2.6 have already defined drivers and barriers of energy culture for each study. Hence, this study directly identified drivers and barriers based on the original classifications in those studies. Accordingly, Walton et al. (2020) consisted of four (04) barriers under context A and 11 drivers under context B. Dew et al. (2017), which is identified as context C, contained seven (07) barriers. Five (05) drivers were given in Gill et al. (2015) as the context D. Bell et al. (2014) as context E, had eight (08) barriers. Finally, Stephenson et al. (2010)

comprised of three (03) barriers under context F and four (04) drivers under context G.

Furthermore, the drivers and barriers were assigned with codes for easy reference. For example, for "CAD1", CA represents the relevant context, "D" denotes the driver, and 1 represents the respective driver number. Instead of letter "D", letter "B" is used as the coding letter when coding barriers. Altogether, 43 energy culture descriptors were identified from the studies. Further, the descriptors were distributed between drivers and barriers as 21 and 22, respectively.

Table 2. 7

Descriptors and Attributes of Energy Culture Maturity

No	Descriptors (drivers and barriers)	Attributes
Norms (N)		
1	CAB1—No whole organisation readiness to support the energy related improvements	A1- Green values of owners and senior management
2	CAB2—Energy efficient technologies are not adopted considering energy efficiency mostly but due to other factors	A6 - Priority to energy efficiency in the procurement criteria
3	CAB3—Poor monitoring of energy related investment return only using simple payback period	A5 - Attention to investment analysis considering energy
4	CBD1—Established approaches in whole organisation for energy related improvements driven by knowledge and learning	A8 - Knowledge and training
5	CBD2—Well-established energy policy and planning is available.	A2 - Energy Policy
6	CBD3—Energy-efficient thinking is firmly embedded into norms of the whole organisation	A1- Green values of owners and senior management
7	CBD4—Energy performance based rewarding system for employees upon achievement of energy Key Performance Indicators (KPIs)	A7- Rewarding and recognition for energy-related improvements
8	CBD5—High employee commitment for energy related improvements	A3 - Employee interest for energy-related improvements
9	CBD6—Employees are developing capabilities on energy related improvements through learning.	A8 - Knowledge and training
10	CBD7—Organisation has clearly realised the potential cost savings using energy efficiency	A5 - Attention to investment analysis considering energy
11	CBD8—Owners have strong green values that continually shape the business direction and strategies. Therefore, energy related improvements are the usual choice aligning with green values	A1 - Green values of owners and senior management
12	CBD9—Organisation focuses on a customer base that seeks environmental sustainability	A4 - Focus on a green marketplace
13	CBD10—Organisation even seeks for external energy experts when required	A8 - Knowledge and training
14	CBD11—Energy performance monitoring using energy KPIs is available. Energy performance of the employees are evaluated using the KPI monitoring system	A9 - Energy performance monitoring and management
15	CCB4—Lack of support from top management because energy-efficiency is not their priority	A1 - Green values of owners and senior management

No	Descriptors (drivers and barriers)	Attributes
16	CCB5—Failure to see a clear link between energy related improvements and environmental sustainability	A8 - Knowledge and training
17	CCB6—Less attention from top management on issues of energy inefficient technologies	A1 - Green values of owners and senior management
18	CCB7—Identifying potential energy saving as an intangible benefit by the top management	A1 - Green values of owners and senior management
19	CCB8—Disagreements for energy-efficient technologies due to internal politics in the top management	A10 - Internal politics
20	CCB9—Energy efficiency is not considered in evaluation criteria for technology adoption	A6 - Priority to energy efficiency in the procurement criteria
21	CDD12—Availability of financial savings from adopting energy-efficient technologies	A5 - Attention to investment analysis considering energy
22	CDD13—Satisfaction on environmental benefits of energy related improvements	A3 - Employee interest for energy-related improvements
23	CDD14—Thinking to lead by example by doing energy related improvements	A1 - Green values of owners and senior management
24	CDD15—Willingness to reduce the energy consumption in buildings	A3 - Employee interest for energy-related improvements
25	CDD16—Employees actively seeking ways of increasing the energy efficiency	A3 - Employee interest for energy-related improvements
26	CEB10—Misbelief in advantages of energy inefficient technologies that is not realistic	A8 - Knowledge and training
27	CEB11—Energy inefficient technologies are the choice of both large and growing firms	A9 - Priority to energy efficiency in the procurement criteria
28	CEB12—Misbelief in energy efficient technologies as highly energy consuming	A8 - Knowledge and training
29	CEB13—Strategies for profits is reaching the niche markets and not the energy cost reduction	A5 - Attention to investment analysis considering energy
30	CEB14—Strong acceptance for energy-inefficient technologies by the firm management	A1 - Green values of owners and senior management
31	CEB15—Misbelief in energy-inefficient technologies as most suitable for core business than energy-efficient technologies	A8 - Knowledge and training
32	CEB16—Belief in firms that energy-inefficient technologies as the industry standard	A8 - Knowledge and training
33	CEB17—Considering energy efficient technologies as only suitable technologies for smaller firms	A8 - Knowledge and training
34	CFB18—Lack of energy literacy	A8 - Knowledge and training
35	CFB19—Lack of awareness on global and local essentiality for energy related improvements	A8 - Knowledge and training
36	CGD17—Improved energy literacy	A8 - Knowledge and training
37	CGD18—Improved awareness on global and local essentiality for energy related improvements	A8 - Knowledge and training
38	CGD19—Readiness to accept new energy-efficient technologies when available	A9 - Priority to energy efficiency in the procurement criteria

No	Descriptors (drivers and barriers)	Attributes
Practices (P)		
39	CAB20—Organisation is not ready to change current business practices for energy related improvements	A11 - Changing core business practices for energy-related improvements
40	CBD20—Organisation changes current business practices for energy-related improvements	A11 - Changing core business practices for energy-related improvements
41	CCB21—Operational decision-making delays when replacing energy inefficient technologies	A11 - Changing core business practices for energy-related improvements
Material Culture (MC)		
42	CFB22—Existence of the well-established energy-inefficient technologies	A12 - Availability of energy-efficient technologies
43	CGD21—Availability of the energy-efficient technologies up to some extent	A12 - Availability of energy-efficient technologies

Further, considering the origin of the descriptors, the 43 energy culture maturity descriptors could be categorised under the three (03) components of the energy culture: norms, practices, and material culture. Out of the 16 descriptors from Walton et al. (2020) three (03) barriers and 11 drivers were presented under norms. Further, one (01) barrier and one (01) driver were identified under practices. Considering Dew et al. (2017), six (06) barriers were presented under norms and one (01) barrier was presented under practices out of the total of seven (07) descriptors. Furthermore, Gill et al. (2015) allocated all five (05) descriptors under the norms as drivers. Bell et al. (2014) had nine (09) barriers under norms, one (01) barrier under practices and one (01) barrier under material culture out of the 11 descriptors. Finally, Stephenson et al. (2010) presented two (02) barriers and three (03) drivers under norms, and one (01) barrier and one (01) driver under material culture out of the total of seven (07) descriptors. Accordingly, altogether, 38, 3 and 2 descriptors were originated from norms, practices, and material culture, respectively. Each study has shown that the norms are the principal originator of descriptors, rather than practices or material culture.

Having explained the energy culture maturity descriptors identification in this section, the next section presents the energy culture maturity attributes identified from the five (05) studies.

2.3.3.2 Attributes of energy culture maturity

Upon identifying energy culture maturity descriptors, energy culture maturity attributes were derived based on them. Attributes are the key themes that can represent the energy culture maturity descriptors. Therefore, attributes were derived by grouping the common energy culture maturity descriptors together. Accordingly, Table 2.7 presents 12 attributes developed based on the descriptors of the five (05) studies. The 12 attributes could be classified under norms, practices, and material culture. Accordingly, 10 attributes were available under norms as green values of owners and senior management (A1), energy policy (A2), employee interest for energy-related improvements (A3), focus on a green marketplace (A4), attention to investment analysis considering energy (A5), priority to energy efficiency in the procurement criteria (A6), rewarding and recognition for energy-related improvements (A7),

knowledge and training (A8), energy performance monitoring and management (A9) and internal politics (A10). Further, changing core business practices for energy-related improvements (A11) was categorised under the practices element and availability of energy-efficient technologies (A12) was categorised under material culture. The attributes identified were used for designing of the energy culture maturity conceptual framework.

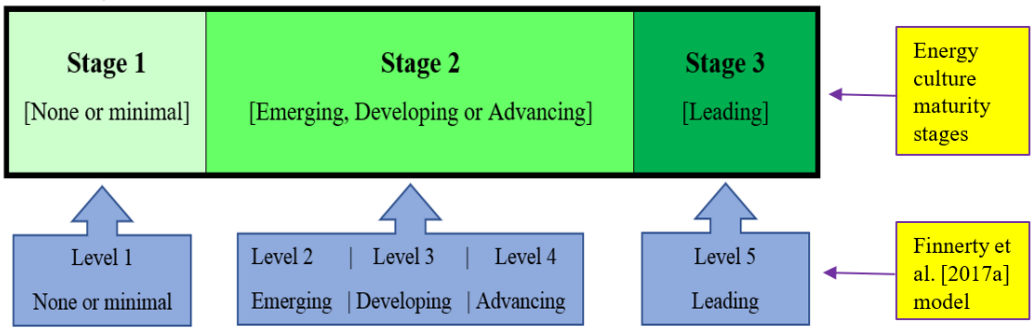
Having defined the energy culture maturity attributes in this section, the next section develops the energy culture maturity stages.

2.3.3.3 Energy culture maturity stages

As previously mentioned, this study adapted Finnerty et al.'s (2017a) energy management maturity framework with five (05) maturity levels. However, it was challenging to define the energy culture maturity for five (05) maturity levels due to limited literature. Therefore, this study had to modify the Finnerty et al. (2017a) framework with five (05) maturity levels to operationalise them in the study while keeping the original structure. Accordingly, a framework with three (03) energy culture maturity stages was developed based on the original maturity framework. Development of the three (03) stages is illustrated in Figure 2.4. The three-staged maturity design could cover the five (05) maturity levels of Finnerty et al.'s (2017) framework, where Stage 1 represents Level 1, Stage 2 represents Level 2, 3 and 4, and Stage 3 represents Level 5 as depicted in Figure 2.5.

Figure 2. 5

Development of Maturity Stages



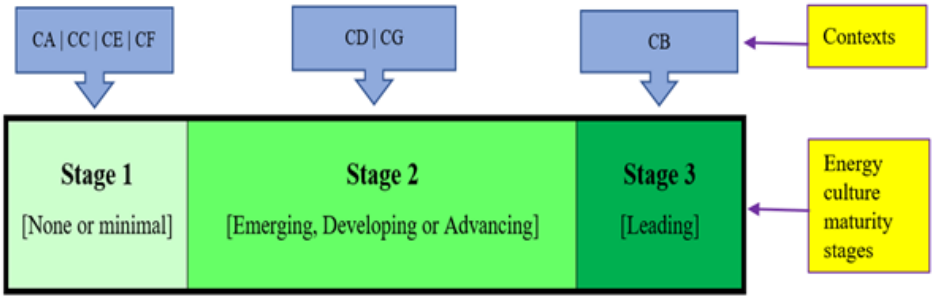
Note. Source: Author developed based on Finnerty et al. (2017a)

Then, the energy cultures of seven (07) contexts given in Table 2.6 were grouped into the three (03) energy culture maturity stages, considering those energy cultures' overall support for energy related improvements. The overall support ranged from the energy cultures that strongly prevent energy-related improvements to energy cultures that exceedingly support energy related improvements. Accordingly, CA, CC, CE, and CF contexts could be identified as the energy cultures that strongly prevent energy related improvements due to significant resistance of the energy culture. Therefore, those contexts were categorised as Stage 1. Then, CB could be identified as an energy culture that remarkably supports energy-related improvements due to intense drivers in the energy culture. Hence, CB energy culture can be identified an example of energy culture excellence. Therefore, CB was categorised as Stage 3, which was the topmost stage of the energy culture maturity. As the remaining contexts, CD and CG represented some drive for energy-related improvements. However, there is a room for

further improvement of these energy cultures to reach the energy culture excellence of Stage 3. Therefore, CD and CG were placed under the Stage 2 energy culture maturity. Figure 2.6 depicts the grouping of seven (07) contexts of the selected five (05) studies under the proposed three (03) energy culture maturity stages.

Figure 2. 6

Grouping Contexts under Energy Culture Maturity Stages



Note. Source: Author developed

Having developed the energy culture maturity attributes, stages and descriptors in this section, the next section presents the designed energy culture maturity conceptual framework.

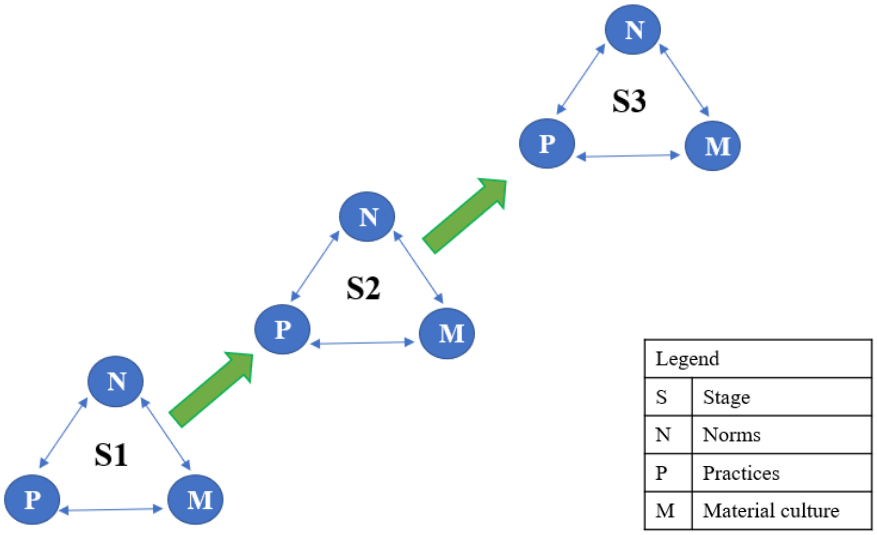
2.3.4 Designing an energy culture maturity conceptual framework

Designing an energy culture maturity conceptual framework is Objective 2 of the study. The design integrated energy culture maturity attributes, descriptors and stages developed in the previous section. Figure 2.7 and Table 2.8 jointly present the developed energy culture maturity conceptual framework by integrating the previous findings. Figure 2.6 depicts the integration of the three-staged energy culture maturity. Each stage represents the interaction between norms (N), practices (P), and material culture (M) as the three (03) components of energy culture. The interaction between components of energy culture is illustrated using two-way arrows that connect each of the components. The framework's maturity moves from Stage 1, the lowest energy culture maturity to Stage 3, the topmost energy culture maturity. The green arrows illustrate the possible trajectory of energy culture maturity towards energy culture excellence. The three (03) stages of energy culture maturity are defined below, considering the overall support of energy culture for energy related improvements.

- Stage 1 (S1): Energy cultures that completely obstruct energy-related improvements.
- Stage 2 (S2): The intermediate stage of energy culture that support energy related improvements up to some extent. There is room for improvement to reach energy culture excellence.
- Stage 3 (S3): Most matured energy cultures that support the best level for energy-related improvements. The culture has reached energy culture excellence.

Figure 2. 7

Energy Culture Maturity Conceptual Framework



Note. Source: Author developed based on Stephenson et al., (2015) and Finnerty et al., (2017a)

Furthermore, Table 2.8 outlines a detailed integration of the energy culture maturity conceptual framework in the form of a matrix table consisting of energy culture maturity attributes presented in rows and energy culture maturity stages outlined in columns. Energy culture maturity descriptors are placed against the respective energy culture maturity attributes and energy culture maturity stages. Thus, the maturity descriptors are shared by the energy culture maturity attributes and the three (03) maturity stages to form the energy culture maturity conceptual framework. Furthermore, considering the vertical arrangement of the conceptual framework, three (03) energy culture maturity stages vertically provide the descriptors belonging to each maturity stage as a whole.

Furthermore, the energy culture maturity conceptual framework elaborates norms, practices, and material culture as the main components of the energy culture. The norms section of the framework consists of 10 energy culture maturity attributes as green values of owners and senior management (A1), energy policy (A2), employee interest for energy-related improvements (A3), focus on a green marketplace (A4), attention to investment analysis considering energy (A5), priority to energy efficiency in the procurement criteria (A6), rewarding and recognition for energy-related improvements (A7), knowledge and training (A8), energy performance monitoring and management (A9) and internal politics (A10). Moreover, practices and material culture sections of the conceptual framework only consist of one (01) attribute each. Changing core business practices for energy-related improvements (A11) and availability of energy-efficient technologies (A12) were those two (02) attributes under practices and material culture respectively. Furthermore, the energy culture maturity descriptors of a given attribute shows the attribute's maturity under three (03) maturity stages.

Table 2. 8

Energy Culture Maturity Conceptual Framework

Attributes	**Energy Culture Maturity Stages and Descriptors**		
	Stage 1 (None)	**Stage 2** (Emerging, Developing or Advancing)	**Stage 3** (Leading)
Norms			
A1- Green values of owners and senior management	Owners and senior management do not have green values that promote the energy related improvements. Therefore, there is no whole organisation readiness to support energy-related improvements. Energy related improvements are not a priority for owners and senior management. Strong acceptance for energy-inefficient technologies by the firm management.	Owners and senior management have moderate green values. However, there is room for improvement. There is whole organisation's readiness to support energy related improvements up to some extent.	Owners and senior management have strong green values that continually shape the business direction. As a result, energy-related improvements are the usual choice of the organisation. Energy conscious thinking is embedded into organisation's norms. There is a whole organisation's readiness to support energy-related improvements always. Owners and senior management intend to lead by example by doing energy related improvements.
A2- Energy policy	No energy policies and strategies are available.	Energy policies and strategies are available. However, the implementation mechanisms require improvement.	Well-established energy policies and strategies are available. Policies are always supported with an implementation mechanism.
A3- Employee interest for energy-related improvements	No employee interest for energy-related improvements. Employees do not actively seek for energy-related improvements.	Employee commitment for energy related improvements is visible up to some extent. Further, employees actively seek energy related improvements up to some extent.	High employee commitment for energy-related improvements is visible. Further employees are actively seeking energy related improvements.

Attributes	Energy Culture Maturity Stages and Descriptors		
	Stage 1 (None)	**Stage 2** (Emerging, Developing or Advancing)	**Stage 3** (Leading)
A4- Focus on a green marketplace	The organisation does not seek a green marketplace.	The organisation seeks green marketplaces occasionally. There is no sole focus on a green marketplace.	The organisation always approaches green marketplaces with a customer base that seeks environmental sustainability.
A5- Attention to investment analysis considering energy	The investment return is poorly monitored and limited to simple payback period. Possible operational cost savings by adopting energy efficient measures are not considered.	Further to the simple payback period analysis, the organisation implements other effective investment analysis methods to some extent. The possibility for operational cost savings by adopting energy efficient measures is considered up to some extent. However, the area needs further improvements.	Further to the simple payback period analysis, the organisation consistently implements other effective investment analysis methods. The organisation has clearly realised the potential of optimum cost savings by adopting energy efficient measures.
A6- Energy performance monitoring and management	There is no energy performance monitoring system and related energy KPIs.	Energy performance monitoring is carried out up to some extent using an energy KPI system. Energy performance of the employees are evaluated using the KPI monitoring system only up to some extent.	Energy performance monitoring is carried out using an energy KPI system. Energy performance of the employees are evaluated using the KPI monitoring system.
A7- Rewarding and recognition for energy-related improvements	There is no rewarding and recognition mechanism available for energy related improvements.	Energy performance based rewarding system for employees is available up to some extent. Sometimes the employees are rewarded upon achievement of energy Key Performance Indicators (KPIs).	Energy performance based rewarding system for employees is available. The employees are rewarded upon achievement of energy Key Performance Indicators (KPIs).

Attributes	Energy Culture Maturity Stages and Descriptors		
	Stage 1 (None)	**Stage 2** (Emerging, Developing or Advancing)	**Stage 3** (Leading)
A8- Knowledge and training	Employees do not have knowledge on the potential energy saving of energy-efficient measures and the drawbacks of available energy-inefficient technologies. Further, relevant employees have lack of knowledge on the suitability of new energy-efficient technologies for the core business and scale of the business. No energy literacy and awareness on global and local essentiality for energy related improvements.	Employees have knowledge on benefits of the energy-efficient measures. However, the knowledge needs to be further improved. Relevant employees have some knowledge of the suitability of new energy-efficient technologies for the core business and the scale of the business. However, there is a need for further advancement of knowledge. Organisation occasionally seeks external energy experts.	Established approaches are available in whole organisation for energy related improvements driven by knowledge and learning. Therefore, employees undergo required training and actively develop energy related capabilities Further, organisation seeks external energy experts when required. Relevant employees are adequately knowledgeable about the suitability of new energy-efficient technologies for the core business and scale of the business. Improved energy literacy and awareness on global and local essentiality for energy related improvements.
A9- Priority to energy efficiency in the procurement criteria	Energy efficiency is not considered in the procurement criteria for technologies. Strong acceptance for inefficient technologies despite the drawbacks and necessity for energy-efficient technologies not being believed. Energy-efficient technologies are procured due to reasons other than energy efficiency.	Energy efficiency is prioritised in the procurement criteria up to some extent. The organisation may procure both energy-efficient technologies and energy inefficient technologies. The acceptance of energy-efficient technologies may not be believed to be a necessity sometimes.	Energy efficiency is strongly considered in the procurement criteria. Procuring of energy-efficient technologies is always believed as a necessity. Energy-inefficient technologies are not procured at all. Always ready to accept new energy efficient technologies when available.

Attributes	Energy Culture Maturity Stages and Descriptors		
	Stage 1 (None)	**Stage 2** (Emerging, Developing or Advancing)	**Stage 3** (Leading)
A10- Internal politics	Energy related improvements are rejected due to the internal politics of the employees.	Energy related improvements are adopted to some extent despite the internal politics of the employees	Energy related improvements are always adopted despite the internal politics of the employees.
Practices			
A11- Changing core business practices for energy-related improvements	Organisation has no or minimum willingness for changing business practices. Hence, energy-related improvements that require alterations in current business practices are not adopted. There are always operational decision-making delays when replacing energy inefficient technologies.	Organisation has willingness up to some extent for adopting changes to business for energy related improvements. There may be some resistance and operational decision-making delays to changing business practices for adopting energy-efficient technologies.	Organisation has high willingness to changing business practices for energy-related improvements. There is no resistance or operational decision-making delays for doing such changes.
Material Culture			
A12- Availability of energy-efficient technologies	Energy-inefficient technologies are well established	Energy-efficient technologies are available up to some extent.	Most of the available energy-efficient technologies have been adopted in the building.

2.4 Chapter summary

Initially, the literature review introduced the energy cultures framework and status of the energy culture research on textile and apparel industrial organisations. After initial searches, it was found that there were no existing studies focused on the energy culture of textile and apparel industrial organisations. Then, this chapter focused on the achievement of Objective 1 and Objective 2 of the study using a systematic literature review. The findings of the systematic literature review constructed the energy culture maturity attributes, descriptors, and stages first as Objective 1 of the study. Accordingly, there were 12 energy culture maturity attributes, 43 energy culture maturity descriptors, and three (03) energy culture maturity stages. Then, the energy culture maturity conceptual framework design was explained following Objective 2 by integrating the components of the energy culture maturity framework as the ultimate outcome of the literature review. As this study follows the abductive research approach, the energy culture maturity conceptual framework was used as the initial step of developing the energy culture maturity framework for textile and apparel industrial organisations, which is further explained in the following chapters. The next chapter explains the research methodology design of the study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology design chosen to achieve the aim and objectives of this study. The research methodology design concerns knowing the available options and making appropriate choices among them. First, Section 3.2 explains the selection of a suitable framework. Then, under the selected framework, suitable choices of philosophical stance, research approach, research strategy, research choice, time horizon, and techniques and procedures are explained. Techniques and procedures of the study are discussed in two (02) phases. The research design for development of the context-specific energy culture maturity framework is explained as Phase I. Subsequently, the research design that facilitates the evaluation of the applicability of the proposed context-specific framework is presented as Phase II. Finally, the validity and reliability of the research is discussed.

3.2 Framework to outline research methodology design

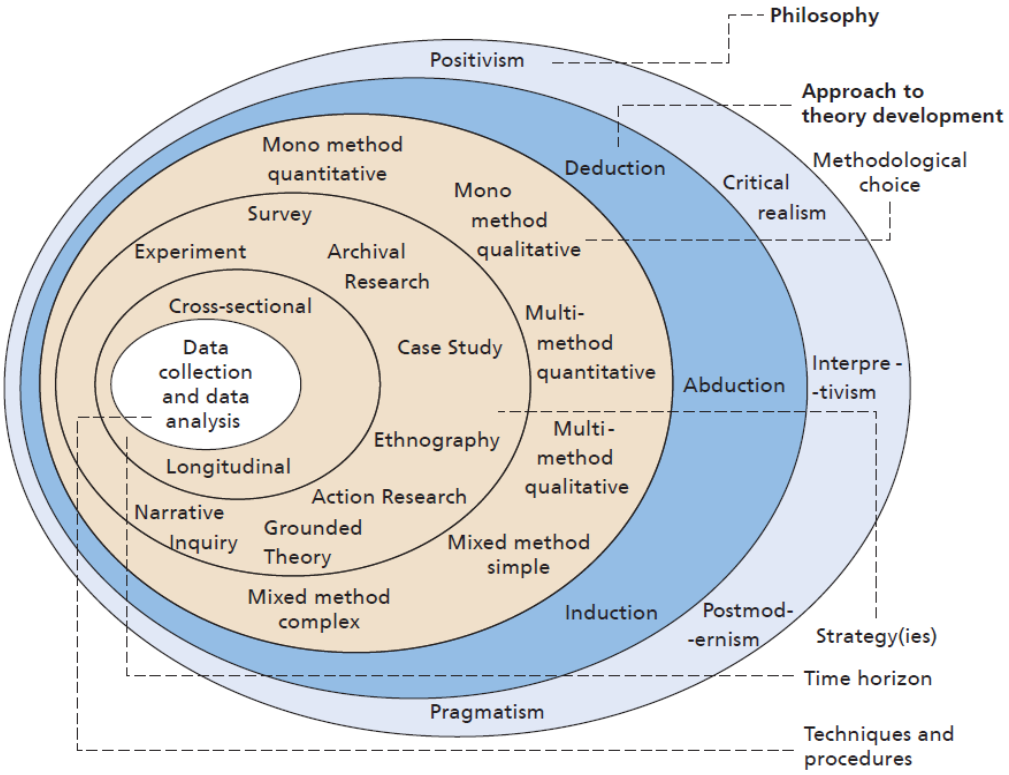
There are several different frameworks that support designing the research methodology of a study. For instance, Kagioglou et al. (2000), introduced a framework (nested model) comprising research philosophy, research approach, and research techniques. Further, Creswell and Creswell (2018) developed a framework interconnecting philosophical worldviews, strategies of inquiry, and research methods. Furthermore, Saunders et al. (2019) proposed another popular framework containing of six (06) components as research philosophy, research approach, research methodological choice, research strategy, research time horizon and research techniques and procedures.

When comparing the components of the above-mentioned frameworks, similar meanings could be found. For instance, philosophies (Saunders et al. 2019), philosophical worldviews (Creswell & Creswell, 2018) and research philosophy (Kagioglou et al., 2000) represent similar meaning and the compositions represents commonly available philosophical stances. Similarly, strategies (Saunders et al., 2019), strategies of inquiry (Creswell & Creswell, 2018) and research approach (Kagioglou et al., 2000) also provides comparable concepts. Furthermore, research techniques and procedures (Saunders et al., 2019), research methods (Creswell & Creswell, 2018) and research techniques (Kagioglou et al., 2000) also caters for similar concepts. Overall, the available research frameworks outline research methodology designing options in different arrangements that provides more similarities in the overall design. This study utilises the research onion developed by Saunders et al. (2019) to outline the research methodology design because the research onion provides a detailed breakdown of different options available for designing research

methodology compared to other frameworks, like the nested model by Kagioglou et al. (2000) that is limited to three (03) steps. Figure 3.1 depicts the research onion adopted in the study. Accordingly, the selection of appropriate research philosophy, approach, strategy, choice, time horizon, and techniques and procedures are discussed below.

Figure 3. 1

Research Onion



Note. Source: Saunders et al., (2019)

3.3 Research philosophy

The research philosophy is the outermost layer of the research onion as given in Figure 3.1 and the foundation for designing the research methodology. Saunders et al. (2019) highlighted the direct relationship between the research philosophy and knowledge development of any research. Further, the research philosophy contains assumptions regarding the researcher's viewpoint of the world's reality. Those assumptions reinforce selection of research strategy and methods of research (Saunders et al., 2009). Moreover, Creswell and Creswell (2018) also highlighted the importance of identifying the research philosophy despite its largely hidden nature. Hence, understanding the appropriate philosophical stance is an essential step of a study.

Ontology, epistemology, and axiology are the basic assumptions that shape the philosophies. Ontology refers to assumptions about existence or the nature of the world and reality (Saunders et al., 2019). According to Gray (2014) ontology embodies the

understanding of the question "what is reality?". The ontological assumptions made by the researchers throughout their study shape the way the researcher sees and studies the research objectives (Saunders et al., 2019). Epistemology refers to the assumptions about the best way to study the world (Bhattacherjee, 2012). Hence, epistemology embodies understanding the question "how do we know reality?". Therefore, epistemology helps to relate to and understand the research of others and the choices being made. Finally, axiology refers to what role values and ethics play in research (Saunders et al., 2019). In axiological assumptions, the researcher needs to decide the way to maintain both the researcher's values and participants' values in the research study (Saunders et al., 2019).

The philosophies themselves are different from each other. The research onion presents five (05) different research philosophies: positivism, critical realism, interpretivism, postmodernism, and pragmatism, as given in the outermost layer in Figure 3.1. Positivism takes the natural scientist's position who works with observable reality. Therefore, it suggests that "reality" exists external to the researcher and can be explored through the rigorous process of scientific inquiry that leads to producing law-like generalisations (Saunders et al., 2019). The philosophy of critical realism takes the position that reality is composed of underlying structures, tendencies, and powers beyond observable events. Critical realists believe that the underlying structures, tendencies, and powers shape observable events (Patomäki & Wight 2002). On the other hand, interpretivism acknowledges the need for rich insights into the social world and humanity because attempting to generate law-like generalisations is not meaningful in the social sciences compared to natural sciences. Interpretivists believe human beings and the social world are different from physical phenomena since humans create meanings (Saunders et al., 2019). Further, Bhattacherjee, (2012) stated that the interpretivists study the social order based on the subjective interpretations of the participants gathered through techniques such as interviews. Moreover, postmodernism questions the dominant ways of thinking and promotes alternative worldviews that have been side-lined by the dominant worldviews (Saunders et al., 2019). According to Morgan (2014), pragmatism identifies the research question as the most vital determinant of the research philosophy. Pragmatism's ability to effectively integrate mixed-methods research provides more practical approaches to problem-solving that is not obtainable by fitting to the conventional positivism or interpretivism philosophies.

Philosophies have differences and similarities in their basic assumptions concerning ontology, epistemology, and axiology. Table 3.1 provides a comparison between them and the three (03) basic assumptions.

Table 3. 1

Comparison of Research Philosophies

Philosophies	Ontology	Epistemology	Axiology
Positivism	There is only a single reality or truth	Knowledge can only be measured using observable and measurable data or facts	Value-free
Critical realism	Reality is external and independent, which is not directly accessible	Knowledge is situated historically, and transient facts are socially constructed, contribution as a history-based causal explanation	Value-laden
Interpretivism	Availability of multiple realities; reality is socially constructed	Subjective meanings and social phenomena, reality needs to be interpreted to discover the underlying meanings, novel understandings as contributions	Value-bound
Postmodernism	Nominal complex, rich, Socially constructed through power relations	Truth and knowledge are decided by leading ideologies, Exposure of power relations and challenge of leading ideologies as the contribution	Value-constituted
Pragmatism	Reality involves practical consequences based on the research question	Knowledge should be examined using the tools that are best to solve the research question	Value-driven

Note. Source: Adapted from Saunders et al., (2019)

Having considered different research philosophies given in Table 3.1, this study selected interpretivism as the suitable research philosophy due to several reasons. Saunders and Tosey (2013) proposed interpretivism as a suitable research philosophy when the research is people-based rather than objective-based and when researchers are willing to gather rich understandings into subjective meanings rather than delivering law-like generalisations. The aim of this study is focused on developing a mechanism to assess the level of energy culture maturity of textile and apparel industrial organisations in Sri Lanka. The energy culture is a people-based area that explores norms, practices, and material culture relating to a given context. In addition, this study required an in-depth understanding of energy culture maturity features for different maturity levels of textile and apparel industrial organisations that invites rich and subjective understanding of the area. Therefore, the study perfectly fits the interpretivism philosophy.

Furthermore, Saunders et al. (2009) highlighted the suitability of an interpretivist perspective in an area like organisational behaviour. Specially, this study examines the energy culture of organisations that reflects energy-related organisational behaviours. Overall, considering the people-based nature, focus on a subjective and rich understanding, and relation with organisational behaviour, interpretivism is justified

as a suitable research philosophy. In contrast, as explained in Table 3.1 positivism, critical realism, postmodernism, and pragmatism are philosophies not strongly aligned with the nature of this research. Following the choice of an interpretivist research philosophy, the following sections explain the adopted research approach that link with this framework.

3.4 Research approach

The research approach is the next outer layer of the research onion, which divides in to three (03) as deduction, abduction, and induction. Research approaches deal with theory development (Saunders et al., 2019). Deductive and inductive approaches are contrasting mechanisms for the theory development. According to Saunders et al. (2019) deductive reasoning begins with a theory and/or hypothesis development and then aligning the research strategy to test the hypothesis. Conversely, the inductive approach involves developing the theory by data collection and analysis. As proposed by Saunders et al. (2019), deduction represents positivism and induction represents interpretivism. Mills et al. (2010) stressed the need for an abductive reasoning apart from the two (02) contrasting deductive and inductive approaches for the generation of new concepts with imaginative theorising, since deduction and induction are inadequate for such new theoretical developments. Further, Lewis-Beck et al. (2004) identified abduction as an approach compatible with the interpretivism research philosophy as well.

Even though there are other types of culture maturity frameworks, such as safety culture maturity frameworks (Jean & Zaleschuk, 2018; Lee, 2019; Musonda et al., 2018; Stiles et al., 2018), there are not any maturity frameworks developed for the energy culture maturity in current literature. Therefore, the abductive approach can be utilised to develop this new theory relating to an energy culture maturity framework. According to Mills et al. (2010) abduction starts with a conceptual framework as it requires an established hypothesis at the beginning. Accordingly, this study developed a conceptual framework based on the literature review as Objective 2. Then, Objective 3 developed a textile and apparel industry specific energy culture maturity framework as explained in Chapter 4. Hence, objectives 2 and 3 involved the theory development aspect of this study. Further, Saunders et al. (2019) highlighted the importance of such data collection to develop or modify the theory and further need for subsequent testing of the developed theory using additional data collection. Similarly, the proposed energy culture maturity framework was tested afterwards using case studies to evaluate the applicability as given in Chapter 5. Accordingly, the research was designed in a way that fulfils the abductive research approach. As the next step, the methodical choice of the research is explained.

3.5 Methodological choice

Methodological choice discusses selection of quantitative and/or qualitative techniques and procedures in research. According to Saunders et al. (2019), one way

of differentiating quantitative research from qualitative research is to distinguish between numeric data (numbers) and non-numeric data (words, images, audio recordings, video clips, and other similar material). As per Saunders et al. (2019), methodical choices can be divided into six (06) categories: mono-method qualitative, mono-method quantitative, multi-method qualitative, multi-method quantitative, mixed-method simple, and mixed-method complex. Basically, the six (06) categories are derived from the three (03) research designs as quantitative, qualitative, and mixed method research designs. Mono-method refers to use of a single data collection technique and respective data analysis procedure that can be either qualitative or quantitative. Whereas the multi-method qualitative category refers to use of multiple qualitative data collection and analysis techniques and vice versa in the multi-method quantitative category. Moreover, mixed method research utilises a combination of qualitative and quantitative data collection techniques and respective data analysis procedures (Saunders, et al., 2019).

Saunders and Tosey (2013) stated that research following an interpretivism research philosophy are likely to utilise in-depth qualitative data collection and respective data analysis techniques. As this study required an in-depth inquiry into energy culture maturity a qualitative approach was needed as per the aim and objectives planned. Hence, this study was also limited to qualitative data collection and respective analysis techniques. Furthermore, a qualitative research design that uses a single data collection technique is known as a mono-method qualitative study and a qualitative research design that uses more than one (01) qualitative data collection technique is known as a multi-method qualitative study (Saunders et al., 2019). Both Phase I and II of the study incorporated multiple qualitative data collection and analysis techniques. Accordingly, Phase I of the study collected data using semi-structured interviews and focus groups and Phase II utilised focus groups, document reviews and observations of the selected case studies. Phase I utilised qualitative content analysis techniques and Phase II incorporated pattern matching and cross-case synthesis. Because of using multiple data collection techniques and respective data analysis procedures this study's methodical choice can be identified as the multi-method qualitative. The research strategy is explained in the next section as the next layer of the research onion.

3.6 Research strategy

Research strategies are the fourth layer of the research onion. There are several research strategies including archival research, ethnography, grounded theory, action research, case study, survey, and experiment. Each research strategy has its own uniqueness. Therefore, the appropriate research strategies should be selected considering the nature of the study. When selecting the appropriate research strategies, several factors matter, such as nature of the research question, aim and objectives, depth of the existing knowledge, resources availability and researchers' philosophical preferences (Saunders et al., 2019).

According to Saunders et al. (2019) the archival research approach is used for research questions focused on history and related changes over time. The common sources of data are the historical records in the focussed area. Ethnography is identified as a long-term research strategy rooted in the inductive approach that explains the social world in depth (Saunders et al., 2019). Further, grounded theory is focused on theory building to predict and explain the behaviour through a combination of induction and deduction. Hence, without having a theory at the beginning, it is developed at the end of the study based on data generated by a series of observations (Khan, 2014; Saunders et al., 2019). Action research focusses on organisational issues and carries out both data collection and the real-time facilitation of change in the research setting (Saunders et al., 2019; Coghlan 2019). Yin (2018) identified a case study strategy's suitability for empirical investigations of a particular contemporary phenomenon within its real-life context, by incorporating multiple sources of evidence. Further, it generates answers to "how" and "why" questions and provides rich understandings of the research context. Moreover, a survey strategy is usually associated with the deductive approach. However, recent developments have proposed the existence of qualitative survey in the social science research domain as a category that can be clearly separated from other research strategies (Jansen, 2010). Finally, experiment as the remaining strategy mostly relates to the natural sciences research and not social science research (Saunders et al., 2019).

It was important to select appropriate research strategies considering their capabilities. Therefore, each strategy was considered in terms of the suitability for the study. The ethnography strategy was not suitable to implement in the textile and apparel industry due to the difficulties in conducting the research within that organisational setting for an extended time-period due to difficulties in obtaining permission and having a limited time-period to conduct research within. Specially, it was impossible due to the regulation on access restrictions to textile and apparel industrial organisations in Sri Lanka during the Covid-19 pandemic. Grounded theory does not start with an existing theory. However, this study is underpinned on existing theories; the energy cultures framework (Stephenson., 2010) and energy management maturity framework (Finnerty et al., 2017a) Hence, the purpose of the study is not in line with the grounded theory requirements. Moreover, action research facilitates implementation of changes in the organisations parallel to carrying out the research. However, this study did not aim to change the energy culture of organisations but rather attempts to assess the energy culture maturity of textile and apparel industrial organisations. Hence, the action research strategy was also not suitable. Further, archival research was not applicable due to the non-historic nature of this study and experiment is also not suitable since its focus is on the natural sciences. Therefore, through this process of elimination and assessment, the approach selected was both qualitative survey and case study strategies as the appropriate strategies. Their suitability was assessed due to several reasons including the ability to facilitate the abduction research approach's expected theory development and subsequent testing by combination of the two (02)

strategies. The suitability of the qualitative survey and case study strategies are explained in detail in the following Section 3.6.1 and 3.6.2 respectively.

3.6.1 Applicability of qualitative survey strategy

As mentioned in the previous section, a qualitative survey was considered as a separate research strategy that has its own applications distinctive from the traditional survey strategy. A qualitative survey can incorporate qualitative data collection techniques, such as semi structured interviews and focus groups (Thai et al., 2020). Therefore, it is suitable for qualitative research designs like this study. Furthermore, the qualitative survey strategy can facilitate both a pre-structured (predetermined) nature and open/inductive nature of qualitative data collection (Jansen, 2010). A qualitative survey's inductive and deductive data collection capability is in accordance with the selected abductive research approach and its role in this research.

The abductive research approach focuses on theory development and subsequent theory testing. Accordingly, the study started with the conceptual framework development as Objective 2. Then, before testing the conceptual framework it needed to be contextualised to the textile and apparel industrial organisations in Sri Lanka. Therefore, the study had to move forward from the conceptual framework to develop a context-specific framework to fulfil the theory development in abduction. According to Jansen (2010) qualitative surveys are ideal for both inductive and deductive approaches of theory development. Therefore, the predetermined nature of the study, due to the involvement of a conceptual framework and subsequent need to inductively develop a context-specific energy culture maturity framework, could be effectively fulfilled by the qualitative survey strategy under different steps of data collection and analysis. Hence, a qualitative survey was adopted as the research strategy to develop an energy culture maturity framework for the textile and apparel industrial organisations in Sri Lanka (Objective 3). Overall, suitability of the qualitative survey to meet the expectation of an abductive approach and qualitative survey's ability to incorporate qualitative data collection techniques, such as semi-structured interviews and focus groups, are identified as the reasons to incorporate a qualitative survey as a research strategy in this study.

3.6.2 Applicability of the case study strategy

This study fulfilled the abductive approach's need for theory development with the energy culture maturity framework developed for the textile and apparel industrial organisations in Phase I. Then, the subsequent theory testing was the next step associated with abduction. Hence, this study utilised a case study strategy under Phase II of the research considering the appropriateness for the purpose of evaluating the applicability of the proposed energy culture maturity framework in a real word situation. A case study strategy's suitability for this study can be justified in several ways.

According to Yin (2018), if a study meets three (03) conditions, those make it highly suitable to proceed under a case study strategy. Those three (03) conditions are having "how" or "why" types of research questions, none or minimal control over behavioural events, and focus on a contemporary phenomenon. First, this study's research question is a "how" type question. Secondly, this study attempts to assess the energy culture maturity of textile and apparel industrial organisations without doing any manipulation to the existing behaviour events of the organisation. Finally, the study aimed to assess the energy culture maturity of selected organisations, in the contemporary context rather than focussing on the historical events under the archival research strategy (Saunders et al., 2019). Hence, appropriateness of the case study strategy under Phase II can be justified considering the study's ability to meet all three (03) conditions proposed by Yin (2018).

Accordingly, the proposed framework's applicability was evaluated by using case study approach as Objective 4. Accordingly, the abduction's need to test the applicability of the framework was also fulfilled by using case studies. Details of the case study design is explained under Section 3.8 while the results of the case studies are provided in Chapter 5.

3.7 Time horizon of research

According to the concept of a research onion, the time horizon is the inner-most layer just before the core. The time horizon is twofold as cross-sectional studies and longitudinal studies. The cross-sectional studies focused on a snapshot at a particular time, whereas the longitudinal research involves real-time monitoring over a period such as when conducting experiments. This research focussed on the energy cultures of large-scale textile and apparel industrial organisations at a given time rather than employing an on-going observation. The study assesses the energy culture maturity of textile and apparel industrial organisations in a given time using focus groups, documentary reviews and limited observations. Therefore, the time horizon of the study was identified as a cross-sectional study.

3.8 Techniques and procedures of research

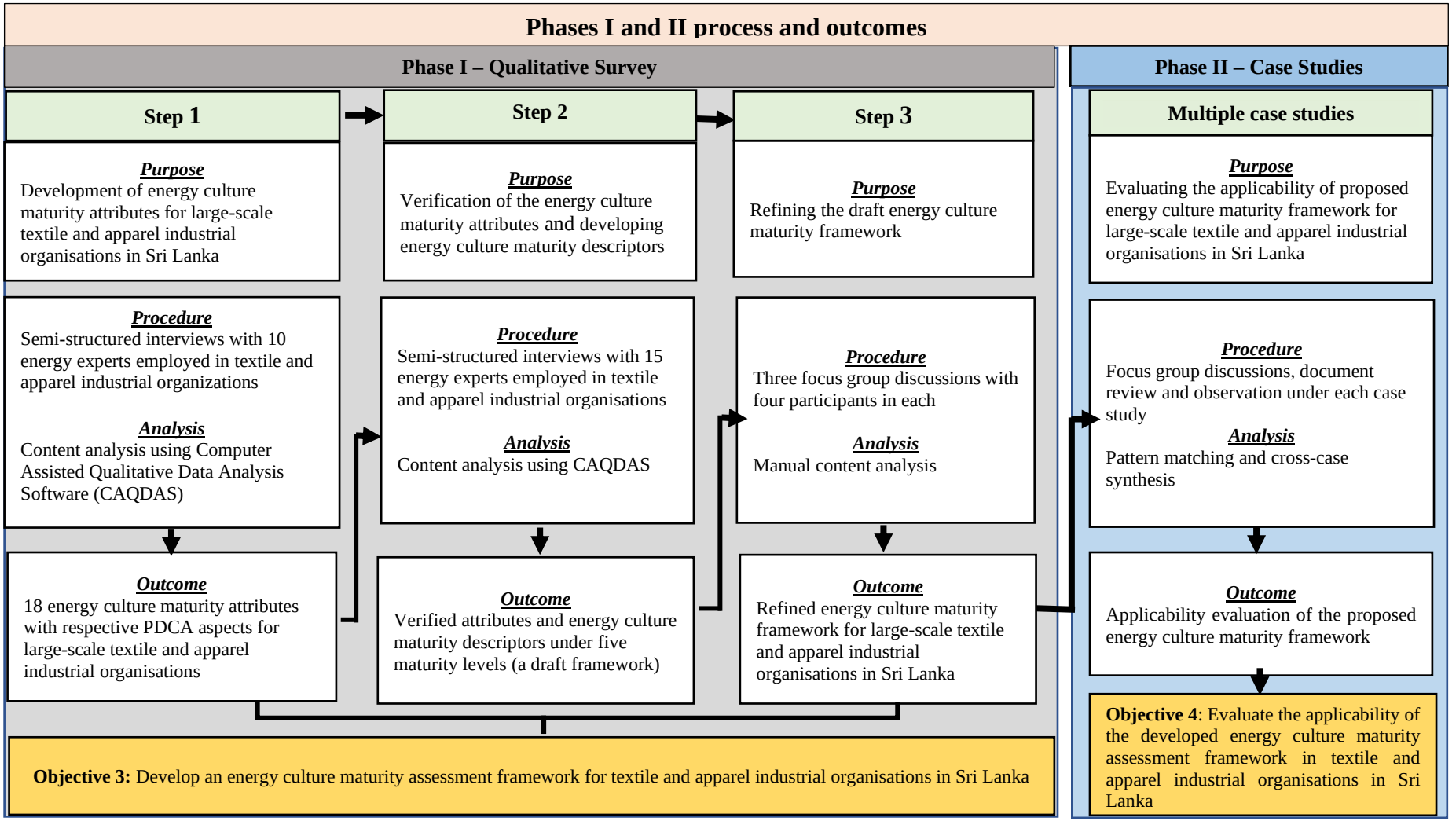
The techniques and the procedure of research is at the core of the research onion. This section considers employment of data collection and analysis techniques based on the research questions and objectives. There are various type of techniques and procedures available to adopt in research. According to Saunders and Tosey (2013) research that follows an interpretivism philosophy are likely to utilise in-depth qualitative data collection and respective analysis techniques with small samples. The data collection and data analysis techniques incorporated in this study are explained in this section. Furthermore, the study has obtained Deakin University's human ethics approval under the reference number SEBE-2020-39. Appendix 11 contains a copy of ethics approval received from Deakin University. Hence, compliance demonstrated with human ethics

in data collection and analysis is also explained in this section under respective data collection and analysis steps.

Data collection and analysis took place under two (02) phases as Phase I and Phase II. Phase I of the study focused on developing an energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka to fulfil Objective 3. Subsequently, Phase II evaluated the proposed framework's applicability using case studies as Objective 4. Figure 3.2 depicts a summary of the phases I and II process and outcomes. Further, details on Phases I and II data collection and analysis are presented thereafter.

Figure 3. 2

Phases I and II Process and Outcome



3.8.1 Phase I data collection and analysis

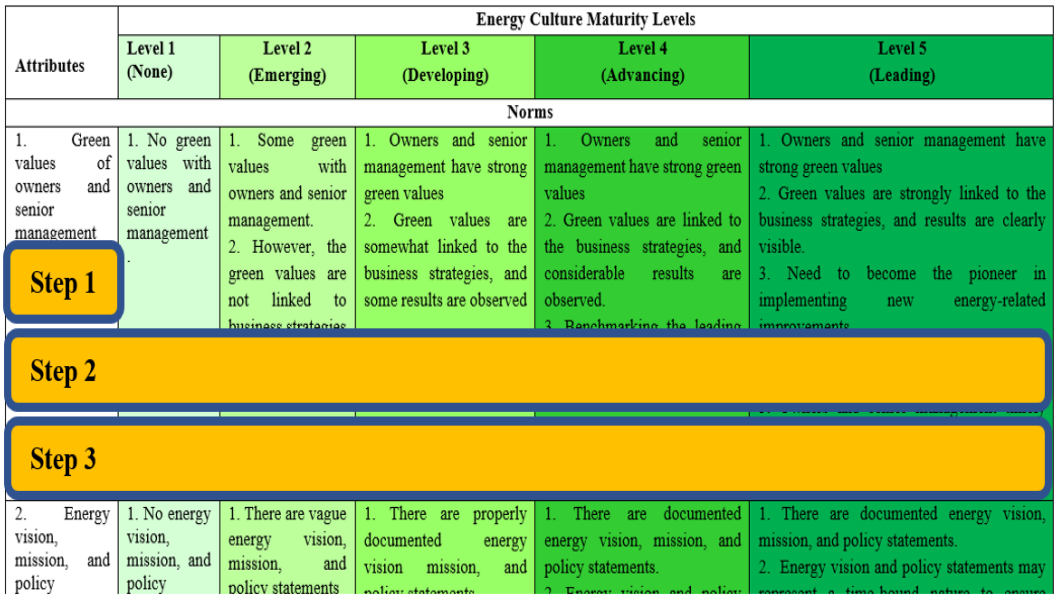
Section 3.6.1 explained a qualitative survey's suitability as the research strategy to achieve Objective 3 of the study as Phase I. Hence, Phase I incorporated the data collection and data analysis techniques required to develop an energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka. Phase I's data collection and analysis were conducted under three (03) steps to ensure gradual development of the proposed energy culture maturity framework.

3.8.1.1 Phase I data collection

Phase I's data collection was conducted under three (03) steps. Figure 3.3 illustrates focused areas of data collection under each step in Phase I.

Figure 3. 3

Three Steps' Contribution to Framework Development



Accordingly, Step 1 was limited to identification of the energy culture maturity attributes and related PDCA aspects. Then, Step 2 verified Stage 1's attributes and developed energy culture maturity descriptors under five (05) maturity levels against the Step 1's attributes. Finally, the outcome of Step 2 (a draft energy culture maturity framework) was presented to focus groups as Step 3 and refined. Data collection techniques used in Phase I under the three (03) steps are explained in the following section.

3.8.1.1.1 Semi-structured interviews under steps 1 and 2

Qualitative interviews can be conducted with open-ended questions using either informal, conversational interviews, semi-structured interviews, or standardised interviews. Semi-structured interviews are often used in qualitative data collection

wherein the interviewer has a list of issues or questions to be covered but the order of questions can change depending on what direction the interview takes. Further, the semi-structured interview technique also facilitates the possibility to ask additional questions (Grey, 2014). Semi-structured interviews are widely used under a qualitative survey strategy (Grieve et al., 2021; Joubert, et al., 2022; Thai, et al., 2020), which demonstrates the appropriateness of semi-structured interviews as a data collection tool for this study.

A qualitative survey requires structure in the data collection while facilitating for inductive interpretations (Jansen, 2010). Further, McIntosh and Morse (2015) stressed the semi-structured interview technique's possibility to be used for the confirmative purpose with more structure rather than only limiting to the popular inductive use. In the confirmative semi-structured interviews subjective opinions are collected from interviewees based on previous theoretical frames/objective knowledge.

On the other hand, research that follows an abductive research approach starts with the conceptual framework and then develops the context-specific framework. Therefore, this study uses objective knowledge based on the conceptual framework to obtain subjective explanations to develop the proposed context-specific energy culture maturity framework for textile and apparel industrial organisations. Following this, semi-structured interviews with some confirmative features were selected as the appropriate data collection tool for Steps 1 and 2 data collection, considering its applicability in using a qualitative survey strategy and to fulfil requirements in using an abductive research approach. Accordingly, semi-structured interview guidelines of Steps 1 and 2 were developed by incorporating both predetermined codes and inductively emerging information.

Furthermore, Step 1's semi-structured interviews were focused to collect details on energy culture maturity attributes of textile and apparel industrial organisations and related PDCA aspects. Hence, Step 1's interview guideline (see Appendix 1) aimed at confirmation of the suitability of energy culture maturity attributes identified from the conceptual framework (outcome of Objective 2) for the textile and apparel industrial organisations in Sri Lanka. Thereafter, there was development of new energy culture maturity attributes and related PDCA aspects specific to textile and apparel industrial organisations in Sri Lanka.

Step 2's interview guideline (see Appendix 2) was mainly targeted at confirmation of the energy culture maturity attributes identified from Step 1's findings and the development of energy culture maturity descriptors under five (05) maturity levels. Step 2's semi-structured interview guideline was developed by integrating Step 1's findings (energy culture maturity attributes and related PDCA aspects) and Finnerty et al. (2017a) framework's maturity levels and PDCA structure as predetermined codes. Furthermore, despite the Step 2 interview guideline's predetermined structure, there were provisions that allowed inductively emerging information as well. Details on predetermined codes relevant for Steps 1 and 2 interview guidelines are further explained under development of a hybrid approach to coding in Section 3.8.1.2.1.

a. Data collection procedure of semi-structured interviews

Sampling technique

Steps 1 and 2 of the data collection required to select experts as explained in the next section. Hence, judgemental sampling (purposive/purposeful sampling) was used instead of commonly used techniques like snowball sampling in qualitative interviews. Judgemental sampling is an improvement of the convenience sampling and selects participants using experience and judgement of the researcher (Fogelman & Comber, 2002). Accordingly, the researcher had to put in considerable effort to identify the suitable participants by researching the potential participants' expertise in the subject area. LinkedIn professional network was helpful in obtaining details of the expertise of the potential participants. Thus, expertise and exposure of the potential participants was verified using LinkedIn profiles without simply following a snowballing technique to find suitable participants. Hence, only the most appropriate participants were selected by screening the participants considering their expertise knowledge in energy culture of the textile and apparel industrial organisations.

Using experts for semi-structured interviews

As this study focused on developing an energy culture maturity framework based on textile and apparel industrial organisations, it required an in-depth investigation on energy culture maturity in the textile and apparel industrial organisations' social setting. Therefore, the specific knowledge area of the energy culture should be unveiled for this purpose using semi-structured interviews. Bogner, Littig, and Menz (2009) identified experts as the people who have specific knowledge on a certain area of a social setting. Further, Libakova and Sertakova (2015) highlighted the ability of expert interviews to provide valid results in the studies focused on culture. Therefore, employing energy experts based in the textile and apparel industry was an important consideration taken in this study. Further, according to Bogner, Littig, and Menz (2009) experts can be clearly distinguished due to special knowledge and skills gained by them over the other actors in the same setting. Similarly, the energy management related knowledge is widely available with the energy management and sustainability related professionals working in the textile and apparel industrial organisation compared to the other employees, like production-related employees who are not much aware of the energy management and energy culture even though they are a part of it. Hence, this study focused on conducting semi-structured interviews with the professionals who are engaged in energy management and sustainability in the apparel and textile industrial organisations.

Furthermore, Bogner, Littig, and Menz (2009) stressed that it is almost impossible to assess quality of one expert over the other and further stated that the availability of specific knowledge with the experts can be considered through factors like learning and training received in the specific knowledge area. Therefore, experts were selected considering their job role's exposure and professional background's relationship to

energy management. Accordingly, aspects like current job role, professional qualifications, and having undergone energy-related training were considered as the relevant aspects to determine suitability as an energy expert in textile and apparel industrial organisations. Further, judgemental sampling as the sampling technique itself facilitated the selection of the appropriate experts for conducting the semi-structured interviews.

Conducting semi-structured interviews

Data collection was conducted as per the agreed human ethics procedure. Initially, the potential experts were identified using judgemental sampling technique and this created a pool of 21 experts who were invited for the Steps 1 and 2 expert interviews. The potential participants were contacted through phone and the plain language statement, and the consent forms were sent via email asking them to return the consent forms prior to the interview date if they were happy to join as interviewees. Interviewees participated for data collection in Step 1 and Step 2 are given in Table 4.1 and Table 4.2 respectively. Then, Appendix 1 and Appendix 2 provides Step 1 and Step 2 interview guidelines respectively. Steps 1 and 2 interviews were conducted online due to the social distancing and access restrictions during the Covid-19 pandemic. Accordingly, the Microsoft Teams software application was used for conducting the interviews and interviews were recorded upon receiving the permission from the interviewees. Before starting the data collection, interviews were educated about the study using a very brief Microsoft PowerPoint presentation, which lasted less than five (05) minutes. The content of the presentation included the aim of the research, instruction to energy culture and introduction to maturity frameworks and relevant data collection predetermined structures of the interview guideline. Then, data was collected following relevant interview guidelines.

Determination of saturation

According to Creswell and Creswell (2018) qualitative data collection stops when the new data no longer provides new insights. Hence, data collection should be carried out until the saturation is reached (Saunders et al., 2019). Accordingly, this study's Step 1 data collection was stopped after conducting 10 expert interviews since there were no additional energy culture maturity attributes generated from the interviews at this point. Further, Step 2's data collection was conducted with up to 15 interviewees to obtain the saturation in terms of the energy culture maturity descriptors for five (05) maturity levels. Therefore, despite the availability of a pool of 21 experts, data collection was stopped at the point of saturation in both Steps 1 and 2.

3.8.1.1.2 Focus groups under Step 3

According to Morgan (2019) focus group discussion is an interview type qualitative data collection technique that generates data through the discussion. The main strength of the focus group is the insights generated through interactive discussion among the

participants. Thai et al. (2020) demonstrated suitability of focus groups under the qualitative survey strategy. Step 3 of Phase I aimed to refine the draft energy culture maturity framework developed based on Step 2 findings. Saunders et al. (2019) identified focus groups as a tool that is suitable to carry out a discussion based on a clearly defined topic. The draft energy culture maturity framework can be used as the clearly defined interview guide for focus group considering its comprehensiveness. Hence, a focus group technique's suitability for Step 3's data collection was established considering the appropriateness for the research strategy and nature of the topic expected to examine.

Morgan (2002) expressed the existence of both more-structured and less-structured versions of focus groups. More-structured focus groups are conducted based on a pre-determined set of questions, whereas the less-structured focus groups proceed more inductively with the participants involvement in the discussion. Step 3's focus groups interview guideline (see Appendix 3) was designed with more-structured nature by incorporating the draft energy culture maturity framework (outcome from Steps 2). The draft framework itself worked as the predetermined structure for focus group discussion and at the same time participants were allowed to inductively contribute with new information as well.

a. Data collection procedure of focus groups

Focus group design

Morgan (2019) highlighted the importance of recruiting participants with appropriate knowledge on the subject matter. Further, a focus group's best results can be obtained when the participants are interested in both topic of the discussion and other members' opinions on the topic. Hence, careful designing of the focus group was vital. There are various discussions on the appropriate number of participants for a focus group discussion. According to Morgan (2019) the number of participants may vary from three (03) to 12. Further, Morgan (2019) explained that small focus groups allow more time for each participant to contribute for the discussion. Therefore, Step 3's focus groups were designed with four (04) participants considering the effectiveness of small focus groups and convenience of practical implementation.

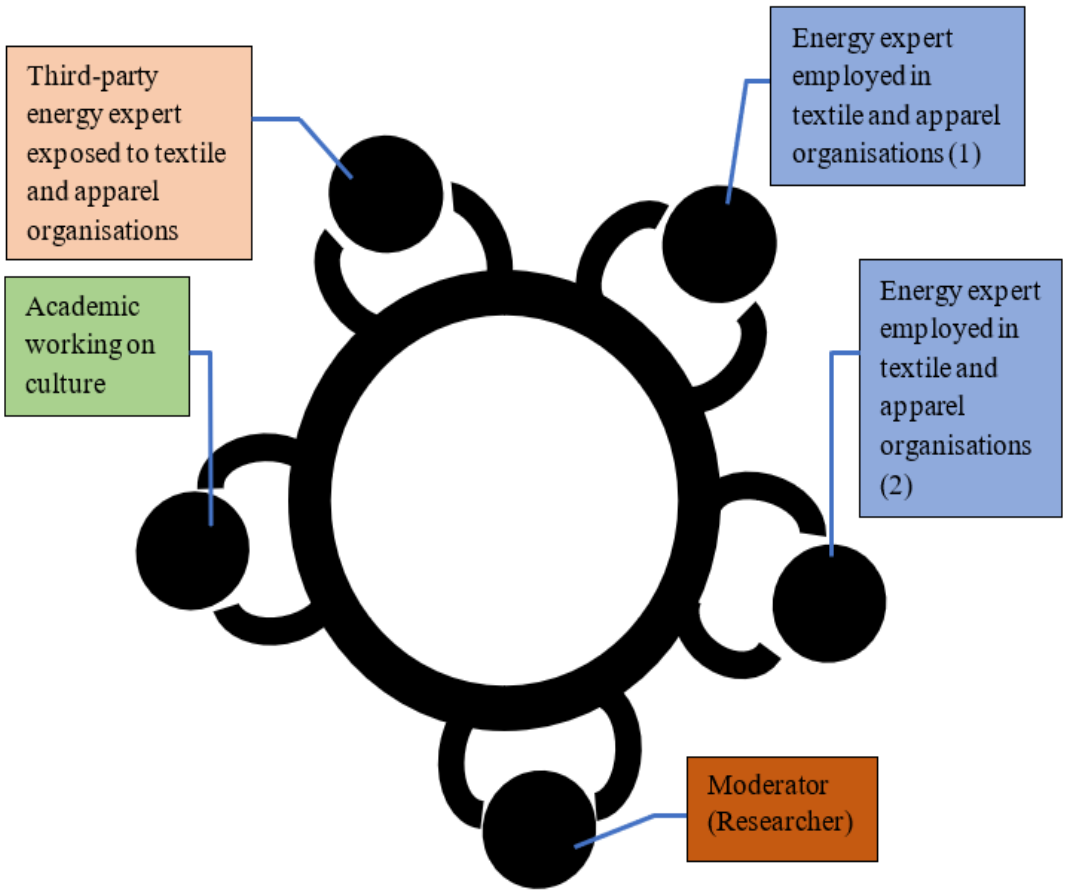
The draft energy culture maturity framework (outcome of Step 2) was developed using energy experts employed in the textile apparel industrial organisations. The focus groups were designed to refine the draft energy culture maturity framework. It was essential to decide the composition of the focus group's participants when designing focus groups. Morgan (2019) identified two (02) types of focus groups based on composition of the participants as homogeneous groups and mixed groups. Homogeneous groups are the commonly used type in which all participants have common interest in the research topic. On the other hand, participants in a mixed group have different perspectives on the research topic. Mixed groups were adopted in this study considering the importance of the different perspectives to refine the framework. Further, Morgan (2019) identified mixed focus groups as an under-researched area due

to the dominance of the homogeneous focus groups and stressed the need to carry out further research to find possibilities of the mixed focus group designs. Hence, working on mixed focus groups contributes to research methodology advancements in the area as well.

Figure 3.4 presents the composition of the participants of the mixed focus group that includes three (03) types of participants as energy experts employed in textile and apparel industrial organisations, third-party energy experts who have exposure to energy management in textile and apparel industrial organisations and academics working on culture studies.

Figure 3. 4

Composition of the Focus Group Participants



Refining of the draft framework was planned in a way that integrates multiple perspectives without limiting to the energy experts employed in textile and apparel organisations. Thus, the framework can be verified from the different perspectives before using it in Phase II to evaluate its applicability using case studies. Table 3.2 outlines the contribution of different participants and number of participants under each category.

Table 3. 2

Types of Participants in Step 3 Focus Groups

Types of Participants	Contribution in Focus Group	Number
1. Energy experts working in textile and apparel industrial organisations	Providing their view on the draft framework based on the energy culture they are experiencing	2
2. Third-party energy experts who have exposure to textile and apparel industry	Providing feedback as a third-party on the developed framework	1
3. Academics working on culture	Providing feedback on appropriateness of the framework for "culture" aspect.	1

The focus group's participant composition allowed two (02) experts employed in the apparel industry as they are the people who have the closest exposure to the energy culture of the textile and apparel industrial organisations than other participants. Hence, use of two (02) participants ensured the output of the focus group discussion is rich with the energy culture of textile and apparel industrial organisations. Whereas a third-party energy expert with exposure to textile and apparel industrial organisations provides the outsider perspective on energy culture of the textile and apparel industrial organisations. In addition, an academic expert on culture provided the insights on the framework's compatibility with cultural aspects. Details of the focus group participants is given in Table 4.3. Furthermore, as expressed by Creswell and Creswell (2018) focus groups facilitated "member checking" of the semi-finished product (draft energy culture maturity framework) with the interviews of previous steps since some of the participants of focus groups were interviewees in Step 1 and 2 data collection as well.

Sampling technique

Like Steps 1 and 2, Step 3 also employed judgemental sampling (purposive/purposeful sampling) as the appropriate sampling technique to identify suitable participants for the focus groups. Morgan (2019) stressed the importance of carefully identifying participants for focus groups using judgemental sampling considering the participants' ability to contribute to the research topic rather than rely on techniques like snowball sampling. Hence, the researcher had to verify potential participants' expertise and experience using LinkedIn professional network profiles to screen the suitable participants.

Conducting focus groups

Initially, potential participants were identified according to the mixed groups design for five (05) focus groups (4 x 5 = 20 potential participants) using judgemental sampling. Then, they were initially contacted by phone and the researcher explained the planned focus groups. Upon their willingness, the plain language statement and

consent forms were sent through email requesting them to return the consent from if they agreed to participate in the study.

Conducting focus groups was a challenging task due to many potential problems. First, it was challenging to find a time that worked for everyone in the group. Hence, each participant was asked to provide their availability in the days of a selected two (02) weeks' period and the time of availability in each available day. Accordingly, the available days and times were collected from all participants of the focus group. Then, the date and the time of the focus group was agreed considering the common time slots possible for all members of the focus group. Furthermore, even after finding a suitable time, there can be sudden absence of selected participants due to unavoidable matters. In that situation, the focus group was rescheduled, or replacements made. For such situations a backup plan was prepared by identifying extra participants to bring in such unforeseen situations and rescheduling was considered as the next option.

Due to the difficulties of carrying out face-to-face meetings due to the Covid-19 restrictions, the focus groups were conducted online using the Microsoft Teams software application. A meeting was scheduled using the Microsoft Teams application in advance and shared with the participants. When conducting the focus groups, the researcher acted as the moderator and facilitated the discussion.

There was very brief presentation by the researcher before proceeding with discussion that introduced the nature of the research, energy culture, proposed draft energy culture maturity framework for textile and apparel industrial organisations and purpose of the focus group discussion. All participants in each focus group agreed to record the discussion and therefore each discussion was recorded.

Determination of saturation

According to Morgan (2019) focus groups reach the adequacy of data collection upon saturation, which is same as other qualitative data collection techniques. Overall, the focus groups themselves did not propose huge changes for the draft energy culture maturity framework. Upon completion of the three (03) focus groups the saturation was achieved due to unavailability of new information emerging. Further, Krueger and Casey's (2015), as cited in Saunders et al. (2019). advice to plan for three (03) or four (04) number of focus groups and if there is no new information generated after third or fourth focus group that means the study has achieved the saturation. As mentioned previously, this study planned for five (05) focus groups initially. However, the data collection was stopped after conducting three (03) focus groups due to saturation.

This section explained the data collection techniques adopted in Phase I and the next section explains respective data analysis techniques used to analyse collected data from Phase I.

3.8.1.2 Phase I data analysis

Section 3.6.1 explained the suitability of the qualitative survey as the research strategy to achieve Objective 3 of the study. Accordingly, Phase I data collection was designed and conducted in accordance with the qualitative survey strategy using both an inductive and pre-determined nature as explained earlier. Then, the data analysis procedure for Phase I is explained in this under Steps 1, 2 and 3.

There are various techniques to analyse qualitative data and among those content analysis is a widely used technique that is identified as a methodical analysis of a given text's content by employing either a quantitative or qualitative mechanism. Elo and Kyngäs (2008) and Hsieh and Shannon (2005) explained the content analysis's ability to generate meaningful content categories based on the systematic analysis of a given text.

Content analysis incorporates coding that refers to organising data into text segments and identifying words that can represent such segments called categories (Creswell & Creswell, 2018). Hsieh and Shannon (2005) identified three (03) approaches to qualitative content analysis as conventional/inductive content analysis, hybrid/direct content analysis and summative content analysis. According to Creswell and Creswell (2018), Fereday and Muir-Cochrane (2006) and Hsieh and Shannon (2005) a conventional content analysis approach allows codes to be generated inductively while analysing data. Whereas hybrid content analysis allows the researcher to use both predetermined codes (deductive codes) and codes emerging during the data analysis (inductive codes) as a combination (Creswell & Creswell, 2018; Hsieh & Shannon, 2005; Fereday & Muir-Cochrane, 2006). On the other hand, summative qualitative content analysis approach is carried out by counting the frequency of specific keywords or content available in qualitative data sets (Hsieh & Shannon, 2005). Table 3.3 summaries the distinctive features of the three (03) approaches to qualitative content analysis.

Table 3. 3

Comparison of the Three Approaches for Qualitative Coding

Content Analysis Approach	Time of Coding	Source of Coding
Conventional/inductive approach	At the time of data analysis	Extracted from data
Hybrid/direct approach	Both predefined codes and at the time of data analysis	Extracted from existing theories or research findings
Summative approach	Both predefined keywords and keywords at the time of data analysis.	Researcher's interest or literature review generates keywords

Note. Source: Adapted from Hsieh and Shannon (2005) and Fereday and Muir-Cochrane (2006)

3.8.1.2.1 Selecting a content analysis approach for this research

According to Table 3.3, the three (03) approaches to content analysis can contribute differently for the qualitative data analysis. Hence it is important to select the appropriate approach for the research. This study does not adhere to a conventional content analysis approach due to the absence of the codes purely generated based on the data analysis. Moreover, the summative approach to content analysis is also not applicable due to not focussing on keywords and their frequencies. However, the hybrid approach can be considered as the ideal method for the study for several reasons. Content analysis approach is influenced by the research approach employed. For instance, inductive codes used in the conventional content analysis approach are more likely to develop from a study based on the inductive research approach. Since abduction combines both deduction and induction approaches, respective coding is also likely to represent both deductive and inductive coding. Hence, from the research design itself this study is aligned with a hybrid content analysis, which use a combination of emerging (inductive) and predetermined (deductive) codes. Accordingly, data collection and analysis were conducted utilising both predetermined (deductive) and emerging (inductive) coding.

a. Application of hybrid content analysis

This study's predetermined coding can be identified under four (04) area as energy culture maturity attributes identified from the conceptual energy culture maturity framework (outcome of the Objective 2), energy culture maturity attributes and its PDCA aspects (Step 1 findings), Finnerty et al. (2017a) framework's five (05) maturity levels and its PDCA structure, and a draft energy culture maturity framework (Step 2 findings). The four (04) predetermined coding arrangements used in the study are further explained below.

Firstly, Step 1 used the inputs from the conceptual framework as predetermined codes to develop the energy culture maturity attributes along with the respective PDCA aspects for textile and apparel industrial organisations as the findings of Step 1.

Then, Step 1's findings (energy culture maturity attributes and related PDCA aspects) were used as the predetermined coding structure for Step 2's data collection and analysis. Specially, the purpose of the Step 1's PDCA aspects was to use in the Step 2's interview guideline. Figure 3.5 provides an extract of the predetermined coding structure developed based on Step 1 for the Step 2 data collection and analysis (see Appendix 10) for the complete list of attributes and its PDCA aspects.

Figure 3. 5

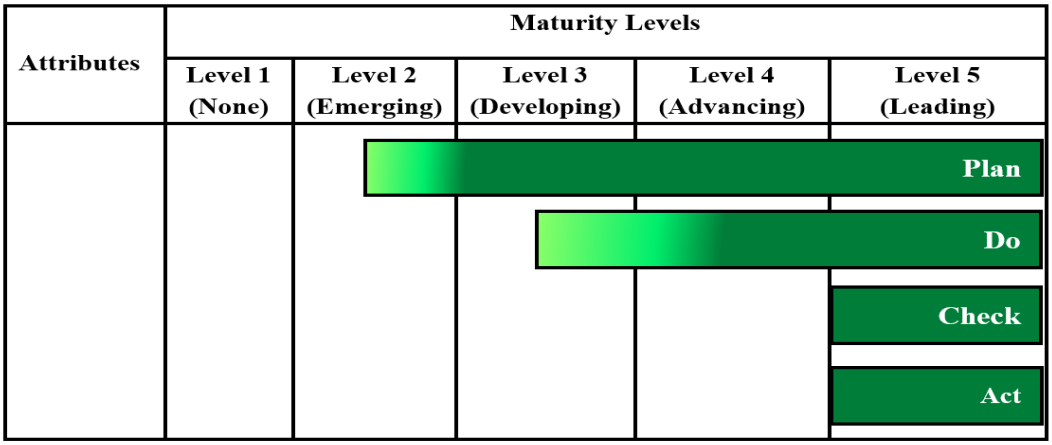
Extract of the Predetermined Codes from Step 1

Attribute 1: Green Values of Owners and Senior Management	
P: Availability of green values	**D:** Green values' link with business strategies
C: Review deployment	**A:** Continual improvement of deployment
Attribute 2: Energy Vision, Mission, and Policy Statements	
P: Availability of documented statements	**D:** Level of acceptance by senior leadership
C: Review statements	**A:** Continual improvement of statements

Thirdly, the use of five (05) maturity levels given in Finnerty et al.'s (2017a) framework and its PDCA structure was identified as another predetermined coding structure used in Step 2 data collection and analysis. Figure 3.6 shows the arrangement of five (05) maturity levels and respective PDCA structure under different maturity levels based on Finnerty et al. (2017a) framework.

Figure 3. 6

Finnerty et al.'s (2017a) Maturity Levels and Related PDCA Structure



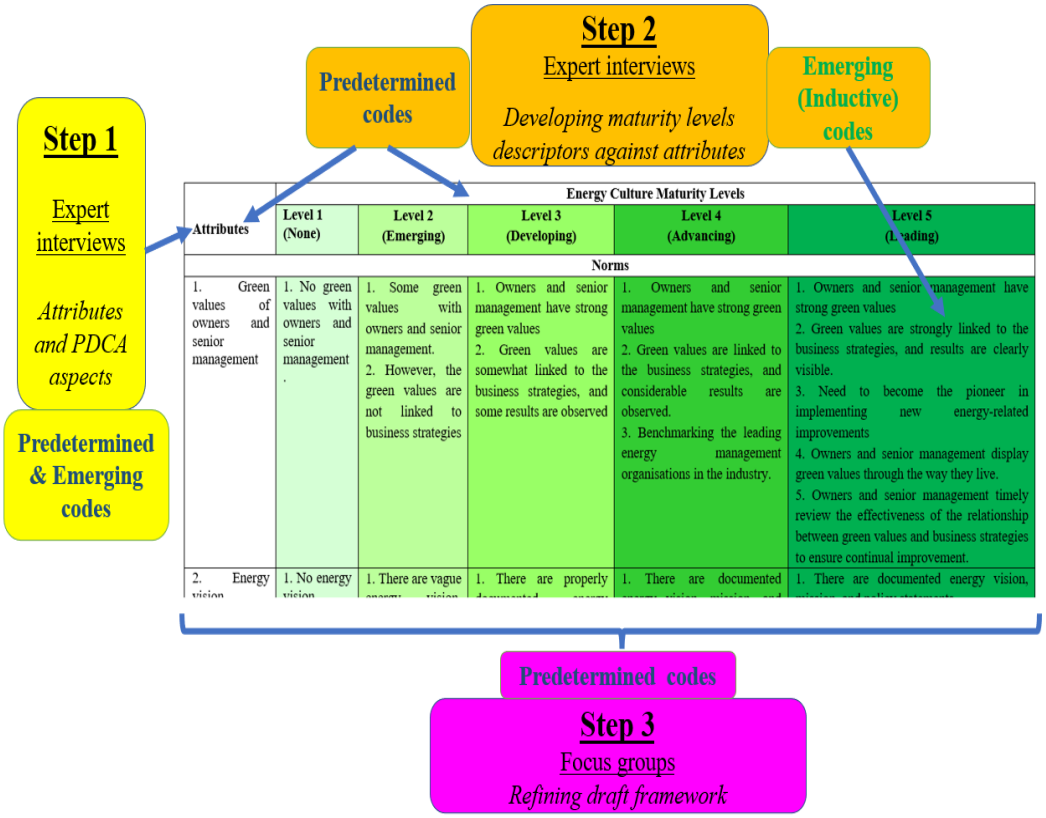
Accordingly, Finnerty et al.'s (2017a) five (05) maturity levels and respective PDCA structure themselves act as a predetermined coding structure in Step 2's interview guideline as explained in 3.8.1.1.1**.** In Step 2, energy culture maturity descriptors for five (05) levels were determined considering the respective PDCA structures of each level. For instance, Level 1 (None) does not represent any PDCA elements and PDCA structure starts from Level 2 onwards. Plan (P) as the initial step of PDCA structure, starts at Level 2 (Emerging) with some minor planning initiatives, and then it is well established from Level 3 (Developing) onwards. Do (D) as the next step of PDCA structure represents deployment of plans that starts at Level 3 (Developing) with limited deployments, and then it is well established in Level 4 (Advancing) and Level 5 (Leading). Finally, Check (C) and Act (A) steps are well established at Level 5 (Leading) where this completes the PDCA structure. Overall, Level 2 to Level 5 consisted of different combinations of PDCA structure in each level that were considered as one of the predetermined coding structures used in Step 2.

Thirdly, Step 3 also utilised a predetermined coding structure because Step 3 focussed on refining the draft energy culture maturity framework (outcome of Step 2) using focus group discussions. Section 3.8.1.1.2 explained the incorporation of draft energy culture maturity framework in the interview guidelines. Accordingly, the draft energy culture maturity framework itself can be identified as the predetermined coding structure used for the data collection and analysis in Step 3.

Overall, it is important to highlight that the conceptual framework's energy culture maturity attributes acted as a predetermined coding structure in Step 1 data collection and analysis. Then, Step 1's findings have generated set of predetermined codes for the Step 2 data collection and analysis. Thereafter, findings of Steps 2 (draft energy culture maturity framework) have created a predetermined coding structure for Step 3's data collection and analysis. Likewise, the above-explained four (04) predetermined coding structures established the predetermined coding component of hybrid content analysis in the study. On the other hand, emerging (inductive) codes on areas such as energy culture maturity attributes and related PDCA aspects in Step 1, energy culture maturity descriptors in Step 2 and energy culture maturity attributes and descriptors in Step 3 can be identified as emerging (inductive) coding component of the hybrid content analysis. Figure 3.7 visualises integration of hybrid content analysis under three (03) steps in Phase I that combines both predetermined codes and emerging (inductive) codes.

Figure 3. 7

Integration of Hybrid Content Analysis in Three Steps of Phase I



Having selected the hybrid content analysis as the appropriate qualitative content analysis approach, the next section explains the content analysis procedure followed in the research.

3.8.1.2.2 Application of software-based and manual content analysis

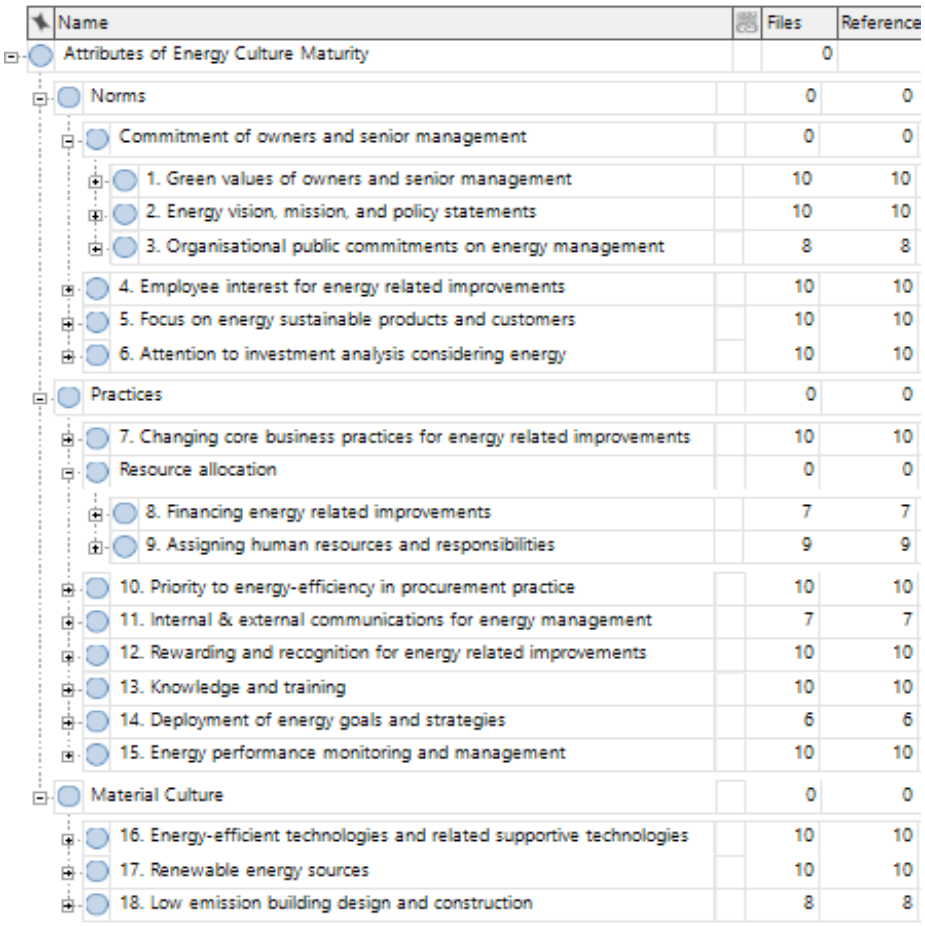
There are two (02) ways of conducting content analysis via Computer Assisted Qualitative Data Analysis Software (CAQDAS) and manual content analysis (hand coding) (Creswell & Creswell, 2018). Generally, CAQDAS provides the ability to efficiently sort and locate qualitative data faster than manual content analysis (Creswell & Creswell, 2018). However, the manual content analysis technique is also used in appropriate situations, despite the time consumption and laborious nature compared to CAQDAS (Creswell & Creswell, 2018; Mary & Dongre, 2022). Hence, both the CAQDAS and manual content analysis methods can be applied appropriately based on the research design and nature and depth of the data generated. This study selected both CAQDAS and manual content analysis techniques considering appropriateness for the data analysis in different stages.

There are various CAQDAS such as MAXqda, Atlas.ti, Provalis and QDA Miner, Dedoose and QSR NVivo. Despite some specific characteristics, many CAQDAS packages offer all commonly required tools for qualitative content analysis (Creswell & Creswell, 2018; Saunders et al., 2019). Therefore, there is not much difference in one CAQDAS package over another. Hence, this study selected QSR NVivo-12 as the suitable CAQDAS for Steps 1 and 2 data analysis where much complex and in-depth data was generated. In addition, Step 3 was largely dependent on a predetermined coding structure, which is the draft energy culture maturity framework. Hence, development of the emerging codes was very limited and mostly involved in refining the existing codes. Hence, Step 3's data was analysed using manual content analysis considering there was less complexity and less data generated.

There were several steps followed in the CAQDAS process. First, interview data were transcribed using Microsoft Word by referring to interview recordings. Then, the transcripts were uploaded to QSR NVivo-12 to proceed with the content analysis. Accordingly, suitable codes were assigned by examining the text segments that can be categorised under certain meaningful labels. Figure 3.8 shows sample coding structure developed under Step1's data analysis using QSR NVivo-12.

Figure 3. 8

Sample Coding Structure



Name	Files	Reference
Attributes of Energy Culture Maturity	0	
Norms	0	0
Commitment of owners and senior management	0	0
1. Green values of owners and senior management	10	10
2. Energy vision, mission, and policy statements	10	10
3. Organisational public commitments on energy management	8	8
4. Employee interest for energy related improvements	10	10
5. Focus on energy sustainable products and customers	10	10
6. Attention to investment analysis considering energy	10	10
Practices	0	0
7. Changing core business practices for energy related improvements	10	10
Resource allocation	0	0
8. Financing energy related improvements	7	7
9. Assigning human resources and responsibilities	9	9
10. Priority to energy-efficiency in procurement practice	10	10
11. Internal & external communications for energy management	7	7
12. Rewarding and recognition for energy related improvements	10	10
13. Knowledge and training	10	10
14. Deployment of energy goals and strategies	6	6
15. Energy performance monitoring and management	10	10
Material Culture	0	0
16. Energy-efficient technologies and related supportive technologies	10	10
17. Renewable energy sources	10	10
18. Low emission building design and construction	8	8

Having presented Phase I's data collection and analysis procedures in this section, the next section presents Phase II's data collection and analysis techniques and procedures.

3.8.2 Phase II data collection and analysis

Phase II data collection and analysis related to fulfilment of Objective 4 of the study, which was focused on evaluating the applicability of the proposed energy culture maturity framework developed during Phase I. Thus, Phase II conducted case studies using large-scale textile and apparel industrial organisations in Sri Lanka to evaluate the applicability of the proposed framework, since case study strategy was identified as the appropriate strategy for the purpose as explained in Section 3.6.2.

3.8.2.1 Phase II data collection

Phase II data collection's procedure is explained in this section that includes case study design, case study selection, and data collection techniques used in the case studies.

3.8.2.1.1 Case study design

An appropriate case study design was vital to achieve Objective 4 of this study. The case study design is explained in this section including defining case, unit of analysis of the case studies and multiple case study design.

a. **Defining the case.**

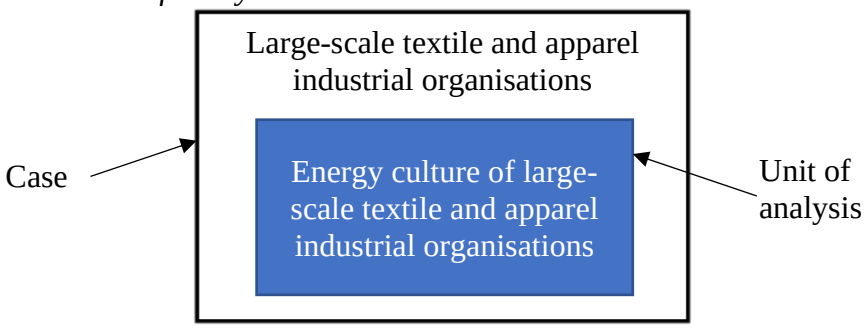
Yin (2018) identified the importance of defining "case" as an initial step of designing a case study. A case can be in various forms, such as individual, small group, event, or organisation that represents a real-world situation. Further, Yin (2018) explains the need to define the case based on a study's research question. This study's research question is focused on assessing the energy culture maturity of textile and apparel industrial organisations in Sri Lanka. Hence, the research question is focussed on energy culture maturity of the textile and apparel industrial organisations. Furthermore, the scope of the study is focused on large-scale organisations in the textile and apparel industry. Hence, the case was defined as a large-scale textile and apparel industrial organisation.

b. **Unit of Analysis.**

Further, Yin (2018) explained that the identification of unit of analysis is vital in a case study research design because it relates to the basic problem of defining "case". Unit of analysis of a case shows the unit that is used to analyse a selected case to answer the research question. Hence, Yin (2003) stressed the need for establishing a clear unit of analysis considering the research question. As defined in the previous section, large-scale textile and apparel industrial organisations being the case of the study, the research question required to focus on energy culture within the case. Hence, this study's unit of analysis was identified as the "energy culture of large-scale textile and apparel industrial organisations" considering the research problem's focus. The unit of analysis locates within the defined case as given in Figure 3.9. Further, Saunders et al. (2019) highlighted that unit of analysis as the factor that determines the holistic or embedded nature of the case study, which is explained in the next section.

Figure 3. 9

Case and Unit of Analysis



c. Multiple case study design.

Yin (2018) proposed four (04) types of case study designs with respect to selection of cases. Those are holistic single-case design, holistic multiple-case design, embedded single-case design and embedded multiple-case design. Out of the four (04) types, embedded designs focused on multiple units of analysis in each case whereas the holistic case study designs are limited to a single unit of analysis. As mentioned in the previous section, this study has identified a single unit of analysis as energy culture of large-scale textile and apparel industrial organisations. Hence, the embedded case designs are not applicable. Then, the study had to be aligned with either the holistic single-case design or holistic multiple-case design, which represent cases with single unit of analysis.

Yin (2018) prefers the multiple-case study designs over the single-case study designs due to the several shortcomings of the single case studies. Further, strong justifications are required for single-case study designs, such as the case being an extremely unique case or revelatory case. Whereas the multiple case study designs are stronger than the single case designs due to number of reasons, such as being more convincing and robust Yin (2018). Hence, the holistic multiple case study design was selected as the case study design of the study due to the suitability of multiple over single case studies.

Multiple case study designs require the selection of a replication logic, which is twofold as literal replication and theoretical replication (Saunders et al., 2019). Literal replication forecasts similar results from the multiple cases. Whereas theoretical replication predicts contrasting results in the multiple cases due to predicted reasons (Yin, 2018). This study selected literal replication as the appropriate replication logic because of the expectation to see similar results in the multiple case studies. Accordingly, availability of the 19 energy culture maturity attributes was expected to be seen in each case as similar results. Further, the availability of all 19 attributes in each case study was later evidenced from the energy culture maturity assessment results. Therefore, the findings also confirmed the compliance with the expected literal replication logic of the study when designing the case studies. On the other hand, there was no intention to see contrasting results in the multiple case studies when designing multiple case studies. Hence, the literal replication can be confirmed as the replication logic for conducting multiple case studies in this study.

Having explained the case study design in this section, the next section provides the criteria for the selection of multiple case studies.

3.8.2.1.2 Case studies selection criteria

Large-scale textile and apparel industrial organisations in Sri Lanka were selected as the case studies due to the significance of focussing on the large-scale textile and apparel industrial organisations over the small and medium scale organisations, as explained in Chapter 1. There are two (02) classifications available to determine the scale of the organisations in Sri Lanka. Those are the criteria established for Sri Lanka

National Energy Efficiency Awards by Sri Lanka Sustainable Energy Authority (2020) and categorisation by the Ministry of Industry and Commerce based on the number of employees and annual turnover (Ministry of Industry and Commerce, 2015).

Accordingly, Sri Lanka Sustainable Energy Authority (2020) determines the scale of organisations based on the cost of monthly energy consumption for electricity and fuels as given in the Table 3.4. Under that, an organisation's monthly energy bill should go beyond 1,200,000.00 rupees to classify as a large-scale organisation.

Table 3. 4

Scaling Organisations Based on Energy Consumption

Scale	**Total Monthly Energy Bill (In Sri Lankan Rupees)**
Large	above 1,200,000.00
Medium	500,000.00 to 1,200,000.00
Small	below 500,000.00

On the other hand, Ministry of Industry and Commerce's (2015) classification required organisations to have more than 300 employees and annual turnover above 750 million rupees to be considered as large-scale organisations.

This study planned for conducting five (05) case studies based on large-scale textile and apparel industrial organisations. Accordingly, compliance of the potential case studies was checked against both criteria to determine suitability of the scale of the organisation; Table 3.5 presents the details of each case against the criteria.

Table 3. 5

Comparison of Potential Case Studies with Large Scales' Criteria.

Case Studies	**Cost of monthly energy bill over 1,200,000.00 Sri Lankan rupees**	**Number of employees over 300 and annual turnover over 750 million rupees.**
Case A	√	√
Case B	√	√
Case C	√	√
Case D	√	√
Case E	√	√

According to Table 3.5 all five (05) potential case studies were compatible with all requirements of the two (02) criteria. Hence, the five (05) case studies were identified as the potential case studies for the study. However, the conducted case studies were limited to Case A, Case B, and Case C due to saturation during the data collection, as explained in Section 3.8.2.1.3. The Case A is an organisation that owns 12 factories

with a total employment around 19000. The Case B is an organisation with 53 factories and employs approximately 99,000 employees. Thirdly, the Case C is an organisation that has 25 factories and approximately 52000 employees. Further details of the selected three (03) case studies are given in Chapter 5. Having explained the case study design in this section, the following section presents data collection techniques employed in the case studies.

3.8.2.1.3 Data collection from case studies

a. Preparation for data collection in case studies.

As mentioned in Section 3.8.2.1.2 large-scale textile and apparel industrial organisations were selected to conduct case studies. First, an organisation consent form and plain language statement were sent to authorised officers who can permit data collection for case studies. The authorising officers were asked to nominate three (03) suitable participants for case study focus groups at the same time of obtaining organisation consent. Morgan (2019) explained the possibility of conducting small focus groups with three (03) participants and its ability to provide more time for each participant. Further, the researcher explained the nature of the planned data collection and need of participants who can provide data on the energy culture of the whole organisation. This is because the proposed energy culture maturity framework (see Figure 4.20 and Table 4.22) represents energy culture attributes of the whole organisation starting from organisation's corporate level to factory level. Hence, the importance having participants who were familiar with energy culture of the corporate level as well as the factories was agreed. Accordingly, each focus group of the three (03) case studies was designed with the participants representing both corporate division and factory division.

Further, it was ensured that the participants were working in energy management related disciplines in the organisation, so that they can explain energy culture of the organisation in detail. Hence, the sampling technique incorporated in case study focus groups can be identified as the judgemental (purposeful) sampling. However, the judgment on selecting the suitable participants were made with the involvement of both researcher and the officer authorised data collection in case studies considering the participants' expertise to provide data on energy culture. In addition, Case B and Case C organisations requested the researcher to sign non-disclosive agreements prior to data collection to ensure confidentiality of information shared. Therefore, evidence collected under the document review technique from those case studies were not included as examples in the data analysis or in other forms. The next section explains the data collection techniques used in case studies.

b. Data collection techniques.

Yin (2018) explained the importance of gathering multiple sources of evidence when collecting data form the case studies. Accordingly, this study utilised three (03) types of data collection techniques as focus groups, document reviews and observations.

Application of the three (03) data collection techniques in case studies is explained in this section.

Focus Group Discussions

Focus groups were used as the main data collection tool in the case studies. Upon identifying the potential participants for the focus groups, plain language statements and individual consent forms were provided to them. Then, participants were appointed for the focus groups upon receiving their consent. Sections 5.2.1.2, 5.2.2.2 and 5.2.3.2 present details of the focus group participants in Case A, Case B and Case C respectively. Further, focus groups were conducted online due to the Covid-19 regulations that prevented accessing textile and apparel industrial organisations. Hence, Microsoft Teams was used to conduct the online focus groups and each discussion was recorded with the permission of the participants. Case study focus groups were not difficult to schedule and conduct due to participants recruitment from the same organisation comparing to Step 3's (Phase I) focus groups.

The proposed energy culture maturity framework was used in the focus group's interview guideline (see Appendix 4) and each case study's energy culture maturity was assessed using the proposed framework to evaluate the applicability of the energy culture maturity framework as Objective 4. Energy culture maturity assessment using the proposed framework was identified as the "detailed energy culture maturity assessment". Accordingly, participants were asked to identify their maturity status against 19 energy culture maturity attributes of the proposed framework. It is important to note that the detailed assessment did not use names of the maturity levels (e.g., Level 1 (none)). Rather, Type A, Type B, Type C, Type D and Type E names were used to represent five (05) maturity levels (Level 1 to Level 5) to ensure participants do not follow the names of the maturity levels and propose magnified results than the reality. A similar approach was used in Jovanović and Filipović's (2016) study to ensure no misleading results are promoted. Further, participants were informed about the anonymous nature of the research reporting without using the name of the organisation, which also reduces potential underestimations or overestimations of the organisation's maturity status. Furthermore, the detailed energy culture maturity assessment was supported by the documentary reviews and observations.

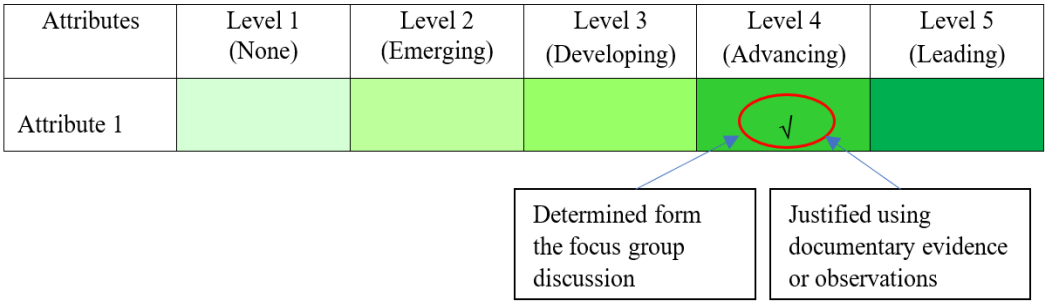
In addition to the detailed assessment, the overall maturity preference of each case was separately identified using the overall energy culture maturity summary statement (see Appendix 5) at the end of each focus group. The overall energy culture maturity summary statement was developed by the researcher and verified with four (04) academics relevant to the research area before being used for the assessment in case studies. The purpose of using the overall maturity summary statement was to compare the overall energy culture maturity result of detailed energy culture maturity assessment with the results of the summary statement to see up to which extent both mechanisms can provide similar results that can evaluate the applicability of the proposed framework. Compared to the detailed energy culture maturity assessment,

the overall energy culture maturity summary statement clearly mentioned the names of maturity levels (levels 1 to 5) and a summary statement explaining each level. Then, participants were asked to select energy culture summary statements (maturity level) that best describe their organisation's energy culture maturity.

Morgan (2002) classified focus groups based on level of structuredness into more-structured and less-structured types. The focus groups of the case studies clearly fitted the more-structured type than less-structured type because the focus group discussion was a highly structured one using proposed energy culture maturity framework in the interview guideline. Hence, focus groups attended to check where the organisation fits in terms of the maturity under the given five (05) maturity levels rather than obtaining new information. The researcher (as the moderator) shared the interview guide (see Appendix 4) that included the proposed energy culture maturity framework using the screen sharing option in Microsoft Teams and participants were asked to select the best fit of the maturity descriptors for their organisation under each of the 19 attributes. According to the data gathered, participants' common ground on the maturity results could be identified clearly without proposing different maturity preferences by individuals. Overall, a within-group saturation was identified from the data generated by the three (03) participants of each focus group since they could agree on the status of the energy culture maturity of the organisation given in the proposed framework in a "common ground" as expected by Morgan (2019) in such homogeneous and structured focus group designs. Figure 3.10 depicts how multiple sources of evidence were incorporated in the focus group data collection in case studies.

Figure 3. 10

Determination of the Maturity Using Multiple Sources of Evidence



As given in Figure 3.10, focus group discussion determined the maturity position and, at the same time, the researcher requested evidence wherever possible (in terms of documentary evidence and observations) from the participants to justify that they belong to a certain maturity level under a given attribute.

Document reviews

As explained in the previous section, documentary evidence was requested wherever possible to justify the energy culture maturity status claimed by the participants under each attribute. Relevant documents were shared using the screen sharing feature

available in Microsoft Teams and after the focus groups. However, due to the organisations' restrictions some of the documentary evidence was not shared, such as the documents relating to capital and operational budget allocation for energy-related improvements under attribute 8. In addition, participants' previous experience in facing the third-party sustainability related audits made the online document review easier. Participants also had such energy-related documents readily available with them due to the regular usage in facing external audits during the Covid-19 pandemic. Chapter 5's within-case analysis presents various documentary evidence gathered from each case study.

Observations

According to Yin (2018) observational evidence is useful to provide additional information on the topic being studied. Further, Saunders et al. (2019) highlighted that the observations are ideal for generating both accurate and rich data. However, due to Covid-19 regulations and related access restrictions, the researcher was not allowed to enter textile and apparel industrial organisations at the time of data collection. Therefore, it was impossible to conduct observations at the site. However, an alternative method was employed during and after the focus groups by observing the photographs of the aspects that were expected to be observed with the support of the participants. The participants were familiar with such indirect/remote observation mechanisms since they have already facilitated that while facing the third-party online sustainability audits. However, it is important to note that the observations conducted in this nature is not a replacement to on site observations due to its limitation of allowing for partial observations.

c. Saturation in the case study data collection.

Fusch and Ness (2015) stated the importance of deciding the number of case studies based on the saturation of the data in the case studies. Initially, the study planned to conduct five (05) case studies and five (05) potential case studies were identified. When proceeding with data collection, it was noted that the saturation could be achieved using three (03) case studies due to several reasons. All three (03) cases were consistent with 19 energy culture maturity attributes of the proposed framework. Further, all selected case studies could locate their maturity within the maturity descriptors of the five (05) maturity levels in the proposed framework. Therefore, no additional energy culture maturity attributes or descriptors could be found in the three (03) case studies during data collection. Hence, the three (03) case studies could ensure the saturation requirement in terms of the number of cases is met. Yin's (2018) suggestion on adequacy of two (02) to three (03) cases for the studies following the literal replication was also confirmed from this study's actual saturation with three (03) case studies.

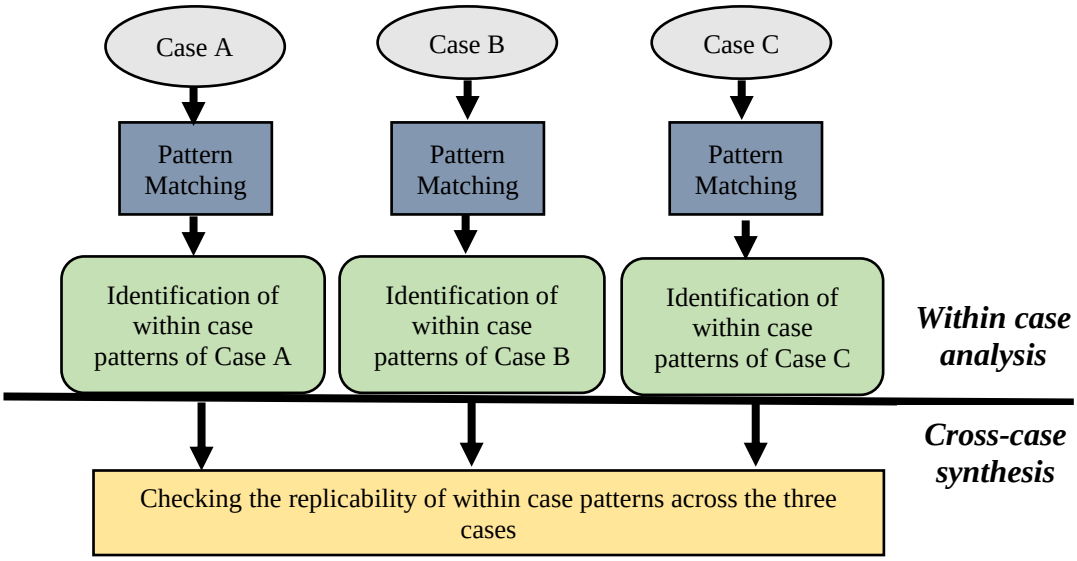
This section explained the data collection techniques used in Phase II. The following section describes respective data analysis techniques incorporated in analysing case study data.

3.8.2.2 Phase II data analysis techniques

According to Yin (2018), there are several analytic techniques for analysing the case study data, such as explanation building, time series analysis, logic models, pattern matching and cross-case synthesis. This study has selected pattern matching and cross-case synthesis as the appropriate data analysis techniques in case studies due to appropriateness for the data generated and the case study design. Pattern matching was mainly incorporated during the within case analysis of results for individual case studies. Then, the overall energy culture maturity of each case was determined using energy culture maturity scoring system. Subsequently, cross-case synthesis was conducted considering the findings from within case analysis. Figure 3.11 presents the incorporation of pattern matching and cross-case synthesis in the study.

Figure 3. 11

Use of Pattern Matching and Cross-Case Synthesis



3.8.2.2.1 Pattern matching.

Yin (2018) identified pattern matching as a technique that compares patterns of the case study findings with the predicted pattern established prior to the data collection in case studies. This study initially designed a conceptual energy culture maturity framework as Objective 2 and then the conceptual framework was expanded to a context-specific energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka as Objective 3. Hence, the proposed context-specific energy culture maturity framework can be identified as the predicted patterns of energy culture maturity in textile and apparel industrial organisations. Then, the case study data collection was conducted using the interview guideline that

incorporated proposed context-specific framework (see Appendix 4). Accordingly, the data collection compared the predicted patterns of the proposed framework with the case study findings in within-case analysis. Furthermore, the findings of within-case analysis were established based on the analysis of multiple sources of evidence (focus group discussion, document reviews and observations) under 19 attributes.

3.8.2.2.2. Determination of overall energy culture maturity of the case studies.

Mainly, the overall energy culture maturity status of the study was determined through the maturity scoring system incorporated into the detailed energy culture maturity assessment. In addition, there were two (02) assistive approaches (the most chosen maturity level and overall energy culture maturity preference) used to compare the overall maturity result of the detailed energy culture maturity assessment. The comparison was made to understand the applicability of the overall maturity status identified from the detailed energy culture maturity assessment. Further details on the maturity scoring system used for detailed energy culture maturity assessment and other two (02) approaches used to identify the overall energy culture maturity are explained below.

a. Maturity scoring system under detailed energy culture maturity assessment.

The maturity scoring system was used under the detailed energy culture maturity assessment. Accordingly, this study employed a scoring system to calculate the energy culture maturity score for each case using the Likert scale (1 to 5 scoring system) where Level 1 (none) = 1 and Level 5 (leading) = 5 and similarly for the other levels were also given respective values. Finnerty et al.'s (2017a) work as the foundation framework of this study also incorporated the Likert scale scoring system to interpret maturity. Further, culture maturity frameworks such as Jespersen et al.'s (2016) also incorporated the Likert scale as a maturity interpreting scoring system. According to the proposed Likert scale-based scoring system each of the 19 attributes can receive a 1 to 5 score based on the level of energy culture maturity status of the attribute. In addition, there is the possibility to have mixed maturity results where the maturity of an attribute might fit energy culture maturity descriptors of two (02) or more maturity levels. In that case, an intermediate score is proposed. For example, when an attribute represents mixed maturity results in Levels 4 and 5, the intermediate score is calculated as (4+5) / 2 = 4.5. The Likert scale is considered as an ordinal scale, which means having ordered scores. Hence, developing an intermediate score between any of the two scores (e.g., intermediate score of 4.5 between 4 and 5) still, keeps the scoring system in order. Therefore, intermediate scores were identified to represent the potential mixed maturity results.

Further, it is important to highlight that incorporating the Likert scale scoring system in this qualitative study does not convert it to a mixed method research. Generally, mixed method research requires to employ both qualitative and quantitative results. However, results generated through the Likert scale in this study cannot be categorised

as quantitative results due to the unavailability of any hypothesis testing or correlations that are required to qualify as quantitative results. Therefore, the usage of the maturity scoring system maintains the study as qualitative research.

In addition, maturity score ranges were identified under five (05) maturity levels based on the proposed Likert scoring system. Table 3.6 presents proposed ranges for calculating the overall maturity score of a case study.

Table 3. 6

Maturity Scoring Against the Levels

Maturity levels	Maturity Score range
Level 5	77-95
Level 4	58-76
Level 3	39-57
Level 2	20-38
Level 1	0-19

b. Overall energy culture maturity preference.

Data on the overall energy culture maturity preference collected using the overall energy culture maturity summary statement (see Appendix 5) was considered under this approach. The outcome of the overall energy culture maturity preference was the best fitting maturity level chosen by the focus group participants considering the summary statement. Hence, the outcome is a maturity level selected from the maturity levels 1 to 5. At the final stage of the within case analysis, the overall energy culture maturity level identified from the detailed energy culture maturity assessment was compared with the overall energy culture maturity preference result.

c. Most chosen maturity level.

The most chosen maturity level represents the level where the greatest number of maturity results of the detailed energy culture maturity was fitted. The most chosen maturity level was identified by counting the maturity choices available under each maturity level resulted from detailed energy culture maturity assessment. Thus, the maturity level represents the greatest number of choices selected as the overall maturity of a selected case study under this method. The result of the most chosen maturity also compared with the outcome of the detailed energy culture maturity assessment.

Overall, the results of the detailed energy culture maturity assessment are compared with the results of the two (02) assistive approaches. High uniformity between the results of the detailed energy culture maturity assessment and the results of other two

(02) approaches suggest high applicability of the proposed energy culture maturity framework for textile and apparel industrial organisations.

3.8.2.2.3 Cross-case synthesis.

Yin (2018) identified cross-case synthesis as an analytic technique that can be used for data analysis in multiple case studies. Further, the author stated the need for within case analysis in case studies prior to conducting cross-case synthesis. Hence, first the within-case analysis of each case was conducted by considering the data inputs from the focus group discussion, document review and observations by incorporating pattern matching. Within-case analysis identified the within case patterns and supports to generate tentative conclusions about the within case patterns. Subsequently, the cross-case synthesis was carried out to explore the replicability of the within case patterns and tentative conclusions across all cases concerning the literal replication logic adopted.

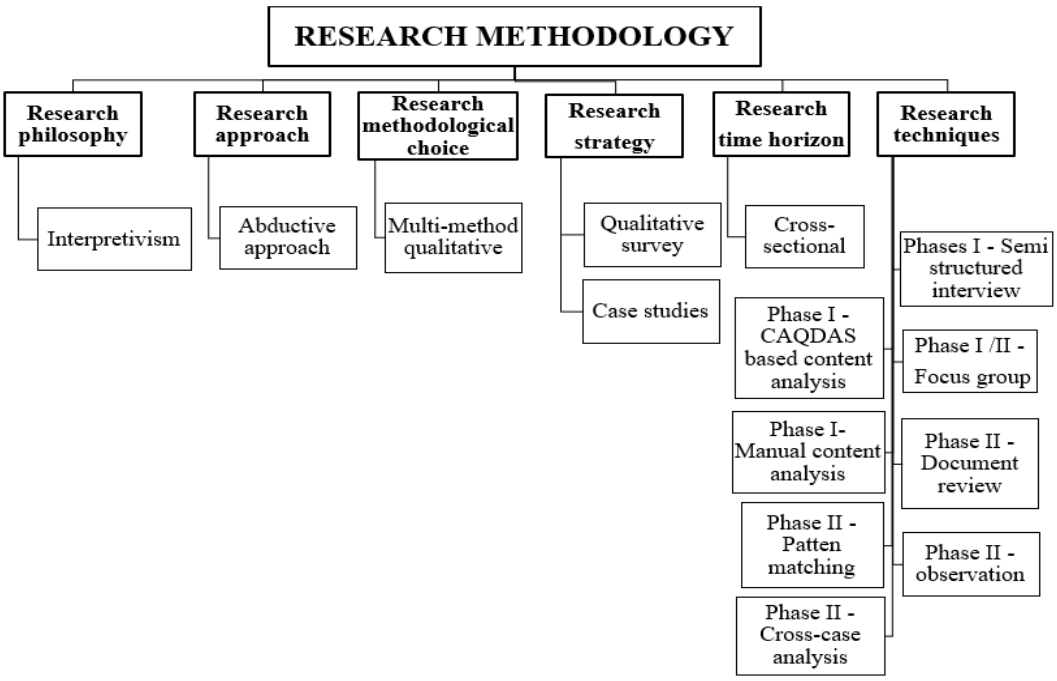
Having explained the research techniques and procedures under data collection and analysis techniques in this section, the next section provides the summary of the research methodology using a research methodology map.

3.9 Research methodology map

The research methodology map depicted in Figure 3.12 presents a summary of the research methodology design of the study. The research methodology map shows the appropriate choices made for this research among the available options.

Figure 3. 12

Research Methodology Map



3.10 Validity and reliability of the research

This section explains the validity and reliability of the study. Validity is explained under the incorporated validity procedures and external validity. Then, the study's approach to ensure the reliability of the research is explained.

3.10.1 Validity of the research

3.10.1.1 Incorporated validity procedures

According to Creswell and Creswell (2018) validity in qualitative research is different from quantitative research. In qualitative research, validity refers to the researcher's attempt to check the accuracy of the research findings by adopting certain procedures. Further, Creswell and Creswell (2018) proposed eight (08) validity procedures that can be used to check the validity of the qualitative research and advice to use multiple validity procedures to ensure the accuracy of the findings as it adds strength to the research. This study adopted three (03) of such validity procedures proposed by Creswell and Creswell (2018); namely, using external auditors, triangulation and using member checking. Further details on adopted validity procedures are given in the Table 3.7.

Table 3. 7

Validation Procedures Adopted

Validity Procedure	Implementation in the Research
(a) Use an external auditor Obtaining the support of external parties who are not familiar with the research to review the research for all or selected dimensions.	This approach was strongly adopted in the research using several external auditors. • The researcher obtained the generous support from a globally renowned scholar who is full professor. The professor was contacted through the ResearchGate platform using private messages. The professor is renowned for qualitative and mixed method research and has a strong scholarly profile, which included a ResearchGate score of beyond 940 and Google Scholar citations beyond 60,000. The researcher contacted this professor over 15 times and clarified various matters relating to the research methodology design and other aspects of the research. The advice received from the professor in the role of an external auditor has provided a strong support to shape the study's direction and created a massive value addition. • Further, the research methodology design and semi-finished outcomes were presented to senior academics of the School of Architecture and Built Environment at Deakin University, Australia in the annual research day competition. Feedback from senior academics and appreciation received as the best presentation award further strengthened and shaped the research direction.
(b) Triangulation Triangulation involves developing themes in qualitative	• This research occupied multiple perspectives with triangulation using various energy experts employed in the textile and apparel industry, third-party energy experts with exposure in the textile and apparel

research using multiple data sources or multiple perspectives of the people involved.	industry, and academics working on culture research in Phase I, Step 3 focus groups. • Further, Phase II case studies conducted focus groups with three (03) participants from each case study. Thus, the multiple perspectives on energy culture maturity of the case studies were gathered. Further, multiple sources of evidence were used as focus group discussion, document review and observations from case studies. • The case studies occupied detailed energy culture maturity assessment using the interview guideline that consisted of the proposed framework. At the same time, the overall energy culture maturity preference was collected from case studies using the overall energy culture maturity summary statement. Both approaches described the overall energy culture maturity in the organisation using two (02) different sources.
(c) Using member checking Allowing to check accuracy of the work by presenting semi-finished products, such as draft major findings to the participants	• Step 3's focus groups included some energy experts who participated in Steps 1 and 2. Hence, "member checking" could be facilitated within the Step 3 focus groups due to the involvement of the previous interviewees. Furthermore, the focus group design itself is a mechanism to refine the findings of Step 2 (draft energy culture maturity framework.) • In addition, semi-finished products were sent via email to some of the interviewees who participated in Steps 1 and 2, asking them to comment on the appropriateness.

3.10.1.2 Generalisability/external validity of the research

According to Creswell and Creswell (2018) generalisability is limited in qualitative research since the focus is to develop context-specific description and theme development instead of gaining generalisability of the findings. However, Yin (2018) discussed the generalisability/external validity of the case study findings outside the immediate study. However, case studies aim for analytic generalisations rather than quantitative statistical generalisations. Analytic generalisation tries to generalise the case study findings to specific situations. On the other hand, Lincoln and Guba (1985) discussed the transferability of the case study findings to similar settings rather than generalisability. Transferability refers to describing other situations where the case study findings might be relevant. Overall, Yin (2018) and Lincoln and Guba (1985) have focused on identifying the other situations where the findings of the case studies can be considered.

This study generated findings using three (03) large-scale textile and apparel industrial organisations in Sri Lanka as case studies. Other large-scale textile and apparel industrial organisations in Sri Lanka can be considered another immediate setting where the findings of the three (03) case studies can be transferred and relevant.

On the other hand, Bell et al. (2014) and Stephenson et al. (2015) have identified the industry distinctive nature of energy cultures. Therefore, there is a possibility to consider the transferability of the findings to large-scale textile and apparel industrial organisations in other countries as well since those share the same industry. This is

supported by the availability of the similar type of machinery (material culture) and production processes (practices) in the textile and apparel industry in other countries as well. However, when considering the textile and apparel industrial organisations in other countries, it is important to consider that the organisations manufacture for international brands, since the large-scale textile and apparel industrial organisations in Sri Lanka are focused on that export market of international brands.

3.10.2 Reliability

Yin (2018) explained the reliability of research as the ability of a researcher to obtain same findings and conclusions by repeating the same procedures used by the original researcher. Hence, the aim of the reliability is to reduce the biases and errors in research. Furthermore, the author highlighted the importance of documenting the procedure followed in the research as the mechanism to ensure the reliability of the research. Accordingly, this study has documented the detailed information on the techniques and procedures followed in the research to arrive at the current findings and conclusions. Section 3.8.1. provides the evidence for such documented procedures under both Phases I and II of the study, which clearly explains the data collection and data analysis procedures followed in the study. In addition, the use of systematic literature review has increased the reliability of the literature review in the study.

3.11 Chapter summary

This chapter explained the research methodology design adopted in this study based on the concept of a research onion (Saunders et al., 2019). The study incorporated two (02) research strategies as the qualitative survey and case studies for Phase I and Phase II of the study respectively. Phase I of the study developed the energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka under three (03) steps. Accordingly, Step 1 involved semi-structured interviews with 10 energy experts to develop energy culture maturity attributes. Then, Step 2 carried out semi-structured interviews with 15 energy experts to verify the energy culture maturity attributes and develop energy culture maturity descriptors for five (05) maturity levels against the identified energy culture maturity attributes. Thereafter, Phase I's Step 3 used three (03) focus groups with four (04) participants in each to refine the framework. Both CAQDAS and manual content analysis were employed as the data analysis techniques in Phase I. Then, Phase II used multiple case studies (three (03) case studies) to evaluate the applicability of the framework. The case studies used focus groups, documentary reviews and observations data collection techniques as the multiple sources of evidence. Further, data analysis of case studies was conducted using pattern matching and cross-case synthesis. Ultimately, the study's validity and reliability were discussed and found to meet requirements.

CHAPTER 4

PHASE I - ANALYSIS AND FINDINGS

4.1 Introduction

Having developed the energy culture maturity conceptual framework in Chapter 2, this chapter develops an energy culture maturity framework specifically for textile and apparel industrial organisations as Phase I of the study. Phase I's data collection and analysis was conducted over three (03) steps. Step 1 identified the attributes of the energy culture maturity along with their Plan, Do, Check and Act (PDCA) aspects using expert interviews. Then, Step 2 of Phase I developed the energy culture maturity descriptors under five (05) maturity levels against the attributes identified. Finally, Step 3 completed the development of the energy culture maturity framework by refining step 2's draft energy culture maturity framework, using three (03) focus group discussions.

4.2 Phase 1: Development of an energy culture maturity framework

Figure 3.2 presents Phase I's overall process and outcomes and its linkage to Phase II of the study. Section 4.2.1 presents the development of textile and apparel industry specific attributes along with their PDCA aspects as the findings of Step 1. Subsequently, Section 4.2.2 provides the findings of Step 2 expert interviews and Step 3 focus groups. Accordingly, Phase I of the study fulfilled Objective 3 of the study.

4.2.1 Step 1: Verified attributes of energy culture maturity framework

The energy culture maturity conceptual framework developed in Chapter 2 consisted of 12 energy culture maturity attributes under norms, practices, and material culture. This section verified the conceptual framework's attributes and developed energy culture maturity attributes specific for textile and apparel industrial organisations as the Step 1's findings. In addition, Step 1 identified the PDCA aspects under each attribute to use as the predetermined codes for Step 2's data collection, as explained in Section 3.8.1.2.1. Step 1's data was gathered using semi-structured interviews with energy experts employed in textile and apparel industrial organisations, as given in Table 4.1. Step 1's interview guideline is given in Appendix 1. Further, Section 3.8.1.1.1 explained further details on the Step 1 data collection process. Appendix 6 provides a sample transcript of Step 1 semi structured interviews.

Table 4. 1

Details of Step 1 Expert Interviewees

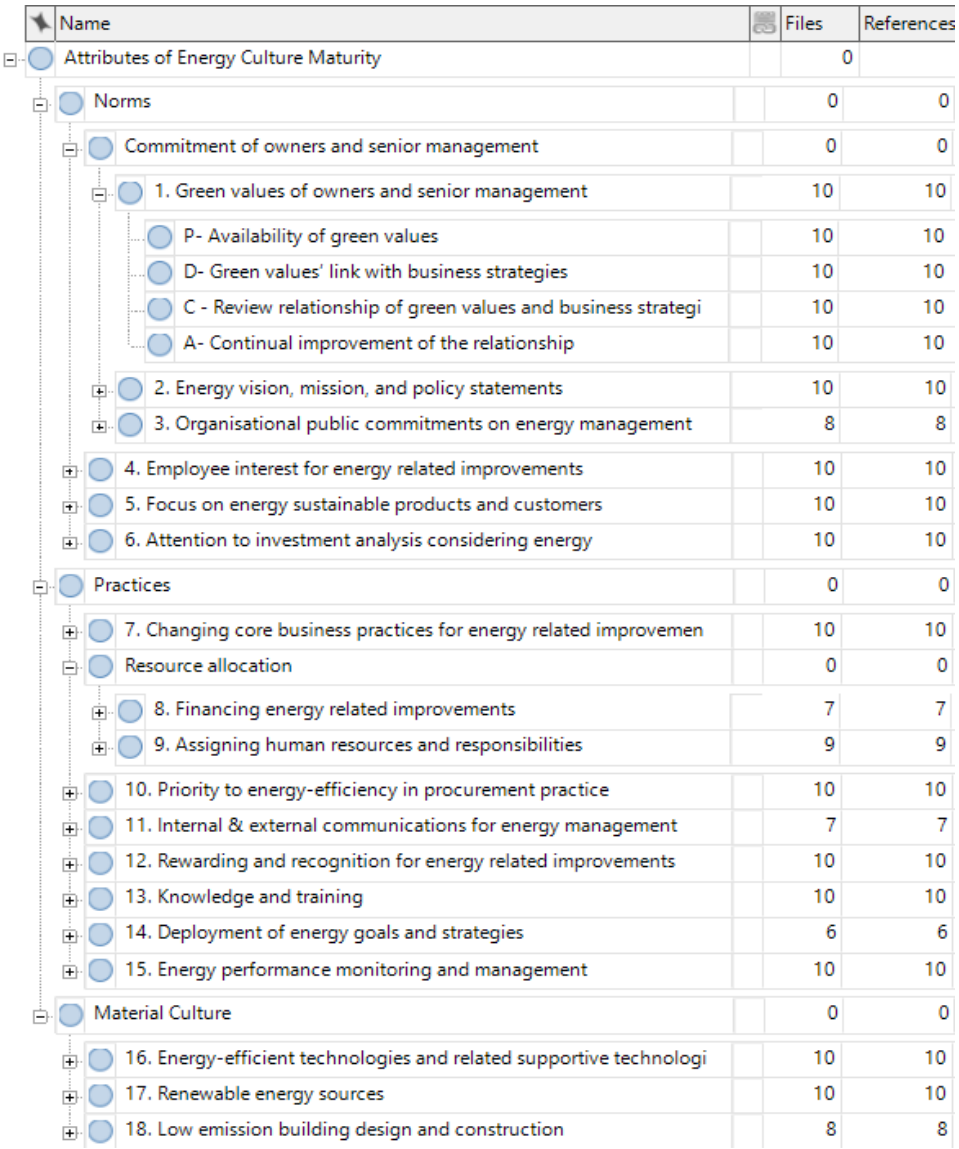
Code	Designation	Experience	Areas of expertise
S1-E1	General Manager - Sustainable Business	16 years	Energy management, energy auditing, environmental sustainability
S1-E2	Deputy General Manager - Engineering	10 Years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance, energy auditing
S1-E3	Manager Environmental Sustainability	12 Years	Energy management, energy auditing, environmental sustainability
S1-E4	Deputy General Manager- Compliance	11 years	Energy management, energy auditing, environmental sustainability
S1-E5	Senior Manager Systems and Compliance	26 years	Energy management, energy auditing, environmental sustainability
S1-E6	Assistant Manager – Sustainability	9 years	Energy management, energy auditing, environmental sustainability
S1-E7	Manager - Environment and Compliance	16 years	Energy management, energy auditing, environmental sustainability
S1-E8	General Manager - Engineering	22 years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
S1-E9	Divisional Head of Maintenance	25 Years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
S1-E10	Senior Manager - Environmental Sustainability	13 years	Energy management, energy auditing, environmental sustainability

Accordingly, 18 energy culture maturity attributes were developed as the findings of Step 1. When developing attributes, Step 1 involved considering the suitability of predetermined attributes of the conceptual framework and allowed emerging new attributes for the context of textile and apparel industrial organisations in Sri Lanka (see Step 1's interview guideline in Appendix 1). The 18 attributes could be categorised under norms, practices, and material culture as six (06), nine (09) and three (03) respectively. Accordingly, sections 4.2.1.1, 4.2.1.2 and 4.2.1.3 describe the development attributes under norms, practices, and material culture, respectively.

Figure 4.1 depicts the coding structure developed based on the findings of Step 1 relating to attributes of the energy culture maturity framework and related PDCA aspects.

Figure 4. 1

Coding Structure for Attributes of the Energy Culture Maturity Framework



Name	Files	References
Attributes of Energy Culture Maturity	0	
Norms	0	0
Commitment of owners and senior management	0	0
1. Green values of owners and senior management	10	10
P- Availability of green values	10	10
D- Green values' link with business strategies	10	10
C - Review relationship of green values and business strategi	10	10
A- Continual improvement of the relationship	10	10
2. Energy vision, mission, and policy statements	10	10
3. Organisational public commitments on energy management	8	8
4. Employee interest for energy related improvements	10	10
5. Focus on energy sustainable products and customers	10	10
6. Attention to investment analysis considering energy	10	10
Practices	0	0
7. Changing core business practices for energy related improvemen	10	10
Resource allocation	0	0
8. Financing energy related improvements	7	7
9. Assigning human resources and responsibilities	9	9
10. Priority to energy-efficiency in procurement practice	10	10
11. Internal & external communications for energy management	7	7
12. Rewarding and recognition for energy related improvements	10	10
13. Knowledge and training	10	10
14. Deployment of energy goals and strategies	6	6
15. Energy performance monitoring and management	10	10
Material Culture	0	0
16. Energy-efficient technologies and related supportive technologi	10	10
17. Renewable energy sources	10	10
18. Low emission building design and construction	8	8

4.2.1.1 Norms

Six (06) attributes developed under the norms for the energy culture maturity framework are elaborated in this section, along with the respective PDCA aspects for each attribute.

Attribute 1: Green values of owners and senior management.

According to Bell et al. (2014) owners and senior management's thinking to lead by example for energy savings shows the green values owned by them. Dew et al. (2017) and Gill et al. (2015) also highlighted the significance of the green values of owners and senior management in this study's conceptual framework. Similarly, all interviewees agreed on the significance of **green values of owners and senior**

management as an attribute that highly affects the energy culture maturity of textile and apparel industrial organisations**.** S1-E6 highlighted that the green values of owners and senior management is one of the essential attributes for any organisation to achieve energy culture excellence. Furthermore, S1-E2 elaborated that

> In our organisation, when we are going for costly investments, we must go for a board paper or CAPEX. In that approval process, the question always comes from the owners and senior management is: Are we going ahead with the latest energy-efficiency technology? Likewise, the sustainability is driven by the owners and senior management.

The attribute was identified under the main category of **commitment of the owners and senior management** under the norms section.

In addition, by evaluating the views of the interviewees, the PDCA aspects for this attribute can be presented as below.

- **Plan:** Availability of green values
- **Do:** Green values' link with business strategies
- **Check:** Review relationship between green values and business strategies
- **Act:** Continual improvement of the relationship between green values and business strategies

Attribute 2: Energy vision, mission, and policy statements.

Based on Walton et al. (2020) an energy policy was included as an attribute in this study's conceptual framework by highlighting a well-established energy policy's capability to drive energy cultural excellence. Similarly, all interviewees agreed on the suitability of including energy policy as an attribute under norms of textile and apparel industrial organisations. However, the attribute was further expanded by S1-E1, S1-E2, S1-E3, S1-E5, S1-E7, S1-E8, S1-E9 and S1-E10 with an addition of energy vision and mission. Hence, the availability of energy vision, mission and policy statements was agreed by the interviewees. According to S1-E10, owners and senior management should act or give prominence to implement energy vision, mission, and policy statements in an organisation: "Whether the senior leadership is adhering and driving the energy, vision, mission, and policy statements or not, should be considered. Therefore, the level of prominence given by owners and senior management for the statements should be included". The attribute could be categorised under the commitment of the owners and senior management as a major category.

In addition, PDCA areas under the proposed attribute can be presented as follows based on the opinions of interviewees.

- **Plan**: Availability of documented energy vision, mission, and policy statements

- **Do**: Level of acceptance of statements by owners and senior management
- **Check**: Reviewing statements
- **Act**: Continual improvement of statements

Attribute 3: Organisational public commitments to energy management.

Most of the interviewees stressed the need to consider organisation's public commitments since this can drive the energy related improvements to a greater extent. According to interviewees it is likely there are public commitments by the textile and apparel industrial organisations. Overall, S1-E1, S1-E3, S1-E4, S1-E5, S1-E6, S1-E7, S1-E8 and S1-E10 proposed the importance of having organisational public commitments to energy management as an attribute under the commitment of the owners and senior management. Therefore, this attribute could be identified as a newly added one outside the attributes referred in the conceptual framework. S1-E1 As further stated that

> Better to include the public commitments made by the owners and senior management for energy-related improvements such as the commitment for Science Based Targets Initiative (SBTi) that focuses on the implementation of the Parris Agreement by limiting the global temperature rise to 1.5^0C compared to the global temperature in the pre-industrial stage. For instance, despite the business growth, our organisation plans to reduce X amount of total absolute carbon emission annually in line with our public commitment for SBTi.

Additionally, by considering the views of the interviewees, the PDCA aspects for this attribute can be presented as

- **Plan:** Availability of energy-related public commitments
- **Do:** Progress of investments on public commitments
- **Check:** Review of public commitments
- **Act:** Continual improvement of public commitments

Attribute 4: Employee interest for energy-related improvements.

S1-E3 highlighted that "even though the energy management is not their key job role, the employees can commit to reducing the energy-related environmental impacts. Therefore, employees' concern on energy-related impacts of their activities is a factor to be considered". All interviewees agreed on using employee interest for energy-related improvements as an attribute in the framework. Walton et al. (2020) and Gill et al. (2015) also stressed the importance of high employee commitment and actively seeking energy related improvements in this study's conceptual framework. Therefore,

the feedback of the interviewees confirmed the attributes applicability in textile and apparel industrial organisations in Sri Lanka.

Further, the below PDCA areas could be identified based on the discussion with the interviewees.

- **Plan**: Employee interest availability for energy related improvements
- **Do**: Employee engagement for energy related improvements
- **Check**: Review employee engagement
- **Act**: Continual improvement of employee engagement

Attribute 5: Focus on energy sustainable products and customers.

Focus on a green marketplace was identified as an attribute under norms in this study's conceptual framework. Walton et al. (2020) highlighted the possible focus of organisations for customer base that seeks environmental sustainability. All interviewees agreed on the need to consider the organisation's focus on the green customer base. Further, many interviewees proposed that the term *product sustainability* should also be integrated into the attribute since textile and apparel industrial organisations largely focused on product sustainability. Hence, the attribute was improved as **focus on energy sustainable products and customers**. S1-E9 expressed that "Product sustainability can be integrated into this. We also have some products like that. For example, in the product label itself, we have mentioned the CO_2 emissions of the product. Likewise, the product-specific energy-related emissions are calculated".

Further, based on the responses of interviewees the following PDCA areas under the proposed attribute could be identified.

- **Plan:** Plans for energy sustainable products and customers
- **Do:** Presence of energy sustainability focussed customers and product sustainability certificates
- **Check:** Review focus for sustainable products and customers
- **Act:** Continual improvement of focus for sustainable products and customers

Attribute 6: Attention to investment analysis considering energy.

Attention to investment analysis considering energy was identified in this study's conceptual framework based on Walton et al. (2020) and Gill et al. (2015). Further, interviewees also highlighted the importance of having the attribute for the textile and apparel industrial organisations. Accordingly, all interviewees confirmed the suitability of attention to investment analysis considering the energy as an attribute of energy culture maturity in textile and apparel industrial organisations. Walton et al. (2020) highlighted the twofold nature of energy-related investment analysis as basic investment analysis, like simple basic payback period and other advanced analysis

techniques. Similarly, interviewees also discussed the availability of basic investment analysis methods such as the simple payback period and lifecycle cost analysis as the potential energy investment analysis methods under the attribute. S1-E2 further stressed the importance of investment analysis:

> We can do energy-efficiency improvements that have the pay back around ten years. But the long durations are not considered in reality. Further, when purchasing significant energy-consuming equipment like a compressor, we cannot just look at the up-front investment. If we are looking only at the upfront investment, it is like buying furniture. We must do lifecycle analysis for such significant investment to ensure that the most energy-efficient equipment is purchased.

PDCA areas under the proposed attribute can be presented as follows based on the views of interviewees.

- **Plan:** Interested in basic investment analysis methods and lifecycle cost analysis
- **Do:** Application of basic investment analysis methods and lifecycle cost analysis
- **Check:** Review investment analysis approaches considering energy
- **Act:** Ensure continual improvement in the investment analysis approaches

Having identified attributes under norms, the following section explains the attributes identified under practices for the energy culture maturity framework.

4.2.1.2 Practices

This section discusses nine (09) energy culture maturity attributes and related PDCA aspects identified for the textile and apparel industrial organisations under the practices component.

Attribute 7: Changing core business practices for energy-related improvements.

Walton et al. (2020) and Dew et al. (2017) identified changing core business practices for energy-related improvements as an attribute under this study's conceptual framework. This attribute explains an organisation's attempts to change core business practices for the purpose of implementing energy related improvements. All interviewees agreed on the suitability of "changing core business practices for energy-related improvements" as an energy culture maturity attribute for textile and apparel industrial organisations. According to S1-E8:

> In some situations, If the machine is energy-efficient, the management is ready to change the business practices. Recently, we took such decisions based on energy. In one factory, we were asked to make the entire plant

> air-conditioned. We proposed to go for dehumidifiers instead of air-conditioning. We designed a separate place to keep the garments according to the change. There is a huge energy saving in that change. Therefore, we can consider businesses' readiness to change their business practices as an attribute to consider in energy culture.

By evaluating the views of the interviewees, the PDCA for this attribute can be presented as

- **Plan:** Plans to change current business practices for energy management improvements
- **Do:** Implementation of the planned changes
- **Check:** Review the need for changing business practices for energy related improvements
- **Act:** Continual improvement of changing business practices for energy related improvements

Attribute 8: Financing energy related improvements.

Financing energy-related improvements was identified by S1-E4, S1-E5, S1-E6, S1-E7, S1-E8, S1-E9, and S1-E10 as a suitable energy culture maturity attribute for the proposed framework. This attribute was not available in this study's conceptual framework. Therefore, can be considered as a new addition from the interviewees. According to interviewees financing is a much important aspect since energy-related improvements need investments most of the time. According to S1-E2 financing should be started at the budget level, which shows the priority of the organisation for energy related improvements. S1-E4 highlighted that "we can say there is an annual budget to finance the energy-related improvements under operational expenses. In that case, we can say that some portion of the profit is allocated for the annual budget for energy-related improvements". Therefore, this attribute could be placed under resource allocation category.

Additionally, PDCA aspects were identified based on the opinions of interviewees under the proposed attribute can be presented as follows.

- **Plan:** Availability of documented annual budget for energy-related improvements
- **Do:** Actual finance allocation for budgeted items
- **Check:** Review the energy budget
- **Act:** Continual improvement of the energy budgeting

Attribute 9: Assigning human resources and responsibilities.

This attribute was also newly added from the data collection. S1-E1, S1-E2, S1-E3, S1-E4, S1-E6, S1-E7, S1-E8, S1-E9, and S1-E10 proposed to consider the **assigning**

human resources and responsibilities as an attribute for the proposed framework. According to interviewees, the right human resource allocation for energy management related jobs is important to ensure proper energy management in an organisation. S1-E6 stated that

> Companies have defined sustainability teams' structure. For example, we have set pillars under the sustainability strategy. Despite the potential employee turnover, we generally have a set structure for sustainability for driving our energy strategy forward. Having a team with experience and expert knowledge for the job is important. For example, someone should have energy management experience, carbon foot printing experience, etc. Whoever in the technical team should have the correct experience and expertise to do the job.

Attribute 9 also could be placed under the resource allocation category like attribute 8.

Based on the opinions of interviewees, the following PDCA aspects could be identified under this attribute.

- **Plan:** Organisation structure with energy-related positions
- **Do:** Assigned energy responsibilities
- **Check:** Review energy-related human resources and responsibilities
- **Act:** Continual improvement of the energy-related human resources and responsibilities

Attribute 10: Priority to energy efficiency in procurement practice.

Walton et al. (2020) and Dew et al. (2017) highlighted the importance of having an energy-efficiency focused procurement criterion. Accordingly, this study's conceptual framework incorporated the same. S1-E7 expressed that "energy-efficiency should be considered when purchasing equipment. For example, we recently purchased a plate washing machine for the factory. In that, also we evaluated the energy-efficiency first. Similarly, any equipment should have an energy-related analysis prior to purchasing". Similarly, all interviewees agreed on the need for energy-conscious procurement practices in the framework. Accordingly, priority to energy-efficiency in procurement practice was identified as an attribute of the energy culture maturity framework. In addition, there was a contradiction about positioning this attribute. In the conceptual framework, this attribute was identified under norms. However, most of the interviewees preferred to identify the attribute under the practices category. Interviewees argued that the procurement can be identified as a day-to-day practice in textile and apparel organisations and, therefore, should be considered under practices rather than norms. Accordingly, the attribute was considered under practices.

This attribute's PDCA aspects were identified below based on the interviewee preferences.

- **Plan**: Availability of energy-related procurement procedure

- **Do**: Implementation of the procurement procedure
- **Check**: Review procurement procedure
- **Act**: Continual improvement of the procurement procedure

Attribute 11: Internal and external communications supporting energy management.

Interviewees discussed the importance of communication as an important element of an energy culture. However, this study's conceptual framework did not include any attribute related to communications. Based on the opinions of S1-E1, S1-E2, S1-E3, S1-E4, S1-E5, S1-E9, and S1-E10, **internal and external communications supporting energy management** was added as an attribute in the proposed framework. S1-E5 expressed the significance of the communication as "organisation should communicate internally up to the grassroot level to create a well-informed workplace on energy management. Further, there should be external communications with the relevant stakeholders".

In addition, based on the interviewees' opinions the PDCA elements were identified as follows.

- **Plan:** Availability of energy-related internal and external communication plan
- **Do:** Implementation of energy-related internal and external communication plan
- **Check:** Review of energy-related internal and external communication
- **Act:** Continual improvement of energy-related internal and external communication

Attribute 12: Rewarding and recognition for energy-related improvements.

All interviewees highlighted **rewarding and recognition for energy related improvements** as an important attribute in an energy culture maturity framework. According to interviewees, appropriate rewarding systems and recognition motivates employees, which results in improvement of the energy culture in many ways. S1-E7 stated that "there should be a rewarding culture in the organisations for energy relate improvements. Therefore, rewarding and recognition can be considered as an important attribute of the proposed energy culture maturity framework. energy Improvements can be rewarded in annual events". Furthermore, Walton et al. (2020) highlighted rewarding and recognition as a vital factor in an energy culture. Accordingly, this study's conceptual framework also incorporated rewarding and recognition for energy-related improvements. However, there was a disagreement about the attribute's position. The conceptual framework had put the attribute under

the norms section. However, most interviewees preferred that to be incorporated under practices because the rewarding and recognition is an activity resulting from energy enhancement practices of employees. Therefore, the attributes position was confirmed under practices.

Interviewees' opinions suggested the below PDCA aspects under the attribute.

- **Plan:** Availability of formal rewarding and recognition mechanism
- **Do:** Status of the rewarding and recognition practice
- **Check:** Review rewarding and recognition mechanism
- **Act:** Continual improvement of rewarding and recognition mechanism

Attribute 13: Knowledge and training.

Walton et al. (2020), Dew et al. (2017), Gill et al. (2015), Bell et al. (2014) and Stephenson et al. (2010) discussed about the relevance of knowledge and training as an energy culture maturity attribute. Therefore, it was incorporated into this study's conceptual framework. Similarly, all interviewees agreed on this suitability of knowledge and training as an attribute for the proposed framework. S1-E3 elaborated on energy-related knowledge and training as an essential attribute. According to S1-E3

> Organisations provide energy knowledge for employees using different mechanisms such as training. For example, organisations send employees for energy-related exhibitions and local training programs. Further, some organisations even send the employees for energy-related foreign training. Accordingly, whether the organisation has required technical knowledge and energy management training can be considered an attribute for the framework.

This attribute was positioned under norms in the study's conceptual framework. Conversely, interviewees preferred to consider the attribute under practices. This was because they identified knowledge and training as a part of activities (practices) of employees than something involved with the values and believes (norms). Hence, this attribute was placed under the practices despite the positioning in the conceptual framework. The following PDCA aspects could be identified based on the interviewees' ideas under this attribute.

- **Plan:** Availability of an annual training plan for energy-related training
- **Do:** Providing training, energy-related knowledge availability
- **Check:** Review of energy-related knowledge and training
- **Act:** Continual improvement of energy-related knowledge and training

Attribute 14: Deployment of energy goals and strategies.

Interviewees highlighted that it is important to consider the deployment part of the energy vision, mission, and policy explained under norms (attribute 2). Hence, the idea was, prior to the energy performance monitoring (attribute 15), there should be provisions about the deployment of energy goals and strategies. Then, the energy performance monitoring follows the deployment of energy goals and strategies. Accordingly, S1-E1, S1-E4, S1-E5, S1-E7, S1-E9 and S1-E10 stressed the need to incorporate **deployment of energy goals and strategies** as an attribute for the framework. S1-E1 further explained that

> I think it better to talk about the strategy deployment. There is no use of the set policies unless those are driven through the deployments. You can have an attribute relating to the deployment of energy goals strategies. We can also consider the things like setting KPIs in accordance with the energy goals and strategies.

This attribute was not available in this study's conceptual framework. Therefore, it was added as a new attribute required for the proposed energy culture maturity framework for textile and apparel industrial organisations. The following PDCA aspects of this attribute could be identified based on the views of the interviewees.

- **Plan:** Availability of long term and short-term energy goals, availability of multiyear and annual strategies
- **Do:** KPIs are available and cascaded down
- **Check:** Review energy-related goals, strategies and KPIs
- **Act:** Continual improvement of energy-related goals, strategies and KPIs

Attribute 15: Energy performance monitoring and management.

Walton et al. (2020) highlighted the aspect of energy performance monitoring based on energy key performance indicators (KPIs) in organisations as an attribute in this study's conceptual framework. All interviewees stated the need to consider **energy performance monitoring and management** under the proposed framework as an essential item. S1-E8 explained the significance of energy performance monitoring and related practices in an organisation. According to S1-E8

> Energy performance monitoring is a vital attribute**.** As I said, we have the KPIs for energy management. Our sustainability division collects energy data from plant maintenance managers and compile it into a report. Then, the status report on KPI achievement is even sent to the directors. The directors also review the status and ask for reasons for the deviations (if any). If required, they provide the resources also to be on track with the KPIs.

Moreover, there was confusion about the position of this attribute. According to this study's conceptual framework the attribute was identified under norms. However, interviewees highlighted the attribute's suitability under practices due to energy performance monitoring being directly related to energy related activities. Hence, the attribute was categorised under practices. According to interviewees' perspectives the following PDCA aspects could be identified under this attribute.

- **Plan:** Availability of proper energy performance monitoring mechanisms
- **Do:** Implementation of energy performance monitoring
- **Check:** Review energy performance monitoring
- **Act:** Continual improvement of energy performance monitoring

Having explained the attributes under practices, the following section explains the attributes relating to the material culture of textile and apparel industrial organisations.

4.2.1.3 Material culture

As the third element, the material culture consists of three (03) attributes relevant for the energy culture maturity framework and the respective PDCA aspects of each attribute.

Attribute 16: Energy-efficient technologies and related supportive technologies.

Availability of energy-efficient technologies was identified as an attribute in this study's conceptual framework based on Stephenson et al. (2010). S1-E2 also stated the importance of highlighting availability of an energy-efficient material culture as an attribute. According to S1-E2

> We have adopted energy-efficient technologies like magnetic bearing chillers and tri-generation plants, which are still less popular. Further, we have made the energy-efficient technologies as the organisation's standard despite the high cost. For instance, we only go for the energy-efficient magnetic bearing chillers for all our new factories.

S1-E9 highlighted the availability of supportive technologies for energy monitoring and controlling, such as the building management systems (BMS). Overall, based on the views of all interviewees, **availability of energy-efficient technologies and related supportive technologies** could be identified as an attribute under the material culture. Based on the interviewees' opinions, the following PDCA aspects could be identified under this attribute.

- **Plan:** Attention to energy-efficient technologies and energy management supportive technologies
- **Do:** Availability of energy-efficient technologies, energy management supportive technologies

- **Check:** Review energy-efficient technologies and energy management supportive technologies
- **Act:** Continual improvement of energy-efficient technologies and energy management supportive technologies

Attribute 17: Renewable energy sources.

All interviewees proposed the need to consider the **availability of renewable energy sources** in organisations as an attribute. Further, S1-E3 highlighted the importance of broadly considering all possible renewable energy options without just limiting to factory rooftop solar projects. S1-E3 further explained that

> We can consider the plans for going renewable energy sources as an attribute. It might not be limited to rooftop solar panels. We may go for other options like constructing a mini-hydro powerplant somewhere and offsetting our energy use with that or power purchasing agreements etc. Likewise, we can check whether the organisations have worked to increase the use of the renewable energy sources.

However, this attribute was not identified in the study's conceptual framework. Therefore, the attribute can be highlighted as a new addition. The below PDCA aspects could be identified based on the discussion with the interviewees under this attribute.

- **Plan:** Plans to implement renewable energy sources
- **Do:** Status of implementation of the planned renewable energy sources
- **Check:** Review the use of renewable energy sources
- **Act:** Continual improvement of the use of renewable energy sources

Attribute 18: Low emission building design and construction.

Most of the interviewees discussed low emission buildings and their relationship with the energy culture maturity. S1-E1, S1-E2, S1-E4, S1-E5, S1-E6, S1-E7, S1-E8, and S1-E10 suggested having **low emission building design and construction** as an attribute under the material culture because the building design and construction have lifecycle impacts on energy consumption and related greenhouse gas emissions of a building. S1-E6 stressed that

> Energy culture matured organisations will go for low emission buildings. So, for example, we can say the facilities are certified for Net Zero carbon. As we go on, the Net Zero certified buildings would be a must in the future. Therefore, better to integrate that here.

Furthermore, this attribute is a new addition since it was not identified under the study's conceptual framework. Based on the opinions of interviewees, the following PDCA elements could be identified under this attribute.

- **Plan:** Attention to low-emission building design and construction

- **Do:** Actual low emission building design and construction, related certifications
- **Check:** Review the status of low-emission building design and construction
- **Act:** Continual improvement in low-emission building design and construction

4.2.1.4 Step 1 summary

As explained above, Step 1 developed energy culture maturity attributes for textile and apparel industrial organisations based on the findings of the expert interviews and attributes identified in the energy culture maturity conceptual framework. Hence, Step 1's attributes development involved verification of attributes identified in the study's conceptual framework and emerging attributes from the expert interviews. This study's conceptual framework (see Section 2.3.4) consisted of 12 attributes. However, the outcome from Step 1 was 18 energy culture maturity attributes identified for textile and apparel industrial organisations. Under 18 attributes, there were 11 attributes taken from the study's conceptual framework. Internal politics attribute was the only attribute dropped from the conceptual framework's attributes due to difficulties of assessing the status of internal politics as per the opinion of the interviewees. Moreover, seven (07) new attributes (attributes 3, 8, 9, 11, 14, 17 and 18) emerged from the findings of Step 1.

There were few position changes between the attributes in the conceptual framework and findings of Step 1. Accordingly, there were four (04) attributes (attributes 10, 12, 13, and 15) that belonged to the norms category under the conceptual framework but were moved to the practices category based on the recommendations of the experts, considering the nature and behaviour of those attributes in textile and apparel industrial organisations.

In addition, Step 1's coding structure that includes the attributes and respective PDCA aspects (see Appendix 10) was used as one of the predetermined coding structures in the Step 2 data collection and analysis, as explained in the Section 3.8.1.2.1

Having identified the attributes for the energy culture maturity framework, the following section presents the development of energy culture maturity descriptors against the identified attributes.

4.2.2 Steps 2 and 3: Developed maturity descriptors and energy culture maturity framework

This section developed the energy culture maturity descriptors and prepared a draft energy culture maturity framework for textile and apparel industrial organisations as Step 2 of the study. In addition, the suitability of Step 1's energy culture maturity attributes were also verified in Step 2. Subsequently, Step 3 refined the draft energy culture maturity framework developed from Step 2, using three (03) focus group

discussions, and established the final energy culture maturity framework for textile and apparel industrial organisations in Sri Lanka (see Figure 4.20 and Table 4.22).

As explained in Section 3.8.1.1.1, Step 2 of Phase I conducted 15 semi-structured interviews with energy experts employed in textile and apparel industrial organisations as given in Table 4.2. Appendix 2 provides the interview guideline used to conduct Step 2 semi-structured interviews. Further, Appendix 7 presents a sample transcript of the Step 2 semi-structured interviews.

Table 4. 2

Details of Energy Experts from Textile and Apparel Organisations

Code	Designation	Experience	Areas of Expertise
S2-E1	Senior Manager Systems and Compliance	26 years	Energy management, energy auditing, environmental sustainability
S2-E2	Senior Manager Environmental Sustainability	13 years	Energy management, energy auditing, environmental sustainability
S2-E3	Manager Environmental Sustainability	12 Years	Energy management, energy auditing, environmental sustainability
S2-E4	Project professional – Environmental sustainability	15 years	Energy management, energy auditing, environmental sustainability
S2-E5	Manager environmental sustainability	11 years	Energy management, energy auditing, environmental sustainability
S2-E6	Deputy General Manager- Compliance	11 years	Energy management, energy auditing, environmental sustainability
S2-E7	Divisional Head of Maintenance	25 Years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
S2-E8	Engineer sustainability	13 years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
S2-E9	Deputy General Manager Engineering	10 Years	Energy management, energy-efficient factory designing and maintenance, energy auditing
S2-E10	Deputy General Manager – Environmental Engineering	21 years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
S2-E11	Manager Environment and Compliance	16 years	Energy management, energy auditing, environmental sustainability
S2-E12	Assistant Manager Sustainability	10 Years	Energy management, energy auditing, environmental sustainability
S2-E13	General Manager Engineering	22 years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
S2-E14	Senior Executive Sustainability	15 years	Energy management, energy auditing, environmental sustainability
S2-E15	Senior Executive Engineering	9 years	Energy management, energy auditing, environmental sustainability

Then, Step 3 of Phase I conducted three (03) focus group discussions to refine the draft energy culture maturity framework developed from Step 2 of Phase I, as explained in Section 3.8.1.1.2. Table 4.3 provides the details of the participants of three (03) focus groups. Each focus group consisted of four (04) participants, including two (02) energy experts employed in textile and apparel industrial organisations (FG-TAEE), one (01) third-party energy expert who has been exposed to energy management in textile and apparel industrial organisations (FG-TEE) and one (01) academic working on culture studies (FG-AE).

Table 4. 3

Participants for the Focus Group Discussions

Focus Group	Code	Designation	Experience	Academic/ Professional Qualifications
Focus group 1	FG1-TAEE1	General Manager - Sustainable Business	16 years	Energy management, energy auditing, environmental sustainability
	FG1-TAEE2	Sustainability Engineer	7 years	Energy management, environmental sustainability
	FG1-TEE 1	Chief Executive Officer	27 years	Energy auditing, energy consultancy
	FG1- AE1	Senior Lecturer	11 years	Culture research, environmental sustainability
Focus group 2	FG2-TAEE1	Manager Environment, Safety & Health Management Systems	12 Years	Energy management, energy auditing, environmental sustainability
	FG2-TAEE2	Compliance Manager	9 years	Energy management, energy auditing, environmental sustainability
	FG2-TEE 1	Senior Energy expert	12 years	Energy auditing, energy consultancy
	FG2-AE1	Senior Lecturer	10 years	Culture research, energy efficiency in buildings
Focus group 3	FG3-TAEE1	Manager-Engineering	10 Years	Energy management, environmental sustainability, energy-efficient factory designing and maintenance
	FG3-TAEE2	Manager – Sustainability	10 Years	Energy management, energy auditing, environmental sustainability
	FG3-TEE1	Manager Energy Management	11 Years	Energy auditing, energy consultancy
	FG3-AE1	Post-doctoral Researcher	11 Years	Culture research, energy-efficiency in buildings

As explained in Section 3.8.1.2.1, this study incorporated predetermined coding and emerging coding under Steps 2 and 3 data collection and analysis. Step 2's predetermined coding structures are twofold as 18 energy culture maturity attributes and related PDCA aspects identified from Step 1 (see Appendix 10) and the five (05) maturity levels related PDCA structure from Finnerty et al.'s (2017a) framework. Finnerty et al. (2017a) framework's PDCA structure is given under each maturity level as listed below.

- **Level 1 (None)**: No "Plan", "Do", "Check" and "Act" structures are available
- **Level 2 (Emerging)**: "Plan" is minor
- **Level 3 (Developing)**: "Plan" is strongly available, "Do" is minor
- **Level 4 (Advancing)**: "Plan" is strongly available, "Do" is strongly available,
- **Level 5 (Leading)**: All "Plan", "Do", "Check" and "Act" are strongly available.

Accordingly, data analysis in Step 2 was conducted using the hybrid content analysis that incorporates both predetermined and emerging codes. Appendix 7 presents a sample transcript developed based on Step2 data collection. QSR Nvivo-12 was used as the CAQDAS in analysing Step 2's data. Details on the data analysis procedure in Step 2 is explained in Section 3.8.1.2.

Then, Step 3 used the draft energy culture maturity framework (The draft framework was made from the content given in each table under each attribute in Step 2 findings presented below) as the predetermined coding structure for data collection and analysis. The purpose of Step 3 was refining Step 2's draft energy culture maturity framework, which was carried out using three (03) focus group discussions. Appendix 3 provides the interview guideline used to conduct Step 3's focus group discussions. Further, Step 3's interview guideline was a highly structured and that led to generating less new data. Therefore, the content was analysed manually as explained in Section 3.8.1.2.2 Appendix 8 provides a sample transcript of Step 3 focus groups.

Further details predetermined coding of the study can be found in Section 3.8.1.2.1 The findings from Steps 2 and 3 are presented together under each attribute except for attribute 16 (maintenance management supporting energy performance), which was developed solely based on Step 3 focus group discussions. Moreover, the findings of the attributes are presented under norms, practices, and material culture, in sections 4.2.2.1, 4.2.2.2, and 4.2.2.3 respectively. Findings of each attribute is presented under two Steps as findings from expert interviews (Step 2) and findings from focus groups (Step3). Lastly, the final energy culture maturity framework refined based on the Step 3 findings is given in Figure 4.20 and Table 4.22. Further, the changes made based on the Step 3 findings to the draft framework is highlighted in light blue in Table 4.22.

4.2.2.1 Norms

This section explains the development of energy culture maturity descriptors under the six (06) attributes relating to norms.

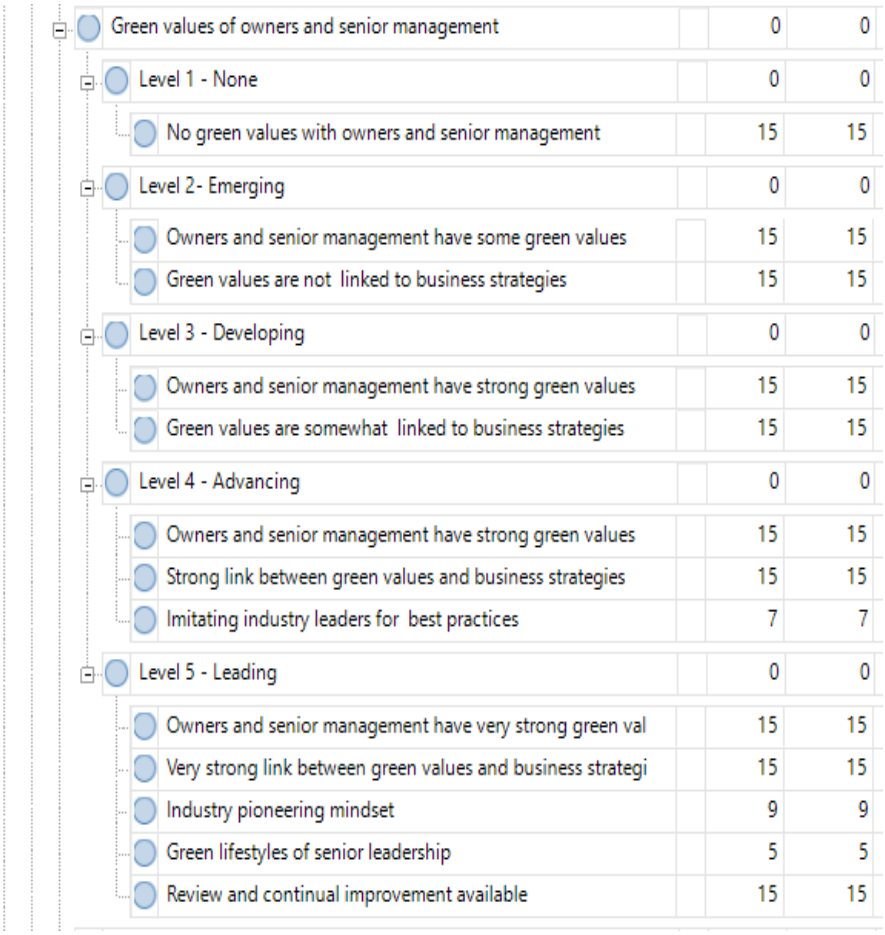
Attribute 1: Green values of owners and senior management.

<u>Findings from Expert Interviews.</u>

Green values of owners and senior management is one of the three (03) attributes under commitment of owners and senior management category. Figure 4.2 depicts coding structure for energy culture maturity descriptors under this attribute.

Figure 4. 2

Coding Structure for Green Values of Owners and Senior Management



Level 1 (none) organisations do not represent any PDCA structure. According to S2-E2, "in a level 1 organisation, owners or senior management do not have green values supporting energy management". Similarly, interviewees agreed that **there cannot be green values with owners and senior management** that promote energy-related improvements in the maturity level 1.

Then, the PDCA structure of the **Level 2 (emerging)** organisations is only limited to some planning (Plan) without any deployments (Do). All interviewees identified this

as a situation where **the owners and senior management have some green values** relating to energy-related improvements. However, interviewees highlighted that the **green values are not linked to business strategies for implementations** since there are no deployments element in level 2.

Level 3 (Developing)'s PDCA status shows the availability of planning (Plan) to a considerable extent**.** S2-E6 highlighted that "I think the owners should have high interest in a level 3 and senior management also should align with that". Similarly, all interviewees agreed that **owners and senior management should have strong green values** at this maturity level. Further, the PDCA structure in this level confirms the existence of minor level deployment (Do). Accordingly, interviewees suggested that the **green values of the owners and senior management are somewhat linked to the business strategies,** and **some results are observed.** However, the link is insufficient to deliver significant results since the deployment part is weak under this level's PDCA structure.

Level 4 (Advancing) organisation's PDCA structure shows strong existence of the Plan and Do elements. Hence, interviewees agreed that there should be **strong green values with owners and senior management**. According to S2-E2, "In an Advancing organisation, there is a strong link between the green values of the senior leadership and the business strategies. Therefore, considerable results can be observed in the deployment side". All interviewees confirmed **the link between the green values of senior leadership and business strategies**. S2-E1, S2-E3, S2-E4, S2-E6, S2-E8, S2-E10 and S2-E12 added that advancing organisations are **imitating the energy management best practices** of the leading organisations in the industry intending to improve in the energy management.

Ultimately, **Level 5 (Leading)** organisations own the most matured status of the green values of owners and senior management, where all four (04) steps of the PDCA structure are completely mature. Interviewees agreed that the **owners and senior management have very strong green values** on energy-related improvements at this level. Further, interviewees proposed a **very strong link between green values of owners and senior management and the business strategies**. S2-E6 identified the mindset of the owners and senior management to be the pioneer. "We need to achieve the number one (01) in the industry for energy-related improvements. So, we are giving all force to achieve that". Further, an organisation's focus to **be the pioneer in the industry** for energy-related improvements was also confirmed by S2-E1, S2-E2, S2-E3, S2-E6, S2-E8, S2-E11, S2-E12, S2-E13 and S2-E15. In addition, S2-E1, S2-E3, S2-E8, S2-E12 and S2-E14 proposed that the owners and senior management **changes their lifestyle** to reduce energy-related emissions. As per the PDCA structure, level 5 is the only place where Check and Act elements are completely available. All interviewees agreed that the level 5 organisations **timely review the effectiveness of the relationship between green values and business strategies to ensure continual improvement**. Table 4.4 presents the green values related to maturity descriptors summary for the five (05) maturity levels derived from the findings of expert interviews.

Table 4. 4

Maturity Descriptors Summary for Green Values of Owners and Senior Management

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1.Owners or senior management are not interested in energy-related improvements.	1. Owners and senior management have some green values for energy-related improvements. 2. The interest is not linked to the business strategies.	1. Owners and senior management have strong green values. 2. Green values are somewhat linked to the business strategies and some results are observed.	1. Owners and senior management have strong green values. 2. Green values are linked to the business strategies, and considerable results are observed. 3. Try to imitate the leading energy management organisations in the industry.	1. Owners and senior management have very strong green values. 2. Green values are very strongly linked to the business strategies, and results are clearly visible. 3. Need to become the pioneer in implementing new energy-related improvements. 4. Both parties display green values through the way they live. 5. Both parties timely review the effectiveness of the relationship between green values and business strategies to ensure continual improvement.

Findings from focus groups.

All participants of the focus group FG1, FG2 and FG3 confirmed the suitability of attribute 1 for the framework. FG1-TAEE 1 advised changing the term "both parties" in descriptors 4 and 5 of level 5 to make it more specific as "**owners and senior management**". All participants in the FG1 agreed on the same. Further, FG2-TAEE1 stated, "In advancing, you say to try to imitate. I think better to use a word like benchmarking instead of term imitate". All participants in the FG2 agreed to use the term **benchmarking** instead of imitating. Furthermore, all FGs agreed with the given content of attribute 1. Accordingly, refined energy culture maturity descriptors are given in Table 4.22.

Attribute 2: Energy vision, mission, and policy statements.

Findings from expert interviews.

Energy vision, mission and policy statements is the second attribute under the commitment of owners and senior management category. Figure 4.3 depicts the coding structure of this sub-attribute.

Level 1 (None) is the lowest maturity level that does not consist of any PDCA elements. S2-E7 mentioned that "level 1 organisations can not have any of the energy vision, mission, and policies". All interviewees agreed on the unavailability of energy

vision, mission, and policy statements in the level 1 organisations due to the absence of any PDCA elements.

Level 2 (Emerging) organisations have the Plan element to a minor extent without any deployments (Do). Interviewees agreed that vague energy vision, mission and policy statements are available in the level 2 organisations. Further, S2-E12 stated that

> I have seen organisations who develop energy vision, mission and policy statements just for facing third party audits. In such organisations, the senior leadership does not have any interest in these statements and, therefore, are not implemented. This kind of organisation fits level 2.

Similarly, interviewees stated that owners and senior management do not care about the statements.

Figure 4. 3

Coding Structure for Energy Vision, Mission, and Policy Statements

The PDCA status of **Level 3 (Developing)** organisations consists of a considerable level of "Plan" element and a minor level of "Do" element. Accordingly, all interviewees agreed on the **availability of properly documented energy vision, mission, and policy statements** in the level 3 organisations. However, interviewees stressed that the **owners and senior management have only a minor acceptance** for the statements since deployment (Do) element is weak. S2-E4 provided an example: "If an energy or environmental sustainability-related employee goes to the owners and

senior management with improvements for energy vision, mission and policy, the owners and senior management will have less interest in those improvements most of the times". In addition, S2-E4, S2-E5, S2-E7, S2-E9, S2-E10, S2-E12 and S2-E15 agreed that the organisations at this level do not have the deployment initiatives for the energy vision, mission, and policy statements and, therefore, the statements are **weakly linked with the organisation's business strategies**.

Considering **Level 4 (Advancing)**, PDCA structure Plan and Do elements are in a stronger position. Accordingly, all interviewees confirmed the availability of **properly documented energy vision, mission, and policy statements**. S2-E9 mentioned that "without being vague, the organisation announces the vision and policy statements with some time-boundness. For instance, we are planning to go for net-zero by 2030". The **time-bound nature of the vision and policy** was also confirmed by S2-E3, S2-E4, S2-E10 and S2-E12 as well. Furthermore, all interviewees confirmed that **owners and senior management have high acceptance** for the statements at this level. In addition, S2-E4, S2-E5, S2-E7, S2-E9, S2-E10, S2-E12 and S2-E15 mentioned that the **statements are linked to the energy strategies** in level 4 organisations since such organisations have considerable deployment as per the PDCA structure's status.

Level 5 (Leading) organisations represent the PDCA structure's fully matured status. Accordingly, all interviewees proposed the availability of **properly documented energy vision, mission, and policy statements** at this level as well. S2-E3, S2-E4, S2-E9, S2-E10 and S2-E12 identified the **time-bound nature of the vision and policy statements** as a feature in a level 5 organisations like level 4 organisations. All interviewees stated that **owners and senior management have a very high acceptance** for the statements. According to S2-E4, S2-E5, S2-E7, S2-E9, S2-E10, S2-E12 and S2-E15, **statements are effectively linked to energy strategies** in level 5 organisations due to high-level deployment under PDCA structure. S2-E4 stated that

> Especially, the energy vision, mission, and policy in this leading level have to be pretty much implementation focussed without limiting to the papers. Organisations should develop strategies to achieve the vision and mission, and they have appointed a team to work on it.

The PDCA structure's Check and Act elements are completely mature in level 5. Accordingly, all interviewees confirmed that the energy vision, mission, and policy statements are **timely reviewed, and actions are taken to ensure the continual improvement** in level 5 organisations.

Table 4.5 presents the summary of the maturity descriptors for energy vision, mission, and policy statements

Table 4. 5

Maturity Descriptors Summary for Energy Vision, Mission, and Policy Statements

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No energy vision, mission, and policy statements are available.	1. There are vague energy vision, mission, and policy statements. 2. Owners and senior management do not care about the statements. 3. The statements are not linked to the energy goals and strategies.	1. There is properly documented energy vision mission, and policy statements. 2. Owners and senior management have only a minor acceptance for statements. 3. The statements are poorly linked to the energy goals and strategies.	1. There are documented energy vision, mission, and policy statements. 2. Energy vision and policy statements may represent a time-bound nature to ensure timely results. 3. Owners and senior management have high acceptance on statements. 4. The statements are linked with energy goals and strategies but still there is a need to improve the effectiveness.	1. There are documented energy vision, mission, and policy statements. 2. Energy vision and policy statements may represent a time-bound nature to ensure timely results. 3. Owners and senior management have a very high acceptance on the statements. 4. The statements are effectively linked to the energy goals and strategies. 5. Statements are timely reviewed for effectiveness, and continual improvement is ensured.

Findings from focus groups.

All participants of the FG1, FG2 and FG3 confirmed the suitability of attribute 2 for the framework. FG1-TAEE1 commented that "it says owners and senior management do not care about statements. Can you reword it? Because the statement is a bit casual. Something like owners and senior management don't see its value". All participants in the FG1 agreed to replace the available term (do not care about the statements) with a more formal term (do not see a value). FG1-AE1 mentioned that "If there is any situation where the energy vision mission and policy statements are linked with energy management strategies and energy culture but not linked with the corporate strategies and corporate culture. If there is such, where it goes?". FG3-TAEE1 also commented that "If organisations want to drive energy sustainability, energy vision mission and policy should be in line with organisations vision and mission as the essential part, if not energy team and the company will go in different directions". Accordingly, FG1 and FG3 participants agreed on the need for a provision for the **relationship between energy vision, mission and policy and the corporate vision and mission** under attribute 2 for levels 4 and 5. Refined energy culture maturity attributes and descriptors are given in Table 4.22.

Attribute 3: Organisational public commitments on energy management.

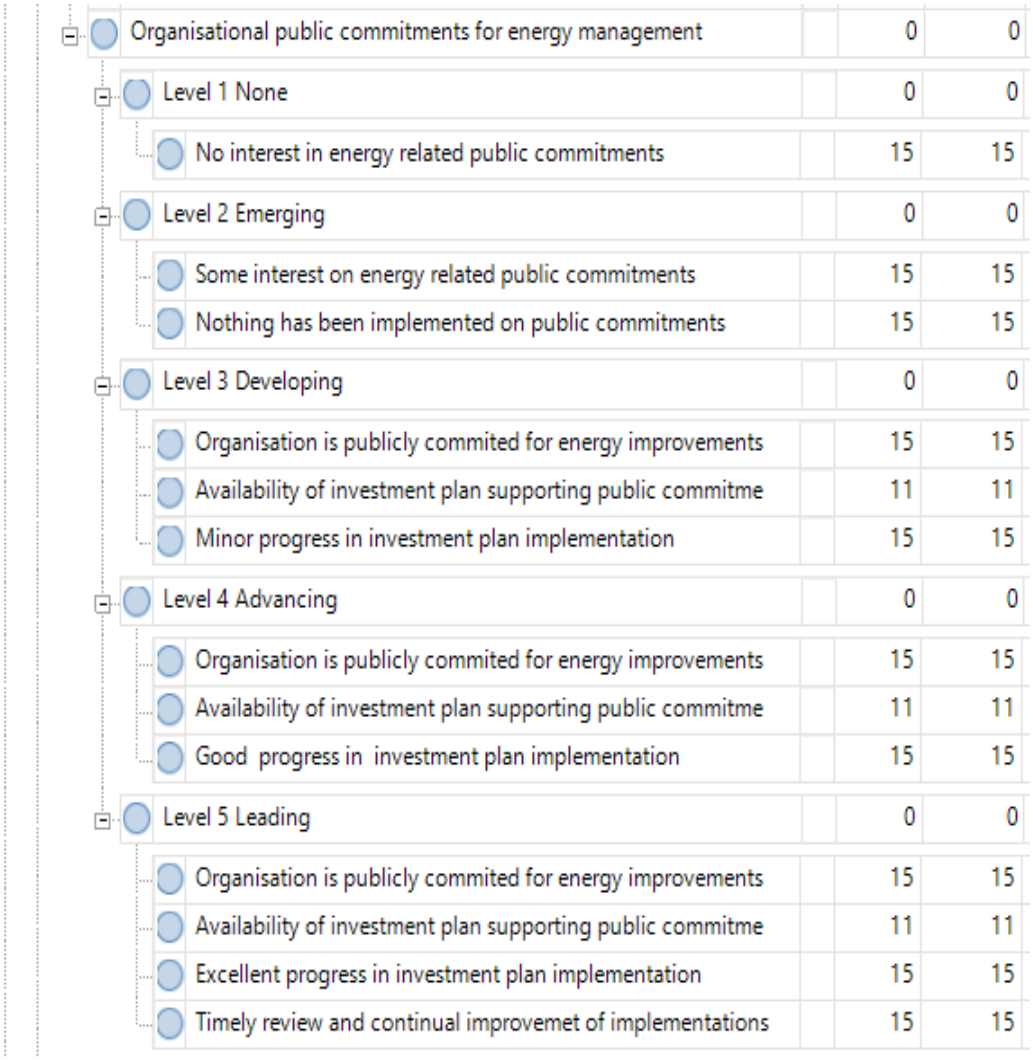
Findings from expert interviews.

Organisational public commitments on energy management are the third attribute that comes under the commitment of owners and senior management category. Figure 4.4 depicts the coding structure of this attribute.

All interviewees agreed that the **level 1 (None)** organisations have **no interest in energy-related public commitments** due to the absence of any PDCA elements. According to S2-E3, "Considering the thinking on public commitments for energy-related improvements, there is nothing in level 1 organisations".

Figure 4. 4

Coding Structure for Organisational Public Commitments



Considering the PDCA structure of the **Level 2 (Emerging)** organisations, all interviewees stated that there is **some interest available for energy-related public commitments** in the level 2 organisations. However, the interviewees confirmed that **nothing is implemented relating to public commitments** in the level 2 organisations.

As stressed by S2-E10, “comparing to higher-level organisations, the emerging organisations have little knowledge on the importance of having public commitments on energy-related improvements, but they do not have proper plans and implementations on the same”.

Level 3 (Developing) organisations have a strong Plan element. In line with that, all interviewees stated that level 3 **organisations have public commitments to energy-related improvements.** Further, S2-E1, S2-E2, S2-E4, S2-E5, S2-E6, S2-E8, S2-E9, S2-E10, S2-E13, S2-E14, S2-E15 confirmed that there should be an **investment plan to support the public commitment on energy improvements**. Based on PDCA structure, all interviewees highlighted that even though there is an investment plan in this type of organisation, there is only **minor progress in the actual deployment of the investment plan.** As confirmed by S2-E5, “People do plan many things, but at the end of the day, they do not really invest or do those things adequately. Organisations of this nature are represented by the level 3”.

Level 4 (Advancing) organisations also have well-established Plan element of PDCA structure. All interviewees confirmed that the level 4 organisations are **publicly committed to energy-related improvements.** The **availability of an investment plan for public commitments** was proposed by S2-E1, S2-E2, S2-E4, S2-E5, S2-E6, S2-E8, S2-E9, S2-E10, S2-E13, S2-E14 and S2-E15. In addition, all interviewees highlighted that the level 4 organisations have **good progress in the implementation of investment plans** compared to a level 3 organisations. “The advancing organisations are working towards deploying the investment plan to meet the public commitments. However, the maximum potential of implementations is not achieved yet,” as stated by S2-E10.

Level 5 (Leading) organisations also consist of the Plan element like levels 3 and 4. Accordingly, all interviewees confirmed the existence of **public commitments for energy-related improvements** in the level 5 organisations as well. Further, S2-E1, S2-E2, S2-E4, S2-E5, S2-E6, S2-E8, S2-E9, S2-E10, S2-E13, S2-E14 and S2-E15 stated the **availability of an investment plan** for public commitments**.** All interviewees highlighted that there is an **excellent progress in the investment plan’s implementation in line with the public commitments.** As stated by S2-E2, “If it is a leading organisation, there should be excellent progress in the investment plan’s implementation related to public commitments. For instance, 80% of the potential renewable energy and energy efficient investments have been explored and implemented”. In addition, all interviewees explained that the implementation progress of the investment plan for **public commitments are timely reviewed**, and actions are taken to **ensure continual improvement** in level 5 organisations.

Table 4.6 presents the maturity descriptors summary developed for under five (05) maturity levels for this attribute.

Table 4. 6

Maturity Descriptors Summary for Organisation's Public Commitments

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No interest in energy-related public commitments.	1. Little interest is available for energy-related public commitments. 2. However, nothing has been implemented relating to public commitments.	1. Organisation is publicly committed to energy-related improvements. 2. There is an investment plan to support the public commitment to energy improvements. 3. There is minor progress in the investment plan implementation.	1. Organisation is publicly committed to energy-related improvements. 2. There is an investment plan to support the commitment to energy improvements. 3. There is good progress in the investment plan implementation.	1. Organisation is publicly committed to energy-related improvements. 2. There is an investment plan to support the commitment to energy improvements. 3. There is excellent progress in the investment plan implementation in line with the public commitments. 4. The progress of the implementation is timely reviewed against the public commitment, and actions are taken to ensure continual improvement.

Findings from focus groups.

All participants of FG1, FG2 and FG3 confirmed the suitability of attribute 3 for the framework. FG2 and FG3 participants highlighted the potential of integrating **scope 1, scope 2, and scope 3 energy-related emission reduction** parallel to the maturity increase. Under that, the levels were defined as; scope 1 commitment from level 3 organisations, scopes 1 and 2 commitment from level 4 organisations, scopes 1, 2 and 3 commitments from level 5 organisations. Furthermore, FG2 participants highlighted that the level 4 and level 5 **organisations obtain support from the supply chain partners for public commitments.** According to FG2-TAEE 2, "we can say that the organisation tries to convince the supply chain partners for energy-related improvements rather than limiting to internal commitments". FG3 also highlighted the organisations working with supply chain partners on energy-related improvements. In addition, FG2-TAEE1 mentioned that "when we say there is a progress of the implementation of the investment plan. We can mention that there is progress towards achievement of the public commitments rather than saying the investment plan specifically here".

All FG2 participants agreed to use the term "**progress towards achievement of public commitments**" rather than using the "progress of the investment plan", which is a narrower term. FG3-TAEE2 also agreed on the use of term "progress towards public

commitments". All FGs agreed on the rest of the arrangements under this attribute. Accordingly, the refined energy culture maturity framework is given in Table 4.22.

Attribute 4: Employee interest in energy-related improvements.

Findings from expert interviews.

Figure 4.5 depicts the coding structure for employee interest in energy-related improvements.

The employees in **Level 1 (none)** organisations usually do not have any interest in the energy-related improvements. Therefore, they also do not engage in any energy-related improvements as suggested by all interviewees considering the respective PDCA structure of level 1. S2-E3 highlighted that "Employees do not bother about the need for energy conservation and energy-related environmental issues. So, they do not take any initiatives to save energy".

Level 2 (emerging) employees are somewhat interested in energy-related improvements as proposed by all interviewees. However, according to the PDCA structure of this level, there is no deployment available. All interviewees confirmed that despite the employees' little interest, there is no actual engagement for energy-related improvements. S2-E10 explained the typical thinking of level 2 employees as "It is good to see the daylight is there. So, I know that I can save 50% of the energy used for lighting in my company by switching off the artificial lights. However, the (employees) do not actually implement that".

Figure 4. 5

Coding Structure for Employee Interest for Energy-Related Improvements

Employee interest for energy related improvements	0	0
Level 1 - None	0	0
No interest for energy related improvements	15	15
Level 2- Emerging	0	0
Some interest on energy related improvements	15	15
No engagement for energy related improvements	15	15
Level 3 - Developing	0	0
High interest on energy related improvements	15	15
Some employee engagement for improvements	15	15
Availability of some informal teams for energy management	6	6
Informal teams are less impactful	7	7
Level 4 - Advancing	0	0
High interest for energy related improvements	15	15
High employee engagement for energy improvements	15	15
Availability of informal employee teams for energy management	6	6
Informal energy teams are active	6	6
Considerable evidance available for employee engagement	8	8
Level 5 - Leading	0	0
Significant interest for energy related improvements	15	15
Excellent employee engagement for energy related improvement	15	15
Availability of informal employee teams for energy management	7	7
Informal teams are very active	7	7
Many evidences for energy improvements by employees	8	8
Availability of strong bottom-up innitiatives	7	7
Lifestyle changes for energy management	5	5

Level 3 (developing) organisations own a strong Plan element under PDCA structure. All interviewees confirmed that the employees are **interested in the need for energy-related improvements** at this level. However, even though there is strong planning at this level, the Do element is limitedly available. In line with that, all interviewees agreed that there is only **limited employee engagement for the actual implementations of energy-related improvements** despite the available interest. For instance, E6 mentioned that "employees are well-aware about the need for the energy management in organisations, but they are mostly silent and have a limited engagement for that". Moreover, S2-E3, S2-E2, S2-E5, S2-E7, S2-E8, S2-E13 and S2-E14 highlighted that there can be **informal volunteer teams interested in the energy-related improvements** in level 3 organisations. The same interviewees confirmed that these **teams are less impactful in implementing energy-related improvements** considering this level's PDCA structure. According to S2-E2, "You can see the availability of informal teams in developing organisations. However, those teams have less impact when it comes to actual energy-related improvements at this level".

Level 4 (advancing) organisations also consist of solid Plan and Do elements. Hence, all the interviewees confirmed that there is **high interest with the employees for energy-related improvement** and **high actual employee engagement for the same** in level 4 maturity. Furthermore, according to S2-E2, "in level 4 organisations, informal teams should have been formed voluntarily for energy management improvements. Further, these employee teams can give a high impact on energy conservation and related improvements at this level". S2-E3, S2-E2, S2-E7, S2-E8, S2-E13 and S2-E14 also confirmed the existence of **informal employee teams that focus on the organisational energy-related improvements** and **actively engaging nature of the teams for energy-related improvements.** In addition, S2-E1, S2-E3, S2-E6, S2-E7, S2-E8, S2-E10, S2-E13 and S2-E15 stressed that the Advancing organisations should show the **evidence of the employee engagement for energy management is available** to a considerable extent.

According to all interviewees, employees representing the **Level 5 (Leading)** maturity show a **significant interest in the need for energy related improvements** and **excellent engagement for energy related improvement**. E6 stated that "Employees always volunteer without waiting for others to act for energy-based improvements. For instance, if a fan is working in some area without any use employees do not wait for someone else to switch off and attend by themselves". Further, S2-E2, S2-E3, S2-E5, S2-E7, S2-E8, S2-E13, and S2-E14 proposed the **availability of informal employee teams** and **very active engagement of the teams for energy-related improvements** in the level 5. Moreover, S2-E1, S2-E3, S2-E6, S2-E7, S2-E8, S2-E10, S2-E13 and S2-E15 stated that **evidence for the employees' engagement is widely available** because of the high-level interest and the engagement by the voluntary energy teams and individuals. In addition, the availability of **strong bottom-up initiatives by employees for energy management** was highlighted by S2-E3, S2-E5, S2-E6, S2-E8, S2-E12, S2-E13, and S2-E15. According to S2-E12

> Employees come to the engineering or sustainability team and tell; Look, here we have done this energy management initiative in our process, please have a look and evaluate this for the appropriateness. Such high-level bottom-up efforts of employees can be assigned to level 5 maturity.

Furthermore, S2-E1, S2-E2, S2-E7, S2-E8 and S2-E13 proposed that the employees in level 5 have even **changed their lifestyle with more energy consciousness**. As further explained by S2-E13, "sometimes organisations invite employees to practice energy-efficient behaviour beyond the workplace. We have seen that employees have gradually reduced their home electricity bills through lifestyle changes. So that the energy-saving mindset has embedded into their DNA". All interviewees agreed that **employee engagement for energy management is timely reviewed,** and **actions taken for the continual improvement** considering level 5's PDCA structure.

Table 4.7 presents the summary of the maturity descriptors for employee interest in energy-related improvements

Table 4. 7

Maturity Descriptors Summary for Employee Interest in Energy-Related Improvements

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Employees do not have any interest on the need for energy-related improvements.	1. Employees have some interest on the need for energy related improvements. 2. There is no employee engagement for energy-related improvements.	1. Employees have high interest on the need for energy related improvements. 2. There is some employee engagement for energy-related improvements. 3. There are some informal teams for energy management. 4. However, the teams are less impactful in driving the potential improvements.	1.Employees have high interest on the need for energy related improvements. 2. High employee engagement for energy related improvements. 3. Informal employee teams are available 4. Informal teams are actively engaging in energy-related improvements 5. Evidence for employee engagement in energy management is visible considerably.	1.Employees have significant interest on the need for energy related improvements. 2. Excellent employee engagement for energy related improvements. 3. Informal employee teams are available. 4. Informal teams are very actively engaged in energy-related improvements 5. Evidence for employees' engagement in energy management is widely available. 6. Strong bottom-up initiatives by employees are clearly visible for energy management. 7. Employees have changed even their lifestyle with more energy consciousness. 8. Employee engagement for energy management is timely reviewed, and actions are taken for continual improvement.

Findings from focus groups.

All focus groups confirmed the suitability of attribute 4 for the proposed framework. Further, FG1-TEE1 mentioned that "companies have energy management best practices, programs, and projects. We can say the employees have different levels of acceptance for those best practices, projects, and programs as per the maturity levels". Accordingly, all participants in the FG1 proposed to replace the term "energy-related improvements" with a specific term "**energy management best practices, programs and projects**". FG2-TAEE1, FG2-TAEE2 and FG3-TAEE2 also agreed on the use of the term "energy management best practices, programs and projects". Furthermore, all FGs were satisfied with the available content under attribute 4.

Attribute 5: Focus on energy sustainable products and customers.

Findings from expert interviews.

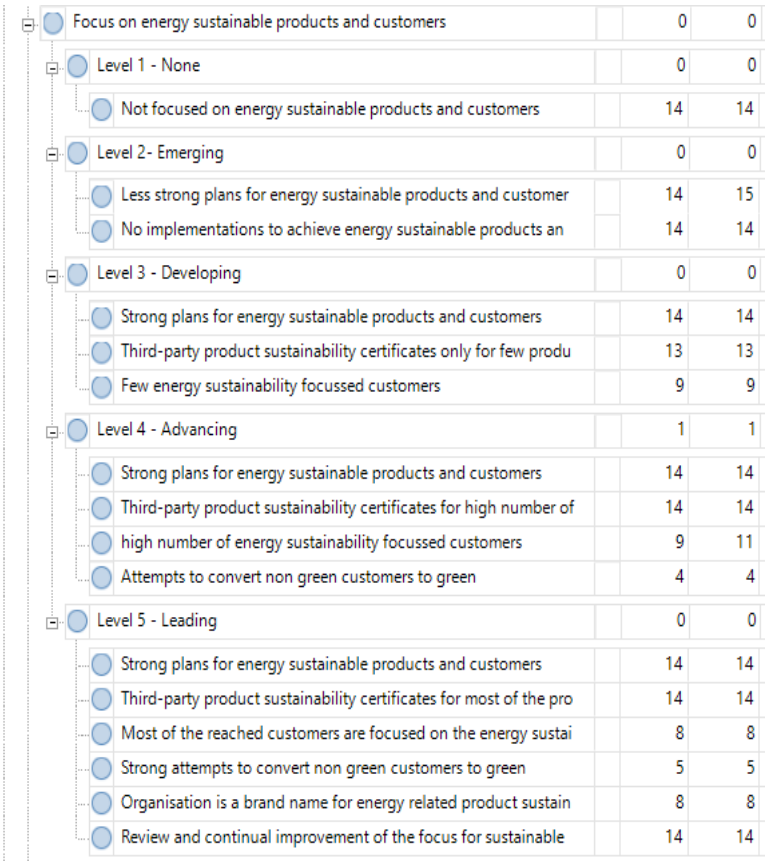
Figure 4.6 depicts the coding structure for the energy sustainable products and customers.

S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E9, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 agreed that **Level 1 (none)** organisations **do not focus on energy sustainable products customers**. As stated by S2-E7 "Usually, organisations can reduce products' energy-related CO_2 emissions using various product sustainability initiatives and then reach sustainability-focused customers with their low carbon footprint products. However, the level 1 organisations never think about such a green marketplace and customers".

Level 2 (emerging) organisations have some planning (Plan) and no deployments (Do) as per the PDCA structure. S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E9, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 confirmed availability of **less intense plans for energy sustainable customers and products.** According to S2-E6, "Emerging organisations have less strong plans to increase energy sustainable products and attract green customers". All the above interviewees agreed that despite the availability of some plans, there is **no actual implementation of the available plans** in the level 2 organisations.

Figure 4. 6

Coding Structure for the Energy Sustainable Products and Customers



Focus on energy sustainable products and customers	0	0
Level 1 - None	0	0
Not focused on energy sustainable products and customers	14	14
Level 2- Emerging	0	0
Less strong plans for energy sustainable products and customer	14	15
No implementations to achieve energy sustainable products an	14	14
Level 3 - Developing	0	0
Strong plans for energy sustainable products and customers	14	14
Third-party product sustainability certificates only for few produ	13	13
Few energy sustainability focussed customers	9	9
Level 4 - Advancing	1	1
Strong plans for energy sustainable products and customers	14	14
Third-party product sustainability certificates for high number of	14	14
high number of energy sustainability focussed customers	9	11
Attempts to convert non green customers to green	4	4
Level 5 - Leading	0	0
Strong plans for energy sustainable products and customers	14	14
Third-party product sustainability certificates for most of the pro	14	14
Most of the reached customers are focused on the energy sustai	8	8
Strong attempts to convert non green customers to green	5	5
Organisation is a brand name for energy related product sustain	8	8
Review and continual improvement of the focus for sustainable	14	14

Level 3 (developing) organisations have **strong plans for energy sustainable products and customers** as proposed by the same interviewees who highlighted this descriptor in level 2. S2-E2 stated that "some organisations might be having 90% of their products as the third-party certified sustainable products, whereas other organisations might be having only a considerably lower percentage of the third-party certified sustainable products and those are the developing organisations". Hence, availability of **third-party product sustainability certificates for a few products** was confirmed by S2-E1, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E9, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 as well. Furthermore, S2-E3, S2-E4, S2-E7, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed that only a **few of the energy sustainability focussed customers** have reached the organisation. S2-E10's statement confirmed this: "Some environmental sustainability-conscious customers are approaching the organisation by identifying the energy sustainability improvements that have been made in the organisation".

Furthermore, **Level 4 (advancing)** organisations have **strong plans for energy sustainable products and customers** as stated by S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E9, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15. Moreover, the availability of the **third-party product sustainability certificates for a high number of products** was highlighted by the same interviewees. According to S2-E6, "level 4 organisations have strong plans to obtain energy-related product

sustainability certificates for their products and have already obtained the certificates for a high number of products*".* In addition, S2-E3, S2-E4, S2-E7, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 highlighted that a **high number of customers focussed on energy related sustainability** have reached the organisation. In addition, S2-E4 highlighted that

> Level 4 organisations should try to convert existing customers to green customers by providing more green products, making them aware and obtaining certifications. I think that is more important rather than finding an already green buyer. So, the advancing organisations should have converted at least some customers who are not green to a green.

The organisation's attempts to **convert non-green customers to green** was proposed by S2-E1, S2-E3, S2-E4 and S2-E10.

Strong plans for energy sustainable products and customers are available in the **level 5 (leading)** organisations like level 4, as confirmed by the same interviewees. The same interviewees stated the availability of **third-party product sustainability certificates for most of the products** in the level 5 matured organisations. S2-E3, S2-E4, S2-E7, S2-E10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 also highlighted that these organisations have **most of the reached customers focused on the energy sustainability.** As stated by S2-E14, "level 5 organisations are usually the pioneers in the industry for energy-related sustainability. As a result, most of the customers with the energy sustainability consciousness approach such leading organisations".

Furthermore, level 5 organisations **vigorously attempt to convert non-green customers to green** as confirmed by S2-E1, S2-E3, S2-E4 and S2-E10. As commented by S2-E1, "organisations demand the customers to change for environmentally sustainable products. Therefore, the organisation initiates the green business avenues and negotiates green business with the customers, such as: we can do these low carbon footprint products for you. Can you commercialise it?". In addition, a level 5 organisation has become **a brand name for the energy-related product sustainability** as explained by S2-E1, S2-E2, S2-E6, S2-E7, S2-E10, S2-E12, S2-E14 and S2-E15**.** According to S2-E10 "level 5 organisations have significantly improved the energy-related environmental sustainability in the organisation to a greater extent. So, the customers are coming behind the organisation". Finally, **timely review and continual improvement of the focus on sustainable products and customers** is available in level 5 organisations as confirmed by S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E9, E S2-10, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15**.**

Table 4.8 presents the summary of the maturity descriptors for the focus on energy sustainable products and customers

Table 4. 8

Maturity Descriptors Summary for the Focus on Energy Sustainable Products and Customers

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1.Organisation do not focus on energy sustainable products and customers.	1. Organisation has less strong plans for energy sustainable products and customers. 2. However, no actual implementations of the plans.	1. Organisation has strong plans for energy sustainable products and customers. 2. Third-party product sustainability certificates focused on carbon footprint reduction have been obtained by the organisation for very few products. 3. Few of the energy sustainability focussed customers have reached the organisation.	1. organisation has strong plans for energy sustainable products and customers 2. Third-party product sustainability certificates focused on carbon footprint reduction have been obtained by the organisation for a high number of products. 4. High number of energy sustainability focussed customers have reached the organisation. 5. Organisation attempts to convert non green customers to green.	1. Organisation has strong plans for energy sustainable products and customers. 2. Third-party product sustainability certificates focused on carbon footprint reduction have been obtained by the organisation for most products. 3. Organisations' most-reached customers are focused on energy sustainability. 4. Organisation strongly attempts to convert non-green customers to green. 5. Organisation has become a brand name for energy-related product sustainability. 6. Organisation has timely review of the status of a focus on energy sustainable products and customers and ensures continual improvement.

<u>Findings from focus groups.</u>

FG1 and FG2 participants proposed to modify the attribute and descriptors to focus on "**carbon footprint reduced products**" without relating this to the "customers". FG3 participants also agreed with the proposed change for the attribute. According to FG1-TAEE1,

> I think it is better to go with the term carbon neutral or low carbon products rather than relating this with customers. Because customers have a range of products, some of the products are low carbon, and some of them are not. So better put the product category than the customer.

Further, FG2-TAEE1 stated that "organisation can innovate eco-conscious products and take to customers. If customers are interested, they would probably come up with

a commercialisation a product out of it". FG2 and FG3 participants agreed on including the **innovation and commercialisation** possibility of reduced carbon footprint products in levels 3, 4 and 5. Participants of FG2 and FG3 highlighted that customers are **reaching organisations capable of manufacturing products with a reduced carbon footprint.** Therefore, that descriptor was also included in level 5.

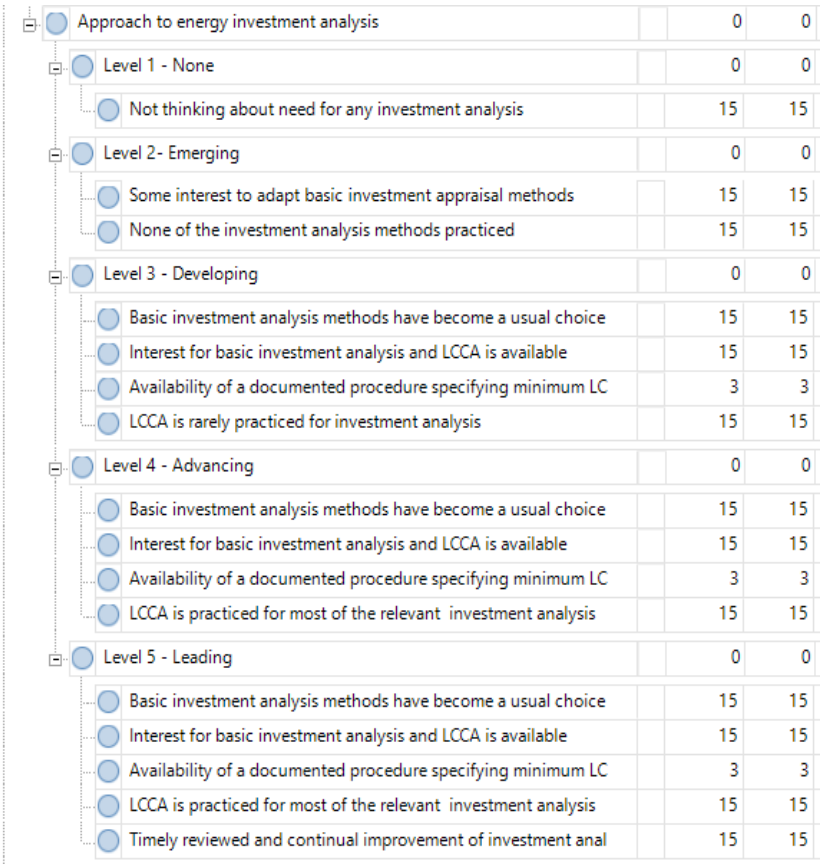
Attribute 6: Attention to investment analysis considering energy.

<u>Findings from expert interviews.</u>

Figure 4.7 depicts the coding structure for attention to investment analysis considering energy.

Figure 4. 7

Coding Structure for Approach to Energy in Investment Analysis



All interviewees agreed that **Level 1 (none)** organisations **do not think about the need for any investment analysis considering energy because** no PDCA elements available at level 1. S2-E2 confirmed that "level 1 organisations do not intend to do any investment return analysis for investments related with energy use".

Considering the PDCA structure, all interviewees suggested that **Level 2 (emerging)** organisations have **some interest to adapt basic investment appraisal methods** such as simple payback period to analyse their investments. However, **none of the**

investment appraisal techniques has been implemented in the level 2 organisations as confirmed by the same interviewees.

Moreover, all interviewees agreed that **Level 3 (developing)** organisations should have the **interest for both basic investment analysis methods and Life Cycle Cost Analysis (LCCA).** However, considering the lack of deployments in this level, interviewees agreed that the **usual practice is mostly basic investment analysis and LCCA is rarely practised** for investment analysis. S2-E3, S2-E9 and S2-E12 highlighted the **availability of a documented procedure specifying the required minimum LCCA results** in the investment analysis. S2-E9 stated that "level 3 organisations have documented SOPs (Standard Operating Procedures) that highlight LCCA should be within a specific range. The documented procedure specifically requests for LCCA calculations".

All interviewees stated that **Level 4 (Advancing)** organisations also **have the interest in both basic investment analysis methods and LCCA as required practices** considering level 4's PDCA structure. Further, interviewees agreed that the deployments (Do) are strong at level 4. Therefore, they stated that **basic investment analysis is always used and LCCA is used for most of the relevant investment analysis.** According to S2-E7

> Some organisations are like this. Even though the T5 lamps are not cost-effective and do not have a good payback period, they have gone for that considering the energy saving in the life cycle. So, there might not be a short-term payback in some of the investments, but still, the organisation is doing that to enhance the energy-related sustainability considering the lifecycle cost. Level 4 organisations undertake such analysis for most of the relevant investments.

Furthermore, S2-E3, S2-E9 and S2-E12 highlighted the **availability of a documented procedure specifying the required minimum LCCA results** for different investment analyses.

Interviewees stated that **Level 5 (Leading)** organisations also **have the interest in both basic investment analysis methods and LCCA as required practices** similar to Level 4 organisations. According to S2-E10, "My view here is like this. We can't expect things like life cycle cost analysis from all companies. Leading companies do that. They consider the whole lifecycle when investing on equipment". Similarly, other interviewees also agreed that the **organisation always uses basic investment analysis and LCCA is used for all relevant investment analysis** in this level. Further, **availability of a documented procedure specifying the required minimum LCCA results for investment** was highlighted by S2-E3, S2-E9 and S2-E12 as a required feature in level 5. All interviewees confirmed that the leading organisations ensures **timely review and continual improvement of the energy in investment analysis approach** since the check and act elements of the PDCA approach matures in this level.

Table 4.9 presents the summary of the maturity descriptors for attention to energy in investment analysis.

Table 4. 9

Maturity Descriptors Summary for Attention to Energy in Investment Analysis

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Do not think about the need for any energy related investment analysis.	1. Organisation has some interest in basic investment analysis methods like simple payback period. 2. However, the investment analysis methods are not implemented.	1. Organisation has the interest for both basic investment analysis methods and life cycle cost analysis (LCCA) as required practices. 2. A documented procedure specifies the required minimum LCCA results. 3. Basic investment analysis techniques are always implemented for energy project assessment. However, the LCCA use is rare.	1. Organisation has the interest in both basic investment analysis methods and LCCA as required practices. 2. A documented procedure specifying the required minimum LCCA results is available. 3. Basic investment analysis are always used and LCCA is used for most of the relevant investment analysis.	1. Organisation has the interest in both investment analysis methods and LCCA as required practices. 2. A documented procedure specifies the required minimum LCCA results. 3. Basic investment analysis are always used and LCCA is used for all relevant investment analysis. 4. The investment analysis approach is timely reviewed, and actions are taken to ensure continual improvement.

Findings from focus groups.

All participants of the FG1, FG2 and FG3 confirmed the suitability of attribute 6 for the framework. Further, FG2-TEE1 mentioned that "better to consider LCCA is for each purchase of significant energy-consuming equipment rather than fast-moving items like bulbs". All FG2 participants agreed on this. Accordingly, the maturity descriptor was amended as LCCA is used for **significant energy consuming equipment.**

Having developed the findings relating to proposed energy culture maturity framework under norms, the next section discusses the findings under the practices element.

4.2.2.2 Practices

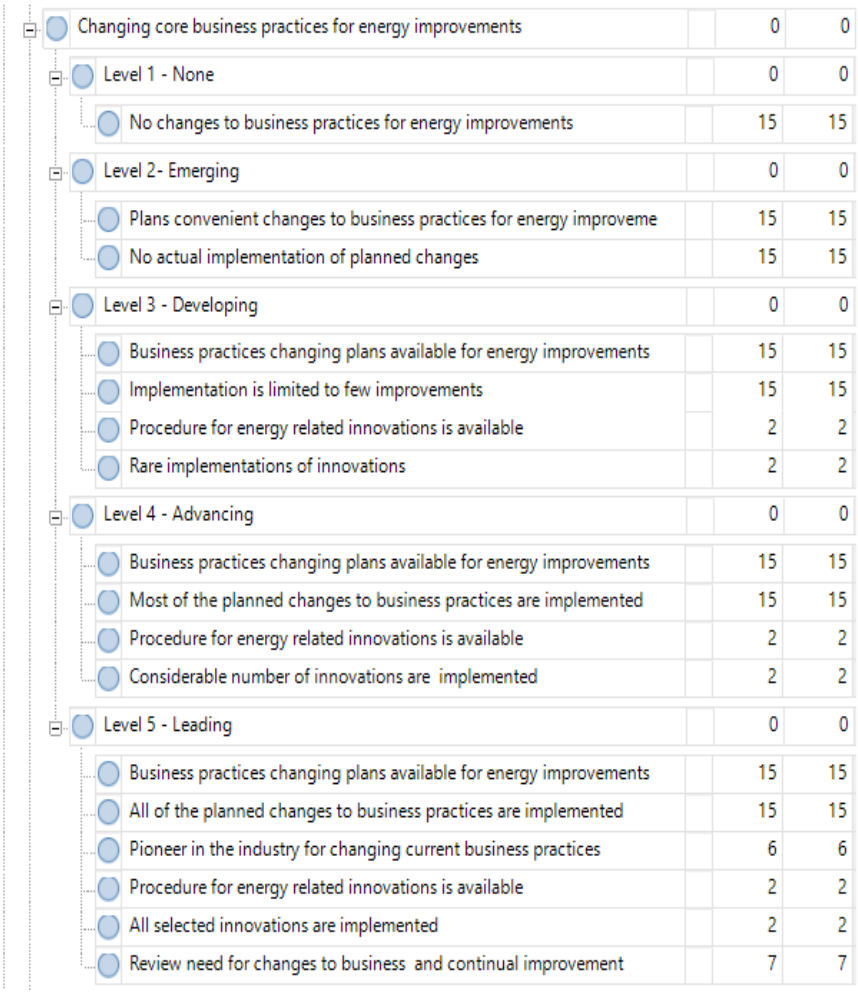
Attribute 7: Changing core business practices for energy-related improvements.

Findings from Expert Interviews.

Figure 4.8 depicts the coding structure for changing core business practices for energy related improvements.

Figure 4. 8

Coding Structure for Changing Core Business Practices for Energy Related Improvements



Changing core business practices for energy improvements	0	0
Level 1 - None	0	0
No changes to business practices for energy improvements	15	15
Level 2- Emerging	0	0
Plans convenient changes to business practices for energy improveme	15	15
No actual implementation of planned changes	15	15
Level 3 - Developing	0	0
Business practices changing plans available for energy improvements	15	15
Implementation is limited to few improvements	15	15
Procedure for energy related innovations is available	2	2
Rare implementations of innovations	2	2
Level 4 - Advancing	0	0
Business practices changing plans available for energy improvements	15	15
Most of the planned changes to business practices are implemented	15	15
Procedure for energy related innovations is available	2	2
Considerable number of innovations are implemented	2	2
Level 5 - Leading	0	0
Business practices changing plans available for energy improvements	15	15
All of the planned changes to business practices are implemented	15	15
Pioneer in the industry for changing current business practices	6	6
Procedure for energy related innovations is available	2	2
All selected innovations are implemented	2	2
Review need for changes to business and continual improvement	7	7

All interviewees stated that **Level 1 (none)** organisations **do not carry out any changes to core business practices to introduce energy-related improvements** considering the PDCA structure of the level 1 organisations. According to S2-E10 "sometimes level 1 organisations [are] ready to do the changes for core business process for some other reasons, but for energy related improvements they do not do any changes for the core business practices".

Considering the PDCA structure of the **Level 2 (emerging)** organisations, interviewees confirmed that level 1 organisations **plan for some convenient changes to business practices for energy management improvements**. As stated by S2-E2 "I think the emerging organisations will focus on the changing exiting business practices to improve their energy-efficiency and sustainability. However, I don't think the organisations would be making changes actually in the business practices". All interviewees confirmed that despite the initial planning there is **no actual implementations** due to the PDCA structure of this level.

Level 3 (developing) organisations consists of a strong planning. Accordingly, all interviewees stated that the organisation **have plans for changing current business practices for required energy management improvements**. Further, interviewees stated that despite the plans for changes, actual **implementation is limited to few improvements** due to the absence of deployment in the PDCA structure in level 3. According to S2-E3 "Developing organisation do limited changes for the business practices for energy management improvements. The priorities can be ad-hoc implementations of the convenient changes". In addition, S2-E3 and S2-E4 agreed that there should **a procedure to identify, evaluate and implement energy related innovations** to change energy inefficient business practices. However, **evidence is rarely visible for the actual implementation** of the selected innovations at this level.

Interviewees agreed that **Level 4 (advancing)** organisations also **plan for changing the current business practices for required energy management improvements** like the level 3 organisations as per the PDCA structure. As stated by S2-E2 "if an organisation is in a level like Advancing, they plan well for changing business practices since they are passionate about energy management". Moreover, interviewees agreed that **most of the planned changes to business practices are implemented** in level 4 organisations comparing to a level 3 organisation. Furthermore, S2-E4 stated that,

> When it comes to changes for business practices to save energy, innovations are a key part. An innovation supported culture must be there in the organisation. So that the innovations are promoted. In Advancing organisations, there should be a procedure for implementation of innovations timely if those are worthwhile.

S2-E3 also confirmed that there should be a procedure to identify and implement energy related innovations to change energy inefficient business practices. Further, S2-E3 and S2-E4 agreed that there should be evidence for the actual implementation of a considerable number of innovations in level 4 organisations.

Level 5 (leading) organisations also plans for changing the current business practices for required energy management improvements as agreed by all interviewees. S2-E3 highlighted that "Level 5 organisations look for all possible significant and non-significant changes to the business practices for better energy management". Further, it was confirmed by the interviewees that the level 5 organisations implement all planned changes for the business practices. S2-E1, S2-E4, S2-E5, S2-E7, S2-E10, and S2-E14 identified level 5 organisations as a pioneer in the industry for changing current business practices for energy management improvements. As highlighted by S2-E10 "The leading organisations are pioneering the changes for business practices in the industry to do energy-related changes. Also, they share their best practices with others". In addition, S2-E3 and S2-E4 stated the availability of a procedure to identify and implement energy related innovations to change energy inefficient business practices in level 5 as well. Moreover, evidence availability for the implementation of all selected innovations was confirmed by both S2-E3 and S2-E4. Further, S2-E1, S2-

E3, S2-E4, S2-E6, S2-E11, S2-E12 and S2-E15 confirmed that the level 5 organisation timely reviews the needs for changing business practices for energy related improvements and actions are taken to ensure continual improvement according to the PDCA structure of level 5.

Table 4.10 presents the maturity descriptors summary under the changing core business practices for energy related improvements attribute.

Table 4. 10

Maturity Descriptors Summary for Changing Core Business Practices for Energy Related Improvements.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Do not change core business practices to introduce energy related improvements.	1. Organisation plans for some convenient changes to business practices to improve energy management. 2. However, nothing is implemented.	1. Organisation plans changes to current business practices for required energy management improvements. 2. However, implementation is limited to few improvements. 3. There is a procedure to identify and implement energy related innovations to change energy inefficient business practices. 4. Evidence is rarely visible for the actual implementation of the selected innovations	1. Organisation plans changes to current business practices for required energy management improvements. 2. Most of the planned changes to business practices are implemented. 3. There is a procedure to identify and implement energy related innovations to change energy inefficient business practices. 4. Evidence is visible for the actual implementation of a considerable number of selected innovations.	1. Organisation plans changes to current business practices for required energy management improvements. 2. All planned changes to business practices are implemented. 3. Organisation is a pioneer in the industry for changing the certain current business practices for energy management improvements. 4. There is a procedure to identify and implement energy related innovations to change energy inefficient business practices. 5. Evidence is visible for the actual implementation of all selected innovations. 6. Organisation timely reviews the needs for changing business practices for energy related improvements and actions are taken to ensure continual improvement.

Findings from focus groups.

All participants of the FG1, FG2 and FG3 confirmed the suitability of the attribute 7 and related energy culture maturity descriptors for the framework.

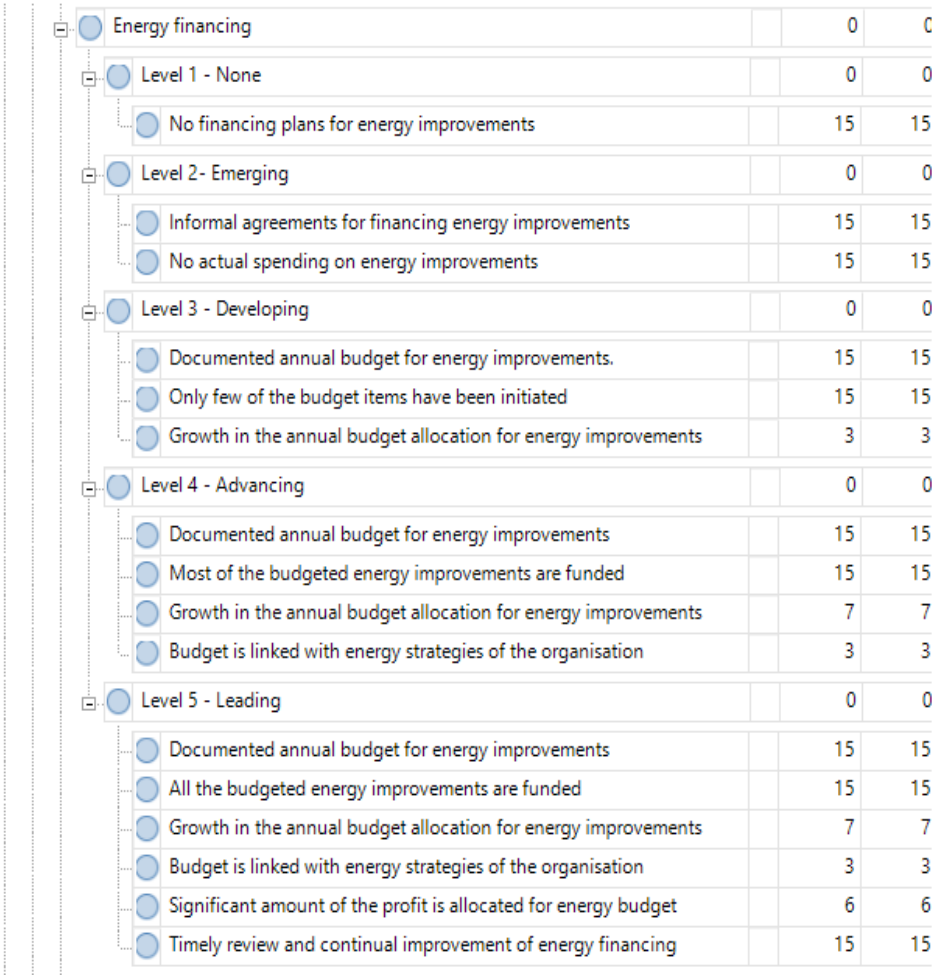
Attribute 8: Financing energy related improvements.

Findings from expert interviews.

Energy financing comes under the resource allocation for energy-related improvements category. Figure 4.9 gives the coding structure for the energy financing attribute.

Figure 4. 9

Coding Structure for Energy Financing



All interviewees agreed that the **Level 1 (none)** organisations have **no financing plans for energy-related improvements** considering the absence of PDCA elements at this level. As stated by S2-E2 "There is no energy improvement budgets in the level 1 organisations".

Furthermore, according to interviewees**, Level 2 (emerging)** organisations have **informal agreements for financing energy improvements without formal budgets**. S2-E3 stated that "Level 2 organisations do not have proper structures to budget energy improvements. People are given informal responsibilities to decide future financing". However, there is not any deployment under the PDCA structure in level 2 organisations. Hence, despite the informal agreements, all interviewees agreed that

there is **no actual spending on energy-related improvements** in level 2 organisations.

Moreover, all interviewees confirmed that **Level 3 (developing)** organisations have a **documented annual budget for energy-related improvements**. Further, the interviewees agreed that despite the availability of the budget, **only few of the budget items have been initiated** since the deployment element of the PDCA structure is not that strong in Level 3. As stated by S2-E10

> the developing type organisations will budget for energy improvements. However, when it comes to actual implementations, they will not spend money as budgeted. They will see cutting down the financial allocations for planned energy efficiency investments as the options to reduce their total expenditure, considering energy-related improvements as a lower priority.

In addition, S2-E2, S2-E3 and S2-E13 stated that there is a **growth in the annual budget allocation for energy related improvements** over the time in developing organisations. S2-E2 explained that "there should be a slow growth of the budget allocations in developing, advancing and leading organisations".

Level 4 (advancing) organisations have a strong Plan element. Hence, all interviewees agreed to the addition of the availability of a **documented annual budget for energy-related improvements**. Further, interviewees stated that **most of the budgeted energy-related improvements are funded** in level 4. S2-E2, S2-E3, S2-E7, S2-E8, S2-E11, S2-E13 and S2-E14 confirmed that there is a **growth in the annual budget allocation for energy-related improvements** over the time in advancing organisations. In addition, S2-E4, S2-E10 and S2-E11 proposed that the **budget should be linked with the energy goals and strategies of the organisation** in the advancing organisations. According to S2-E4

> I think the budget should be connected to energy improvement related strategies in Advancing organisations. Otherwise, you are doing projects, but it is not related to the organisation's energy improvement agenda or the long-term plan. We do finance to do something to achieve something. Therefore, financing should be well connected to what you want to achieve.

Level 5 (leading) organisations also have **documented annual budget for energy related improvements** as agreed by all interviewees, like level 3 and 4. According to interviewees, level 5 organisations **funds all the budgeted energy-energy improvements** unlike the organisations in other levels. S2-E10 expressed that "level 5 companies are not like the lower-level companies. They will budget for the energy improvements adequately and they will definitely give the priority for that and implement all planned improvements". A **growth in the annual budget allocation for energy-related improvements** over the time in level 5 organisations was confirmed by S2-E2, S2-E3, S2-E7, S2-E8, S2-E11, S2-E13 and S2-E14. According

to E4, E10 and E11 the **budget should be linked with the energy goals and strategies of the organisation** in Level 5 as well. According to S2-E11

> In a business, usually it says that a strategy always links with the P & L. That is true. It is not possible to implement strategies if those are not financed. Therefore, energy budget should be linked to the energy strategies of the organisation. This linkage is clearly visible in the leading organisations.

In addition, S2-E1, S2-E2, S2-E5, S2-E7, S2-E12 and S2-E15 proposed that Leading organisations **allocate significant amount of the profit for the energy budget.** S2-E2 confirmed that

> You can say considerable, or a significant amount of the profit is allocated for the energy budget in a level 5 energy culture. Here when you say significant amount it does not have to be 50% or 60% of the total profit. It might be 5% or even less but it is comparatively significant.

Since results and improvement elements of the PDCA structure matures at level 5, all interviewees agreed that the **energy budget is timely reviewed, and actions are taken to ensure continual improvement** in Leading organisations.

Table 4.11 presents the energy financing related maturity descriptors summary.

Table 4. 11

Maturity Descriptors Summary for Energy Financing

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No financing plans for energy related improvements.	1. Informal agreements on energy improvements related to future spending without formal budgets. 2. No actual spending on energy related improvements.	1. There is a documented annual budget for energy improvements. 2. However, only a few of the budget items have been initiated. 3. There is a growth in the annual budget allocation for energy related improvements over time.	1. There is a documented annual budget for energy improvements. 2. Most of the budgeted energy improvements are funded. 3. There is a growth in annual budget allocation for energy related improvements over time. 4. The energy budget is linked with the energy goals and strategies of the organisation.	1. There is a documented energy budgeted that is annually prepared. 2. All budgeted energy improvements are funded. 3. There is a growth in annual budget allocation for energy related improvements over time. 4. The energy budget is linked with the energy goals and strategies of the organisation. 5. Significant amount of the profit is allocated for the energy budget. 6.Energy budget is timely reviewed and action taken to ensure continual improvement.

Findings from focus groups.

All participants of the FG1, FG2 and FG3 confirmed the suitability of attribute 8 for the framework. All FGs agreed that the need for division of the financing/ budgeting in to two (02) areas as **capital expenditure** and **operational expenditure** rather than focusing on a single annual energy budget. Furthermore, all FGs confirmed the need to consider the operational energy **budget as a percentage from the energy expenditure** rather than showing as a percentage from profit. FG1-TEE1 highlighted that "energy expenses represent the energy-related attributes of a company. Hence, percentage out of that as the annual operational energy budget is ideal than the percentage from profit". Moreover, FG1 and FG2 proposed that level 5 organisations **do not need much capital spending** since most of the improvements have been already done at level 5. As expressed by FG2-TEE1 "here energy related capital investments at the initial levels should be high but when most of the things have been installed in the matured organisations the required investments are less".

Attribute 9: Assigning human resources and responsibilities.

Findings from expert interviews.

Figure 4.10 gives the coding structure for the energy financing attribute.

Figure 4. 10

Coding Structure for Assigning Human Resources and Responsibilities

Assigning people and responsibilities	0	0
Level 1 - None	0	0
No one is responsible for energy management	15	15
Level 2- Emerging	0	0
Nominal appointment of existing employee for energy manageme	15	15
Employee is not assigned with energy management responsibilities	15	15
Level 3 - Developing	0	0
Organisation structure with positions responsible for energy mana	15	15
Limited energy responsibilities are assigned to employees	15	15
Availability of energy KPIs for employees	6	6
Few KPIs only linked to the responsibilities of employees	6	6
Limited number of required positions are recruited	7	7
Level 4 - Advancing	0	0
Organisation structure with positions responsible for energy mana	15	15
Most of the energy responsibilities are asigned to relevant employe	15	15
Availability of energy KPIs for employees	6	6
Most KPIs are linked to the responsibilities of employees	6	6
Moderately effective cross-functional energy teams are available	6	6
Considerable number of required positions are recruited	7	7
Level 5 - Leading	0	0
Organisation structure with positions responsible for energy mana	15	15
All energy responsibilities are asigned to relevant employees	15	15
Availability of energy KPIs for employees	6	6
All KPIs are linked to the responsibilities of employees	6	6
Effective cross-functional energy teams are available	6	6
Timely review and continual improvement of human resources allo	15	15

According to S2-E1 “You cannot see a responsible person available for the energy management in level 1 organisations”. Similarly, all other interviewees agreed that **No one is responsible for energy management** in the **Level 1 (none)** organisations since there is not any maturity elements of the PDCA structure in level 1.

According to all interviewees in **Level 2 (emerging)** organisations, there can be a **nominal appointment of an existing employee for energy management.** S2-E11 highlighted that

> …an employee in the middle or lower management is assigning to look after energy management matters. This is mostly a nominal appointment specially to face the external audits and things like that. There is no involvement from the senior management for active energy management and this position is mostly isolated.

Further, the same interviewees agreed that the **employee is not assigned with energy management responsibilities** in level 2 organisations.

Leve 3 (developing) organisations have a strong Plan element. Accordingly, all interviewees agreed that there is an **organisation structure with responsible positions for energy management** in level 3. However, interviewees agreed that only **limited energy management responsibilities are assigned for relevant employees** since the deployment part of the PDCA structure is week in level 3. According to S2-E3 “In Level 3, we can say that the energy management related employees are assigned with only few of the energy related responsibilities”. Further, S2-E3, S2-E4, S2-E5, S2-E8, S2-E12, and S2-E13 interviewees agreed to add the **availability of energy KPIs for employees** in the level 3 organisations. As stated by S2-E4 “I think the KPIs should come into this level. It is not only assigning duties, but availability of the energy KPIs should also be part of that in the level 3 organisations”. Finally, the same interviewees agreed that **only a few KPIs are linked to the responsibilities of employees** due to the lack of deployment of PDCA structure at level 3. Furthermore, S2-E2, S2-E4, S2-E5, S2-E8, S2-E11, S2-E12 and S2-E13 highlighted those level 3 organisations **only fulfil some of the recruitments for energy management**.

Level 4 (advancing) organisations also consist of an **organisation structure with responsible positions for energy management** as agreed by the same interviewees who proposed this descriptor for level 3. Further, the same interviewees commented for level 3 on the same matter agreed that level 4 organisations have **assigned most of the energy management responsibilities to relevant employees.** S2-E1 proposed that “level 4 organisations have assigned most of the energy related job duties in the job descriptions itself for the energy management related employees”. In addition, S2-E3, S2-E4, S2-E5, S2-E8, S2-E12, and S2-E13 stated there should be availability of a **set of energy KPIs for energy related employees in the organisations**. Further, same interviewees confirmed that **most of the KPIs are linked to their responsibilities** in advancing organisations. In addition, there should be **availability of moderately effective cross-functional energy teams** in the level 4 organisations, as identified by S2-E1, S2-E3, S2-E6, S2-E12, S2-E13, and S2-E15. According to S2-E15 “there are

energy teams appointed which attends energy management projects, etc. But the responsibilities are not properly defined in these teams. Formally assigning responsibilities needs improvements". S2-E2, S2-E4, S2-E5, S2-E8, S2-E11, S2-E12 and S2-E13 highlighted those level 4 organisations **fulfil considerable number of required recruitments for energy management**. As highlighted by S2-E2

> Level 4 organisations recruit most of the required positions but still some of the recruitments are not done. For example, they have identified that they need 10 energy managers for 10 factories. But they will only allocate energy managers for most critical factories and for other factories they will say that one manager can look after [a] few factories, or they will say that next year we will look at the rest of the factories and so on.

Moreover, **Level 5 (leading)** organisations are featured with both **organisation structure with responsible positions for energy management** and **assignment of all energy responsibilities to relevant employees**, as confirmed by the same interviewees who commented on the two (02) descriptors in level 4. As expressed by S2-E3 "energy representation is available from the senior management and downwards and there are positions to represent different levels of the organisations. Duties and responsibilities of all energy-related employees have been clearly defined and assigned in level 5 organisations". S2-E3, S2-E4, S2-E5, S2-E8, S2-E12, and E13 confirmed the existence of a **set of energy KPIs for energy related employees** in level 5 organisations like level 4. **All KPIs are linked to their responsibilities of the energy-related employees** as per the further comments of the same set of interviewees. Moreover, **availability of effective cross-functional energy teams** was proposed for level 5 organisations by S2-E1, S2-E3, S2-E6, S2-E12, S2-E13, and S2-E15. According to S2-E12 "there can be a dedicated energy team with the defined responsibilities on energy management. It works as a cross – functional team across the departments. They can drive energy related improvements in the organisations". S2-E2, S2-E4, S2-E5, S2-E8, S2-E11, S2-E12 and S2-E13 highlighted those level 5 organisations **fulfil all required recruitments for energy management**. Unlike other levels, level 5 fulfils the whole PDCA structure. Hence, the review and continual improvement presence at level 5. All interviewees stated that the level 5 matured organisations **timely review energy related human resources** and **take actions to ensure continual improvement of the human resources allocation** for energy management.

Table 4.12 summarised the energy culture maturity descriptors for assigning human resources and responsibilities.

Table 4. 12

Maturity Descriptors Summary for Assigning Human Resources and Responsibilities

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No one is responsible for energy management .	1. Nominal appointment of an employee doing another job role for energy management. 2. The employee is not assigned with energy related responsibilities.	1. Organisation structure with responsible positions for energy management is available. 2. However, only some of the energy management responsibilities are assigned to relevant employees. 3. Set of energy KPIs are available for employees. 4. Few KPIs are linked to the responsibilities of employees. 5. Some of the required recruitments for energy management are provided.	1. Organisation structure with responsible positions for energy management is available. 2. Most of the energy management responsibilities are assigned to relevant employees. 3. Set of energy KPIs are available for employees. 4. Most of the KPIs are linked to the energy responsibilities of the employees. 5. Availability of moderately effective cross-functional energy teams. 6. Fulfil considerable number of required recruitments for energy management.	1. Organisation structure with responsible positions for energy management is available. 2. All energy management responsibilities are assigned to relevant employees. 3. Set of energy KPIs are available for employees. 4. All KPIs are linked to the energy responsibilities of the employees. 5. Availability of effective cross-functional energy teams. 6. All required recruitments for energy management are fulfilled. 7. Timely review of energy related human resources and actions taken to ensure continual improvement.

Findings from focus groups.

All participants of the FG1, FG2 and FG3 confirmed the suitability of attribute 9 for the framework. All FGs expressed the need to consider the **energy-based qualifications and competencies** of the energy-related employees in higher maturity levels. FG1-TEE1 stated that "When talking about energy related qualifications, are they hiring an engineer or a diploma holder or whatever like that for the energy management jobs? That matters a lot". FG2-TAEE2 stated that "Energy related responsibilities can be allocated to an existing person as a role expansion without providing any additional resources in level 2 organisations. Just put it on somebody who already handles another role and not qualified adequately". Other participants also

agreed with the addition of **assigning energy management responsibilities to non-technical employee doing another job role**.

Attribute 10: Priority to energy-efficiency in procurement practice.

Findings from expert interviews.

The coding structure for the priority to energy-efficiency in procurement practice attribute is given below in Figure 4.11.

Figure 4. 11

Coding Structure for The Priority to Energy-Efficiency in Procurement Practice

Priority for energy-efficiency in procurement practice	0	0
Level 1 - None	0	0
Never consider energy efficiency for procurement evaluation criteria	15	15
Level 2- Emerging	0	0
Basic procurement instructions focussed on energy efficiency	15	15
Procurement instructions are not properly documented	8	8
Energy-efficient procurement instructions are not followed	15	17
Level 3 - Developing	0	0
Availability of energy-related comprehensive procurement procedure	15	15
Procurement procedure is properly documented	8	8
Most of the energy related procurements bi-pass the procedure	15	15
Level 4 - Advancing	0	0
Availability of energy-related comprehensive procurement procedure	15	16
Procurement procedure is properly documented	8	8
Most energy significant procurements follows the procedure	15	15
Minimum energy performance requirement available for some equipm	4	4
A procurement person is a member of the energy team	3	3
Level 5 - Leading	0	0
Availability of energy-related comprehensive procurement procedure	15	15
Procurement procedure is properly documented	15	15
Procurement procedure is implemented in all relevant procurements	8	8
Minimum energy performance requirement available for some equipm	4	4
A procurement person is a member of the energy team	2	2
Timely review of procurement procedure and ensure continual improve	15	15

According to S2-E2 “criteria for the procurement evaluation is mainly the initial cost in Level 1 organisations. So, the energy-efficiency is never considered as a part of the procurement evaluation criteria”. All interviewees agreed that **Level 1 (none)** organisations **never consider energy efficiency as a part of the procurement evaluation criteria**, considering the absence of any element of the PDCA structure in level 1.

Level 2 (emerging) organisations consists of a limited Plan element without deployments. All interviewees confirmed that level 2 organisations have **certain basic procurement instructions focussed on energy-efficiency.** S2-E2, S2-E3, S2-E7, S2-E8, S2-E10, S2-E11, S2-E14, and S2-E15 further stated that the **procurement instructions are not properly documented**. S2-E15 explained that “Level 2

emerging organisations may have some procurement instructions given to the parties relevant for procurement, but it is not documented yet". However, all interviewees agreed that **procurement instructions focussed on energy-efficiency are not followed by the procurement division.**

According to S2-E3 "complete procurement procedure should be available in the developing level since the approach under PDCA structure is available for this level organisations". **Availability of energy-related comprehensive procurement procedure** was agreed for the **Level 3 (developing)** organisations by all interviewees. S2-E2, S2-E3, S2-E7, S2-E8, S2-E10, S2-E11, S2-E14, and S2-E15 proposed that the **procurement procedure is properly documented** in developing organisations. S2-E2 highlighted that "In developing level people might be bypassing the existing procurement procedure. Therefore, the majority of the procurements bypasses the energy aspects of the procurement procedure. Considering the lower deployment under the PDCA structure in developing organisations". Similarly, all other interviewees also confirmed that despite the availability of the comprehensive energy related procurement procedure, still **most of the energy related procurements do not follow the procedure**.

The same interviewees who commented in Level 3 on the availability of comprehensive procurement procedure and documented nature of the procedure agreed that the **Level 4 (advancing)** organisations also have an **energy-related comprehensive procurement procedure** and **properly documented nature of the procurement procedure**. Further, all interviewees agreed that the available energy-related **procurement procedure is implemented in most of the energy significant procurements** and still there are some procurements that bypass the procedure. According to S2-E8

> There are businesses that consider the energy impact in the procurement process. Such companies do two (02) procurement evaluations as technical evaluations and financial evaluations before purchasing as per the procurement procedure. Under the technical evaluation, energy is a major consideration. The advancing organisations usually consider such energy impact in most of the procurements.

In addition, S2-E4, S2-E6, S2-E9 and S2-E12 commented that there can be a **specific minimum energy performance requirement available in the procedure for some equipment**. S2-E4 explained that "For example, let's say company X has decided only to purchase air conditioning systems with certain minimum energy performance, that can be specified in the procurement procedure. Then, you think on those lines from the beginning of the procurement process". Furthermore, S2-E1, S2-E3, and S2-E12 identified that **a procurement person is a member of the energy team** in advancing organisations.

Furthermore, **Level 5 (leading)** organisations also have a **energy-related comprehensive procurement procedure** and **properly documented nature of the**

procurement procedure as proposed by the same interviewees about level 4. The procedure's implementation in level 5 was highlighted by S2-E3 as

> When we go to level 5 organisations, the procurement procedure is 100% practiced. Anybody who do a purchase always adhere to the procedure. Likewise, at any given time adherence to the procedure is evidenced in the organisation throughout all the procurement activities.

Similarly, S2-E2, S2-E4, S2-E7, S2-E8, S2-E10, S2-E11, S2-E13, and S2-E15 agreed that the **procurement procedure is implemented in all relevant procurements** in level 5. S2-E4, S2-E6, S2-E9 and S2-E12 proposed that the availability of **specific minimum energy performance requirement in the procedure for some equipment** for level 5. According to S2-E12

> The procurement person should be a member of the energy team in the level 5. Then, he gets familiar with the energy programs of organisation like Science Based Targets Initiative and related commitments. Procurement team involves with suppliers. When procurement team has energy knowledge, they can clearly communicate the requirements to the suppliers.

S2-E1 and S2-E3 also agreed that **a procurement person is a member of the energy team** in level 5 organisations as well. Finally, since Leading organisations have matured Check and Act elements of the PDCA structure, all interviewees agreed with the characteristics **procurement procedure is timely reviewed** and **take actions to ensure continual improvements** of the energy related procurement process.

Table 4.13 below presents the summary of the maturity descriptors under this attribute.

Table 4. 13

Maturity Descriptors Summary for Priority to Energy-Efficiency in Procurement Practice

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Energy-efficiency is never considered as part of the procurement evaluation criteria.	1. Certain basic procurement instructions are available that considers energy. 2. Procurement instructions are not properly documented. 3. Procurement instructions	1. Energy related comprehensive procurement procedure is available. 2. The procurement procedure is properly documented. 3. However, it is implemented on certain	1. Energy related comprehensive procurement procedure is available. 2. The procurement procedure is properly documented. 3. It is implemented in most of the energy significant procurements. Still there are some procurements that	1. Energy related comprehensive procurement procedure is available. 2. The procurement procedure is properly documented. 3. Procurement is implemented in all relevant procurements. 4. Specific minimum energy performance requirement available in the procurement

	focussed on energy-efficiency are not followed by the procurement division.	procurements only. Still, most of the energy related procurements do not follow the procedure.	bypass the procedure. 4. Specific minimum energy performance requirement available in the procurement procedure for some equipment. 5. A procurement person is a member of the energy team.	procedure for some equipment. 5. A procurement person is a member of the energy team. 6. Procedure is timely reviewed for the appropriateness and continual improvement is ensured.

Findings from focus groups.

All participants of the FG1, FG2 and FG3 confirmed the suitability of the attribute 10 for the framework. All FGs proposed that level 4 and level 5 organisations should **inform the supply chain partners about the energy related procurement requirements.** FG3-TEE1 confirmed that "If organisation can aware the suppliers about the energy-related procurement procedure, it is good. So that, you can evaluate the suppliers on the availability of proper energy certifications. It is more appropriate for level 4 and 5". All FG participants agreed on the other maturity descriptors.

Attribute 11: Internal and external communications supporting energy management.

findings from expert interviews.

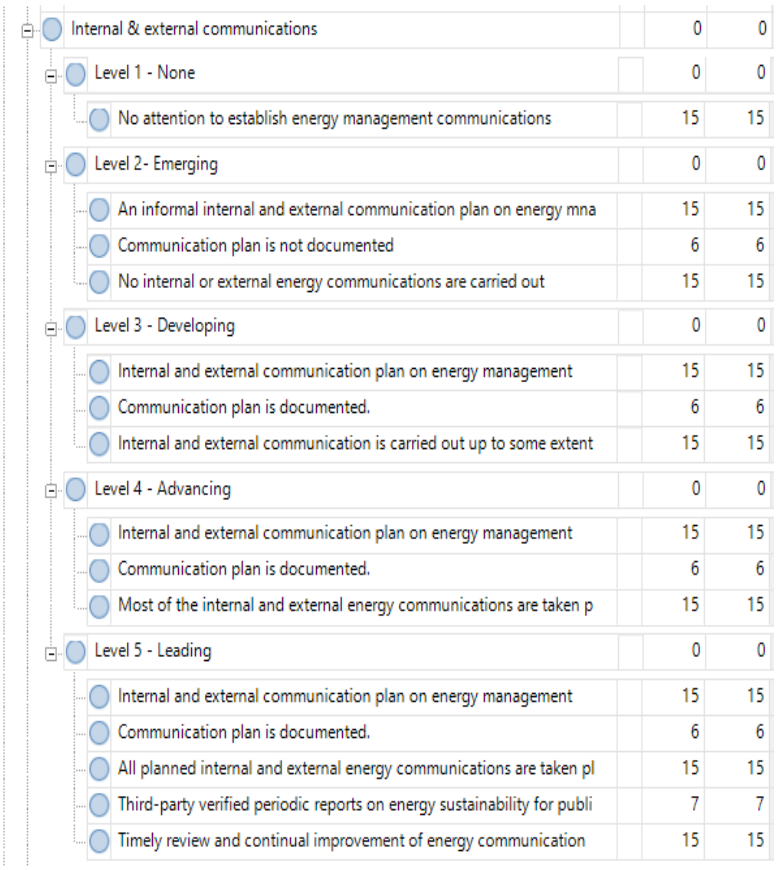
The coding structure for an organisation's internal and external communications supporting energy management is given in Figure 4.12.

All interviewees agreed that **Level 1 (none)** organisations **never pay attention to establish any internal or external communications on energy management** due to absence of a PDCA structure in level 1. S2-E11 stated that "There is no communications available on energy management in level 1 organisations. However, the organisation may meet the minimum legal requirements (if available) on energy-related communications".

Since the **Level 2 (emerging)** organisations have a low-level Plan element in the respective PDCA structure, all interviewees agreed on the potential **availability of an informal internal and external communication plan**. As agreed by S2-E5, S2-E8, S2-E9, S2-E12, S2-E14 and S2-E15 the **internal and external communication plan is not properly documented** in level 2 organisations. However, despite the availability of informal plans, there is **no implementations of the energy-related internal or external communications** in level 2 due to absence of the Do element, as agreed by all interviewees.

Figure 4. 12

Coding Structure for Internal and External Communications Supporting Energy Management



Internal & external communications	0	0
Level 1 - None	0	0
No attention to establish energy management communications	15	15
Level 2- Emerging	0	0
An informal internal and external communication plan on energy mna	15	15
Communication plan is not documented	6	6
No internal or external energy communications are carried out	15	15
Level 3 - Developing	0	0
Internal and external communication plan on energy management	15	15
Communication plan is documented.	6	6
Internal and external communication is carried out up to some extent	15	15
Level 4 - Advancing	0	0
Internal and external communication plan on energy management	15	15
Communication plan is documented.	6	6
Most of the internal and external energy communications are taken p	15	15
Level 5 - Leading	0	0
Internal and external communication plan on energy management	15	15
Communication plan is documented.	6	6
All planned internal and external energy communications are taken pl	15	15
Third-party verified periodic reports on energy sustainability for publi	7	7
Timely review and continual improvement of energy communication	15	15

Level 3 (developing) organisations **have an internal and external communication plan relating to energy management** as commented by all interviewees. S2-E5, S2-E8, S2-E9, S2-E12, S2-E14 and S2-E15 confirmed that a **communication plan is documented** in level 3. Despite the availability of the proper planning, deployment is limited in the PDCA structure in level 3. Accordingly, all interviewees agreed that the **internal and external communication is carried out up to some extent only** in this level. As confirmed by S2-E10 "Level 3 organisations have an internal and external communication plan on energy to educate employees and relevant external parties on energy related matters. But there might not be much implementation [of] the plans".

Level 4 (advancing) organisations have a complete Plan element. Accordingly, all interviewees stated there should be **availability of the internal and external communication plan**. S2-E5, S2-E8, S2-E9, S2-E12, S2-E14 and S2-E15 confirmed that the **communication plan is documented** in level 4 like for level 3. All interviewees agreed that **most of the internal and external communications are taken place** in accordance with the communication plan in level 4 organisations. As confirmed by S2-E1 "In level 4, there is a mechanism to communicate energy matters from the top to the lower levels in [an] organisation. Hence, required communication has effectively gone to the relevant employees most of the times".

Moreover, **Level 5 (leading)** organisations also comprise of an **internal and external communication plan,** which is **documented** according to the same interviewees commented on those matters in the level 4. Level 5 organisations consist of the matured deployment element of the PDCA structure. As a result, **all the internal and external communications are taken place as per the plan**, as agreed by all interviewees. S2-E3 mentioned that "Energy-related communication [have]taken place effectively as per the communication plan. For instance, if we randomly interview an employee in the organisation, he/she is adequately aware [of] the required energy related knowledge". In addition, S2-E3, S2-E6, S2-E7, S2-E9, S2-E12, S2-E13, and S2-E15 proposed that level 5 organisations **periodically publish energy related sustainability reports that is verified by a third-party**. S2-E9 further explained on this matter as "Having third-party verified public report on sustainability with a significant focus on energy performance can be a feature of level 5. For example, they verify form a third party that they have saved 1,000,000 kWh before reporting to public". In addition, all interviewees agreed that the level 5 organisations ensure the **timely review** and **continual improvement of the internal and external communications** on energy management since the review and improvement elements of the PDCA structure matures at level 5.

Table 4.14 presents the summary of the maturity descriptors for this attribute.

Table 4. 14

Maturity Descriptors Summary for Internal and External Communications Supporting Energy Management

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Never pay attention to establish internal or external communications on energy management.	1. An informal internal and external communication plan is available. 2.The communication plan is not documented. 3. Energy management related internal or external communications are not carried out.	1. Internal and external communication plan relating to energy is available. 2. The communication plan is documented. 3. Internal and external communication is carried out up to some extent.	1. Internal and external communication plan relating to energy is available. 2. The communication plan is documented. 3. Most of the internal and external energy communications have taken place.	1. Internal and external communication plan relating to energy is available. 2. The communication plan is documented. 3. All the internal and external communications have taken place as per the plan. 4. Periodically publish a third-party verified energy related sustainability report for the public. 5. Timely review and continual improvement of the energy related communication practice.

<u>Findings from focus groups.</u>

All participants of the FG1, FG2 and FG3 confirmed the suitability of attribute 11 for the framework. FG2-TEE1 stated that "energy vision, mission, and policy related communications also can be included under this attribute". All participants agreed on the suitability of including **energy vision, mission, and policy related communications.** Participants of the other FGs also agreed with the need to consider energy vision, mission, and policy related communications. Further, the FGs proposed to include **use of a variety of effective internal and external communication tools**, such as meetings, emails, newsletters, intranet, LinkedIn, and Facebook for energy related communications. According to FG3-TEE1 "There can be various communication tools in matured organisations. For example, level 4 may have three (03) tools and level 5 may have five (05) communication tools for effective communication". All FG participants agreed on the other maturity descriptors.

Note: According to interviewees, there can be exemption to the above when a mandatory legal reporting exists that is necessary to attend to by any organisation.

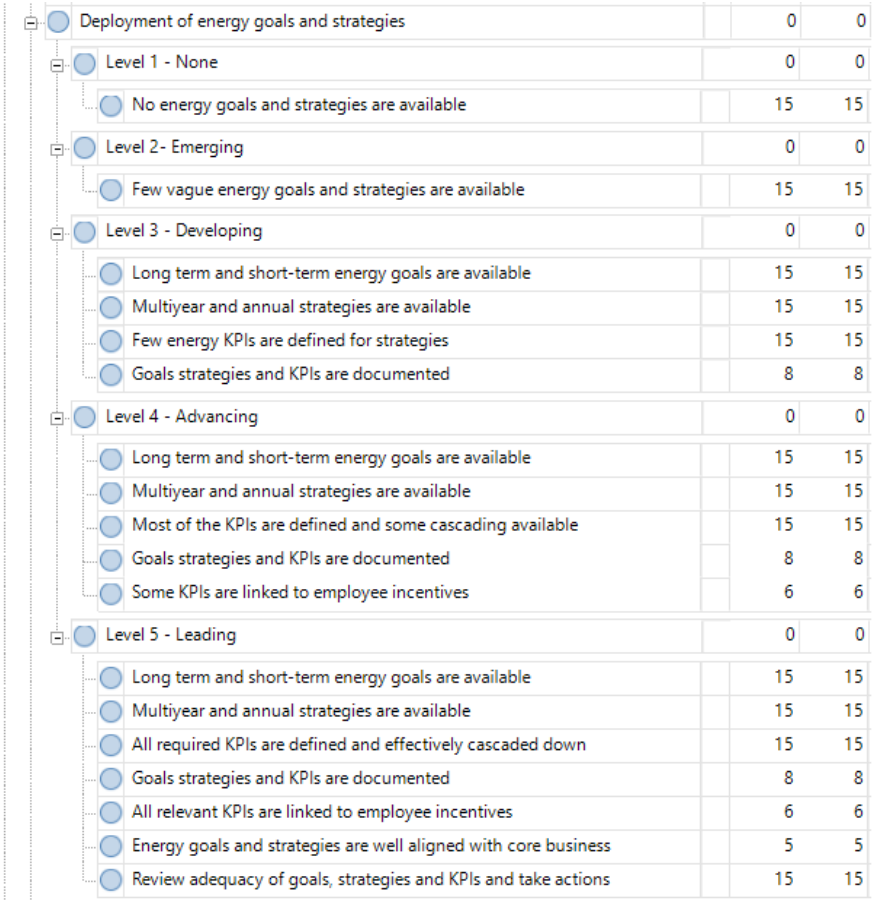
Attribute 12: Rewarding and recognition for energy-related improvements.

Findings from expert interviews.

The coding structure for rewarding and recognition for energy related improvements is given in Figure 4.13.

Figure 4. 13

Coding Structure for Rewarding and Recognition for Energy Related Improvements



S2-E11 stated that "in level 1 organisations, management does not believe in the importance for a rewarding culture for energy-related improvements done by employees. Therefore, no rewarding and recognition is available". All interviewees agreed that **Level 1 (none)** organisations **never focus on rewarding and recognition for energy related improvements** due to the absence of a PDCA structure.

Level 2 (emerging) organisations have a **rewarding, and recognition mechanism that is informally agreed by the management** according to all interviewees. However, S2-E3, S2-E5, S2-E6, S2-E8, S2-E11 and S2-E12 added that the **rewarding, and recognition mechanism is not properly documented** in level 2 organisations. Moreover, despite some planning, **there is no rewarding and recognition that has taken place** since there is no Do element, as agreed by S2-E1, S2-E2, S2-E5, S2-E7, S2-E8, S2-E10 and S2-E12.

According to all interviewees, **Level 3 (developing)** organisations have a **formal rewarding and recognition mechanism** established in the organisation for energy related improvements. S2-E3, S2-E5, S2-E6, S2-E8, S2-E11 and S2-E12 stated that the **rewarding and recognition mechanism is documented** in developing organisations. However, all interviewees highlighted that there is **lack of practice in the rewarding and recognition mechanism** due the poor Do element. As highlighted by S2-E2 "There is a rewarding mechanism identified in the developing organisations. They say that we should do these kinds of evaluations to reward people on energy improvements. But the rewarding and recognition mechanism is limited in implementation". In addition, S2-E2, S2-E3, S2-E7, S2-E8, S2-E9, S2-E10 and S2-E12 stressed that the level 3 organisations have **not communicated the rewarding mechanism well to employees.** S2-E9 explained that "Let's say a large organisation with around 50,000 employees, how do they ensure all employees are aware of the rewarding system? Answer is effective communication. However, rewarding mechanism is not well communicated to employees in level 3."

Furthermore, the availability of a **formal rewarding and recognition mechanism** for **Level 4 (advancing)** was confirmed by all interviewees. The **documented nature of the rewarding mechanism** was confirmed by S2-E3, S2-E5, S2-E6, S2-E8, S2-E11 and S2-E12. According to S2-E3 "When it comes to level 4, there is a proper rewarding mechanism. This can be a written mechanism". S2-E2, S2-E3, S2-E7, S2-E8, S2-E9, S2-E10 and S2-E12 also stated that the **rewarding and recognition mechanism is communicated to most of the employees.** Moreover, S2-E1, S2-E6, S2-E7, S2-E8, S2-E10, S2-E11 and S2-E12 proposed that the **energy related rewarding mechanism is linked with the energy KPIs** of employees. S2-E8 highlighted that "we can say that energy related KPIs are linked to a rewarding system. If employees have achieved the KPIs, that is considered for annual performance evaluation of individuals, which add marks for the salary increments, bonusses, and promotions etc". Furthermore, all interviewees proposed that **most of the identified rewarding and recognition mechanisms have been implemented** and the evidence is available in level 4 organisations.

Like level 3 and 4, **Level 5 (leading)** organisations also consist of a matured Plan element. Therefore, all interviewees confirmed the necessary availability of a **formal rewarding and recognition mechanism.** The **documented nature of the rewarding mechanism** of level 5 was stated by S2-E3, S2-E5, S2-E6, S2-E8, S2-E11 and S2-E12. Moreover, it was confirmed that a **rewarding and recognition mechanism is communicated to all employees** of the organisation by S2-E2, S2-E3, S2-E7, S2-E8, S2-E9, S2-E10 and S2-E12. Additionally, S2-E1, S2-E6, S2-E7, S2-E8, S2-E10, S2-E11 and S2-E12 proposed that the energy related **rewarding mechanism is linked with the energy KPIs** of employees. As explained by S2-E6 "Finally, the rewarding should come with the KPIs to be an effective system. If a person has achieved energy KPIs at the end of the year or so that person is rewarded".

In addition, all interviewees agreed that level 5 organisations **fully implement the rewarding and recognition mechanisms.** According to S2-E3 "[the] rewarding procedure is fully implemented in level 5. There are lot of evidence for the implementation across the organisation, in all departments, among all employees and all teams". Ultimately, the review and improvement of the PDCA structure completes at the level 5. All interviewees confirmed that energy-related **rewarding mechanism is timely reviewed** and **continual improvement** is ensured in Level 5 organisations.

Table 4.15 presents the summary of the maturity descriptors for rewarding and recognition for energy related improvements.

Table 4. 15

Maturity Descriptors Summary for Rewarding and Recognition for Energy Related Improvements

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Never focus on rewarding and recognition for energy related improvements.	1. A rewarding and recognition mechanism is informally agreed by the management. 2. Rewarding, and recognition mechanism is not properly documented. 3. However, there is no rewarding and recognition practiced.	1. A formal rewarding and recognition mechanism is available. 2. The rewarding and recognition mechanism is documented. 3. The mechanism is not well communicated to employees. 4. Lack of practice in rewarding and recognition mechanism.	1. A formal rewarding and recognition mechanism is available. 2. The rewarding and recognition mechanism is documented. 3. The mechanism is communicated to most of the employees. 4. Rewarding mechanism is linked with the energy KPIs. 5. Most of the identified rewarding and recognition mechanisms are	1. A formal rewarding and recognition mechanism is available. 2. The rewarding and recognition mechanism is documented. 3. The mechanism is communicated to all employees. 4. Rewarding mechanism is linked with the energy KPIs. 5. All identified rewarding and recognition mechanisms have been implemented and the evidence is available.

			implemented and the evidence is available.	6. Energy related rewarding mechanism is timely reviewed and ensures continual improvement.

Findings from focus groups.

All FGs confirmed the suitability of attribute 12 for the framework. FG1-AE1 stated that "good energy behaviours are appreciated and rewarded. For example, an employee is doing something not because that is a job duty but a voluntary energy saving behaviour. Encouraging them using a simple appreciation like "job well done" matters [a] lot". Participants agreed to integrate the term "**good energy behaviours are appreciated**". All FG participants agreed to keep all given descriptors in the framework.

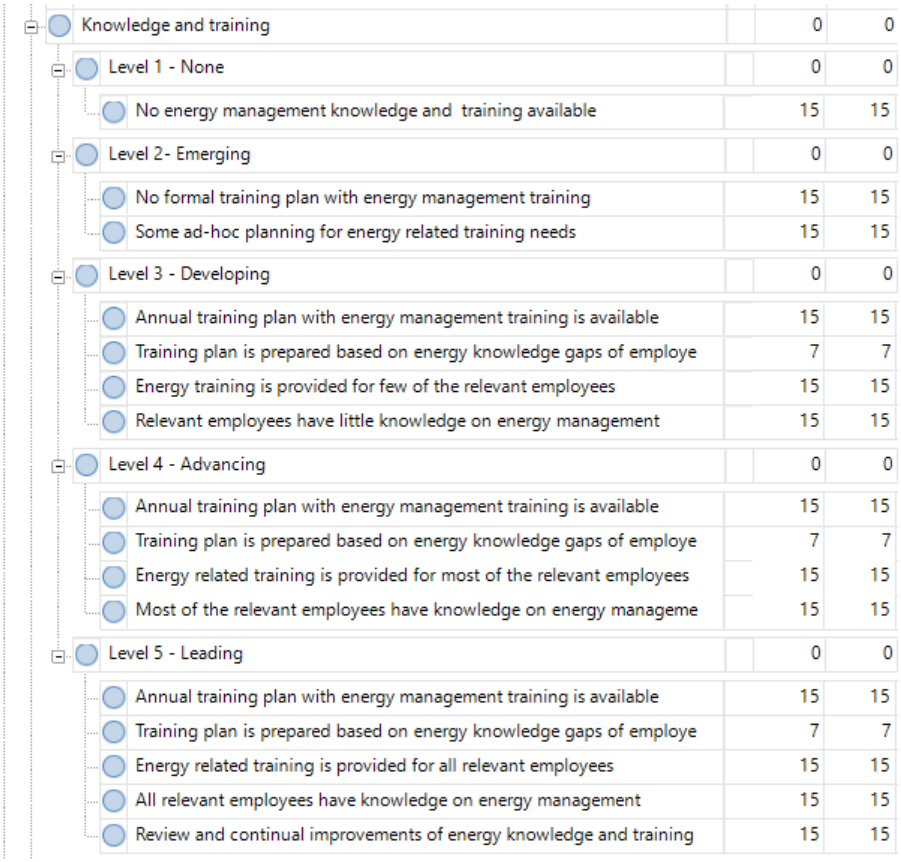
Attribute 13: Knowledge and training.

Findings from expert interviews.

The coding structure for knowledge and training is given in Figure 4.14.

Figure 4. 14

Coding Structure for Knowledge and Training



According to S2-E3 "there is no existing proper knowledge on energy management and emerging energy-efficient technologies that supports energy-related

improvements. Simply, no knowledge available with both energy-related employees and other employees on proper energy management". Similarly, all interviewees agreed that both energy related technical employees and other employees **do not have energy management knowledge** in **Level 1 (none)** organisations.

According to all interviewees there is **no formal training plan that includes energy management related training** in **Level 2 (emerging)** organisations. However, there is **some ad-hoc planning for energy related training needs** since there is a minimum Plan element in level 2, as agreed by all interviewees.

In contrast, **Level 3 (developing)** organisations have a strong Plan element. Hence, all interviewees agreed on the **availability of an annual training plan that includes energy management related training.** Further, S2-E2, S2-E5, S2-E6, S2-E8, S2-E10, S2-E11 and S2-E15 stated that **energy training plan is prepared considering the energy knowledge gaps of the employees**. However, all interviewees stressed that **energy-related training is provided for few of the relevant employees** despite the planning in level 3. S2-E3 confirmed that "even though the training plans are available, actual training is not carried out as per the plans. There is only limited training provided. There might be lack of budget allocation to meet most of the training plan". Furthermore, all interviewees highlighted that **relevant employees have little knowledge of the energy management and related improvements.** S2-E5 confirmed that "relevant employees have little knowledge on latest energy-related improvement in the level 3 organisations".

For **Level 4 (advancing)**, all interviewees stated the **availability of an annual training plan that includes energy management related training**s. According to S2-E10 "organisations plan and budget at the start of the years and then organise training internally as well as externally and get the energy related knowledge". According to S2-E2, S2-E5, S2-E6, S2-E8, S2-E10, S2-E11 and S2-E15 **energy training plan is prepared considering the energy knowledge gaps of the employees** in level 4 organisations. According to S2-E6 "level 4 organisations identify the status of the energy knowledge and knowledge gaps of employees. Further, the training is provided to most of the technical and other relevant employees based on the training plan". All interviewees stated that **energy related training is provided for most of the relevant employees** in level 4 organisations. In addition, all interviewees suggested that **most of the relevant employees have required knowledge on the energy management and related improvements**.

All interviewees proposed the **availability of an annual training plan that includes energy management related training** as a descriptor in **Level 5 (leading) organisations.** S2-E2, S2-E5, S2-E6, S2-E8, S2-E10, S2-E11 and S2-E15 agreed with **preparation of a training plan considering the energy knowledge gaps of the employees** for **Level 5 (leading)** organisations. All interviewees stated that level 5 organisations **provide energy training for all relevant employees.** S2-E1 highlighted that "The organisation should provide both formal and informal energy related training for all relevant employees in level 5. This even includes capturing and sharing of the

tacit knowledge gain through the experience". Considering the knowledge of the employees, all interviewees suggested that **all relevant employees have required knowledge on the energy management and related improvements** in Leading organisations. As stated by S2-E2

> …when you think about energy knowledge of employees, you can't expect all employees are knowledgeable about the energy management. Even in a leading company there might be employees who do not know anything about energy management. It should be required knowledge on energy as per the requirement of the job is available for all employees.

Furthermore, all interviewees suggested that level 5 organisations **review and ensure continual improvements of the energy related knowledge and training**. According to S2-E4 "You can put review and continual improvement here in level 5. Reviews are carried out to find the effectiveness of training provided and ensuring the continual improvement accordingly. It is well available at Level 5".

Table 4.16 presents the summary of the maturity descriptors for knowledge and training.

Table 4. 16

Maturity Descriptors Summary for Knowledge and Training

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. There is no energy management knowledge and related training available with the technical and non-technical employees.	1. There is no formal training plan that includes energy management related training. 2. There is some ad-hoc planning for energy related training needs.	1. An annual training plan is available that includes energy management related training. 2. A training plan is prepared based on the energy knowledge gaps of the employees. 3. Energy related training is provided for few of the relevant employees. 4. Relevant employees have little knowledge on the energy management and related improvements.	1. An annual training plan is available that includes energy management related training. 2. A training plan is prepared based on the knowledge gaps of the employees. 3. Energy related training is provided for most of the relevant employees. 4. Most of the relevant employees have required knowledge on the energy management and related improvements.	1. An annual training plan is available that includes energy management related training. 2.A training plan is prepared based on the knowledge gaps of the employees. 3. Energy related training is provided for all relevant employees. 4. All relevant employees have required knowledge of the energy management and related improvements. 5. Review and ensure continual improvements of the energy related knowledge and training.

Findings from focus groups.

All FG participants agreed to keep attribute 13 in the framework and all related maturity descriptors were accepted without any amendments.

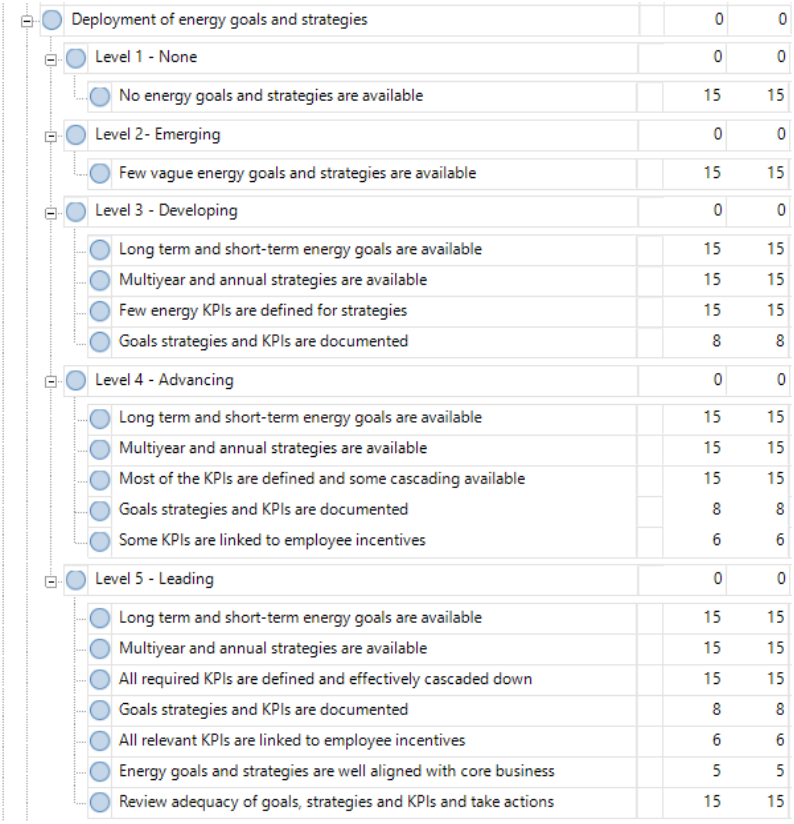
Attribute 14: Deployment of energy goals and strategies.

Findings from expert interviews.

The coding structure for deployment of energy goals and strategies is given in the Figure 4.15.

Figure 4. 15

Coding Structure for Deployment of Energy Goals and Strategies



All interviewees agreed that there are **no energy goals and strategies available** in the **level 1 (none)** organisations, considering the absence of PDCA elements. As stated by S2-E3 “We can say that there are no energy goals and strategies in the level 1 organisations. So, the KPIs related with the strategies are also not available”.

All interviewees stated that **there are a few vague energy goals and strategies** in the **Level 2 (emerging)** organisations due to the poor Plan element. In addition, level 2 organisations do not have any deployment mechanisms even for the available vague goals and strategies.

All interviewees stated that **Level 3 (developing)** organisations have well defined **long-term and short-term energy goals and multiyear and annual strategies for those goals** considering a strong Plan element in the PDCA structure. Considering the implementation of goals and strategies (Do element), all interviewees agreed that level 3 organisations have limited deployments and mentioned the availability of a **few energy KPIs that are defined under energy strategies**. S2-E15 expressed the lack of deployment using KPIs as "I have seen an organisation where they only have some KPIs for the engineering team. But energy KPIs are not well established for the other required areas, such as the production teams and different management levels". Furthermore, S2-E4, S2-E6, S2-E7, S2-E9, S2-E10, S2-E12, S2-E13, and S2-E14 accepted the availability of **documented goals strategies and KPIs** in Developing organisations.

Level 4 (advancing) organisations also consist of **long term and short-term energy goals and related multiyear and annual strategies** as agreed by all interviewees. S2-E6 stated that "when we think about the energy strategies of Level 4 organisations, it is about the short term and long-term energy strategies. We can confirm the availability about short-term and long-term strategies in Advancing organisations". In addition, all interviewees stated that **most of the required KPIs for deployment of goals and strategies are defined with some cascading down to lower levels.** S2-E12 stated that "energy KPIs are available and cascaded down from top to bottom up to some extent in Level 4 organisations such as cascading from the general manager to engineering representative". Moreover, S2-E4, S2-E6, S2-E7, S2-E9, S2-E10, S2-E12, S2-E13, and S2-E14 stated that **goals strategies and KPIs are documented.** According to S2-E3, S2-E4, S2-E8, S2-E11, S2-E12 and S2-E15 **most of the KPIs are linked to incentives of the employees** in the advancing organisations. S2-E2 confirmed that "energy KPIs are linked to the employees' performance. For example, the KPI achievement is linked to individual's bonuses. Likewise, the employees are incentivised to do the energy-related improvements in the Level 4".

The availability of the **long term and short-term energy goals** and **multiyear and annual strategies for those goals** were proposed for **Level 5 (leading)** organisations by all interviewees. All interviews also stated that **all required KPIs are defined and effectively cascaded down into all required lower levels** in the Leading organisations. According to S2-E3

> KPIs are not limited to top level of the plant. Beyond that, KPIs are cascaded into lower levels of the plant. For example, production employees have energy KPIs, or compressor system has energy-efficiency KPIs. Likewise, KPIs are effectively cascaded down.

According to S2-E4, S2-E6, S2-E7, S2-E9, S2-E10, S2-E12, S2-E13, and S2-E14 **goals strategies and KPIs are documented** in the level 5 organisations as well. Moreover, S2-E3, S2-E4, S2-E8, S2-E11, S2-E12 and S2-E15 stated that **all relevant KPIs are linked to incentives of the employees** in leading organisations. S2-E8 explained that

> we can say that energy related KPIs are linked to a rewarding system in the leading organisations. If the KPIs are achieved, that is considered for performance evaluation of individuals, which may add marks for increments, bonusses, promotions and etc.

In addition, S2-E8, S2-E10, S2-E12, S2-E13 and S2-E15 stated that the **energy goals and strategies and KPIs are well aligned with the core business** in level 5. S2-E15 highlighted that

> In level 5, energy goals and strategies are part of the organisation's business strategy. For instance, financial department always encourages engineering department to reduce the energy consumption. Since they have their KPIs to reduce the energy cost of the entire plant.

Furthermore, all interviewees agreed that Level 5 organisations **review adequacy of goals, strategies and KPI system and take actions to ensure the continual improvement** of attribute 14. As mentioned by S2-E11

> When we deploy goals and strategies, challenges and deviations are coming. So, there should be a mechanism to monitor and timely review energy goal and strategy deployment and take actions to ensure continual improvement. Such mechanism is available in Level 5.

Table 4.17 presents the summary of the maturity descriptors under this attribute.

Table 4. 17

Maturity Descriptors Summary for Deployment of Energy Goals and Strategies

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. There are no energy goals and strategies available.	1. There are a few vague energy goals and strategies available.	1. Long term and short-term energy goals are available. 2. Multiyear and annual strategies available for those goals. 3. Few energy KPIs are defined for strategies. 4. Energy goals strategies and KPIs are documented.	1. Long term and short-term energy goals are available. 2. Multiyear and annual strategies available for those goals. 3. Most of the required KPIs are defined with some cascading down to lower levels. 4. Energy goals strategies and KPIs are documented. 5. Most of the available KPIs are linked to incentives of the employees.	1. Long term and short-term energy goals are available. 2. Multiyear and annual strategies available for those goals. 3. All required KPIs are defined and effectively cascaded down into all required lower levels. 4. Goals strategies and KPIs are documented. 5. All relevant KPIs are linked to incentives of the employees. 6. Energy goals and strategies and KPIs are well aligned with the core business. 7. Reviews adequacy of goals, strategies and KPI system and takes actions to ensure continual improvement.

Findings from focus groups.

All FGs agreed on the suitability of attribute 14 for the framework. FG1-TAEE1 proposed that "goals strategies and KPIs should be linked with the energy vision, missions and policy". All participants in FG1 and FG3 agreed to include **linkage of the energy goals, strategies and KPIs with the energy vision, missions, and policy** appropriately in the higher maturity levels. FG1-AE1, FG1-TAEE1 and FG3-TAEE1 proposed to include the **alignment of energy goals, strategies and KPIs with the core business strategies** in level 3 and level 4 also rather than limiting only to level 5 based on the expert interview findings. In addition, FG2-TAEE1 and FG3- TAEE2 proposed the availability of **operational controls to control the significant energy using activities** in level 2, level 3, level 4, and level 5. Furthermore, FG2- TAEE1 explained that "we can say energy KPIs are linked to the individual KPIs of all employees without limiting to the technical staff in level 5. It is sort of an ultimate thing available in the most matured organisations". All FG2 and FG3 participants agreed on the expanding of **energy KPIs to individual KPIs of all employees in the organisation.** All other maturity descriptors were agreed by the FG1, FG2 and FG3 participants as suitable for the framework.

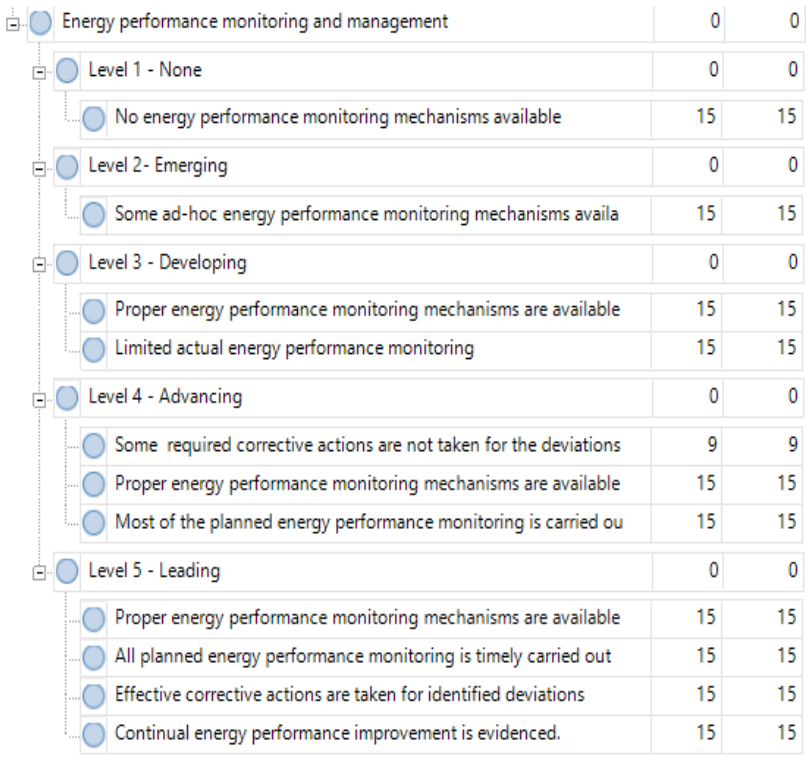
Attribute 15: Energy performance monitoring and management.

Findings from expert interviews.

Figure 4.16 presents the coding structure for energy performance monitoring and management.

Figure 4. 16

Coding Structure for Energy Performance Monitoring and Management



Considering the PDCA status of **Level 1 (none)** organisations, all interviewees proposed the unavailability of the **energy performance monitoring system.** S2-E8 stated that "matured organisations have systems to review the energy performance quarterly or annually. However, Level 1 organisations do not have such energy performance monitoring available".

Level 2 (emerging) organisations consist of minimum planning without any implementations as per the PDCA structure. Accordingly, all interviewees proposed that level 2 consists of **ad-hoc energy performance monitoring mechanisms.** According to S2-E1 "There is an irregular system to evaluate the energy performance of the organisation. So, there is lack of practical implementations of the energy performance monitoring and review".

Moreover, all interviewees agreed on the **availability of proper energy performance monitoring mechanisms** in **Level 3 (developing)** organisations considering the PDCA structure. Despite the availability of a monitoring system, **actual practice for energy performance monitoring is limited** in this level according to all interviewees. S2-E3 confirmed that *"*when we consider level 3 organisations, those are not results oriented on energy performance. We can say that there are energy performance review mechanisms available, but the reviews can be ad-hoc or let's say much limited in this level".

Level 4 (advancing) organisations have a strong Plan element. Accordingly, all interviewees stated that **proper energy performance monitoring mechanisms are available** in **Level 4 (advancing)** organisations as well. S2-E9 confirmed that "Level 4 organisations have proper feedback system that monitors the energy performance of the organisation". Further, all interviewees highlighted that **most of the planned energy performance monitoring is carried out** in the advancing level. However, S2-E2, S2-E3, S2-E5, S2-E6, S2-E7, S2-E9, S2-E10, S2-E11, and S2-E12 proposed that **some of the required corrections are not taken for the identified deviations** in the level 4. S2-E2 stated that "Since Advancing organisations have further room for improvement, we can say that sometimes there is a lack of corrections for some of the identified deviations from energy performance monitoring".

All interviewees agreed on the **availability of proper energy performance monitoring mechanisms** in **Level 5 (leading)** organisations as the topmost matured level. The interviewees also stated that **all planned energy performance monitoring is carried out on time** in level 5. S2-E13 explained that "matured organisations always monitor the status of energy performance periodically such as monthly against the set targets and KPIs. For instance, the relevant divisions collect the energy performance related data against the established targets timely". Furthermore, all interviewees highlighted that **effective corrective actions are taken for the deviations identified from energy performance monitoring.** S2-E11 suggested that

> …check and adjust should be a part of the energy performance monitoring system. If the energy performance deviations are found from the performance monitoring, level 5 organisations take effective corrective

actions on time to ensure continual improvement of the energy performance.

Similarly, all interviewees agreed that the **continual energy performance improvement is evidenced** in the level 5 organisations that completes all elements of the PDCA structure.

Table 4.18 presents the summary of the maturity descriptors for energy performance monitoring and management.

Table 4. 18

Maturity Descriptors Summary for Energy Performance Monitoring and Management

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No energy performance monitoring system is available.	1. Some ad-hoc energy performance monitoring mechanisms available.	1. Proper energy performance monitoring mechanisms are available. 2. However, actual energy performance monitoring is limited.	1. Proper energy performance monitoring mechanisms are available. 2. Most of the planned energy performance monitoring is carried out. 3. However, some of the required corrections are not taken for the identified deviations.	1. Proper energy performance monitoring mechanisms are available. 2. All planned energy performance monitoring is carried out on time. 3. Effective corrective actions are taken for the deviations identified from energy performance monitoring. 4. Continual energy performance improvement is evidenced.

Findings from focus groups.

All FGs agreed on including attribute 15 in the framework. FG3-TEE1 stated that "When it comes to level 5, they can measure the energy performance specifically according to set baselines and KPIs. For example, source wise energy consumption monitoring, which can provide specific details such as electrical energy consumption per product". All FGs agreed on the availability of a **set of specific energy baselines and KPIs facilitates energy performance monitoring** under this attribute. FG1 established that **results of the performance monitoring are timely communicated** to relevant employees and superiors in level 5 organisations. As stated by FG1-TEE1 "real-time data monitoring systems are available in leading organisations. When the data is collected, that comes to your computer. Further, most matured organisations daily calculate KPIs and communicate to employees".

All FGs agreed on the availability of formal review mechanisms, such as **management review meetings, and internal and external energy auditing**, which timely take

place to review the energy management system. Furthermore, FG2 and FG3 participants agreed on the **application of problem-solving techniques to analyse the energy performance deviations** and to develop corrective actions. According to FG3-TAEE2 "Problem-solving tools can be used for decision making. There are standard tools that textile and apparel industry is using for the main business, such as 5Y analysis, fishbone diagrams. Such tools can be used for energy management as well". In addition, all FGs agreed to use the rest of the descriptors as it is.

Attribute 16: Maintenance management supporting higher energy performance.

Findings from focus groups.

Participants of all focus groups proposed to include a new attribute under practices as **maintenance management supporting higher energy performance.** FG2-TAEE2 expressed that

> We do massive investments for energy-efficient or renewable energy technologies. If we don't maintain [this] equipment properly and timely, those will not work with the expected efficiency. For instance, if we install the solar panels, we should ensure the surface is clean. If the surface is not clean, efficiency will drop.

Accordingly, participants agreed on including things like preventive maintenance management and autonomous maintenance under different maturity levels.

Level 1 (none) organisations do not have any element of the PDCA elements. Accordingly, all FGs agreed that Level 1 organisations **do not pay attention to establish proper maintenance management** for the available energy related technologies.

The PDCA structure of **Level 2 (emerging)** organisations only presents some amount of planning without any deployments. Therefore, level 2 was identified as the organisations where there are **limited planned preventive maintenance** for some of the energy significant equipment. However, **preventive maintenance is not carried out according to the plans** and limited to corrective maintenance as agreed by the FG participants.

Level 3 (developing) organisations have a strong Plan element under the PDCA structure and limited deployments. Hence, participants agreed that **a comprehensive preventive maintenance management program is available** to cover all energy significant technologies. As stated by FG1-TEE1, "Definitely, a preventive maintenance program should be available in level 3. Preventive maintenance is very important to maintain the expected energy-efficiency of equipment. Therefore, availability of a preventive maintenance program is very important". Despite the planning, only some of the **preventive maintenance activities are carried out as per the plan** due to the lack of deployments of the PDCA structure at level 3.

Level 4 (advancing) organisations also consist of a **comprehensive preventive maintenance management program** like level 3. Participants agreed that **most of the**

preventive maintenance activities are carried out according to the plan due to the availability of considerable deployment of the PDCA cycle in level 4. According to FG3-TAEE2"we call the maintenance done by the employee himself as autonomous maintenance. The autonomous maintenance can be a feature in level 4 and level 5 organisations". Participants of FG2 and FG3 agreed on the availability of the **considerably functioning autonomous maintenance** in the advancing organisations. Further, FG3 proposed the **availability of computerised maintenance management systems** in level 4.

Level 5 (advancing) organisations consists of a complete PDCA structure. All FGs confirmed the availability of a **comprehensive preventive maintenance management program** to cover all energy significant technologies in the leading organisations. FG2-TEE1 confirmed that "of course, I think availability of a preventive maintenance program is an essential element for energy management in matured organisations". Further, FG participants agreed that all **preventive maintenance activities are carried out according to the plan** in the leading organisations. In addition, FG2 and FG3 participants explained the availability of **effective autonomous maintenance management** as a feature of leading organisations in addition to the preventive maintenance carried out by the maintenance team. FG3-AE1 explained that "under levels 4 and 5, real-time maintenance monitoring supported computerised maintenance management systems can be considered as advanced maintenance management practices". FG participants agreed with the **availability of effective computerised maintenance management systems** in the leading level. Ultimately, all FGs agreed that **maintenance program is timely reviewed and continual improvement of energy performance** is supported in the leading organisations.

Having developed the findings under practices, the next section discusses the findings under the material culture element.

4.2.2.3 Material culture

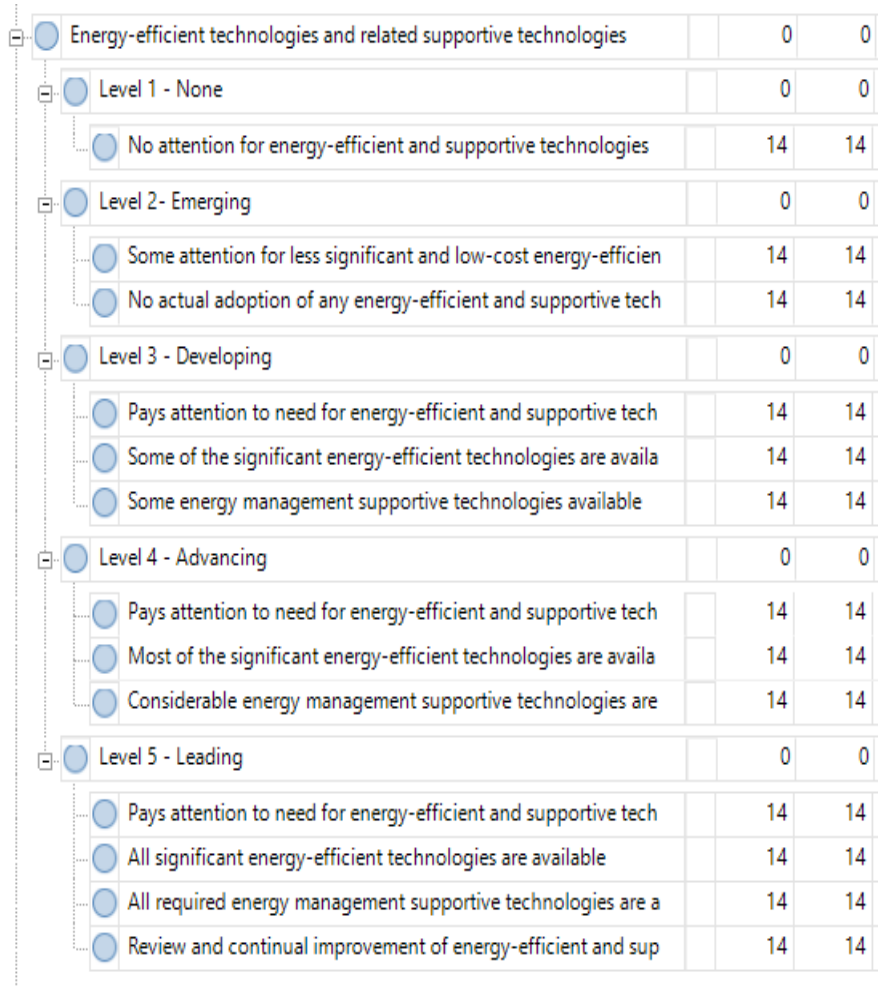
Attribute 17: Energy-efficient technologies and related supportive technologies.

Findings from expert interviews.

Figure 4.17 presents the coding structure for energy-efficient technologies and related supportive technologies.

Figure 4. 17

Coding Structure for Energy-Efficient Technologies and Related Supportive Technologies



According to S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 **Level 1 (none)** organisations **do not pay attention to the need for energy-efficient technologies and related supportive technologies**. As highlighted by S2-E13 "Level 1 management does not feel the need for adding energy-efficient technologies. So, they do not have energy-efficient technologies and supportive technologies such as IT and software, which makes it difficult to monitor and control energy use".

According to S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 **Level 2 (emerging)** organisations have **some attention to less significant and low-cost energy-efficient technologies and related supportive technologies.** As highlighted by S2-E4 "We can say that level 2 organisations look for some convenient and less significant energy-efficient technologies that save less amount of energy". However, same interviewees mentioned that there is **no actual adoption of any energy-efficient technologies and related supportive technologies** due to absence of any deployments in the PDCA structure.

S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 stated that **Level 3 (developing**) organisations **pay attention to the need for energy-efficient technologies and related supportive technologies**. According to S2-E1 "Developing organisations looks for the energy-efficient-technologies such as energy-efficient lighting systems and air conditioning systems". However, due to the limited implementations based on the respective PDCA structure of level 3, actual implementations are limited. Accordingly, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 confirmed that **only some of the significant energy efficient technologies are available** in level 3. S2-E6 agreed that "Level 3 organisations are approaching some of the significant energy-efficient technologies that might be the best practices in the industry." Furthermore, the same interviewees mentioned that **some of the energy management supportive technologies** like energy sub meters, dashboards and software are available in developing organisations.

S2-E15 stated that "We put most of the possible things to reduce building's energy consumption. For example, we installed LED lighting and separate energy-efficient chiller system by replacing split air conditioning. Likewise, we are motivated to adopt most of the energy-efficient technologies". Similarly, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13 and S2-E14 agreed that **Level 4 (advancing)** organisations **pay attention to the need for energy-efficient technologies and related supportive technologies**. At the same time, **they adopt most of the significant energy efficient technologies** as confirmed by the same interviewees. Furthermore, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 discussed the **availability of considerable energy management supportive technologies** such as energy sub meters, dashboards, software and building management systems (BMS) in level 4. S2-E12 confirmed the availability of the energy management supportive technologies and added BMS as a special feature to level 4 organisations "I think the BMS is available to operate the energy technologies in the buildings in the level 4".

Level 5 (leading) organisations are matured with All PDCA elements. S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed that leading organisations **pay attention to the need for energy-efficient technologies and related supportive technologies**. The same interviewees agreed that **all significant energy-efficient technologies are available** in level 5 organisations. S2-E8 highlighted that

> Magnetic bearing chillers have a huge energy saving potential. We clearly experience such savings. For example, magnetic bearing chillers can save energy beyond LKR 100,000 from the energy bill. So, for our all-new plants we definitely go for magnetic bearing chillers even though those are somewhat costly.

In addition, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 identified the **availability of all required**

energy management supportive technologies such as energy sub meters, dashboards software and BMS. According to S2-E7 "If organisations are conscious on energy conservation, they usually implement energy monitoring systems. This can be a BMS. Energy consuming technologies such as chillers are connected to the BMS which monitors the energy consumption of the equipment throughout the day". S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed **timely review and continual improvement of the adequacy of energy efficient technologies and energy management supportive technologies** as a feature of level 5. S2-E1 confirmed that "Level 5 should complete all four (04) elements of PDCA cycle. Organisations should have continual improvement always. The energy technologies are timely reviewed and take actions for continual improvement by replacing technologies with low energy performance with more efficient technologies".

Table 4.19 presents the summary of the maturity descriptors for energy-efficient technologies and related supportive technologies.

Table 4. 19

Maturity Descriptors Summary for Energy Efficient Technologies and Related Supportive Technologies

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. Organisations do not pay attention to the need for energy-efficient technologies and related supportive technologies.	1. Organisation has some attention for less significant and low-cost energy-efficient technologies and related supportive technologies. 2. However, there is no actual adoption of any energy-efficient technologies and related supportive technologies.	1. Organisation pays attention to the need for energy-efficient technologies and related supportive technologies. 2. Some of the significant energy efficient technologies are available. 3. Some energy management supportive technologies like energy sub meters, dashboards and software are available.	1. Organisation pays attention to the need for energy-efficient technologies and related supportive technologies. 2. Most of the significant energy efficient technologies are available. 3. Considerable energy management supportive technologies such as energy sub meters, dashboards, software and building management systems (BMS) are available.	1. Organisation pays attention to the need for energy-efficient technologies and related supportive technologies. 2. All significant energy-efficient technologies are available. 3. All required energy management supportive technologies such as energy sub meters, dashboards software and BMS are available. 4. Adequacy of the existing energy-efficient technologies and energy management supportive technologies are timely reviewed and replaced with more efficient technologies if required to ensure continual improvement.

Findings from focus groups.

All FGs confirmed the suitability of attribute 17 and the related maturity descriptors for the framework. There were no amendments proposed for the attribute and the maturity descriptors.

Attribute 18: Renewable energy sources.

Findings from expert interviews.

Figure 4.18 presents the coding structure for renewable energy sources.

Figure 4. 18

Coding Structure for Renewable Energy Sources

Renewable energy sources	0	0
Level 1 - None	0	0
No plans and implementations of renewable energy sources	14	14
Level 2- Emerging	0	0
Informal plans for renewable energy sources	13	13
Informal plans are not documented	5	5
No renewable energy initiatives are implemented	6	6
Level 3 - Developing	0	0
Formal plans available to implement renewable energy projects	13	13
Renewable energy plans are documented	6	6
Only few of the planned renewable energy projects are implem	13	13
Level 4 - Advancing	0	0
Formal plans available to implement renewable energy projects	14	14
Renewable energy plans are documented	10	10
Considerable number of planned renewable energy projects are	14	14
Level 5 - Leading	0	0
Formal plans available to implement renewable energy projects	14	14
Renewable energy plans are documented	6	6
All planned renewable energy projects are implemented	14	14

Level 1 does not consist of any of the PDCA elements. Accordingly, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed that the **Level 1 (none)** organisations **do not have plans and implementations of renewable energy sources.** As highlighted by S2-E3 "We can forget the old buildings constructed 15 years back. But if you are still constructing new factories without roof strength for solar panels, that shows the organisation do not plan for the rooftop solar energy".

According to S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 **Level 2 (emerging)** organisations have **informal plans for renewable energy sources** because of the minor Plan element in the PDCA structure of level 2. S2-E1, S2-E4, S2-E7, S2-E13 and S2-E14 also

proposed that the informal **renewable energy plans are not documented** in this level. Further, considering level 2's PDCA elements, S2-E3, S2-E6, S2-E8, S2-E12, S2-E13, S2-E14 and S2-E15 stated that the emerging organisations **does not initiate renewable energy initiatives** despite the informal planning.

S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 agreed that **Level 3 (developing)** organisations have **formal plans to implement renewable energy projects**. S2-E13 explained the planning for renewable energy as *"*we have planned for around 14 MW solar project to covers around 10 factories using the roof top solar system. We have plans to expand such projects further". Further, S2-E3, S2-E5, S2-E8, S2-E11, S2-E12, and S2-E15 stated that the **renewable energy plans are documented.** Despite the available plans, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 highlighted that **only a few of the planned renewable energy projects are implemented** in Developing organisations. According to S2-E14 "Yes, in this case we do have the formal plans for solar but for the moment we have not implemented much. I feel we fits to a level 3 organisation".

S2-E12 stated that "In [an] organisation's long-term strategy, they can have power purchasing agreements, on-site renewable energy, and sustainable biomass in the plan as the renewable energy arrangements. Level 4 organisations usually have such plans". Similarly, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E13, S2-E14 and S2-E15 also confirmed the availability of **formal plans to implement renewable energy projects** in the **level 4 (advancing)** organisations. S2-E3, S2-E5, S2-E8, S2-E11, S2-E12, and S2-E15 proposed the **availability of documented renewable energy plans** in level 4 like level 3. Additionally, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed that **considerable number of planned renewable energy projects are implemented** in level 4 organisations. S2-E15 mentioned that "level 4 organisations should have considerable implementation. As an example, in our case, we have installed solar, and we have gone for bio-mass fuelled boilers. Further, we have another main project to install biomass fired thermic heater system".

Level 5 (leading) organisations as the topmost matured level have **formal plans to implement renewable energy projects** as suggested by S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15. S2-E6 explained that

> In this case, the organisations are planning for 100% renewable energy. For instance, we have the target to reach 100% renewable energy. Totally renewable energy used factories is one of the tactical words in the market now. I have seen some of the groups are using that. So, the move is there to go for 100% renewable energy.

Further, S2-E3, S2-E5, S2-E8, S2-E11, S2-E12, and S2-E15 mentioned the availability of **documented renewable energy plans.** In addition, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15

stated that the level 5 organisations **implement all planned renewable energy projects.** As commented by S2-E3 "Level 5 organisations are the businesses that plans for renewable energy and at the same time they have excellent implementations. For example, they may have tried to become net-zero buildings by integrating the renewable sources". Additionally, interviewees discussed the matured Check and Act elements of the PDCA cycle in level 5. Accordingly, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed that level 5 organisations **review and continually improving use of renewable energy sources**.

Table 4.20 presents the summary of the maturity descriptors for renewable energy sources.

Table 4. 20

Maturity Descriptors Summary for Renewable Energy Sources

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No plans and implementations of renewable energy sources.	1. Organisation has informal plans for renewable energy sources. 2. Informal plans are not documented. 3. No renewable energy initiatives are implemented.	1. Organisation has formal plans to implement renewable energy projects. 2. Renewable energy plans are documented. 3. However, only a few of the planned renewable energy projects are implemented.	1. Organisation has formal plans to implement renewable energy projects. 2. Renewable energy plans are documented. 3. Considerable number of planned renewable energy projects are implemented.	1. Organisation has formal plans to implement renewable energy projects. 2. Renewable energy plans are documented. 3. All planned renewable energy projects are implemented. 4. Reviews and continually improves use of renewable energy sources.

<u>Findings from focus groups.</u>

All FGs agreed on the suitability of attribute 18 for the framework. All FGs highlighted to elaborate the descriptor 1 in level 3, 4 and 5 by using the term "short-term, medium-term and long-term plans". FG2-TAEE1 explained that

> Even it could be power purchasing agreements with mini hydro plants, don't just limit to solar and keep it open. We don't have the renewable energy credits for the moment. But if you would like to add it as a provision better to do so. As a general term, we can say that the market-based approaches are used effectively.

All FGs agreed with **use market based renewable energy sources such as renewable energy credits and power purchase agreements when available**. Furthermore, FG1 and FG3 agreed on the availability of **industry leading renewable energy projects**

in Leading organisations. Moreover, all FGs accepted the remaining maturity descriptors as suitable for the attribute.

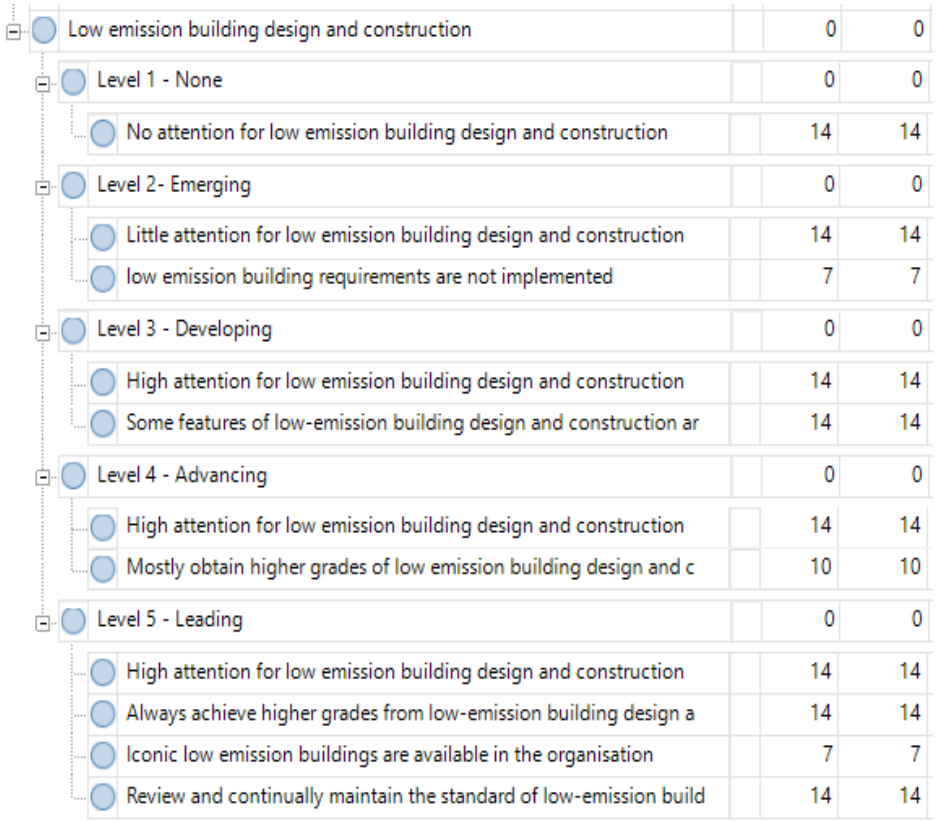
Attribute 19: Low emission building design and construction.

Findings from expert interviews.

Figure 4.19 presents the coding structure for low emission building design and construction.

Figure 4. 19

Coding Structure for Low Emission Building Design and Construction



S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 agreed that **Level 1 (none)** organisations have **no attention for low emission building design and construction** considering the absence of any of the elements of the PDCA structure in level 1. S2-E15 stated that "level 1 organisations do not plan for any low emission building design and construction. Therefore, they do not follow any energy sustainable building design and construction standards focused on energy performance improvements in buildings".

S2-E3 stated that "Emerging organisations have a little focus on voluntary low-emission building design and construction standards such as zero carbon standards and green building standards". S2-E1, S2-E2, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 also confirmed the **little attention for low emission building design and construction** in **Level 2 (emerging)** organisations due to the limited Plan element in in level 2. However, S2-E2, S2-E5, S2-E7, S2-E9,

S2-E12, S2-E13, and S2-E15 further highlighted that **low emission building requirements are not implemented** in emerging organisations.

According to S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 **Level 3 (developing)** organisations have **high attention for low emission building design and construction.** S2-E1 confirmed that "I think you can consider that Level 3 organisations are interested on green building design and construction certifications like LEED". However, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 proposed that only **some features of low-emission building design and construction are available** in level 3 due to the limited deployments under the level 3's PDCA structure.

Moreover, S2-E1, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 agreed that **Level 4 (advancing)** organisations have **high attention for low-emission building design and construction** considering the presence of a strong Planning element under the PDCA structure in level 4. Furthermore, S2-E2, S2-E3, S2-E4, S2-E5, S2-E7, S2-E9, S2-E12, S2-E13, S2-E14, and S2-E15 highlighted that advancing organisations **obtain higher grades from low emission building design and construction rating systems most of the time.** S2-E2 explained that advancing company might not be focussing on threshold grades. I would say, if they are advancing, they should focus on higher grades of low-emission building design and construction certifications systems.

Furthermore, **Level 5 (leading)** organisations also have strong planning in the PDCA structure like Level 4. Hence, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 highlighted the availability of **high attention for low-emission building design and construction** in **Level 5 (leading)** organisations. S2-E12 stated that "Some organisations have commitments to do all new construction in an energy sustainable way such as net zero building". Further, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 stated that the leading organisations **always achieve the higher grades from low-emission building design and construction rating systems**. In addition, S2-E1, S2-E2, S2-E3, S2-E5, S2-E8, S2-E12 and S2-E15 highlighted that **iconic low-emission building design and constructions** are available in level 5 organisations. S2-E8 proposed that "leading organisations most of the times have the target to be the pioneer in low-emission building design and construction schemes since they want to be the world first or leader in that". In addition, S2-E1, S2-E2, S2-E3, S2-E4, S2-E5, S2-E6, S2-E7, S2-E8, S2-E9, S2-E11, S2-E12, S2-E13, S2-E14 and S2-E15 agreed that the leading organisations **review and continually maintain the low-emission building rating systems.** S2-E2 stated that "for the leading organisations you can say that the organisation review and maintains the requirements of the low-emission standards and also renewing the certification".

Table 4.21 presents the summary of the maturity descriptors for low-emission building design and construction.

Table 4. 21

Maturity Descriptors Summary for Low Emission Building Design and Construction

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
1. No attention for low emission building design and construction.	1. Little attention for low emission building design and construction. 2. However, low emission building requirements are not implemented.	1. High attention for low emission building design and construction is available. 2. Some features of low-emission building design and construction are available.	1. High attention for low emission building design and construction is available. 2. Obtain higher grades of low emission building design and construction rating systems most of the time.	1. High attention for low emission building design and construction is available. 2. Always achieving higher grades from low-emission building design and construction rating systems. 3. Iconic low emission buildings are available in the organisation. 4. Reviews and continually maintains the standard of low-emission buildings.

Findings from focus groups.

All FGs agreed on the suitability of attribute 19 for the framework. Considering the maturity descriptors, FG2-TAEE1 stated that

> Does it have to be the external certification always? If there is no case to go for external certifications in business, the organisations would not go for it. So, we can say that even if the organisation is not formally certified, there can be that level implementations. Even it might be internal guidelines rather than external certifications, such as internal guidelines for selection of energy-efficient building materials.

Participants of the FGs also agreed on not limiting the framework for the certified organisations and to keep it open for **organisations have implemented low emission building features without formally certifying** for that. Furthermore, all FGs agreed on the suitability of the other maturity descriptors given under attribute 19.

Having explained the findings of Steps 2 and 3 together in this section, the next section presents the energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka developed as the ultimate outcome of Phase I of the study.

4.2.2.4 Proposed energy culture maturity framework for large-scale textile and apparel industrial organisations

The proposed energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka was developed using Steps 1, 2 and 3 findings of Phase I as explained previously in this chapter. The development of the proposed framework fulfilled Objective 3 of the study. Figure 4.20 and Table 4.22 jointly

presents the energy culture maturity framework for textile and apparel industrial organisations in Sri Lanka. Highlighted text (in light blue) in Table 4.22 represents the modifications added to the draft framework based on Step 3 findings to develop the final framework. Furthermore, the proposed maturity scoring system for this framework is given in Section 3.8.2.2.2 (a).

Figure 4. 20

Energy Culture Maturity Framework for Textile and Apparel Industrial Organisations

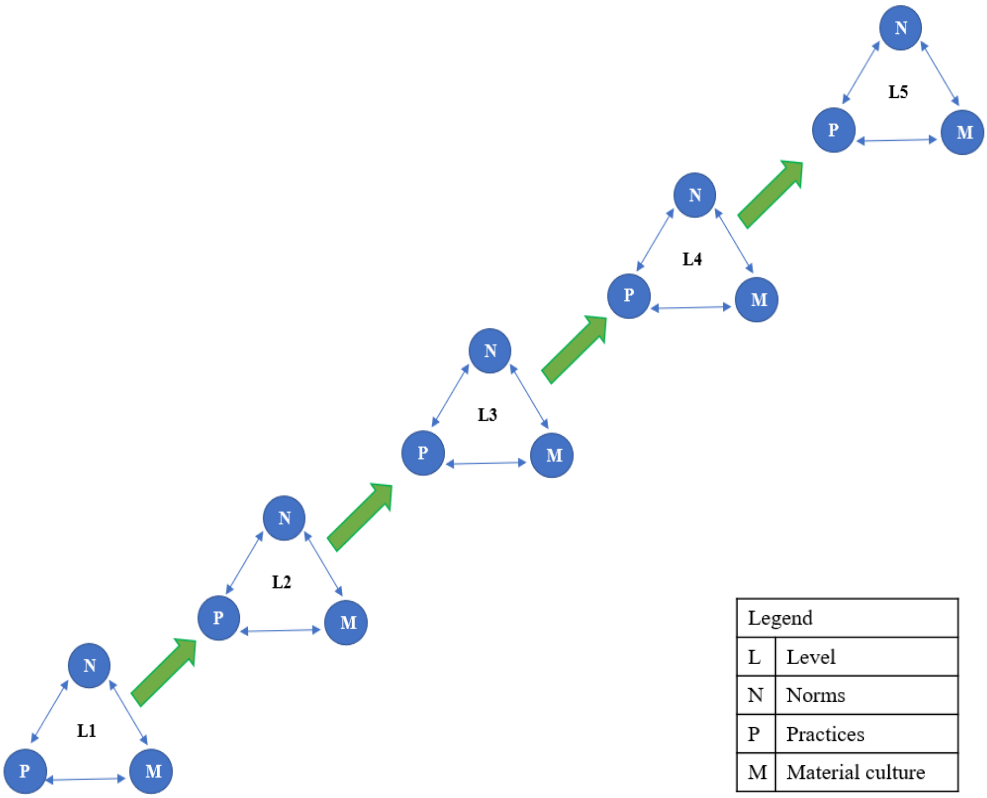


Table 4. 22

Energy Culture Maturity Framework for Textile and Apparel Industrial Organisations

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
Norms					
1. Green values of owners and senior management	1. No green values with owners and senior management.	1. Some green values with owners and senior management. 2. However, the green values are not linked to business strategies	1. Owners and senior management have strong green values 2. Green values are somewhat linked to the business strategies, and some results are observed	1. Owners and senior management have strong green values 2. Green values are linked to the business strategies, and considerable results are observed. 3. Benchmarking the leading energy management organisations in the industry.	1. Owners and senior management have strong green values 2. Green values are strongly linked to the business strategies, and results are clearly visible. 3. Need to become the pioneer in implementing new energy-related improvements 4. Owners and senior management display green values through the way they live. 5. Owners and senior management timely review the effectiveness of the relationship between green values and business strategies to ensure continual improvement.
2. Energy vision, mission, and policy statements	1. No energy vision, mission, and policy available.	1. There are vague energy vision, mission, and policy statements 2. Owners and senior management do	1. There are properly documented energy vision mission, and policy statements. 2. Owners and senior management have minor acceptance of those statements.	1. There are documented energy vision, mission, and policy statements. 2. Energy vision and policy statements may represent a time-bound nature to ensure timely results	1. There are documented energy vision, mission, and policy statements. 2. Energy vision and policy statements may represent a time-bound nature to ensure timely results 3. Owners and senior management well accept the statements.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
		not see the value of the statements. 3. The statements are not linked to the energy goals and strategies	3. The statements are poorly linked to the energy goals and strategies 4. Energy vision, mission and policy are weakly connected with the corporate vision and mission.	3. Owners and senior management have high acceptance of the statements 4. The statements are connected to energy goals and strategies, but still, there is a need to improve the effectiveness. 5. Energy vision, mission, and policy are supported by the corporate vision and mission.	4. The statements are effectively connected to the energy goals and strategies. 5. Energy vision, mission and policy has become a part of the corporate vision and mission. 6. Statements are timely reviewed for the effectiveness, and continual improvement is ensured
3. Organisational public commitments to energy management	1. No interest in energy-related public commitments	1. Some interest is available for energy-related public commitments 2. However, nothing has been implemented relating to public commitments	1. Organisation is publicly committed to scope 1 energy-related emission reduction. 2. There is minor progress towards achievement of the public commitments	1. Organisation is publicly committed to scope 1 and scope 2 energy-related emissions reduction. 2. There is considerable progress towards the achievement of public commitments.	1. Organisation is publicly committed to scope 1, scope 2 and scope 3 energy-related emission reduction. 2. There is up-to-date progress towards the achievement of the public commitments 3. Organisation obtains strong support from supply chain partners for the public commitments. 4. The status of the public commitments is timely reviewed, and appropriate actions are taken to ensure continual improvement.
4. Employee interest for	1. Employees do not have any interest in the	1. Employees have some interest in the need for	1. Employees have a high interest in the need	1. Employees have a high interest in the need for	1. Employees have a significant interest in the need for energy-related improvements.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
energy-related improvements	need for energy-related improvements	energy-related improvements. 2. There is no employee engagement for the available energy management best practices, programmes, and projects.	for energy-related improvements. 2. There is some employee engagement for the available energy management best practices, programmes, and projects. 3. There are some informal teams for energy management. 4. However, the teams are less impactful in driving the potential improvements.	energy-related improvements. 2. High employee engagement for the available energy management best practices, programmes, and projects. 3. Informal employee teams are available 4. Informal teams are actively engaged in energy-related improvements 5. Evidence for employee engagement in energy management is visible considerably.	2. Excellent employee engagement for the available energy management best practices, programmes, and projects. 3. Informal employee teams are available 4. Informal teams are very actively engaged in energy-related improvements 5. Evidence for employees' engagement for energy management is widely available 6. Strong bottom-up initiatives by employees are clearly visible for energy management. 7. Employees have changed even their lifestyle with more energy consciousness 8. Employee engagement for energy management is timely reviewed and actions are taken for continual improvement.
5. Promoting product carbon footprint reduction.	1.Organisation does not plan to promote products with a reduced carbon footprint.	1. Organisation plans to promote a few products with a reduced carbon footprint. 2. However, practical implementations	1. Organisation plan to promote many products with a reduced carbon footprint. 2. Only a few products with reduced carbon footprint have been innovated.	1. Organisation plan to promote many products with a reduced carbon footprint. 2. Among the innovations, a high number of products are reduced carbon footprint products.	1. Organisation plan to promote many products with a reduced carbon footprint. 2. Most of the product innovations of the organisation are products with a reduced carbon footprint. 3. Third-party product carbon footprint certifications have been obtained for all relevant product innovations.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
		have not been started yet.	3. Commercialisation of reduced carbon footprint products has been started with customers for a few products.	3. Third-party product carbon footprint certifications have been obtained for a moderate number of product innovations. 4. A moderate number of reduced carbon footprint product innovations have been commercialised with the customers. 5. Some low carbon product designs are directly received from customers	4. Most of the reduced carbon footprint product innovations have been commercialised by the organisation with customers. 5. Organisation has become a brand name among the customers for manufacturing products with a reduced carbon footprint. Hence, a considerable number of such orders are received. 6. Organisation timely review the plans for promoting products with reduced carbon footprint and take actions to ensure continual improvement.
6. Approach to energy in investment analysis	1. Do not think about the need for any energy-related investment analysis.	1. Organisation has some interest in basic investment analysis methods like simple payback period. 2. However, the investment analysis methods are not implemented.	1. Organisation has the interest in both basic investment basic investment analysis methods and life cycle cost analysis (LCCA) for significant energy-using equipment as required practices. 2. A documented procedure specifies the required minimum LCCA results for the	1. Organisation has the interest in both basic investment analysis methods and LCCA for significant energy-using equipment as required practices. 2. A documented procedure specifies the required minimum LCCA results for the significant energy-consuming equipment. 3. Basic investment analysis are always used and LCCA is	1. Organisation has the interest in both basic investment analysis methods and LCCA for significant energy-using equipment as required practices. 2. A documented procedure specifies the required minimum LCCA results for the significant energy-consuming equipment. 3. Basic investment analysis are always used and LCCA is used for all the significant energy-consuming equipment.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
			significant energy-consuming equipment. 3. Basic investment analysis techniques are always implemented for energy project assessment. However, the LCCA use is rare	used for most of the significant energy-consuming equipment.	4. The investment analysis approach is timely reviewed, and actions are taken to ensure continual improvement.
Practices					
7. Changing core business practices for energy-related improvements	1. Do not change core business practices to introduce energy-related improvements	1. Organisation plans for some convenient changes to business practices to improve energy management. 2. However, nothing is implemented	1. Organisation plans changes to current business practices for required energy management improvements. 2. However, implementation is limited to few improvements. 3. There is a procedure to identify and implement energy-related innovations to change energy-inefficient business practices.	1. Organisation plans changes to current business practices for required energy management improvements. 2. Most of the planned changes to business practices are implemented. 3. There is a procedure to identify and implement energy-related innovations to change energy-inefficient business practices. 4. Evidence is visible for the actual implementation of a considerable number of selected innovations	1. Organisation plans changes to current business practices for required energy management improvements. 2. All planned changes to business practices are implemented. 3. Organisation is a pioneer in the industry for changing the certain current business practices for energy management improvements 4. There is a procedure to identify and implement energy-related innovations to change energy-inefficient business practices. 5. Evidence is visible for the actual implementation of all selected innovations 6. Organisation timely reviews the needs for changing business practices for energy-related

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
			4. Evidence is rarely visible for the actual implementation of the selected innovations		improvements, and actions are taken to ensure continual improvement
8. Financing energy-related improvements	1. No energy-related capital or operational budget allocations or actual spending	1. Informal agreements on capital or operational energy spending are available without formal budgets. 2. However, no actual spending on energy-related improvements	1. There is a documented annual budget for capital and operational expenditure on energy-related improvements. 2. However, only a few of the budget items have been initiated from both capital and operational expenditure. 3. There is a slight growth in the annual budget allocation for both capital and operational energy expenditure.	1. There is a documented annual budget for capital and operational expenditure on energy-related improvements. 2. Organisation has ensured that required financing is available for most planned capital and operational spending. 3. There is a growth in annual budget allocations. Especially, the growth of capital allocation is significant. 4. The budgets are linked to the energy goals and strategies of the organisation.	1. There is a documented annual budget for capital and operational expenditure on energy-related improvements. 2. Organisation always ensures the required financing is available for all planned energy-related improvements 3. A minimum specific percentage from the annual energy bill cost is allocated as the operational energy budget. (e.g., 5% of annual energy cost). The amount allocated is significant. 4. The organisation usually does not have much capital spending required at this level because most of the capital investments have already been made. However, the organisation always allocates capital funds timely when such needs arise. 5. The budgets are well linked with the energy goals and strategies 6. Capital and operational energy budgets are reviewed in a timely manner, and actions are taken to ensure continual improvement.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
9. Assigning human resources and responsibilities	1. No employees are given energy management responsibilities.	1. Nominal appointment of an employee doing another job role for energy management. 2. The employee is not assigned clear energy-related responsibilities.	1. Organisation structure with positions responsible for energy management is available. 2. However, only the some of the energy management responsibilities are assigned to relevant employees 3. Set of energy KPIs is available for relevant employees. However, only a few KPIs are linked to responsibilities. 4. Only some of the required recruitments for energy management are provided 5. Qualifications and competencies of the technical positions are not considered much.	1. organisation structure with positions responsible for energy management is available. 2. Most of the energy management responsibilities are assigned to relevant employees 3. Set of energy KPIs is available for employees. Most of the KPIs are linked to the energy responsibilities of the employees. 4. Availability of moderately effective cross-functional energy teams 5. Fulfil a considerable number of required recruitments for energy management. 6. Appropriately qualified and competent employees are assigned for required jobs most of the times	1. organisation structure with positions responsible for energy management is available. 2. All energy management responsibilities are assigned to relevant employees 3. Set of energy KPIs is available for employees. All KPIs are linked to the energy responsibilities of the employees 4. Availability of effective cross-functional energy teams with designated responsibilities 5. All required recruitments for energy management are provided. 6. Appropriately qualified and competent employees are always for always assigned to required jobs 7. Timely review of energy-related human resources and take actions to ensure continual improvement

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
10. Priority to energy efficiency in procurement practice	1. Energy efficiency is never considered as a part of the procurement evaluation criteria	1. Certain basic procurement instructions are available that consider energy-efficiency. 2. Procurement instructions are not properly documented. 3. Procurement instructions focussed on energy efficiency are not followed in the procurements	1. Energy-related comprehensive procurement procedure is available 2. The procurement procedure is properly documented. 3. However, it is implemented on certain procurements only. Still, most energy-related procurements do not follow the procedure.	1. Energy-related comprehensive procurement procedure is available 2. The procurement procedure is properly documented 3. It is implemented in most of the energy significant procurements. Still, some procurements bypass the procedure. 4. Specific minimum energy performance requirements available in the procurement procedure for some equipment 5. A procurement person is a member of the energy team 6. Most of the relevant supply chain members are informed about the energy-related procurement requirements.	1. Energy-related comprehensive procurement procedure is available 2. The procurement procedure is properly documented 3. Procurement is implemented in all relevant procurements 4. Specific minimum energy performance requirements available in the procurement procedure for some equipment 5. A procurement person is a member of the energy team 6. All relevant supply chain members are informed about the energy-related procurement requirements. 7. Procedure is reviewed on time for appropriateness, and continual improvement is ensured.
11. Internal and external communications supporting	1. Never pay attention to establishing internal or	1. An informal internal and external	1. A documented internal and external communication plan relating to energy	1. A documented internal and external communication plan relating to energy management is available	1. A documented internal and external communication plan relating to energy management is available

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
energy management	external communications on energy management (Excluding mandatory external reporting)	communication plan is available. 2. Communication plan is not documented. 3. Energy management related internal or external communications are not carried out.	management is available. 2. Internal and external communication is carried out to some extent. 3. Organisation has utilised some of the various communication tools for internal and external communication.	2. Most of the internal and external energy communications are taken place. 3. Organisation has utilised various communication tools for internal and external communication. However, the effectiveness of communication tools should be further improved. 4. Energy vision, mission, and policy are communicated to most internal staff and relevant external stakeholders	2. All the internal and external communications occur as per the plan. 3. Organisation has utilised a variety of effective communication tools for effective internal and external communication 4. Third-party verified energy-related sustainability report is published periodically for the public. 5. Energy vision, mission, and policy are effectively communicated to all internal staff and all relevant external stakeholders 6. Timely review and continual improvement of the energy-related communication practice
12. Rewarding and recognition for energy-related improvements	1. Never focus on rewarding and recognition for energy-related improvements	1. A rewarding and recognition mechanism is informally agreed by the management 2. Rewarding and recognition mechanism is not properly documented.	1. A formal rewarding and recognition mechanism is available to appreciate the good energy behaviours of employees. 2. The rewarding and recognition mechanism is documented	1. A formal rewarding and recognition mechanism is available to appreciate the good energy behaviours of employees. 2. The rewarding and recognition mechanism is documented	1. A formal rewarding and recognition mechanism is available to appreciate the good energy behaviours of employees. 2. The rewarding and recognition mechanism is documented 3. The mechanism is communicated to all employees 4. Rewarding mechanism is linked with the energy KPIs. 5. All identified rewarding and recognition mechanisms have been implemented, and the evidence is available

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
		3. However, there is no rewarding and recognition practised.	3. The mechanism is not well communicated to employees 4. Lack of practice in rewarding and recognition mechanism	3. The mechanism is communicated to most of the employees 4. Rewarding mechanism is linked with the energy KPIs. 5. Most of the identified rewarding and recognition mechanisms are implemented, and the evidence is available	6. Energy-related rewarding mechanism is timely reviewed and ensures continual improvement.
13. Knowledge and training	1. There is no energy management knowledge and related training available to the technical and non-technical employees	1. There is no formal training plan that includes energy management related training. 2. There is some ad-hoc planning for energy-related training needs.	1. An annual training plan is available that includes energy management related training. 2. Training plan is prepared based on the energy knowledge gaps of the employees. 3. Energy-related training is provided for a few of the relevant employees 4. Relevant employees have little knowledge of	1. An annual training plan is available that includes energy management related training. 2. Training plan is prepared based on the employees' knowledge gaps. 3. Energy-related training is provided for most of the relevant employees 4. Most of the relevant employees have required knowledge of energy management and related improvements.	1. An annual training plan is available that includes energy management related training. 2. Training plan is prepared based on the employees' knowledge gaps. 3. Energy-related training is provided for all relevant employees 4. All relevant employees have the required knowledge of energy management and related improvements. 5. Review and ensure continual improvements of the energy-related knowledge and training.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
			energy management and related improvements.		
14. Deployment of energy goals and strategies	1. There are no energy goals and strategies available 2. There are no operational controls for energy management available	1. There are a few vague energy goals and strategies available. 2. Some vague operational controls are set for some significant energy-using activities.	1. Long term and short-term energy goals are available. 2. Multiyear and annual strategies available for those goals. 3. Few energy KPIs are defined for strategies 4. Goals, strategies and KPIs are documented 5. Energy goals, strategies and KPIs have minor alignment with the core business strategies 6. Operational controls are in place to control the significant energy-using activities. However, the operational controls are not adhered in most of the times.	1. Long term and short-term energy goals are available. 2. Multiyear and annual strategies available for those goals. 3. Most of the required KPIs are defined, with some cascading down to lower levels. 4. Energy goals strategies and KPIs are documented and have a considerable link with the energy vision, mission, and policy. 5. Most of the available KPIs are linked to incentives of the employees 6. There is a considerable alignment of energy goals, strategies and KPIs with the core business strategies	1. Long term and short-term energy goals are available. 2. Multiyear and annual strategies available for those goals. 3. All required KPIs are defined and effectively cascaded down into all required lower levels. 4. Energy goals, strategies and KPIs are documented and are linked with the energy vision, missions, and policy. 5. All relevant KPIs are linked to incentives of the employees 6. Energy goals, strategies, and KPIs align well with the core business strategies. 7. Energy KPIs are linked to individual KPIs of all employees without limiting to direct energy management employees. That makes it part of the culture and makes everyone responsible for energy management. 8. Operational controls are in place to control the significant energy-using activities. The operational controls are adhered in all times.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
				7. Operational controls are in place to control the significant energy-using activities. The operational controls are adhered in most of the times.	9. Review adequacy of goals, strategies and KPI system and take actions to ensure the continual improvement
15. Energy performance monitoring and management	1. Energy performance monitoring is not available	1. Some ad-hoc energy performance monitoring mechanisms are available	1. Proper energy performance monitoring mechanisms are available 2. However, actual energy performance monitoring is limited 3. There are a few common energy baselines and KPIs available. However, those are not effectively monitored.	1. Proper energy performance monitoring mechanisms are available 2. Number of energy baselines and KPIs are available in different categories such as product-wise, process-wise, machinery-wise and energy source-wise. 3. Most of the planned energy performance monitoring is carried out 4. Formal review mechanisms such as management review meetings and internal and external energy auditing are taken place to review the overall energy management system.	1. Proper energy performance monitoring mechanisms are available 2. Comprehensive set of specific energy baselines and KPIs are available in different categories such as product-wise, process-wise, machinery-wise and energy source-wise. 3. All planned energy performance monitoring is timely carried out 4. The performance monitoring results are timely communicated to relevant employees and superiors. 5. Formal review mechanisms such as management review meetings, and internal and external energy auditing are taken place timely to review the overall energy management system. 6. Application of problem-solving techniques to analyse the energy performance deviations and to develop corrective actions.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
				5. The performance monitoring results are communicated to relevant employees and superiors. 6. However, some of the required corrections are not taken for the identified deviations.	7. Effective corrective actions are taken for the deviations identified from energy performance monitoring. 8. Continual energy performance improvement is evidenced.
16. Maintenance management supporting energy performance	1. Do not pay attention to establishing proper maintenance management.	1. Some planned preventive maintenance activities for some significant energy-consuming equipment. 2. However, the preventive maintenance is not carried out according to the plans and limited to corrective maintenance.	1. A comprehensive preventive maintenance management programme is available to cover all significant energy-consuming technologies 2. Only Some of the preventive maintenance activities are carried out as per the plan	1. A comprehensive preventive maintenance management programme is available to cover all significant energy-consuming technologies 2. Most preventive maintenance activities are carried out according to the plan. However, there are some deviations 3. An autonomous maintenance programme is also in place and is considerably functioning. 4. Considerable use of computerised maintenance management systems that	1. A comprehensive preventive maintenance management programme is available to cover all significant energy-consuming technologies 2. All preventive maintenance activities are carried out according to the plan. 3. Very effective autonomous maintenance management is also in place. 4. Well-functioning computerised maintenance management system that supports real-time monitoring is available 5. Maintenance management programme is timely reviewed, and continual improvement of energy performance is ensured.

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
				support real-time monitoring.	
Material Culture					
17. Energy-efficient technologies and related supportive technologies	1. Organisations do not pay attention to the need for energy-efficient technologies and related supportive technologies	1. Organisation has some attention for less significant and low-cost energy-efficient technologies and related supportive technologies. 2. However, no actual adoption of any energy-efficient technologies and related supportive technologies	1. Organisation pays attention to the need for energy-efficient technologies and related supportive technologies. 2. Some of the significant energy-efficient technologies are available 3. Some energy management supportive technologies like energy submeters, dashboards and software are available.	1. Organisation pays attention to the need for energy-efficient technologies and related supportive technologies. 2. Most of the significant energy-efficient technologies are available 3. Considerable energy management supportive technologies such as energy submeters, dashboards, software and building management systems (BMS) are available.	1. Organisation pays attention to the need for energy-efficient technologies and related supportive technologies. 2. All significant energy-efficient technologies are available 3. All required energy management supportive technologies such as energy submeters, dashboards software and BMS are available. 4. Adequacy of the existing energy-efficient technologies and energy management supportive technologies are timely reviewed and replaced with more efficient technologies if required to ensure continual improvement
18. Renewable energy sources	1. No plans and implementations of renewable energy sources	1. Organisation has informal plans for renewable energy sources. 2. Informal plans are not documented	1. Organisation has formal short-term, medium-term, and long-term plans to implement renewable energy projects 2. Renewable energy plans are documented	1. Organisation has formal short-term, medium-term, and long-term plans to implement renewable energy projects 2. Renewable energy Plans are documented	1. Organisation has formal short-term, medium-term, and long-term plans to implement renewable energy projects 2. Renewable energy plans are documented 3. All planned renewable energy projects are implemented 4. Availability of industry-leading renewable energy projects

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
		3. No renewable energy initiatives are implemented	3. However, only a few of the planned renewable energy projects are implemented	3. Considerable number of planned renewable energy projects are implemented	5. Review and continually improve the use of renewable energy sources
19. Low emission building design and construction	1. No attention to low emission building design and construction	1. Little attention to low emission building design and construction 2. However, low emission building requirements are not implemented	1. High attention to low emission building design and construction is available 2. Some features of low-emission building design and construction are available.	1. High attention to low emission building design and construction is available 2. Obtain higher grades of low emission building design and construction rating systems most of the time (Even if the organisation does not certify for rating systems, required low emission building features are available)	1. Very high attention to low emission building design and construction is available 2. Always achieving higher grades from low-emission building design and construction rating systems (Even if the organisation does not certify for rating systems, required low emission building features are available) 3. Iconic low emission buildings are available in the organisation 4. Review and continually maintain the standard of low-emission buildings.

4.3 Chapter summary

This chapter presented the Phase I findings of the study that developed the energy culture maturity framework for large-scale textile and apparel industrial organisations as Objective 3 of the study. Phase I was conducted via three (03) steps. Step 1 developed the energy culture maturity attributes and their PDCA aspects based on the findings of 10 semi-structured interviews with energy experts employed in textile and apparel industrial organisations. Then, Step 2 developed energy culture maturity descriptors against the identified attributes for five (05) maturity level based on the findings of 15 semi-structured interviews with energy experts employed in textile and apparel industrial organisations. Further, Step 2 developed a draft energy culture maturity framework as the outcome. Finally, Step 3 of the study refined the draft energy culture maturity framework developed in Step 2 using the findings of three (03) mixed focus group discussions. The outcome of Step 3 was the ultimate outcome of Phase I; that is, the energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka. The following chapter explains the evaluation of the applicability of Phase I's framework in multiple case studies.

CHAPTER 5

PHASE II ANALYSIS AND FINDINGS, AND STUDY'S DISCUSSION

5.1 Introduction

Phase I developed an energy culture maturity framework for textile and apparel industrial organisations based on semi-structured interviews and focus group discussions. This chapter presents the evaluation of the applicability of the proposed framework using case studies and the study's discussion. Accordingly, the chapter presents the findings of the within-case analysis in three (03) case studies first. Subsequently, the findings of the cross-case synthesis are presented considering the three (03) case studies. Then, the study's discussion section explains how the proposed energy culture maturity framework and related findings of the study fit existing literature and, beyond that, how the findings of the study have contributed to moving forward the knowledge on energy culture within the study's scope. Accordingly, Phase I and Phase II findings are discussed in several areas in this chapter. In the end, the chapter summary is presented.

5.2 Within-case analysis

This study conducted a detailed energy culture maturity assessment as the main data collection in case studies using the interview guideline given in Appendix 4. Accordingly, focus groups, document reviews and observations were conducted in each case study following the interview guideline. This interview guideline was prepared by incorporating the energy culture maturity assessment framework given in Table 4.22. However, instead of the names of five (05) maturity levels (e.g., Level 1 - none), those were identified using "Type A" to "Type E" name tag to prevent the levels identification by the participants when conducting the assessment. The participants were asked to jointly decide the maturity level best suited for their organisation under each attribute. Then, the documentary and observation evidence were requested from the participants to justify their maturity level preferences for each attribute. Appendix 9 provides sample transcript of a case study focus group. At the end of the focus group discussion in case study, an overall maturity preference was identified using the interview guideline given in Appendix 5. Further details on data collection in case studies is given in Section 3.8.2.1.

Data analysis under case studies was conducted in two (02) stages as explained in Section 3.8.2.2. Accordingly, first within-case analysis was conducted for each case incorporating pattern matching case study data analytic technique. The proposed energy culture maturity framework for textile and apparel industrial organisations was identified as the predicted patterns for pattern matching. Accordingly, energy culture maturity patterns of the proposed framework were matched with the patterns of each

case study to develop the within case findings. Further details on the pattern matching are explained in Section 3.8.2.2.1.

Furthermore, as a part of the within-case analysis, the overall energy culture maturity was identified using the maturity scoring system proposed for the detailed energy culture maturity assessment. The proposed maturity scoring system calculated the energy culture maturity score for each case using Likert scale (1 to 5 scoring system) where Level 1 (none) = 1 and Level 5 (leading) = 5. Based on the Likert scale overall maturity scores for each energy culture maturity level were defined. For instance, Level 1's total maturity score is between 0 to 19. Whereas Level 5's total maturity score is between 77 to 95. Further details on the energy culture maturity scoring system are presented in Section 3.8.2.2.2 (a). Furthermore, two (02) other approaches (most chosen maturity level and overall maturity preference) used to cross-check the overall maturity result of the detailed maturity assessment as explained in Section 3.8.2.2.2

Accordingly, this section presents the findings of the within-case analysis concerning Case A, Case B and Case C separately. Accordingly, the case study description, details of the participants, and the within-case analysis findings are presented. In addition, the results of the detailed energy culture maturity assessment calculated using the maturity scoring system was compared with the most chosen maturity level and overall maturity preference to understand the overall applicability of the results of the proposed framework. Thereafter, the cross-case synthesis was conducted in Section 5.3 as the second stage of data analysis using the findings of within-case analysis.

5.2.1 Within-case analysis of Case Study A

The findings of the Case A are presented in this section. The section contains case study description, details of the focus group participants, findings of the within-case analysis and Summary of the within-case analysis findings.

5.2.1.1 Case study description

Case A is a large-scale organisation in the textile and apparel industry in Sri Lanka, which was established in 2015 and subsequently was listed as a public limited liability company in 2022. The organisation has obtained various compliance, environmental, and product sustainability certifications. Various international compliance and sustainability certificates, such as Worldwide Responsible Accredited Production (WRAP), Ethical Trading Initiative (ETI) and Higg Index 3.0 Facility Environmental Module, can be highlighted as the organisation's achievements. Further, it has obtained several product sustainability certifications, including the Global Recycled Standard and Global Organic Textile Standard.

Over the years, the company has won a number of awards, including Best Exporter Award in Presidential Export Awards, merit award winner for the apparel sector in Presidential Export Awards 2019, Most Inclusive Employer of the Year in the Inclusive Employment Forum 2019, Sustainability Award from the Tesco Non-food

Partner Conference 2021, and Most Sustainable Factory Award from the George Global Sustainability Conference 2021.

The company operates on two (02) levels: the corporate business unit operations based at the head office and the manufacturing operations at the factories. Currently, the organisation operates 12 manufacturing factories with around 19,000 employees. Further, the organisation's manufacturing scope includes both textile and apparel manufacturing processes. As explained in Section 3.8.2.4, the energy culture maturity assessment was conducted considering the energy culture attributes relating to the operations of the corporate level (head office) and a factory. The manufacturing factory was an 80,772 square foot factory established in 2015 and employed 1,465 people.

5.2.1.2 Details of the focus group participants

As explained in Chapter 3, the focus group participants were appointed considering their exposure to energy management and ability to assess energy culture attributes relating to both corporate level and the factories. Table 5.1 presents the details of the Case A focus group participants. The selected team has exposure to energy management in the whole scope of the business.

Table 5. 1

Details of the Participants of Case A Focus Group

Code	Designation	Experience	Energy Management Related Role
CSA-P1	Manager Compliance	8 years	• Representing the central compliance team based at the head office. • Overlooks energy management, energy performance monitoring, and energy auditing in the set of factories in the group.
CSA-P2	Senior Executive Compliance	6 years	• Representing the central compliance based at the head office. • Overlooks energy management, energy performance monitoring, and energy auditing in the set of factories in the group.
CSA-P3	Executive Compliance	5 years	• Representing the selected manufacturing factory • Overlooks energy management, energy performance monitoring, and energy auditing in the selected factory.

5.2.1.3 Findings of the within-case analysis of Case A

This section presents the findings of the within-case analysis of Case A based on the focus group discussion results supported by the relevant documentary evidence and

the indirect observations. The findings are presented for the 19 attributes under norms, practices, and material culture of the energy culture maturity framework.

Norms

Attribute 1: Green values of owners and senior management.

All focus group participants agreed that their organisation fits the **Type C (Level 3 – developing)** status under attribute 1. CSA-P1 expressed that "Our Managing Director has high interest for the sustainability-related aspects of the business. For example, he has a dream to go for a factory that operates with 100% renewable energy in the future". However, the participants highlighted that the senior leadership's green values are somewhat linked to the business strategies and currently provide limited results. Accordingly, all descriptors of the maturity level 3 under this attribute have complied with the current situation of Case A. Participants proposed that there is various evidence to justify the green values of senior leadership. For instance, the current rooftop solar energy project supports achieving "100% renewable energy powered factories" in the future, as expected by the senior leadership.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 2: Energy vision, mission, and policy statements.

CSA-P1 stated that "We have the energy vision mission, and policy statements but those are not adequately linked to the business strategies and energy goals and strategies". Further, the participants stated that the senior leadership has limited priority for those statements regarding actual deployments. Accordingly, participants decided that the organisation fits the **Type C (Level 3 – developing)** maturity under this attribute since the two (02) descriptors of Level 2 best describe Case A's current context. In addition, participants highlighted that instead of having a separate energy vision, mission, and policy statements, the organisation's practice has a common sustainability vision, mission and policy that integrates the energy vision, mission and policy statements. Accordingly, the organisation's sustainability vision, mission and policy statements were proposed as the documentary evidence under attribute.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 3: Organisational public commitments to energy management.

Participants proposed that the organisation matches the **Type B (Level 2 –emerging)** maturity description under this attribute since the maturity descriptors reflect the actual situation of Case A relating to the organisation's public commitments to energy management. CSA-P1 mentioned that "we have identified the importance of energy-related public commitments such as the Science-Based Targets Initiative (SBTi). However, nothing related to public commitments has been implemented yet".

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√			

Attribute 4: Employee interest in energy-related improvements.

Participants agreed that the Case A employees have limited interest in energy management-related enhancements, which is in line with the descriptor 1 of the **Type B (Level 2 – emerging).** Further, they explained that the employees have some engagement in the available energy management best practices, programs, and projects consistent with the descriptor 2 under the **Type C (Level 3 – developing)** maturity. However, none of the other maturity descriptors was in accordance with Case A's status. Employee engagement in the energy-saving initiatives is identified as the evidence supporting this maturity status proposed by the participants.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 5: Promoting product carbon footprint reduction.

Participants stated that they are using a tool that can calculate the carbon footprint of the products based on the product's material composition. According to CSA-P1, "…we have innovated only two (02) or three (03) sustainable products for the moment". Overall, the participants agreed that Case A's maturity status on this attribute is in accordance with the descriptors of the **Type C (Level 3 – developing)** maturity. Documentary evidence available on the new product development justified the choice of the participants.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 6: Attention to investment analysis considering energy.

CSA-P1 stated that the basic investment appraisal methods such as simple payback period are always used when evaluating the suitability of investments. Further, CSA-P3 highlighted that "we have recently recruited a separate person responsible for the life cycle cost analysis (LCCA) who works on the life cycle cost analysis of the investments". Participants stated that the organisation has now established the need for basic investment analysis and the LCCA in practice. However, the LCCA practice is still limited to some investments. Overall, participants agreed to rate the organisation's maturity as **Type C (Level 3 – developing)**, considering the current energy investment analysis approach. Documentary evidence of the recent investment appraisal reports were identified as the evidence that can justify the choice of the participants.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

This section presented the findings of within case analysis under the norms. Then, the next section explains findings under practices.

Practices

Attribute 7: Changing core business practices for energy-related improvements.

CSA-P1 stated that

> We have certain moves directly focussed on the energy conservation. I have experienced this in the high-level discussions at the group level. As an example, we have been doing a project to replace the existing inefficient lighting of all factories with LED lighting. However, it is not a change that we do for the core business to save energy as focused by this attribute. I feel it is not common to make the changes to the core business practices for the energy saving in our place. Energy efficiency is one (01) of the factors considered when changing the business practices, but it is not the factor that drives such changes in our organisation.

Considering the overall situation, CSA-P1 proposed that they fit the Type B organisations under this attribute. Similarly, CSA-P3, also stated that "Yes, I also agree with CSA-P1. As an organisation, we engage in different moves for energy conservation. However, we do not change the organisation's business practices to gain energy savings as the primary reason". Therefore, the focus group participants agreed that their organisation fits the **Type B (Level 2 – emerging)** organisation under the attribute 7 since all maturity descriptors are matched well.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√			

Attribute 8: Financing energy-related improvements.

CSA-P3 mentioned that "We do have an energy budget, but that is only for the operational energy expenses like purchasing fuel and paying electricity bills. But we do not have a formal energy budget for the energy advancements". CSA-P1 also confirmed the unavailability of a formal energy improvement budget and further stated, "currently, we do not have a specific budget for energy-related improvements. However, as I said earlier, we do some ad-hoc investments despite the availability of the formal budgets". Overall, the focus group agreed that the availability of mixed maturity features of the **Type B (Level 2 – emerging)** organisations and **Type C (Level 3 – developing)** organisations in Case A under the attribute because Case A consisted of number 1 and number 2 maturity descriptors of the Type B and Type C organisations respectively.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 9: Assigning human resources and responsibilities.

CSA-P2 stated that "we have specifically defined a sustainability-related organisational structure for the energy management. That structure represents each plant's responsible persons for energy management as well". Furthermore, participants agreed that energy-related human resources aspects are still developing because only recently they have established a separate sustainability department. CSA-P1 expressed that "We have created a new position last year and recruited a general manager engineering and sustainability and a sustainability team under him at the group level. In the plants, energy management is handled by the factory engineer". Therefore, the energy-related team is in the process of defining their scope and related aspects since the last year. Further, the availability of energy related KPIs per product's energy consumption and per hour energy consumption was highlighted. Overall, the focus group participants agreed that their organisation fits the **Type C (Level 3 – developing)** since it complies with all maturity descriptors in the Level 3 organisations under this attribute. In addition, documentary evidence was also provided to justify the availability of organisational structure responsible for energy management from the group level to the manufacturing factories and defined duties for energy management in the job descriptions.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 10: Priority to energy efficiency in procurement practice.

CSA-P3 stated that "We do have certain informal agreements to purchase energy-efficient technologies, such as going for LED light bulbs. However, that is not standardised and documented as a procedure". CSA-P1 and CSA-P2 also agreed on the unavailability of standard procurement instructions for energy-efficient technologies. Accordingly, all participants agreed that the organisation represents maturity descriptor 1 and 2 of Type **B (Level 2 – emerging)** organisations and maturity descriptor 3 of the **Type C (Level 3 – advancing)** organisations.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 11: Internal and external communications supporting energy management.

CSA-P1 explained that "We have a plant wise annual strategy for the sustainability. Under that, energy-related communications and awareness are included". Further, CSA-P3 highlighted that "We have energy awareness sessions and use visual awareness in all plants. For example, stickers pasted asking to switch off the air conditioning when leaving the rooms". Overall, the three (03) participants agreed that their position is well suited to a **Type C** organisation since they have all three (03) maturity descriptors of the **Level 3 – developing** organisations. The sustainability strategy of the plant provided relevant documentary evidence, and sample posters provided the observation evidence to support compliance with the maturity descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 12: Rewarding and recognition for energy related improvements.

All participants agreed that there is no established rewarding and recognition mechanism in the organisation. Further, CSA-P3 stated that "We have done some ad-hoc rewarding for the energy-efficient innovations by the plant maintenance team. Those are not monetary rewards but limited to appreciations of effort". Accordingly, all agreed that the organisation represent number 1 and number 2 descriptors of the

Type B (Level 2 – emerging) and number 4 descriptor of **Type C (Level 3 – advancing)** organisations. Evidence of the ad-hoc rewarding and recognition events were presented for the existence of attribute's maturity level.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 13: Knowledge and training.

CSA-P1 explained that "We do not have a formal training plan that specifies the need for energy-related training. Actual training provided is limited and mostly based on the ad-hoc plans". All participants agreed that the organisation is represented by the number 1 and 2 descriptors of the **Type B (Level 2 – emerging)** and the number 3 descriptor of **Type C (Level 2 – developing).** Further, there was no recent evidence to show the training evidence.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 14: Deployment of energy goals and strategies.

According to CSA-P3, they have established energy goals and strategies for factories for five (05) years. Further, CSA-P3 stated that "We have established energy KPIs based on energy sources to reduce energy use. We review the actual status of the achievement annually as well. For example, electricity use is monitored against the number of pieces produced as an indicator". All participants highlighted that the one (01), two (02), three (03), and four (04) descriptors of the **Type D (Level 4 – advancing)** complied with the organisation's status. However, CSA-P1 stated there is a poor alignment between energy goals, strategies and KPIs within the core business strategies. Further, the participants agreed on the availability of the operational controls even though the practice is lacking. Therefore, those areas are aligned with the descriptor five (05) and six (06) under **Type C (Level 3 – advancing)** organisations. Energy goals, strategies and KPI documents were provided as the documentary evidence for the maturity descriptors. Furthermore, participants explained that "external influences" from the Higg index have positively impacted the development of the maturity under this attribute, in addition to the drive of the organisation. The Higg index is a globally used tool to improve the sustainability aspects of textile and apparel industrial organisations.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√	√	

Attribute 15: Energy performance monitoring and management.

CSA-P1 proposed that "I think we can select Type D as the organisation's situation". CSA-P3 stated that "I also agree with the selection of Type D because we usually monitor the energy KPIs and review the status in the management review meetings appropriately. Further, we also review the baselines annually". All participants agreed that Case A can represent the **Type D (Level 4 – advancing)** maturity status due to fulfilling all maturity descriptors in Level 4 under this attribute. KPI monitoring reports and review meeting minutes supported the choice of the participants. In addition, participants highlighted the positive impact caused by the Higg index on the improvement of maturity under this attribute as a positive "external influence"**.**

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 16: Maintenance management supporting higher energy performance.

CSA-P1 stated that

> We can consider **Type D** as the suitable maturity level in our case. For example, we have preventive maintenance schedules for our machinery, such as air compressors, boilers, generators and sewing machines. Also, we are doing the preventive maintenance according to the schedule mostly based on the running hours.

All participants agreed on the suitability of **Type D (Level 4 – advancing)** maturity status for Case A considering the organisation's firmly established maintenance management system. However, descriptor four (04) (availability of computerised maintenance management system) was not in practice. Other than the descriptor four (04) all other descriptors were compiled by Case A. Preventive maintenance schedules supported the documentary evidence under this attribute.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Having presented the findings under practices in this section, the following section presents the findings relating to material culture.

Material culture

Attribute 17: Energy-efficient technologies and related supportive technologies.

CSA-P1 stated that "we belong to the Type C. Considering the energy-efficient technologies, we have a set of energy-efficient production machinery, such as the sewing machines with servo motors. However, the building services side needs improvements. We do have submeters but not for all required panels". Focus group participants agreed on the suitability of **Type C (Level 3 – advancing)** status for the organisation considering the compliance with all descriptors under this attribute in Level 3. The availability of the energy-efficient production machines and the submeters in the selected manufacturing facility justified the participants' choice.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 18: Renewable energy sources.

CSA-P1 highlighted that "We have a plan to operate all plants with 100% renewable energy. We have successfully implemented solar to a considerable extent. Now, the topics like carbon neutrality are discussed at the top management's meetings". Further, CSA-P3 mentioned that "Yes, considering this plant also we have fixed rooftop solar panels as a renewable energy source". Overall, the participants agreed that their organisation fits to the **Type D (Level 4 – advancing)** under the attribute considering the fulfilment of all relevant maturity descriptors. Long term and short-term renewable energy implementation plans and actual implementation of the rooftop solar panels in the factories supported the participants' claim for the Level 4 advancing maturity. In addition, participants agreed on the progressive influence of the government's rooftop solar promotion program called "Surya Bala Sangramaya" (Battle for Solar Energy) as an "external influence" on the popularity of the rooftop solar system in the organisation.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 19: Low emission building design and construction.

According to participants, the organisation has conventional buildings that are not designed to meet the requirements of low emission buildings. CSA-P1 mentioned that "there are ideas in the management to go for low emission building certifications, but those ideas have never been implemented yet". Overall, the participants agreed on the current maturity status as **Type B (Level 2 – emerging)** considering the current

context of the organisation that is explained well by the maturity descriptors in level 2.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√			

Having presented the findings of the detailed energy culture maturity assessment under all attributes in this section, the following section explains the summary of the Case A's findings.

5.2.1.4 Summary of the within-case analysis of Case A

Table 5.2 summarises the findings of the detailed energy culture maturity assessment discussed in the previous section under 19 energy culture maturity attributes. The finalised maturity result for the focus group discussion is represented in magenta colour against the relevant attribute. Considering the results, levels 2 to 4 can be identified as the maturity spectrum for Case A as it did not represent the other two levels. According to the results of Table 5.2, the organisation mostly fits levels 2 and 3 except for the attributes 14, 15, 16 and 18, representing level 4 maturity. Participants highlighted the impact of the external influences as a significant reason for reporting high maturity results under 14, 15, and 18 attributes except attribute 16, which is supported due to the robust maintenance management system available in the organisation.

As explained in Section 3.8.2.2.2 (a) primarily the overall energy culture maturity was identified from the maturity scoring system based on the detailed energy culture maturity assessment. Then, two (02) other approaches (most chosen maturity level and overall maturity preference) used to cross-check the result of the detailed maturity assessment. Firstly, the respective maturity score for the detailed energy culture maturity assessment of Case A was calculated using the proposed maturity scoring system of the energy culture maturity framework as shown in Table 5.2. As per the results, the overall maturity score was 55, which fits **Level 3 (developing)** since the scores range of Level 3 is between 39 and 57 marks.

Secondly, mostly chosen maturity level was examined. As shown in Table 5.2, the results fit 13 times in level 3, eight (08) times in Level 2 and four (04) times in Level 4. Accordingly, **Level 3 (developing)** could be identified as the most chosen level in the maturity assessment based on the case study findings. Thirdly, the result of the overall energy culture maturity preference was considered, as explained in Section 3.8.2.2.2(b). Under that, the focus group participants selected **Level 3 (developing)** as the most appropriate level to define the overall energy culture maturity of Case A. Hence, the Case A's overall energy culture maturity status identified through the detailed energy culture maturity assessment as **Level 3 (developing)** could be verified through the other two (02) approaches as well that strengthened the findings of the

detailed energy culture maturity assessment conducted using the proposed energy culture maturity framework for textile and apparel industrial organisations in Sri Lanka.

Table 5. 2

Summary of the Within-Case Analysis Results of Case A

	Attributes	Level 1	Level 2	Level 3	Level 4	Level 5
Norms	1			3		
	2			3		
	3		2			
	4		2.5			
	5			3		
	6			3		
Practices	7		2			
	8		2.5			
	9			3		
	10		2.5			
	11			3		
	12		2.5			
	13		2.5			
	14			3.5		
	15				4	
	16				4	
Material Culture	17			3		
	18				4	
	19		2			
Overall maturity score				**55**		

Having presented within-case findings of Case A in this section, the following section presents the within-case findings of Case B.

5.2.2 Within-case analysis of case Study B

The findings of the withing case analysis of the Case B are presented in this section. The section contains case study description, details of the focus group participants, findings of the within-case analysis and Summary of the within-case analysis findings.

5.2.2.1 Case study description

Case B is a large-scale textile and apparel industrial organisation founded in 1987 in Sri Lanka as a private limited liability company, which is currently one of the largest textile and apparel manufacturing entities in South Asia. Currently, it operates 53

factories with around 99,000 employees and caters for leading international brands in both textile and apparel manufacturing operations. They have recently committed to reducing scope 1, scope 2, and scope 3 emissions under the Science-Based Target Initiative (SBTi). Further, the company has obtained various compliance and sustainability standards, such as ISO 14001, ISO 14065, ISO 9001, ISO 45001, Higg Index 3.0 Facility Environmental Module, WRAP, and ETI. In addition, the product sustainability certifications, such as Global Recycled Standard, Global Organic Textile Standard and OEKO-TEX certification, were also obtained by the organisation. Furthermore, the organisation has obtained various awards, including those relating to environmental sustainability, such as the Presidential Environmental Award, National Energy-efficiency Award, and National Cleaner Production Award. In addition, there are some buildings certified as green buildings. The selected manufacturing facility for conducting the case study is a factory constructed in 1999, which employs around 2,500 people.

5.2.2.2 Details of the focus group participants

The focus group participants of Case B were appointed considering their exposure to the energy management and ability to assess energy culture attributes relating to both corporate level and the factories as explained in Section 3.8.2.1.3. Table 5.3 presents the details of the selected focus group participants with the exposure to energy management in the whole scope of the business.

Table 5. 3

Details of the Participants of the Case B Focus Group

Code	Designation	Experience	Energy management related role
CSB-P1	Manager Environmental Sustainability	12 years	Energy and carbon management Energy auditing
CSB-P2	Executive Environmental Sustainability	8 years	Energy and carbon management Energy auditing
CSB-P3	Environmental Sustainability Champion	3 years	Energy and carbon management at the selected factory Energy auditing

5.2.2.3 Findings of the within-case analysis of Case B

Case B's energy culture maturity status was assessed using the proposed energy culture maturity framework. The results identified for the 19 attributes under the norms, practices, and material culture are given below based on the focus group discussion results supported by the relevant documentary evidence and indirect observations.

Norms

Attribute 1: Green values of owners and senior management.

Participants explained the availability of strong green values with owners and senior management. CSB-P2 pointed out that

> Appointing the owner's son as the Head of Sustainability in the whole group of companies itself shows the strength of the green values of owners and senior management in our organisation. Further, we have a separate position called Sustainability Director at the board level to look after the sustainability aspects at the group level.

CSB-P1 also explained that the owners and senior management are very much passionate about the business's environmental sustainability and related energy aspects. CSB-P1 highlighted that "We are a pioneering organisation in the industry who has committed to the full scope of SBTi based on the Paris Agreement". Furthermore, CSB-P2 mentioned that "We can show you our sustainable business policy and objective matrix which shows the business's alignment with the sustainability that is started at the senior leadership level due to the strong green values vested with them". Overall, participants agreed that the organisation fits the **Type E (Level 5 – leading)** maturity status as it complies with all the maturity descriptors. SBTi commitment, sustainable business policy, and objective matrix were shown as the documentary evidence for the maturity descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 2: Energy vision, mission, and policy statements.

Energy vision, mission, and policy statements represent the top management's commitment to energy-related improvements. Participants proposed that the **Type E (Level 5 – leading)** maturity well aligns with Case B's current situation considering all maturity descriptors. Accordingly, CSB-P3 confirmed that "we have our energy vision, mission and policy statements documented in the long-term energy plan. The long-term energy plan clearly provides the time-bound nature for the statements". Further, the participants explained how the energy goals and strategies are derived based on the energy vision, mission and policy statements citing the long-term energy plan. In addition, participants clearly highlighted the integration of the energy vision, mission, and policy as part of the corporate vision and mission. This integration was very clear because the term "sustainability" is included in each of the corporate vision, mission, and value statements. The energy vision, mission, and policy statements; corporate vision, mission, and value statements; long-term energy plan; and sustainable business policy and objective matrix were provided as the documentary evidence to support the existence of the said maturity descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 3: Organisational public commitments to energy management.

Overall, the participants agreed that the organisation aligns with **Type E (Level 5 – leading)** descriptors under this attribute. CSB-P2 highlighted that

> When it comes to public commitments, we have committed for the Scope 1, 2 and 3 emissions under the SBTi. Considering the current progress, we have achieved the required progress at this point as per the plan. Further, we are working with the suppliers to take the required commitment from their side for the public commitments as well.

Further, participants agreed that they have a strong review mechanism relating to the implementation of the public commitments related aspects and action taken to ensure continual improvement. The organisation's SBTi commitment provided documentary evidence for public commitments. In addition, participants highlighted some impact from the customers' side as an "external influence" to make the public commitments. However, the organisation's preference still has a significant impact because the customers need only scope 1 and scope 2 commitments, but the organisation has gone beyond that and committed to the scope 3 emissions because of its own plans.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 4: Employee interest for energy-related improvements.

CSB–P3 expressed employees' active engagement in energy conservation. According to CSB–P3, "We observe employees' commitment for energy conservation in their day-to-day activities. For instance, they actively engaged in using a tag called Fuguai tags when they see a compressed air leakage". Further, CSB–P2 confirmed the employees' acceptance of the available energy management programs, projects, and best practices. As stated by CSB–P2, "We have a feedback mechanism called Kizen suggestions, and under that, both individual employees and groups are actively providing their suggestions for the energy-related improvements". Considering the overall interest of the employees, focus group participants proposed that **Type D (Level 4 – advancing)** is the most suitable grading for their organisation. Images of the Fuguai tags used by the employees were presented as evidence of the employees' commitment to energy saving.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 5: Promoting the product's carbon footprint reduction.

Participants highlighted their initiatives for manufacturing products with a reduced carbon footprint, including the recent change in the business strategies supporting sustainability. CSB-P2 explained the compliance with 1, 2, 5 and 6 maturity descriptors in the Type E maturity. According to CSB-P2

> We have strong initiatives to reduce the carbon footprint of the products. We have recently made a huge change to our strategies that significantly improve the business's product sustainability and general sustainability aspects. Because of that change, most of our product innovations are now focused on product sustainability. For example, we are supplying garments for one of the world's leading brands. We are one of the top suppliers for them. Let us say we are one of the top three (03) suppliers for them. So, our organisation has been given such importance in their supply chain. For instance, we received an order to produce a low carbon product designed for Olympic athletes of a leading country in the Olympic games. Our commitment to sustainability is one of the major reasons for receiving that.

However, the participants highlighted that the organisation has mixed features of **Type D (Level 4 – advancing)** and **Type E (Level 5 – leading)** maturity levels. According to participants, Case B is aligned with Type E's one (01), two (02), five (05), and six (06) descriptors and three (03) and four (04) descriptors of Type D maturities. Participants explained that the availability of the third-party product carbon footprint certifications and commercialisations of the reduced carbon footprint product innovations in moderate numbers as the reason for selecting Type D maturity under two (02) and four (04) descriptors. Low carbon product catalogues and the new business strategy supporting low carbon products were presented as documentary evidence for supporting participants' judgements.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	√

Attribute 6: Attention to investment analysis considering energy.

Participants agreed that they are aligned with all maturity descriptors of the **Type E (Level 5 – leading)** maturity under this attribute. According to participants, the organisation considers basic investment analysis methods in all investments. Further, CSB-P2 stated that "We practice life cycle cost analysis for all significant energy-consuming equipment in the organisation". Documentary evidence was provided for

the procurement procedure, which includes a requirement to evaluate and compare alternative options using the life cycle cost analysis.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

This section presented the within case findings under norms. The following section contains the within case findings relating to practices.

Practices

Attribute 7: Changing core business practices for energy-related improvements.

CSB-P2 stated that

> We have a team responsible for innovations in the organisation. We are discussing with them to look for energy-related innovations based on the autonomation for energy saving. However, still, it is not fully functioning. We have a change management procedure that assesses the energy impact of any changes to business practices. However, this attribute focuses on the other way around to consider changing business practices due to energy impact, which is limited. So, overall, I feel Type C is a more appropriate maturity status under this attribute.

Participants agreed that **Type C (Level 3 – developing)** is the most appropriate status for the organisation, considering the compliance with all maturity descriptors at that level.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 8: Financing energy-related improvements.

CSB-P1 explained that

> I think we would probably be somewhere between Type D and Type E here. We have budgets, and most energy-related expenses will be covered under engineering budgets. Further, an additional sustainability budget is allocated for special projects focusing on energy and other environmental projects. There is a Capex and Opex focussing on sustainability. Furthermore, most of the operational requirements like maintenance which, of course, is part of energy management, would be covered under the plant engineering budgets. So those are there. Then, we do have public

commitments like SBTi. However, to be honest, yet to sort out some of the financing matters.

All participants agreed that the organisation entirely complies with all Type D energy maturity descriptors **(Level 4 – advancing)**. In addition, all participants agreed that both capital and operational energy budgets are timely reviewed, and actions are taken to ensure continual improvement, which is the descriptor 6 of the **Type E (Level 5 – leading)**. However, considering the organisation's restrictions on financial information sharing, no documentary evidence could be provided under this attribute.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	√

Attribute 9: Assigning human resources and responsibilities.

Participant proposed that Case B is suitable for **Type E (Level 5 – leading)** maturity level under this attribute since the organisation aligns with all maturity descriptors. CSB-P2 mentioned that "energy management responsibilities are assigned to both energy-related technical employees and senior management" in this plant. Further, CSB-P1 comprehensively explained the organisation's context relating to the attribute. According to CSB-P1,

> We have an annual sustainability index for KPIs, and energy KPIs are a part of it. KPIs cascade down from the general manager to the relevant people, such as the technical team. Further, responsibility wise, there is a cross-functional energy team representing different departments. Then, the sustainability champion and the factory engineer have energy-related job responsibilities in their job descriptions from the factory's end. For them, energy targets are set at the beginning of every year and reviewed at the end of the year. Every year, a learning and development plan is prepared, and training is provided based on that. Further, the human resource (HR) management system assesses the skills and competencies. HR learning and development system includes the relevant training based on the goals of different employees.

Participants presented the relevant documentary evidence that includes organisation structure with energy-related positions (including cross-functional teams), job descriptions with energy-specific duties and related skills, competencies, and qualifications as the evidence to justify the suitability for the maturity Level 5.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 10: Priority to energy efficiency in procurement practice.

Participants agreed that they have adhered to all maturity descriptors in the **Type E (Level 5 – leading)** maturity under this attribute**.** CSB-P3 explained that "We have a procurement procedure for energy-critical machines. The procedure considers the energy aspects when procuring energy-consuming machinery. We practice this in the energy significant procurements. For example, the recent air conditioner was purchased following this procedure". Further, CSB-P2 confirmed the availability of other descriptors such as the presence of the procurement officer in the energy team, supply chain awareness of the procedure, attention to the minimum energy performance of equipment, and timely review and continual improvement of the procedure. Documentary evidence, including procurement procedure, actual procurement evaluation reports, and their environmental sustainability calibration tool (specifying minimum energy performance of equipment), were provided to support the selected maturity status.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 11: Internal and external communications supporting energy management.

Type E (Level 5 – leading) was proposed as the suitable maturity level for the attribute by the participants due to their compliance with all descriptors of type E. Participants explained how they have implemented the descriptors in the organisation. For instance, CSB-P2 stated that "we have a communication plan for separate divisions and in the plant level that specifically focus on energy-related communications". Further, CSB-P3 expressed that "We use various communication tools in real-time such as meetings, emails, flyers, LinkedIn, reports etc. for the energy-related internal and external communications". Further, the participants showed various evidence for implementing the communication, such as flyers and emails to support their choice.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 12: Rewarding and recognition for energy-related improvements.

Participants explained the availability of various rewarding and recognition mechanisms and how those mechanisms are practised.

CSB-P2 expressed that

> …of course, we have a rewarding system linked to the energy KPIs as a standard practice. We also have plant-wise competitions for special events

like “Earth Hour” and “World Environment Day”. We have a calendar plan for these specific dates and plans for the specific events. A rewarding system for these competitions is available.

Further, CSB-P3 highlighted that “We have a program for reducing home electricity bill by employees. It is a one-year program to show the reduction of the home energy bill during the period due to energy conservation measures. Then, employees are rewarded based on that”. Overall, the participants agreed that the organisation fits **Type E (Level 5 – leading)** maturity by complying with all relevant descriptors. Further, the documentary evidence was given for the established rewarding and recognition mechanisms, and photos were provided for the actual rewarding and recognition events to justify the selection.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 13: Knowledge and training.

CSB-2 explained that

> We have many things relating to knowledge and training in our organisation. Usually, the organisation annually reviews the training needs of the employee department wise. Then, the human resources and sustainability divisions arrange required energy-related training based on the identified training needs. For example, the sustainability champion of this plant is a new employee with less experience in energy management. Therefore, we sent the person for external energy management training based on the evaluations.

Further, CSB-3 explained the mechanism to review the adequacy of the training provided for technical employees directly handling energy management functions. According to CSB-3, “We have a skill matrix for the technical employees. In that the energy-related competencies also reviewed timely, and the trainings are allocated based on the need”. Participants agreed on the suitability of the **Type E (Level 5 – leading)** maturity status for the organisation. Further, documentary evidence, such as annual training needs identification, the annual training plan and skill matrix, was provided to justify the maturity descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 14: Deployment of energy goals and strategies.

Overall, participants agreed that they comply with all descriptors in **Type E (Level 5 – leading)** maturity under this attribute. According to CSB-P3

> We have a Long Run Energy Plan. Under that, we have set our energy-related long-term goals and strategies until 2025. Under that, we have set the main KPIs as reducing energy intensity by 1.7% from the 2020 baseline, reducing carbon intensity (minimising GHG emissions) and reducing GHG absolute emissions. The major KPIs are cascaded down into several areas in the manufacturing plants, such as the critical energy using utilities, departments, and energy sources. Similarly, we have an action plan with strategies for each year that guides achieving the annual targets of the Long Run Energy Plan.

Further, CSB- P2 explained aligning energy goals, strategies and KPIs with the core business strategies. According to CSB- P2, "Alignment with core business can be shown using our "Sustainable Business Policy and Objective Matrix called "Hoshin". In the Hoshin, we have an 8.4% carbon emission reduction from the business. This is an absolute carbon reduction plan based on the SBTi initiative". Participants supported the organisation's compliance with the maturity descriptors, using documentary evidence such as Long Run Energy Plan, including goals, strategies and KPIs, Sustainable Business Policy and objective matrix (Hoshin) and annual action plan and strategies.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 15: Energy performance monitoring and management.

Participants confirmed that they belong to the **Type E (Level 5 – leading)** maturity under this attribute since they comply with all the maturity descriptors. CSB- P3 stated that

> We can obtain the real-time energy data using the computerised energy management system (EMS) for all plants in the group. EMS has submeters set for energy-critical operations and machinery. Further, we have specific energy baselines and KPIs, such as machine-wise and energy source wise, defined under the Long Run Energy Plan. The KPIs are monitored at appropriate intervals, such as weekly and monthly.

CSB-P2 explained Case B's practices relating to management review meetings, energy audits, use of problem-solving techniques to develop corrective actions and continual improvement of the energy performance. A computerised energy management system, submeter wise energy consumption analysis report, long-run energy plan, management review meeting minutes, energy team review meeting minutes, real-time problem-

solving tools (corrective actions) and energy audit reports were provided as the documentary evidence to justify the availability of the maturity descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 16: Maintenance management supporting higher energy performance.

CSB-P2 explained that "We have preventive maintenance management programs for all significant energy-consuming technologies. Also, the preventive maintenance activities are carried out as per the plan. In addition, we are doing autonomous maintenance perfectly". According to the participants, they have maturity descriptors belonging to **Type E (Level 5 –leading)**. However, there is no computerised maintenance management system in the organisation, which is the descriptor four (04) under the maturity Level 5. Therefore, it could be concluded that Case B aligned with all maturity descriptors except the descriptor four of Level 5. The annual preventive maintenance management program and the records on actual completion of the planned maintenance activities were presented as documentary evidence for the descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Having presented the findings of within-case analysis under practices in this section, the next section presents the findings under the material culture.

Material culture

Attribute 17: Energy-efficient technologies and related supportive technologies.

Participants proposed that they belong to the **Type D (Level 4 – advancing)** maturity under this attribute, considering the availability of most of the significant energy-efficient technologies and related supportive technologies. CSB-P2 explained that "We have various energy-efficient technologies such as VFD-equipped central air-conditioning system, LED lighting system, and various energy-efficient production machinery". Further, CSB-P2 highlighted that despite the availability of various energy management supportive technologies, there is unavailability of a building management system (BMS). According to CSB-P2, "We have all other elements under the Type D. But we do not have a building management system in the plant". In addition, participants presented documentary evidence for the availability of an energy submeter system and energy performance monitoring dashboards.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 18: Renewable energy sources.

According to the participants, they have significant initiatives on the renewable energy side. CSB-P2 explained that

> We have gone to the maximum possible capacity based on the rooftop solar panels in this plant. We have a separate team responsible for the solar energy projects in the company. In addition, we use solar water heaters in the plant. Further, as a company we are ready to use the systems like renewable energy credits, which is not available for the moment in the country.

Furthermore, CSB-P3 highlighted that "We have a sustainable bio-mass project using an invasive plant called "Kalapu Andara" as the firewood for the boilers. Further, we have planned a bio-gas project using the food waste of the factory". Overall, participants rated the organisation as **Type E (Level 5 – leading)**. The master plan for the rooftop solar energy projects and report submitted to United Nations Global Compact provided documentary evidence for the initiatives.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 19: Low emission building design and construction.

Participants proposed that they are in the **Type D (Level 4 – advancing)** maturity, considering the attribute. CSB-P3 added that

> We have some plants certified for the LEED rating system. However, instead of certifying all plants, we integrate some of the LEED rating system's requirements into our internal calibration tool. Therefore, even if we have not been certified for the rating systems, we comply with the selected requirements at the design and construction stages.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Having presented the within-case findings of each attribute under norms, practices and material culture, Case A's summary of the findings is presented next.

5.2.2.4 Summary of the within-case analysis of Case B

Table 5.4 below summarises findings of Case B based on the energy culture maturity assessment under the 19 attributes. Respective maturity results for the attributes are marked using yellow against each attribute. The findings show that the results are limited to Level 3, Level 4, and Level 5. Especially most of the results fit Level 5 (leading) maturity, whereas only attribute 7 (changing core business practices for energy-related improvements) fits Level 3 (developing) maturity.

Table 5. 4

Summary of the Within-Case Analysis Results of Case B

	Attributes	Level 1	Level 2	Level 3	Level 4	Level 5
Norms	1					5
	2					5
	3					5
	4				4	
	5				4.5	
	6					5
Practices	7			3		
	8				4.5	
	9					5
	10					5
	11					5
	12					5
	13					5
	14					5
	15					5
	16					5
Material Culture	17				4	
	18					5
	19				4	
Overall Maturity Score						**89**

Under the detailed energy culture maturity assessment, Case B's maturity score was calculated using scoring system as per the procedure explained in Section 3.8.2.2.2(a). Accordingly, the overall maturity score of the Case B was 89 marks as given in Table 5.4. The overall score range between 77 and 95 belongs to the Level 5 (leading) maturity. Therefore, the Case B could be identified as a Level 5 (leading) matured organisation.

Then, the most chosen maturity level also could be identified as Level 5 (leading) with the presence of 15 attributes. Whereas the next most selected level was Level 4 (advancing) with only five (05) attributes. Furthermore, the overall energy culture

maturity preference was also identified as Level 5 (leading) from the focus group discussion. Hence, the overall energy culture maturity level identified from the detailed energy culture maturity assessment using the proposed framework was in line with the result of the other two (02) approaches. Uniformity of the overall energy culture maturity level identified from three (03) approaches strengthened the applicability of the proposed energy culture maturity framework

Having explained Case B's within-case findings, the following section presents Case C's within-case findings.

5.2.3 Within-case analysis of case study C

Case C's within-case analysis and findings are explained in this section. This section includes case study description, details of the focus group participants, findings of the within-case analysis and summary of the within-case analysis findings of the Case C.

5.2.3.1 Case study description

Case C is a large-scale organisation in the textile and apparel industry in Sri Lanka. It was started in 1900 as a small-scale retail clothing business. Over the decades, it has expanded and operates 25 factories with around 52,000 employees. The company carries out both textile and apparel operations. Further, it has received awards such as the National Energy-efficiency Award – 2010, Most Sustainable Factory – 2014, Garment Maker of the Year – 2014 and Japan Sri Lanka Technical and Cultural Association (JASTECA) gold award – 2015. In addition, the organisation is certified for various compliance and sustainability standards for different factories. Accordingly, the certifications such as Leadership in Energy and Environmental Design (LEED) green building certification, Worldwide Responsible Accredited Production (WRAP), Ethical Trading Initiative (ETI), Fair Trade, ISO 14001, ISO 45001, and Carbon Neutral have been obtained for different factories of the company. The selected factory for the case study was established in 2012 and operates with 2,100 employees currently. Further, the factory is certified for the LEED green building certification under the building design and constructions category.

5.2.3.2 Details of the focus group participants

Case C's focus group participants were appointed considering their experience in energy management and ability to assess energy culture attributes relating to both corporate level and the factories, as highlighted in Section 3.8.2.1.3. Table 5.5 presents the details of the selected focus group participants with the exposure to energy management in the whole scope of the organisation.

Table 5. 5

Details of the Participants of the Case C Focus Group

Code	Designation	Years of experience	Energy management related role
CSC-P1	Manager Environmental sustainability	8 years	• Representing the central sustainability team based at the head office. • Overlooking energy management aspects of different factories
CSC-P2	Manager maintenance	9 years	• Responsible for the energy management of the selected factory
CSC-P3	Executive Maintenance	6 years	• Responsible for the energy management of the selected factory

5.2.3.3 Findings of the within-case analysis of Case C

This section presents the findings of the within-case analysis of Case C based on the focus group discussion with support from the relevant documentary evidence and indirect observations. The findings are presented under the 19 attributes related to the energy culture maturity framework's norms, practices, and material culture elements.

Norms

Attribute 1: Green values of owners and senior management.

Participants stated a strong position regarding the green values of owners and senior management in their organisation. CSC-P1 explained that

> I think we can propose Type E maturity under this attribute. We have the total commitment from the top management. For instance, a director board member is appointed as the Director of Sustainability. The appointment itself justifies the strong green values of senior leadership. That director drives the sustainability strategy of the whole group. This sustainability strategy focused on reducing 20% of the group's energy consumption and certifying all plants as green buildings by 2025. The sustainability director has assigned KPIs for the senior management of each factory based on the strategy. Further, we have a pioneering carbon-neutral clothing factory in Asia, which is certified for carbon neutrality every year.

Overall, all participants agreed that the organisation fits **Type E (Level 5 – leading)** maturity due to the alignment with all maturity descriptors. Sustainability Strategy and 2025 roadmap and sustainability governing organisational structure can be identified as documentary evidence supporting the green values of owners and senior management.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
				√

Attribute 2: Energy vision, mission, and policy statements.

Participants proposed that the organisation suits **Type D (Level 4 – advancing)** maturity category. CSC-P3 mentioned the availability of the energy vision, mission, and policy statements integrated into the environmental sustainability vision, mission, and policy, instead of having a separate one. Further, CSC-P1 highlighted the availability of strong acceptance for the statements by the senior leadership and the commitment of the sustainability director himself to link the statements with the sustainability strategy and 2025 roadmap and related KPIs. Furthermore, participants agreed that the corporate vision and mission support the sustainability vision, mission, and policy since they have become an integral part. Documentary evidence such as the sustainability strategy and 2025 roadmap and sustainability vision, mission and policy support the availability of the Level 4 (advancing) maturity with the organisation under the attribute.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 3: Organisational public commitments to energy management.

Participants agreed that the organisation is not that mature in public commitments. According to CSC-P1, "We have considered available public commitments such as SBTi. However, we have not officially signed any public commitment yet. Our sustainability strategy and 2025 roadmap are progressing towards the requirements of energy-related public commitments". Therefore, the organisation fits the maturity descriptor one (01) in **Type B (Level 2 – emerging)** maturity and maturity descriptor two (02) in **Type C (Level 3 – developing)** maturity. Despite the unavailability of any official public commitment, the documentary evidence, such as sustainability strategy and 2025 roadmap, provides the evidence that the organisation is progressing in this area.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 4: Employee interest for energy-related improvements.

Participants highlighted the considerably energy-conscious behaviours available with the employees. CSC-P2 explained that

> In our organisation, the employees have considerable energy consciousness. For example, they call and inform the engineering team if they note an energy wastage in a common area. Further, employees have integrated energy-saving behaviours into their routing. For instance, we need a higher lux level beyond 1,000 lux in the cutting department. Therefore, we have a high number of light bulbs fixed there. When the cutting machine operators go for their lunch and tea breaks, they usually switch off the lights. Likewise, most of the time, employees are engaged in the energy saving in day-to-day routine.

Furthermore, CSC-P1 explained the energy-conserving behaviours of the technical team: "Engineering team also have high energy consciousness. They actively work on different initiatives for energy saving". Overall, the organisation fits **Type D (Level 4 – advancing)** maturity. However, it was noted that the informal employee groups are not available in the organisation that represent the maturity descriptors three (03) and four (04). Images of the employee engagement programs supported the participants' explanations.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 5: Promoting product carbon footprint reduction.

Participants agreed on the suitability of **Type C (Level 3 – developing)** maturity status for this attribute. According to CSC-P1, "We occasionally have product specified carbon footprints calculations. There are not many numbers of such products. Those carbon-neutral products are manufactured at our carbon neutral factory. When such special project comes, that is directed to this factory". Documentary evidence of such products manufactured at the organisation supports the organisation's justification for this maturity.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 6: Attention to investment analysis considering energy.

According to the participants' explanations, **Type D (Level 4 – advancing)** maturity status is suitable to represent the current thinking of the organisation on energy investment analysis. According to the participants, they use both basic investment analysis and the lifecycle cost when analysing investments. CSC-P2 explained the organisation's practice in investment analysis considering energy:

> The lifecycle cost considers the costs from the initial cost to disposal. Our organisation pays attention to the lifecycle costs without limiting the initial cost because we have long factory operation hours. Therefore, equipment is not suitable if the operational cost is high. Therefore, we consider the initial cost and energy efficiency of the equipment. So, we do not purchase cheap equipment with low energy efficiency and related high energy costs. Even our finance division pays high attention to implementing the lifecycle cost analysis.

The projects analysed using the basic investment analysis and the lifecycle cost analysis are considered as the documentary evidence supporting the selected maturity.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

This section presented the findings of within-case analysis under norms. The next section contains the findings under practices.

Practices

Attribute 7: Changing core business practices for energy-related improvements.

All participants concluded that the organisation's maturity meets **Type B (Level 2 – emerging)** maturity descriptors. CSC-P1 mentioned, "We can say that we occasionally consider small changes that do not involve much investment". However, CSC-P3 explained the unavailability of implementation of such changes in the actual context. According to CSC-P3:

> Considering the organisation's practices, we can say that mainly the core business activities are not changed considering the sustainability as the primary reason. However, we can say we are trying the sustainability best practices. For example, we usually go for the energy-efficient option if we need a new boiler for the core business.

Accordingly, it was decided to consider Type B as the appropriate maturity status for the organisation. However, there is no documentary evidence available since there are no relevant actions at this maturity level.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√			

Attribute 8: Financing energy-related improvements.

All participants agreed that they belong to **Type C (Level 3 – developing)** maturity. CSC-P3 explained their situation and recent improvements in the energy-related financing area, and others agreed on the same. According to CSC-P3:

> I think we can go to the Type C. We had been in the B category, and our focus had been on improving the business's operational performance rather than sustainability. We changed the strategic direction one (01) year back to focus more on sustainability. We have established sustainability targets for 2025 based on the United Nations program. Based on that, we prepared two (02) separate budgets for the first time for the capital and operational expenses on energy-related improvements. Still, there are some limitations of the implementation of budgeted items.

Due to confidentiality, the participants did not present the related documentary evidence.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 9: Assigning human resources and responsibilities.

Participants agreed that they fit the **Type C (Level 3 – developing)** maturity status under this attribute. CSC-P1 mentioned, "We have assigned the energy management responsibilities to the maintenance management team at the factory level, and some energy KPIs are also available for them". Further, CSC -P2 also mentioned that

> The energy KPIs are started from the General Manager level and then cascaded down to other relevant employees. For example, as the maintenance manager of this plant, I have six (06) KPIs, and out of these, one relates to energy management. Further, we have some considerations for the energy qualifications of the employees as well.

CSC-P3 highlighted that "currently, the organisation has filled only limited vacancies of the sustainability executive positions in the plants, even though that is available in the organisation structure. We do not have all required positions designed for the energy management". The energy-related organisation structure, sample job descriptions and employee KPIs were provided as the documentary evidence supporting the maturity status.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
		√		

Attribute 10: Priority to energy efficiency in procurement practice.

According to the participants, descriptors of this attribute represent both **Type B (Level 2 – emerging)** and **Type C (Level 3 – developing)** maturity features. CSC-P3 pointed out that "We do not have a documented procurement procedure that caters for energy-efficiency requirements of the equipment that we purchase". Further, CSC-P2 explained the current practice:

> The purchase orders are going through the engineering department for the energy-consuming equipment. We may consider the energy efficiency when doing so, but there is no such formal procedure or requirement. Therefore, procurement practice can be changed based on the person handling the procurement since there is no procedure. However, despite such procedure unavailability, there is some evidence for energy-efficient procurements.

Sample procurement evaluations conducted including energy-efficiency as one of the criteria can be considered documentary evidence supporting the participants' choices.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 11: Internal and external communications supporting energy management.

Participants proposed the **Type D (Level 4 – advancing)** as the suitable maturity grading for the organisation under this attribute. CSC-P2 explained, "I think we can select Type D. We have energy vision, mission, and policy communicated to third parties such as buyers. However, some further improvements are required". Further, CSC-P1 highlighted that

> We have a documented internal and external communication plan for environmental sustainability. This plan covers energy-related communications. We use various communication tools such as posters, Higg index, LinkedIn, Facebook, and presidential environmental awards to communicate the energy-related improvements. For instance, we plan to share our new sustainability strategy to various external stakeholders such as brands, universities, and Central Environmental Authority through the corporate communications division.

Internal and external communication plans for environmental sustainability and sample communications were the documentary evidence supporting the choice of maturity.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 12: Rewarding and recognition for energy-related improvements.

CSC-P2 explained that "When employees do energy-related innovations, we appreciate them at the meetings at the plant level. Nevertheless, we do not give them money as a reward. Further, if the innovation is important, we share that with other plants as well". Further, CSC-P1 explained the unavailability of a documented rewarding and recognition mechanism in the organisation and the availability of some informal rewarding and recognition events on an ad-hoc basis. Overall, the participants' feedback provided mixed results to the organisation representing descriptors one (01) and two (02) under **Type B (Level 2 – emerging)** maturity and descriptor four (04) under **Type C (Level 3 – developing)** maturity. Evidence of the rewarding and recognition events supported the selection of the maturity status.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 13: Knowledge and training.

Participants agreed on the suitability of **Type D (Level 4 – advancing)** maturity status for the organisation under this attribute since they adhere to the respective descriptors. CSC-P3 stated that

> The company has an annual training plan prepared based on the training needs under various knowledge areas relevant to energy management. For instance, the training on energy management best practices. Further, the training arrangement for energy management is integrated under the sustainability KPI of the plant.

A training plan with provisions for energy management training was provided as the documentary evidence supporting the maturity status.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
	√	√		

Attribute 14: Deployment of energy goals and strategies.

Overall, the participants explained that they belong to this attribute's **Type D (Level 4 – advancing)** maturity status. Accordingly, participants explained the robust mechanism for deploying the energy goals and strategies. CSC-P2 highlighted that

> Overall, we have given high importance to the deployment of energy goals and strategies. We have a marking system for the KPIs. Energy-related KPIs own a significant portion of that marking scheme. The important thing is, unlike other KPIs, if we fail to achieve energy KPIs, minus marks are allocated that highly impact on reducing the employee's overall performance. Further, the KPI status is considered when deciding the salary increments for the employees. In addition, the air conditioner follows an operational control. If we work from 7.00 am to 5.00 pm, we do not switch on the air conditioning systems simultaneously. Instead, we switch on the air conditioners at 9.00 am since the temperature in the morning is lower. Then, the air conditioner is switched off at 4.00 pm in the evening.

Further, CSC-P3 pointed out that the energy vision, mission, and policy are integrated into the environmental sustainability vision, mission and policy instead of having a separate one. Participants agreed on the link between the environmental sustainability vision, mission and policy and the energy goals, strategies and KPIs. Furthermore, CSC-P3 explained how the energy KPIs are cascaded down from the top level to the lower levels of the employees in the plant. Energy goals strategies and KPIs system and operational control record supported as the documentary evidence for the preferred maturity.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 15: Energy performance monitoring and management.

Participants agreed that the organisation aligns with **Type D (Level 4 –advancing)** maturity due to fulfilling all relevant maturity descriptors. CSC-P3 explained that

> Our central sustainability team sets the energy KPIs and related baselines for the plants based on the energy goals of the group. The performance of the KPIs is monitored monthly. Other than that, we have other energy performance review mechanisms like management review meetings, third-party energy audits, and sustainability audits by the internal central sustainability team. We take corrective actions for the identified deviations of energy performance and audit findings.

Monthly environmental sustainability KPI performance monitoring reports, energy audit reports, management review meeting minutes and corrective action reports are the documentary evidence supporting the organisation's maturity.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 16: Maintenance management supporting higher energy performance.

Participants agreed that Case C adheres to **Type D (advancing)** maturity. According to CSC-P2

> Normally, we have a preventive maintenance program that is performing well. The maintenance program covers all significant energy-consuming equipment. We do have around 50 maintenance checklists to carry out preventive maintenance for different machinery. Of course, there can be minor deviations. Nevertheless, those deviations are covered as soon as possible. In addition, employees do autonomous maintenance for some machines like sewing machines and cutting machines twice a day in the time intervals allocated with the cleaning music.

However, there was no computerised maintenance management system in the organisation, which is the fourth descriptor in Type D maturity. Preventive maintenance plans and checklists can be considered as documentary evidence supporting compliance with Type D maturity descriptors.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Findings under practices related attributes were presented in this section. The next section provides three (03) attributes' findings under material culture.

Material culture

Attribute 17: Energy-efficient technologies and related supportive technologies.

Overall, Case C's situation is in line with the **Type D (Level 4 – advancing)** maturity based on the participants' feedback. According to CSC-P2

> Normally, we have leading energy-efficient machines most of the time. For example, the current energy-efficient technologies such as auto-cutter, compressors and generators can be highlighted. If we can implement a BMS and connect it to the air conditioning system, we can save more energy than this. Further, there are some air conditioners without the inverters, which are less energy efficient. Considering submeters, we have separate submeters for the high energy-consuming machinery like compressors and different submeters for the production floor areas.

However, CSC-P1 mentioned the unavailability of some energy management supportive technologies such as BMS, energy management software and dashboards. Overall, the organisation complies with most of the descriptors of Type D maturity. The availability of energy-efficient production machines and submeters in the selected manufacturing facility justified the participants' choice.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 18: Renewable energy sources.

CSC-P1 confirmed the availability of renewable energy plans and implementations. "We have a plan to convert the possible plants to produce the maximum amount of rooftop solar energy by 2030. In this plant, the maximum potential for the rooftop solar has been already achieved by now". Further, CSC-P2 explained the implementations: "We have rooftop solar panels as the main renewable energy source, which generates around 920 kWh. Other than that, we use the solar hot water system in the factory". Overall, the organisation complies with **Type D (Level 4 – advancing)** maturity status**.** A renewable energy implementation plan provided documentary evidence to support the above choice. Further, the images of the implemented rooftop solar systems provide evidence for the actual implementations.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Attribute 19: Low emission building design and construction.

Participants proposed that **Type D (Level 4 – advancing)** maturity suits the organisation under this attribute. According to CSC-P2, "In our organisation, the top-level people have the attention for low emission building design and construction. This plant has already obtained the LEED Gold certification under new constructions". Further, CSC-P1 stated a strategy at the group level to certify all factories as low emission buildings. The available certifications provide documentary evidence to support the proposed maturity of the organisation.

Level 1 (None)	Level 2 (Emerging)	Level 3 (Developing)	Level 4 (Advancing)	Level 5 (Leading)
			√	

Having presented each attribute's maturity of Case C, the summary of Case C's findings of the within-case analysis is given next.

5.2.3.4 Summary of the within-case analysis of Case C

Table 5.6 summarises the findings discussed under 19 attributes in the previous section. The maturity status of each attribute is marked using the blue colour. The maturity of Case C ranges from Level 2 to Level 5. However, most of the time, maturity results fit Level 4 (advancing) maturity. Further, the only attribute that came

under Level 5 (leading) was attribute 1 (green values of owners and senior management.)

Table 5. 6

Summary of the Within-Case Analysis Results of Case C

	Attributes	Level 1	Level 2	Level 3	Level 4	Level 5
Norms	1					5
	2				4	
	3		2.5			
	4				4	
	5			3		
	6				4	
Practices	7		2			
	8			3		
	9			3		
	10		2.5			
	11				4	
	12		2.5			
	13				4	
	14				4	
	15				4	
	16				4	
Material Culture	17				4	
	18				4	
	19				4	
Overall Maturity Score					67.5	

Case C's overall energy culture maturity score was identified based on the detailed energy culture maturity assessment conducted using the proposed framework as explained in Section 3.8.2.2.2(a). Accordingly, the overall maturity score based on the detailed energy culture maturity assessment was calculated as 67.5 that comes under the Level 4's score range (58-76) as given in Table 5.6.

In addition, most chosen maturity level and overall energy culture maturity preference was used to compare the overall maturity level identified from the detailed energy culture maturity assessment. Accordingly, the most chosen maturity level was Level 4 (advancing) with 11 results. Whereas Level 3 (developing) was the next highest preference with only six (06) choices. Furthermore, overall energy culture maturity preference was confirmed Level 4 (advancing) as the most appropriate overall maturity position for Case C. Therefore, overall maturity level derived from the detailed energy culture maturity assessment conducted using this study's proposed framework was confirmed by other two (02) approaches as well. Thus, the results suggest high

applicability of the proposed energy culture maturity framework for textile and apparel industrial organisations.

Having conducted the within-case analysis of the three (03) case studies, the following section presents the findings of the cross-case synthesis of the three (03) cases.

5.3 Cross-case synthesis

After conducting the within-case analysis of the three (03) cases, cross-case synthesis was conducted to see the replicability of the within-case patterns across the cases by comparing the patterns. The cross-case synthesis provides feedback on the applicability of the proposed energy culture maturity framework based on the findings of three (03) case studies. To support the cross-case synthesis, Table 5.7 summarises the three (03) case studies' energy culture maturity assessment results. The findings of the cross-case synthesis based on the applicability of the proposed energy culture maturity framework are discussed first. Then, the other findings revealed from the three (03) case studies are presented.

Table 5. 7

Summary of the Energy Culture Maturity Results of Case Studies

	Attributes	Level 1			Level 2			Level 3			Level 4			Level 5		
		Cases			Cases			Cases			Cases			Cases		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Norms	1															
	2															
	3															
	4															
	5															
	6															
Practices	7															
	8															
	9															
	10															
	11															
	12															
	13															
	14															
	15															
	16															
Material culture	17															
	18															
	19															

Note. Colours for case results: Case A, Case B, Case C

5.3.1 Applicability of the proposed energy culture maturity framework

This study's Objective 4 was focused on evaluating the applicability of the proposed energy culture maturity framework in textile and apparel industrial organisations in Sri Lanka. Accordingly, application of the proposed framework for energy culture maturity assessment in the given case studies provided valuable feedback on the framework's applicability which are discussed in this section.

5.3.1.1 Presence of the proposed attributes in the case studies

The proposed energy culture maturity assessment framework consisted of 19 attributes, against which the energy culture maturity of case studies were assessed. During the energy culture maturity assessments in the three (03) case studies, the maturity of each case could be assessed against all 19 energy culture maturity attributes available in the proposed energy culture maturity framework for large-scale textile and apparel industrial organisations in Sri Lanka. Therefore, the presence of all 19 attributes in all three (03) cases strengthened the proposed framework's applicability.

5.3.1.2 Fewer deviations of the results among maturity levels

If there is a minimum variation in selecting the relevant maturity descriptors of the proposed framework in case studies, this shows higher validity of the framework. According to the findings of the three (03) case studies, less variation could be observed in the maturity results for all attributes. When considering the purely fitted results of the three (03) cases, Case A, Case B and Case C were purely aligned to a certain maturity level in 13, 17 and 16 attributes, respectively, out of the total 19 attributes in each. Therefore, most of the time, the attributes of each case were purely fitted to a particular maturity level. However, there were some exceptions since some of the attributes had mixed results representing two (02) maturity levels. The mixed results were reported as six (06), two (02), and three (03) attributes in Case A, Case B, and Case C. However, despite mixed results, variations of those results were limited only to the adjacent two levels without creating a considerable variation. Therefore, overall, the variation in the maturity levels selection was minimal in all three (03) cases considering both purely fitted results and mixed results. Hence, the minimum variation shows high validity of the framework in real-world energy culture maturity assessments in the textile and apparel industrial organisations.

5.3.1.3 Uniformity of the overall maturity score

Sections 5.2.1.4, 5.2.2.4 and 5.2.3.4 presents the overall maturity result of Cases A, B, and C respectively. The overall energy culture maturity score was calculated in the detailed energy culture maturity assessment in which the proposed energy culture maturity framework was used with a Likert scale scoring system. The maturity score of three (03) cases were 55, 89, and 67.5 in Case A, Case B and Case C respectively. On the other hand, most chosen maturity level and overall energy culture maturity

preference were used as two (02) approaches to verify the overall maturity level judgement from the detailed energy culture maturity assessment conducted using proposed framework. According to the findings, the overall maturity level determined through the detailed energy culture maturity assessment was in line with the identified overall maturity level using other two (02) approaches in all three (03) case studies. Such uniformity of the results of three (03) approaches showed high applicability of the proposed energy culture maturity framework in textile and apparel industrial organisations.

5.3.1.4 Integration of energy aspects under the term sustainability in the real-world scenario

The proposed framework has provisions to cover energy-related aspects of the organisation. However, when conducting the energy culture maturity assessment in the case studies, the term "energy" is sometimes not directly visible for some of the attributes under real-world conditions. There are several examples found in each case for such differences. For instance, the framework's attribute nine (09) describes the availability of "cross-functional energy teams" in a descriptor. However, it was found in the case studies that the term used for such teams is "sustainability team" instead of an "energy team". It should be noted that the sustainability term itself covers the energy aspects other than the water and waste management related aspects. Therefore, the expected scope from the energy team is still covered by the "sustainability team" in the case studies. Following this, there is no harm in considering the sustainability team is similar to the energy team when assessing the energy culture maturity if the expected purpose is fulfilled. Hence, it is essential to ensure that the energy aspects hidden under the term sustainability are captured when doing energy culture maturity assessments in textile and apparel industrial organisations to ensure the accuracy of the results.

This section explained the findings from the cross-case synthesis that directly relate to the evaluation of the applicability of proposed energy culture maturity framework in textile and apparel industrial organisations. Next the other findings derived from the cross-case synthesis are explained.

5.3.2 Self-reinforcing norms, practices, and material culture

According to Stephenson et al. (2010) norms, practices and material culture have a self-reinforcing behaviour in their energy cultures framework. Findings of the energy culture maturity assessment using the proposed framework demonstrated self-reinforced behaviour among norms, practices, and material culture in each case study. For example, in Case A, norms, practices and material culture were mostly settled at the Level 3 (developing) maturity, and the overall maturity was also identified at the same level. Similarly, in Case B and Case C, the interaction of the three (03) components were mostly self-reinforced around Level 5 (leading) and Level 4 (advancing), respectively. Accordingly, all three (03) cases provide evidence for self-

reinforced behaviours of the norms, practices, and material culture in their respective maturity levels.

5.3.3 Low maturity of attribute 7: changing core business practices for energy-related improvements

Relatively low maturity was observed in all case studies for attribute 7, which focused on changing core business practices for energy conservation. Case A and Case C were fitted to Level 2 (emerging), and Case B was aligned with Level 3 (leading) under this attribute. Attribute 7 was the only attribute that has put Case B to a maturity level lower than Level 4 (advancing). Similarly, this is the only situation where Case C's result also purely became a Level 2 (emerging) maturity. Hence, the argument can be made that making changes to core business with the purpose of energy-related improvements is an area with low maturity, considering the similar pattern in all three (03) cases.

5.3.4 Organisations fitting to the maturing area of the framework

According to the proposed energy culture maturity framework, Level 1 (none) represents organisations that do not have any energy culture maturity. The maturity journey starts with limited provisions in Level 2 (emerging) and then gradually moves up to the most mature status of Level 5 (leading). According to the results of all three (03) case studies, none of the organisations fits any of the maturity descriptors of the Level 1 (none) maturity. Case A has the lowest overall maturity; still, there is no representation for any attributes under the Level 1 maturity. Even though the selected organisations are on a large scale, there are differences among them in terms of the market size, number of years in the business, and production capacity. For example, Case A is a new business compared to Case B and Case C. Despite the organisations' differences, findings showed that the organisations at least fit the Level 2 (emerging) features. Overall, the results showed that the three (03) case studies belong to the maturing area of the framework, which is featured in Level 2 (emerging), Level 3 (developing), Level 4 (advancing) and Level 5 (leading) maturity levels. Further, in terms of the overall maturity of the cases, all cases belong to Level 3 (developing), Level 4 (advancing) and Level 5 (leading) maturity statuses. Hence, it can be argued that all selected large-scale textile and apparel industrial organisations are in the maturing range of the framework without any representation for Level 1 (none) maturity.

5.3.5 Absence of the computerised maintenance management for significant energy-consuming equipment

Maintenance management supporting the energy performance of the machinery fits higher maturity levels in all three (03) cases. For instance, in Case A and Case C, this attribute fits Level 4 (advancing) maturity, and the attribute fits Level 5 (leading) maturity in Case B. However, one common thing that is absent in all three (03) cases was the computerised maintenance management system integrated into significant

energy-consuming machinery. Overall, the absence of a computerised maintenance management system is a common feature in all three (03) cases despite the maturity of other maintenance management descriptors.

5.3.6 Impact of green values of senior leadership on overall energy culture maturity

Walton et al. (2020) highlighted that an owner's strong green values is a special factor that strengthens the energy culture in an organisation. The proposed framework's attribute 1 (green values of owners and senior management) describes the availability of very strong green values, strong linkage of green values with business strategies and an industry pioneering mindset in implementing new energy-related improvements at the maturity Level 5. Such high-level green values of owners and senior management impact the whole business's energy consciousness, as explained by Walton et al. (2020). When considering the case study results, the solid green values are available in Case B and Case C since the maturity assessment fits Level 5 under attribute 1. Further, the overall maturity results of Case B and Case C represents higher maturity levels, such as Level 5 (leading) and Level 4 (advancing), respectively. Conversely, Case A featured Level 3 (developing) maturity descriptors under attribute 1, which shows a moderately strong green value of the owners and senior management due to the limited linkage of the green values with business strategies. Further, the overall maturity of Case A belongs to Level 3 (developing). All in all, by examining the results of the three (03) cases, the availability of very strong green values is visible in Case B and Case C, and simultaneously the overall energy culture maturity is also at higher maturity levels. Conversely, Case A represents moderately strong green values (at Level 3), and the overall energy culture maturity score of Case A also fits Level 3 (developing). Hence, based on the results of the three (03) cases, green values' impact on the overall energy culture maturity is in line with the findings of Walton et al. (2020)'s energy culture study. Furthermore, the comparison of Case A's findings with the finding of Case B and C has strengthened this argument.

5.3.7 Impact of the external influences on the energy culture of organisations

There was evidence for the impact of external influences on some of the attributes, which led to achieving higher maturity levels. For instance, as agreed in all cases, the government's project called "Soorya Bala Sangramaya" (The Battle for Solar Energy) is such an external influence that promotes rooftop solar panels in the factory rooftops of the textile and apparel industrial organisations. All the cases are in Level 4 (advancing) or Level 5 (leading) under attribute 18, which relates to renewable energy sources. Participants of all three (03) cases highlighted the government's project to promote rooftop solar panels as a significant reason for the considerable progress under attribute 18.

Furthermore, according to the case study evidence, the Higg Index (a customer accepted tool that promotes the sustainability implementations) has supported to

improve attribute 14 (deployment of energy goals and strategies) and attribute 15 (energy performance monitoring and management) in all cases. Therefore, the Higg Index can also be identified as an external influence that has positively impacted increasing the maturity of these attributes. Case A is a good example that shows the impact of external influences. Usually, Case A fits maturity Level 3 (developing) in terms of most of the attributes. However, attribute 14, 15 and 18 of Case A represents Level 4 (advancing) maturity descriptors. Similarly, Case B and C also highlighted the impact of external influence on these three (03) attributes. Overall, it can be determined that external influences play an influencing role in the energy culture maturity in selected cases. Literature also has highlighted the impact of the external influences on the energy culture of organisations (Bell et al., 2014; Dew et al., 2017; Stephenson et al., 2015; Walton et al., 2020).

5.3.8 Relating the organisation's context and energy culture maturity results.

Despite all being large-scale organisations, the three (03) case studies vary in terms of the factors like size of the business. For instance, Case A consists of 12 factories with around 19,000 employees; Case B owns 53 factories and approximately 99,000 employees; Case C consists of 25 factories and around 52,000 employees. When the overall energy culture maturity assessment results of the cases are compared with the sizes of the three (03) businesses, it can be seen that the size of the business and the energy culture maturity results are aligned. When sorting cases in the ascending order based on size, the order is Case A, Case C, and then Case B. When sorting the energy culture maturity results, Level 3 (developing), Level 4 (advancing) and Level 5 (leading) were the outcomes in the ascending order for Case A, Case C and Case B, respectively. Hence, the results proposed a relationship between the size of the business and energy culture maturity level. However, this study has not examined a relationship between the size of the organisations and the energy culture maturity. Therefore, further research in this area can examine such a relationship.

5.4 Discussion of the study

5.4.1 Self-reinforced natures of norms, practices, and material culture

The findings of the three (03) case studies revealed that there is a self-reinforced relationship among norms, practices, and material culture in each case study as explained in Section 5.3.2. For instance, Case A's norms, practices, and material culture were located mostly at Level 3 (developing) maturity. In Case B, overall alignment of the norms, practices and material culture was at Level 5 (leading) maturity. Furthermore, Case C's norms, practices, and material culture demonstrated an overall alignment with Level 4 (advancing) maturity. Thus, the findings of three (03) case studies demonstrated that there is a self-reinforced interaction of the behaviour of norms, practices, and material culture in each study.

Similarly, Stephenson et al. (2010) stressed the self-reinforced nature of the behaviour of norms, practices and material culture in their study that developed the first energy cultures framework. Further, several other energy culture studies based on organisations also revealed similar relationships among norms, practices, and material culture. For instance, Walton et al.'s (2020) study on business organisation in New Zealand, Bell et al.'s (2014) study on New Zealand's timber industry and Dew et al.'s (2017) study on the United States Navy's ships confirmed the self-reinforced nature of the norms, practices, and material culture in those different contexts. Similarly, as a study based on the energy culture of large-scale textile and apparel industrial organisations in Sri Lanka, this study also demonstrated the similar nature self-reinforced relationship among norms, practices, and material culture by fitting to a unique overall energy culture maturity level in each study based on the behaviour of three (03) elements. These self-reinforced elements show the importance of considering the holistic view of all three (03) elements (norms, practices, and material culture) rather than seeking energy culture improvements by treating them in isolation.

Furthermore, Stephenson et al. (2010) discussed the existence of "clusters of energy cultures" created from self-reinforced nature of the norms, practices, and material culture. Accordingly, the findings from three (03) case studies can be identified as three (03) different clusters of energy cultures as they belong to three (03) energy culture maturity levels (Case A: Level 3 (developing), Case B: Level 5 (leading), Case C: Level 4 (advancing)). Further, the framework itself facilitates to identify five (05) different clusters of energy cultures from its five (05) energy culture maturity levels. According to Stephenson et al. (2010) the classification of organisations into clusters of energy cultures facilitates to carryout cluster specific interventions to improve them rather than working with universal solutions. Hence, the clustering ability of the proposed energy culture framework supports bringing context specific improvements to energy cultures.

5.4.2 Influence of green values of owners and senior management

Walton et al. (2020) discussed the role of green values of owners and senior management in creating different energy cultures in their study conducted on New Zealand's business organisations. According to Walton et al. (2020), high level green values of owners and senior management continually shape the business direction with considerable energy-related improvements. Whereas business organisations with poor green values of the owners and senior management creates strong barriers in the whole organisation for energy-related improvements. Further, Dew et al.'s (2017) study based on the United States Navy ships and Bell et al.'s (2014) study on New Zealand's timber industry demonstrated the strong acceptance of energy-inefficient technologies in respective organisations due to poor green values of owners and senior management.

Considering the findings of this study, Case B and Case C fitted to Level 5 (leading) maturity under green values of owners and senior management (Attribute 1) and obtained the overall energy culture maturity of the case studies at Level 5 (leading)

and Level 4 (advancing) respectively. Whereas in Case A, Attribute 1 was aligned with Level 3 (developing) maturity and overall energy culture maturity of the Case A was also at Level 3 (developing). Thus, the findings of the case studies revealed that the organisations with high green values of owners and senior management (Case B and Case C) also have high overall energy culture maturity compared to Case A, where the green values of owners and senior management and overall energy culture maturity was in level 3. Hence, this study's findings are in line with the impact of green values of owners and senior management highlighted by Bell et al. (2014), Dew et al. (2017) and Walton et al. (2020) in their studies. However, the study has not examined the extent of the impact green values of owners and senior management on overall energy culture maturity which invites future research.

5.4.3 Attributes with low maturity

During the actual application of the framework through the case studies, it was revealed that Attribute 7 (changing core business practices for energy-related improvements) have low maturity score across all case studies, as explained in Section 5.3.3. Thus, attribute 7 presented a unique situation that is completely different from all other energy culture maturity attributes. This could be because textile and apparel industrial organisations are not ready to make changes to core business activities for the purpose of energy-related improvements even though they are ready to do other energy-related improvements that do not need to change the core business activities. Bell et al. (2014) explained a similar situation about the availability of barriers to changing core business practices to establish energy-efficient heat pump dryers in New Zealand's timber industry. Further, Walton et al. (2020) also highlighted the energy cultures of business firms in New Zealand that do not support changing core business practices to adopt energy-related improvements. Hence, it is vital for the textile and apparel industrial organisations to pay attention for the ways of improving those low performing attributes.

5.4.4 Development of an energy culture maturity framework

Different culture research domains have developed respective culture maturity frameworks. For instance, the safety culture maturity framework (Lee, 2019; Jean and Zaleschuk, 2018; Musonda, 2018; Stiles, 2018; Zwetsloot et al., 2020;), for the safety culture research domain; health safety and environment culture maturity framework (Bordage et al., 2012), for the health safety environment culture research domain; food safety culture maturity framework (Jespersen et al., 2016), for the food safety culture research domain; and organisational culture maturity framework (Chaitanya & Madala, 2008), for the organisational culture research domain. However, the relatively recent energy culture research domain has not expanded to develop an energy culture maturity framework yet.

Initially, the pioneering energy culture maturity conceptual framework (Soorige et al., 2022) was developed by this study by incorporating the existing energy culture

literature. However, the proposed conceptual framework was limited to three (03) energy culture maturity stages due to the lack of available energy culture studies. Then, this study progressed beyond the conceptual framework to develop a context-specific energy culture maturity assessment framework based on the textile and apparel industrial organisations in Sri Lanka as the outcome of Phase I of the study given in Chapter 4. Thereafter, Chapter 5 presented the findings related to the evaluation of the applicability of the proposed context-specific framework using three (03) case studies in large-scale textile and apparel industrial organisations in Sri Lanka as Phase II. Phase II findings demonstrated considerable applicability of the proposed framework for assessment of the energy culture maturity in selected case studies as explained in Chapter 5.

Hence, the development of energy culture maturity frameworks has added the energy culture maturity assessment capability for the energy culture research domain similar to the other culture research domains like safety culture. As explained by Finnerty et al. (2017a) availability of a maturity framework provides the baseline and benchmark capabilities. Therefore, the proposed energy culture maturity frameworks can be used for assessment of energy cultures and develop baselines and benchmarks based on the assessment. Then, the framework can guide textile and apparel industrial organisations to reach the energy culture excellence. Furthermore, since this study was focused only on the large-scale organisations in the textile and apparel industry in Sri Lanka, further research can be conducted in other significant contexts to expand the application of energy culture maturity frameworks.

5.4.5 Expanding three maturity stages to five maturity levels

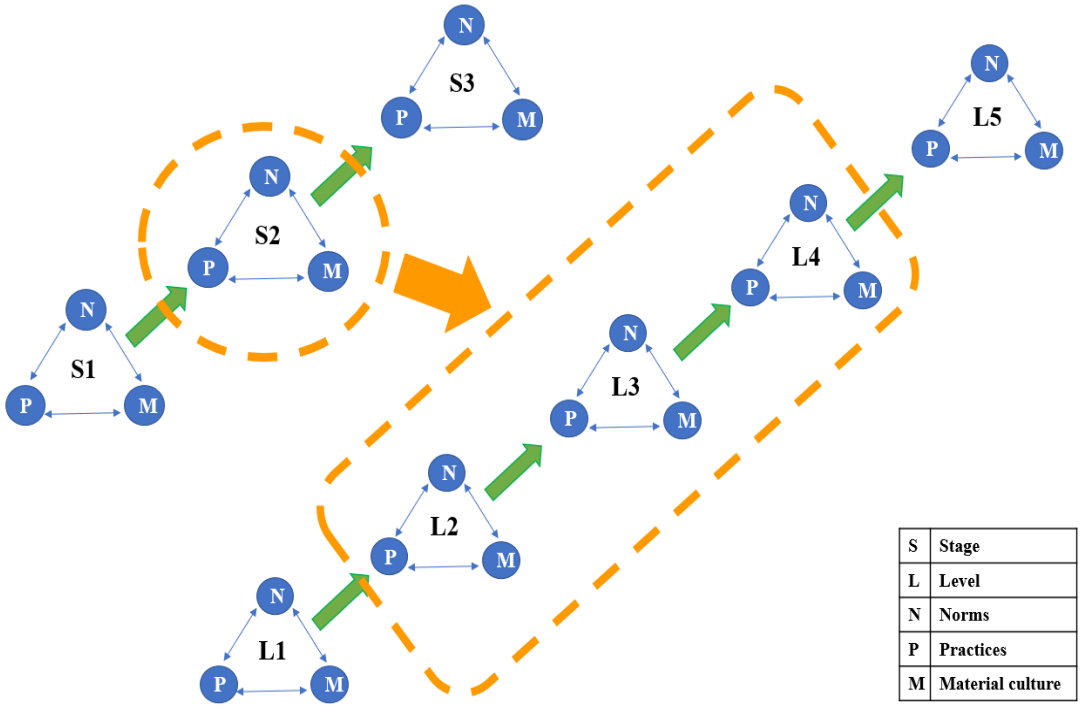
This study incorporated Finnerty et al.'s (2017a) energy management maturity framework with five (05) maturity levels as the foundation to develop this study's framework. However, the pioneering conceptual energy culture maturity framework (Soorige et al., 2022) developed from this study was limited to three (03) energy culture maturity stages as given in Section 2.3.3.3 due to the lack of energy culture literature to define five (05) energy culture maturity levels. Therefore, the conceptual framework could be identified as a solely literature based and non-industry distinctive framework. Therefore, the context-specific energy culture maturity framework was developed using the Phase I finding of the study as the next step.

The context-specific framework could expand the three-staged conceptual energy culture maturity framework with five (05) energy culture maturity levels as depicted in Figure 4.20. Accordingly, the conceptual framework's shrunk "Stage 2" (explained in Section 2.3.3.3) was expanded as Levels 2, 3 and 4 of the context-specific framework. Therefore, the context-specific framework complies with the five (05) levels structure of Finnerty et al. (2017a) framework used as the foundation maturity framework in this study. Accordingly, Soorige et al. (2022) conceptual framework was expanded with industry-specific energy culture maturity attributes and respective

maturity descriptors under five (05) maturity levels based on textile and apparel industry in Sri Lanka.

Figure 5. 1

Expansion of the Maturity Levels



The availability of five (05) maturity levels provides high capabilities to identify "clusters of energy cultures" (explained in Section 5.4.1) than the three-staged conceptual framework. Further, the industry-specific five (05) maturity levels maturity better represent the maturity position of a large-scale textile and apparel industrial organisation.

5.4.6 Facilitates energy culture maturity levels identification and continual improvement

The energy cultures framework (Stephenson et al., 2010) has been used to examine different energy cultures in terms of the related norms, practices, and material culture without indicating any status on the maturity of that energy culture (Bell et al., 2014; Gill et al., 2015; Dew et al., 2017; Walton et al., 2020). However, the other culture research domains such as safety culture provide an understanding of the current maturity status of the respective safety culture and the way forward to achieve more mature levels using safety culture maturity frameworks (Lee, 2019; Jean and Zaleschuk, 2018; Musonda, 2018; Stiles, 2018; Zwetsloot et al., 2020).

The proposed energy culture maturity framework facilitates textile and apparel industrial organisations to understand the current position in terms of the energy culture's maturity level. Hence, the novel framework has expanded the possibilities of the energy cultures framework by providing a mechanism to assess the level of energy

culture maturity without just limiting to examinations of energy cultures as per the previous energy culture studies conducted using Stephenson et al.'s (2010) energy cultures framework. Furthermore, the proposed context-specific energy culture maturity framework shows the way forward for textile and apparel industrial organisations to achieve higher energy culture maturity levels as the incorporation of the PDCA elements guides continual improvement.

5.4.7 Exploring textile and apparel industry-specific energy cultures

According to Lutzenhiser (1992), Stephenson et al. (2010) and Bell et al., (2014) energy culture studies should be industry-specific due to the industry distinctive nature of energy cultures. Currently, none of the existing energy culture studies has focused on the energy culture of textile and apparel industrial organisations. Hence, this study explored the energy culture in the context of textile and apparel industrial organisations. Accordingly, the study's Phase I findings have established textile and apparel industrial organisations specific 19 energy culture attributes under norms, practices, and material culture and five (05) possible energy culture maturity levels along with the respective maturity descriptors.

Moreover, when evaluating the context-specific framework's applicability in Phase II of the study using the three (03) case studies, all case studies were fitted within the given attributes, maturity levels and maturity descriptors of the proposed framework. Therefore, the high-level applicability of the proposed context-specific framework to represent different energy cultures of textile and apparel industrial organisations was evidenced. Hence, the study has contributed to the current energy culture literature by exploring the energy culture specific to textile and apparel industry organisations, which has not been explored by any other studies yet. Therefore, the framework can be used to assess the energy cultures of textile and apparel industrial organisations.

5.4.8 Expansion to the energy cultures framework as a benchmarking and baselining tool

Available culture maturity frameworks (e.g.: safety culture maturity frameworks) provide benchmark and baseline capabilities by quantifying the maturity assessment results in respective fields (Lee, 2019; Jean and Zaleschuk, 2018; Musonda, 2018; Stiles, 2018; Zwetsloot et al., 2020). Baseline and benchmark capabilities of culture maturity frameworks support organisations in monitoring and improving culture maturity. However, the energy culture research domain did not have benchmarking and baselining ability due to the unavailability of the energy culture maturity assessments.

The proposed energy culture maturity framework developed from Phase I findings could provide this missing ability of baselining and benchmarking to the energy culture research domain. Further, Phase II energy culture maturity assessment results proved this capability from the calculated maturity scores of the selected three (03) case studies. Accordingly, as three (03) large-scale organisations in the textile and apparel

industry, cases A, B, and C received 55, 89 and 67.5 overall maturity scores, respectively. The overall maturity score shows Case B as the most matured organisation located at Level 5 (leading). In contrast, Case A fitted to Level 3 (developing) maturity, the lowest among the three (03) cases. Further, Case C was located at Level 4 (advancing) between cases B and A. Therefore, textile and apparel industrial organisations can use the overall results of the assessment to benchmark with external peers and other factories of their own organisation (Finnerty et al., 2017a). Furthermore, baselining capability (Finnerty et al., 2017a) enables establishing a standard point of reference against which the progress of the energy culture maturity can be calculated for an organisation from time to time. Hence, further studies using the energy culture maturity framework can establish appropriate baselines for the large-scale textile and apparel industrial organisations. Therefore, baselining and benchmarking abilities provided by the proposed energy culture maturity framework have upgraded the capabilities of Stephen et al.'s (2010) energy cultures framework.

In addition to the overall energy culture maturity results, the proposed framework also provides the ability to assess the results at the energy culture components (norms, practices, and material culture) level and individual attribute level under each of the 19 attributes. Chapter 5 provides component and attribute-wise results of the selected case studies. This facilitates setting benchmarks and baselines even at the micro-level, such as energy culture component-wise or attributes-wise.

5.4.9 Feedback on overall applicability of the proposed framework

Phase II evaluated the applicability of the proposed framework using three (03) case studies. The findings of the within-case analysis and cross-case synthesis showed considerable applicability of the framework in the selected case studies due to several reasons as explained below.

First, Phase II findings showed the availability of all 19 attributes of the proposed framework in all selected case studies. This justified the suitability of the framework's attributes in real-world context of textile and apparel industrial organisations. Then, when it comes to the assessment, a less variation was observed in maturity level choices. Most of the time maturity choices under attributes were purely fitted to a certain maturity level. For instance, assessment results of cases A, B, and C purely fitted to maturity levels under 13, 17 and 16 attributes respectively out of the 19 attributes assessed in each case study. On the other hand, the remaining attributes of each case study provided mixed maturity choices where the maturity assessment result represents more than one maturity level under those attributes. However, the variation of those mixed maturity results was also limited to two (02) adjacent maturity levels in all three (03) case studies. Therefore, the mixed maturity results also showed less variation. Hence, the purely fitted maturity results as the majority and the few mixed results demonstrated less variation in the assessment results. Such less variation in the results of the proposed framework shows the high validity of the proposed framework.

Furthermore, the overall maturity identified using the proposed scoring system (see Section 3.8.2.2.2 (a)) of the framework was verified using two (02) other approaches as the overall energy culture maturity preference and most chosen level as explained in Section 3.8.2.2.2 (b) and 3.8.2.2.2 (c) The overall energy culture maturity level derived (using the maturity scoring system) from the detailed energy culture maturity assessment based on the proposed framework was the same as the results of the other two (02) approaches in each case study. The commonality of the results from the three (03) approaches also strengthened the results and the overall applicability of the proposed framework.

Overall, application of the proposed framework in selected case studies demonstrated the framework's suitability for energy culture maturity assessment concerning several areas, such as the presence of all attributes, less variation of the maturity results, the similarity of overall maturity obtained using three (03) approaches, and compliance with the provisions of the energy cultures framework as explained above. Hence, Phase II findings have strengthened the applicability of the proposed energy culture maturity framework for assessing the energy culture maturity of textile and apparel industrial organisations. Overall, considerable applicability of the proposed framework could be understood based on the evaluation of applicability of the proposed framework in textile and apparel industrial organisations.

5.5 Chapter summary

First, this chapter presented Phase II findings of the study aimed at evaluating the applicability of the proposed energy culture maturity framework for large-scale textile and apparel industrial organisations using case studies as Objective 4. Accordingly, the findings of three (03) case studies of large-scale textile and apparel industrial organisations are presented using within-case analysis and cross-case synthesis. Then, the chapter presented the study's discussion section. Discussion section explained how the findings of this study can be contextualised in the energy culture research domain. The discussion was conducted based on the findings on the development of the energy culture maturity framework in Phase I and the evaluation of the developed framework in Phase II. The developed framework in Phase I could be identified as a novel addition to energy culture research domain that complies with the provisions of existing energy culture frameworks and going beyond from conventional energy culture research to establish energy culture maturity. Phase II findings revealed applicability of the proposed context-specific framework in evaluating the energy culture maturity of large-scale textile and apparel industrial organisations that opens a new avenue for conventional energy culture research for energy culture maturity assessment. The next chapter provides the conclusions of the study.

CHAPTER 6

CONCLUSIONS

6.1 Introduction

This chapter presents the conclusions drawn from the research study and related recommendations. Initially, the conclusions drawn based on the findings under each objective are presented. Then, the contribution to knowledge is identified under theoretical implications, research methods and practical implications. Finally, the chapter highlights study limitations and provides directions and areas for future research.

6.2 Research summary

This study was focused on developing a framework to assess the level of energy culture maturity of textile and apparel industrial organisations. Chapter 1 of the study established the research problem aim and objectives of the study. Further, summaries of the research methodology, scope and limitations, and contributions were incorporated under Chapter 1. Chapter 2 first presented the literature review on energy culture maturity. Then, a systematic literature review established the attributes, descriptors, and stages of energy culture maturity as Objective 1. Thereafter, the energy culture maturity conceptual framework was designed based on the systematic literature review findings as the ultimate outcome of Chapter 2. Next, Chapter 3 formulated a comprehensive research methodology design for this research study to achieve objectives 3 and 4. Chapter 4 presented data analysis and findings that developed the energy culture maturity assessment framework for textile and apparel industrial organisations in Sri Lanka as Objective 3. Thereafter, Chapter 5 presented the findings on evaluation of the applicability of the developed framework as Objective 4 which was conducted using three (03) case studies. Ultimately, Chapter 5 carried out the discussion of the study.

6.3 Major contributions

The research began with the question of “How can the energy culture maturity be assessed in textile and apparel industrial organisations in Sri Lanka?”. Therefore, the study was set out with the aim to develop a mechanism to assess the level of energy culture maturity of textile and apparel industrial organisations in Sri Lanka. The research has taken a step-by-step process to achieve this aim. Accordingly, under four (04) objectives, the research has reviewed attributes, levels and descriptors of energy culture maturity, designed an energy culture maturity conceptual framework, developed an energy culture maturity assessment framework for large-scale textile and apparel industrial organisations in Sri Lanka, and evaluated the applicability of the developed energy culture maturity assessment framework in textile and apparel

industrial organisations in Sri Lanka. The major contributions based on the findings of each objective are presented below.

6.3.1 Objective 1 - Review attributes, descriptors, and stages of energy culture maturity

Since there were not any previous energy culture maturity frameworks established (Soorige et al., 2022), Objective 1 reviewed energy culture literature to find elements of energy culture maturity (attributes, maturity levels, and descriptors) by incorporating a systematic literature review, as explained in Section 2.3.3. Accordingly, findings of the systematic literature review established 12 energy culture maturity attributes, including green values of owners and senior management, energy policy, employee interest for energy-related improvements and focus on a green marketplace, three (03) energy culture maturity stages and 43 energy culture maturity descriptors, as presented in Section 2.3.3 as the elements of energy culture maturity. Therefore, since the elements of the energy culture maturity were not established by the previous studies, the outcomes of Objective 1 have expanded the knowledge on energy culture research by establishing the elements of energy culture maturity. Furthermore, the identification of the elements was an essential step in designing the first energy culture maturity conceptual framework as the next objective of the study.

6.3.2 Objective 2 - Design an energy culture maturity conceptual framework

This study brought together the concepts from the energy cultures framework (Stephenson et.al., 2010) and the energy management maturity framework (Finnerty et al., 2017a) to design the first energy culture maturity conceptual framework. Accordingly, the energy culture maturity elements developed through Objective 1 were integrated to design the conceptual framework. Being a pioneering framework, the energy culture maturity conceptual framework has created a significant contribution to the energy culture research domain by establishing a novel approach for energy culture research. Therefore, here onwards the term “culture maturity” can be used in the energy culture research domain like any other culture maturity research domains, such as safety culture maturity.

The energy culture maturity conceptual framework provides the ability to understand the holistic energy culture maturity that was not available in the previous energy culture research frameworks (Stephenson et al., 2010). The conceptual framework presented in Figure 2.7 and Table 2.8 consists of three (03) stages of energy culture maturity as Stage 1 (none), Stage 2 (emerging, developing and advancing), and Stage 3 (leading). Further, the 12 energy culture maturity attributes are placed under norms, practices, and material culture. Each attribute is given energy culture maturity descriptors under three (03) energy culture maturity stages. Likewise, the design of the conceptual framework presents a roadmap for energy cultural excellence from Stage 1 to Stage 3, where Stage 3 is the highest stage of energy culture maturity. Further, having three (03) energy culture maturity stages facilitates organisations to understand

their current maturity position in the spectrum. In addition, the energy culture maturity conceptual framework is in a generic form. Therefore, there is a need to make industry-specific adjustments prior to application of the conceptual framework in an industry considering the distinctive nature of energy cultures in different industries. Finally, from the research methodical perspective, development of a conceptual framework facilitated the implementation of abduction as the study's research approach.

6.3.3 Objective 3 - Develop an energy culture maturity assessment framework for textile and apparel industrial organisations in Sri Lanka

This third objective was focused on developing an energy culture maturity assessment framework specific to textile and apparel industrial organisations, considering the industry distinctive nature of energy cultures. This objective was achieved through the findings of Phase I of the study that consisted of three (03) steps as explained in Section 4.2. Accordingly, the outcome of Objective 3 was the energy culture maturity assessment framework for large-scale textile and apparel industrial organisations in Sri Lanka, which is presented in Figure 4.20 and Table 4.22.

The proposed framework was constructed using energy culture maturity attributes, descriptors, and levels specific to large-scale textile and apparel industrial organisations in Sri Lanka. Accordingly, there were 19 energy culture maturity attributes identified under norms, practices, and material culture. Norms consisted of six (06) attributes, including green values of owners and senior management, energy vision, mission, and policy statements, and organisational public commitments to energy management. Practices contained 10 attributes including changing core business practices for energy-related improvements, financing energy-related improvements and assigning human resources and responsibilities. Lastly, material culture comprised of three (03) attributes as energy-efficient technologies and related supportive technologies, renewable energy sources and low emission building design and construction. Then, there were 316 energy culture maturity descriptors identified altogether in the framework. Further, the framework's five (05) energy culture maturity levels were developed as Level 1 (none), Level 2 (emerging), Level 3 (developing), Level 4 (advancing) and Level 5 (leading).

The proposed framework can be identified as a mechanism for assessing energy culture maturity of textile and apparel industrial organisations due to its industry distinctive nature. The maturity scoring system (see Section 3.8.2.2.2(a)) incorporated into the framework also facilitates the baseline and benchmark capabilities that help organisations to use energy culture maturity baselines and benchmarks. Furthermore, the proposed energy culture maturity framework is a significant outcome since it is the pioneering industry-specific framework developed based on large-scale textile and apparel industrial organisations in Sri Lanka. However, due to the industry distinctive nature of energy cultures, this framework might need industry specific adjustments prior to application in other industries.

6.3.4 Objective 4 - Evaluate the applicability of the developed energy culture maturity assessment framework in textile and apparel industrial organisations in Sri Lanka

The intended use of the proposed framework was to assess the level of energy culture maturity of textile and apparel industrial organisations in Sri Lanka. Hence, the framework had to be evaluated in the real-world situation in textile and apparel industrial organisations to obtain feedback on its applicability. Accordingly, as Phase II of the study, the proposed framework was evaluated based on the results of energy culture maturity assessments conducted in the three (03) case studies in textile and apparel industrial organisations in Sri Lanka.

The findings of Phase II reflect the applicability of the proposed framework. The findings showed the presence of the framework's 19 energy culture maturity attributes in case studies, as explained in Section 5.3. Accordingly, all 19 attributes were available in each of the three (03) case studies. Further, maturity assessment results of each attribute demonstrated less variation. Most of the time, attributes received pure results specific to one (01) of the maturity levels from Level 1 (none) to Level 5 (leading). Accordingly, 13, 17 and 16 attributes in Cases A, B and C respectively out of the total 19 attributes demonstrated results purely fitting to a specific maturity level. On the other hand, only six (06), two (02) and three (03) attributes out of the 19 attributes displayed mixed results in Cases A, B and C respectively. However, the mixed results also showed a minimum variation where the variation was only limited to two adjacent levels under the given attributes. Therefore, such limited variation in the results shows the considerable validity of the energy culture maturity descriptors arrangement in each level of the proposed framework.

Furthermore, the findings revealed that the overall energy culture maturity of Cases A, B and C fits to Level 3 (developing), Level 5 (leading) and Level 4 (advancing) respectively. The overall energy culture maturity result of each case was determined mainly using the maturity scoring system given in Section 3.8.2.2.2(a). In addition, the overall maturity of each case was verified using two (02) other approaches (overall energy culture maturity preference and the most chosen level) as explained in Section 3.8.2.2.2(b)) and Section 3.8.2.2.2(c)). The findings of the three (03) approaches on overall energy culture maturity of each case study were similar in each case. Hence, the uniformity of the results from the three (03) approaches also strengthened the overall applicability of the proposed framework. Furthermore, the self-reinforced nature of norms, practices and material culture was reported from findings in case studies as explained in Section 5.3.2., which is in accordance with the behaviour explained in the pioneering energy cultures framework (Stephenson et al., 2010). Therefore, this added further value towards the applicability of the proposed framework.

Overall, the findings of Objective 4 revealed that the proposed energy culture maturity framework has considerable applicability for assessing the level of energy culture maturity in large-scale textile and apparel industrial organisations in Sri Lanka.

Moreover, development and subsequent evaluation of the proposed energy culture maturity framework based on large-scale textile and apparel industrial organisations has carried out the expected "development of a mechanism" to assess the level of energy culture maturity of textile and apparel industrial organisations in Sri Lanka as the aim of the study. Hence the research question of the study was successfully answered.

6.4 Contribution to knowledge – Theoretical implications

Although several studies have examined different culture maturity frameworks, such as safety culture maturity (Jean & Zaleschuk, 2018; Lee, 2019; Musonda, 2018; Stiles, 2018; Zwetsloot et al., 2020) there has not been a focus on developing an energy culture maturity framework. Therefore, this study establishes an energy culture maturity framework for the first time. Initially, a three-staged energy culture maturity conceptual framework (see Figure 2.7 and Table 2.8) was developed based on the literature as the pioneering framework on energy culture maturity (Soorige et al., 2022). The development of a novel energy culture maturity conceptual framework was a significant contribution to the energy culture research domain as it establishes an innovative approach to undertake energy culture research.

Having established the pioneering conceptual framework, this research subsequently developed an industry-specific energy culture maturity framework for the first time that is focused on large-scale textile and apparel industrial organisations in Sri Lanka based on Objective 3. This framework was then evaluated for its applicability in response to Objective 4. The proposed industry-specific energy culture maturity framework itself is also a contribution to knowledge since the energy culture research requires development of industry distinctive energy culture frameworks. Therefore, the proposed industry specific energy culture maturity framework given in Figure 4.20 and Table 4.22 also added a substantial contribution to the energy culture research domain.

6.5 Contributions to research methods

Focus groups are categorised as homogeneous focus groups and mixed focus groups based on the types of participants involved. Morgan (2019) highlighted a considerable lack of studies designed using mixed focus groups that brings participants from different backgrounds together. Therefore, there was inadequate knowledge on how a mixed focus group performs. Professor David Morgan, who authored *Basic and Advanced Focus Groups* (Morgan, 2019), is a notable scholar in the area of focus group research methods with substantial contributions to scientific literature. Hence, the researcher identified Morgan's (2019) recent call for future research on mixed focus groups, which have been limited in application in research. Further, Morgan (2019) explains the need to find ways of establishing the common ground for mixed focus groups.

Phase I's Step 3 of the study planned to use mixed focus groups to refine the draft energy culture maturity framework developed from Step 2 using multiple perspectives related to energy culture. Therefore, the participants were selected representing different disciplines, as explained in Section 3.8.1.1.2, which created a mixed focus group. Morgan (2019) highlighted the difficulty in establishing the "common ground" when multiple perspectives are involved. However, this study was able to fulfil the expected purpose of the Step 3 focus groups and also achieved the data collection saturation using three (03) mixed focus groups via a "more structured" mixed focus group, as explained in Section 3.8.1.1.2. Therefore, this study's mixed focus group design is part of the contribution of this study, and specifically to research methods development, by fulfilling Morgan's (2019) call for more studies to conduct mixed focus group designs.

6.6 Contributions to knowledge - practical implications

The proposed framework can be identified as a readily applicable energy culture maturity assessment mechanism as proved using the application in three (03) case studies. Therefore, there is a considerable potential contribution because it is a practice-oriented framework. Based on the findings of the research, practical implications of the proposed framework can be identified as follows.

- As already proved using the case studies, the proposed framework can be used by large-scale textile and apparel industrial organisations to assess their energy culture maturity. Further, having established the energy culture maturity journey in the proposed framework from the levels 1 to 5, the organisations can understand the way forward from their current maturity position to achieve a more matured status.
- The assessment conducted in three (03) case studies proved that the proposed energy culture maturity framework can establish the overall maturity status of the organisation, using the proposed maturity scoring system as explained in Section 3.8.2.2.2 (a). Therefore, ability to identify the maturity score for individual organisations demonstrated the baselining and benchmarking capability of the proposed framework. Baselining capability can be used by textile and apparel industrial organisations to set energy culture maturity baselines for them and monitor the progress of the energy culture maturity against the set baseline. Being multi-site organisations, textile and apparel industrial organisations can also use the proposed benchmarking capabilities of the energy culture maturity framework to compare the status of energy culture maturity between different factories of the same group.
- The proposed framework can also be used by the energy related third-party stakeholders of the textile and apparel industry in Sri Lanka. For example, the Sri Lanka Sustainable Energy Authority, which is the

government's authority responsible for the energy-related improvement of the textile and apparel industry. The Sri Lanka Sustainable Energy Authority can use the proposed framework's baselining and benchmarking capabilities to set industry level energy culture maturity baselines and benchmarks for the textile and apparel industry. Additionally, it could also establish a monitoring system for tracking improvements.

6.7 Limitations of the research

There are some limitations of the research that is essential to highlight, as follows.

- The study's findings derived from a cross-sectional data collection rather than longitudinal data. Therefore, the data gathering about the energy culture of textile and apparel industrial organisations could not be conducted over a longer period of time. Further, there is a potential for the cross-sectional data to be affected by the mindset of the participants at the time of data gathering.
- The data collection was limited to large-scale organisations in the textile and apparel industry. Therefore, the findings cannot be generalised to small and medium scale organisations in the same industry.
- The data collection in the case studies was designed to cover the whole scope of textile and apparel industrial organisations, which included corporate level and factories. Textile and apparel industrial organisations have centralised corporate office and the factories spread as multiple sites. The study could not cover all factories of an organisation due to time and location limitations. Therefore, data collection was limited to a selected factory and the corporate office.

6.8 Recommendations for future research

The following future research directions can be proposed based on the findings of the study.

- This study was aimed on developing a mechanism to assess the level of energy culture maturity in textile and apparel industrial organisations. Accordingly, an energy culture maturity assessment using the proposed framework provides the status of the energy culture maturity of a textile and apparel industrial organisation. However, the proposed framework was not intended to provide guidance on "how to change" energy culture maturity from a lower level to a higher level, which is also vital to promote the application of an energy culture maturity framework. Stephenson et al. (2015) also highlighted the significance of studying

"how to change" energy cultures. Hence, using this study as a starting point, there is a strong avenue for future research to focus on "how to change" energy culture maturity in textile and apparel industrial organisations.

- A study can be conducted on energy culture maturity of small and medium scale organisations in the textile and apparel industry since this study was limited to large-scale organisations.
- This study's energy culture maturity framework was specific to the textile and apparel industrial organisations due to the industry specific nature of the energy cultures (Bell et al., 2014; Stephenson et al.,2015). However, using this study for reference, future research can be conducted based on other types of energy significant industries and organisations on energy culture maturity.
- There was a pattern noticed in the case study findings of three (03) cases, which shows a relationship between the size of the business and energy culture maturity results, as explained in Section 5.3.8. However, this study did not examine such relationship since it was not a focus of the research. Therefore, it is worth examining such a relationship in future research.

6.9 Chapter summary

This chapter presented the major contributions and recommendations drawn from this study, with acknowledgement of the study's limitations. The development of both conceptual and context-specific energy culture maturity frameworks added a substantial contribution to knowledge as the pioneering energy culture maturity frameworks. Hence, the research area is novel and there is a considerable room for future research focussing on the area of energy culture maturity to expand from this study's findings. This is especially so in the important area of how organisations might assess their energy culture maturity level.

Details of Publications

Soorige, D., Karunasena, G., Kulatunga, U., Mahmood, M. N., & De Silva, L. (2022). An Energy Culture Maturity Conceptual Framework on Adopting Energy-Efficient Technology Innovations in Buildings. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(2), 60. https://doi.org/10.3390/joitmc8020060

Soorige, D., Karunasena, G., & Li, H. X. (2020). Energy-Efficient Technologies in the Apparel Industry: Limitations of Existing Energy Research. *Journal: Encyclopedia of the UN Sustainable Development Goals Affordable and Clean Energy*, 1-11. https://doi.org/10.1007/978-3-319-71057-0_94-1

Soorige, D., Karunasena, G., Kulatunga, U., De Silva, L., & Mahmood, M. N. (2021). Evolution of energy culture in energy behavior research in buildings. *In IEOM 2021: proceedings of the 11th annual international conference on industrial engineering and operations management* (pp.1090-1099). IEOM Society International. http://ieomsociety.org/singapore2021/papers/206.pdf.

Publication in progress

- A novel framework to assess the level of energy culture maturity: the case of textile and apparel industrial organisations (Journal article)

REFERENCES

Ambrosio-Albalá, P., Upham, P., & Bale, C. S. (2019). Purely ornamental? Public perceptions of distributed energy storage in the United Kingdom. *Energy Research & Social Science*, *48*, 139–150. https://doi.org/10.1016/j.erss.2018.09.014

Antunes, P., Carreira, P., & da Silva, M. M. (2014). Towards an energy management maturity model. *Energy Policy*, *73*, 803–814. https://doi.org/10.1016/j.enpol.2014.06.011

Axon, S., Morrissey, J., Aiesha, R., Hillman, J., Revez, A., Lennon, B., Salel, M., Dunphy, N., & Boo, E. (2018). The human factor: Classification of European community-based behaviour change initiatives. *Journal of Cleaner Production*, *182*, 567–586. https://doi.org/10.1016/j.jclepro.2018.01.232

Bach, L., Hopkins, D., & Stephenson, J. (2020). Solar electricity cultures: Household adoption dynamics and energy policy in Switzerland. *Energy Research & Social Science*, *63*, 101395. https://doi.org/10.1016/j.erss.2019.101395

Bardazzi, R., & Pazienza, M. G. (2020). When I was your age: Generational effects on long-run residential energy consumption in Italy. *Energy Research & Social Science*, *70*, 101611. https://doi.org/10.1016/j.erss.2020.101611

Bardazzi, R., & Pazienza, M. G. (2017). Switch off the light, please! Energy use, aging population and consumption habits. *Energy Economics*, *65*, 161–171. https://doi.org/10.1016/j.eneco.2017.04.025

Bell, M., Carrington, G., Lawson, R., & Stephenson, J. (2014). Socio-technical barriers to the use of energy-efficient timber drying technology in New Zealand. *Energy Policy*, *67*, 747–755. https://doi.org/10.1016/j.enpol.2013.12.010

Bhattacherjee, A. (2012). *Social science research: Principles, methods, and practices*. http://scholarcommons.usf.edu/oa_textbooks/3

Bogner, A., Littig, B., & Menz, W. (Eds.). (2009). *Interviewing experts*. Springer.

Bordage, P., Fox, C., Arce, L. M., Villarreal, G., & Zambrano Celly, J. J. (2012, January). *Innovative ways to inspire new employees to embrace an HSE culture* [Paper presentation]. International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Perth, Australia.

Çay, A. (2018). Energy consumption and energy saving potential in clothing industry. *Energy*, *159*, 74–85. https://doi.org/10.1016/j.energy.2018.06.128

Central Bank of Sri Lanka. (2022, April). *Annual Report 2021*. https://www.cbsl.gov.lk/en/publications/ economic-and-financial-reports/annual-reports/annual-report-2021

Chaitanya, C. K., & Madala, M. K. (2008). A study on board characteristics and corporate performance of Indian oil and gas upstream companies-Evolving a board performance culture maturity model. *Indian Journal of Corporate Governance*, *1*(1), 5–23. https://doi.org/10.1177%2F0974686220080102

Coghlan, D. (2019). *Doing action research in your own organization*. Sage publications.

Conti, J., Holtberg, P., Diefenderfer, J., LaRose, A., Turnure, J. T., & Westfall, L. (2016). *International energy outlook 2016 with projections to 2040* (No. DOE/EIA-0484 (2016). USDOE Energy Information Administration (EIA),. https://doi.org/10.2172/1296780

Conti, John, Holtberg, Paul, Diefenderfer, Jim, LaRose, Angelina, Turnure, James T., & Westfall, Lynn. *International Energy Outlook 2016 With Projections to 2040*. United States. https://doi.org/10.2172/1296780

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage publications.

Dew, N., Aten, K., & Ferrer, G. (2017). How many admirals does it take to change a light bulb? Organizational innovation, energy efficiency, and the United States Navy's battle over LED lighting. *Energy Research & Social Science*, *27*, 57–67. https://doi.org/10.1016/j.erss.2017.02.009

Dunlop, T. (2019). Mind the gap: A social sciences review of energy efficiency. *Energy Research & Social Science*, *56*, 101216. https://doi.org/10.1016/j.erss.2019.05.026

Edirisinghe, L.G.L.M., & De Alwis, A. A. P. (2021) Waste flow analysis in textile and apparel sector, A case study of textile and apparel wet processing industries in Sri Lanka. *Journal of Research Technology and Engineering 2(4).*

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Embuldeniya, A. (2015). Impact of apparel industry on the economy of Sri Lanka. *Journal of Social Statistics,* 02(01): 01-14, http://repository.kln.ac.lk/handle/123456789/10625

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, *5*(1), 80–92. https://doi.org/10.1177%2F160940690600500107

Finnerty, N., Sterling, R., Coakley, D., Contreras, S., Coffey, R., & Keane, M. M. (2017a). Development of a global energy management system for non-energy intensive multi-site industrial organisations: A methodology. *Energy*, *136*, 16–31. https://doi.org/10.1016/j.energy.2016.10.049

Finnerty, N., Sterling, R., Coakley, D., & Keane, M. M. (2017b). An energy management maturity model for multi-site industrial organisations with a global presence. *Journal of Cleaner Production*, *167*, 1232–1250. https://doi.org/10.1016/j.jclepro.2017.07.192

Fogelman, K., & Comber, C. (2002). *Surveys and sampling: Research methods in educational leadership and management*, Sage.

Fontana, E. (2019). Pioneering environmental innovation in developing countries: The case of executives' adoption of Leadership in Energy and Environmental Design. *Journal of Cleaner Production*, *236*, 117675. https://doi.org/10.1016/j.jclepro.2019.117675

Ford, R., Walton, S., Stephenson, J., Rees, D., Scott, M., King, G., Williams, J., & Wooliscroft, B. (2017). Emerging energy transitions: PV uptake beyond subsidies. *Technological Forecasting and Social Change*, *117*, 138–150. https://doi.org/10.1016/j.techfore.2016.12.007

Fowler, L., Neaves, T. T., Terman, J. N., & Cosby, A. G. (2017). Cultural penetration and punctuated policy change: Explaining the evolution of US energy policy. *Review of Policy Research*, *34*(4), 559–577. https://doi.org/10.1111/ropr.12240

Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report*, *20*(9), 1408–1416. https://doi.org/10.46743/2160-3715/2015.2281

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research policy*, *33*(6-7), 897-920. https://doi.org/10.1016/j.respol.2004.01.015

Gill, N., Osman, P., Head, L., Voyer, M., Harada, T., Waitt, G., & Gibson, C. (2015). Looking beyond installation: Why households struggle to make the most of solar hot water systems. *Energy Policy*, *87*, 83–94. https://doi.org/10.1016/j.enpol.2015.08.038

Gray, D. E. (2014). *Doing research in the real world (3rd ed.)*. Sage.

Grieve, R., Woodley, J., Hunt, S. E., & McKay, A. (2021). Student fears of oral presentations and public speaking in higher education: A qualitative survey. *Journal of Further and Higher Education*, *45*(9), 1281–1293. https://doi.org/10.1080/0309877X.2021.1948509

Henriques, J., & Catarino, J. (2016). Motivating towards energy efficiency in small and medium enterprises. *Journal of Cleaner Production*, *139*, 42–50. https://doi.org/10.1016/j.jclepro.2016.08.026

Hickel, J., & Kallis, G. (2019). Is Green Growth Possible? *New Political Economy*, *25*(4), 469–486. https://doi.org/10.1080/13563467.2019.1598964

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277–1288. https://doi.org/10.1177%2F1049732305276687

International Energy Agency. (2018*). World energy outlook 2018*. https://webstore.iea.org/download/summary/190?fileName=English-WEO-2018-ES.pdf

International Energy Agency (2019), *The critical role of buildings*, https://www.iea.org/reports/the-critical-role-of-buildings

International Energy Agency (2021), *Net zero by 2050*, https://www.iea.org/reports/net-zero-by-2050

International Energy Agency (IEA), International Renewable Energy Agency (IRENA), United Nations Statistics Division (UNSD), World Bank, & World Health Organization (WHO). (2021). *Tracking SDG 7: The energy progress report*.https://www.irena.org//media/Files/IRENA/Agency/Publication/2021/Jun/SDG7_Tracking_Progress_2021.pdf

Introna, V., Cesarotti, V., Benedetti, M., Biagiotti, S., & Rotunno, R. (2014). Energy management maturity model: an organizational tool to foster the continuous reduction of energy consumption in companies. *Journal of Cleaner Production*, *83*, 108–117. https://doi.org/10.1016/j.jclepro.2014.07.001

Ishak, M. H. (2017). Modelling energy consumption behaviour using “energy culture” concept for student accommodations in Malaysian public universities. *Facilities*, *35*(11/12), 658–683. https://doi.org/10.1108/F-12-2015-0084

Ishak, M. H., Sipan, I., Sapri, M., Mar Iman, A. H., & Martin, D. (2016). Estimating potential saving with energy consumption behaviour model in higher education

institutions. *Sustainable Environment Research*, *26*(6), 268–273. https://doi.org/10.1016/j.serj.2016.04.017

Ishak, M. H., Sipan, I., Mar Iman, A. H., & Sapri, M. (2015). A preliminary assessment of energy consumption behaviour pattern and factors influence among Malaysian higher education institutions students. *Jurnal Teknologi*, *74*(2). https://doi.org/10.11113/jt.v74.4524

Jansen, H. (2010). The logic of qualitative survey research and its position in the field of social research methods. *Forum: Qualitative Social Research*, *11*(2). https://doi.org/10.17169/fqs-11.2.1450

Jääskeläinen, A., Tappura, S., Pirhonen, J. (2020). Safety performance measurement maturity in finnish industrial companies. *Occupational and Environmental Safety and Health II*. Springer. https://doi.org/10.1007/978-3-030-41486-3_5

Jean, M. S., & Zaleschuk, L. P. (2018, September). *Safety culture assessment and continuous monitoring approach* [Paper presentation]. 2018 12th International Pipeline Conference, Alberta, Canada.

Jespersen, L., Griffiths, M., Maclaurin, T., Chapman, B., & Wallace, C. A. (2016). Measurement of food safety culture using survey and maturity profiling tools. *Food Control*, *66*, 174–182. https://doi.org/10.1016/j.foodcont.2016.01.030

Jin, Y., Long, Y., Jin, S., Yang, Q., Chen, B., Li, Y., & Xu, L. (2021). An energy management maturity model for China: Linking ISO 50001:2018 and domestic practices. *Journal of Cleaner Production*, *290*, 125168. https://doi.org/10.1016/j.jclepro.2020.125168

Johnson, O. W., Gerber, V., & Muhoza, C. (2019). Gender, culture and energy transitions in rural Africa. *Energy Research & Social Science*, *49*, 169–179. https://doi.org/10.1016/j.erss.2018.11.004

Joubert, A. E., Moulds, M. L., Werner-Seidler, A., Sharrock, M., Popovic, B., &

Jovanović, B., & Filipović, J. (2016). ISO 50001 standard-based energy management maturity model–proposal and validation in industry. *Journal of Cleaner Production*, *112*(4), 2744–2755. https://doi.org/10.1016/j.jclepro.2015.10.023

Jürisoo, M., Serenje, N., Mwila, F., Lambe, F., & Osborne, M. (2019). Old habits die hard: Using the energy cultures framework to understand drivers of household-level energy transitions in urban Zambia. *Energy Research & Social Science*, *53*, 59–67. https://doi.org/10.1016/j.erss.2019.03.001

Kagioglou, M., Cooper, R., Aouad, G., & Sexton, M. (2000). Rethinking construction: The generic design and construction process protocol. *Engineering, Construction and Architectural Management, 7*(2),141–153. https://doi.org/10.1108/eb021139

Khan, I. 2020. Impacts of energy decentralisation viewed through the lens of the energy cultures framework: Solar home systems in the developing economies. *Renewable and Sustainable Energy Reviews, 119,* 109576. https://doi.org/10.1016/j.rser.2019.109576

Khan, S. N. (2014). Qualitative research method: Grounded theory. *International Journal of Business and Management, 9*(11), 224–233. http://dx.doi.org/10.5539/ijbm.v9n11p224

Kraus, S., Breier, M., & Dasí-Rodríguez, S. (2020). The art of crafting a systematic literature review in entrepreneurship research. *International Entrepreneurship and Management Journal*, *16*(3), 1023–1042. https://doi.org/10.1007/s11365-020-00635-4

Lee, J. (2019). Safety culture evaluation model at construction site. *International Journal of Engineering Research and Technology. 12*(11),1972–1977.

Lewis-Beck, M., Bryman, A. E., & Liao, T. F. (2004). *The Sage encyclopedia of social science research methods*. Sage Publications.

Libakova, N. M., & Sertakova, E. A. (2015). The method of expert interview as an effective research procedure of studying the indigenous peoples of the north. *Journal of Siberian Federal University: Humanities & Social Sciences*, *1*, 114–129.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Luo, Y., Song, K., Ding, X., & Wu, X. (2021). Environmental sustainability of textiles and apparel: A review of evaluation methods. *Environmental Impact Assessment Review*, *86*, 106497. https://doi.org/10.1016/j.eiar.2020.106497

Lutzenhiser, L. (1992). A cultural model of household energy consumption. *Energy*, *17*(1), 47–60. https://doi.org/10.1016/0360-5442(92)90032-U

Mary, J. F., & Dongre, A. R. (2022). Effect of a community-based intervention on self-care among diabetes patients in rural Tamil Nadu: A mixed-method study. *Primary Care Diabetes*. https://doi.org/10.1016/j.pcd.2022.05.001

McIntosh, M. J., & Morse, J. M. (2015). Situating and Constructing Diversity in Semi-Structured Interviews. *Global Qualitative Nursing Research*, *2*. https://doi.org/10.1177/2333393615597674

Mendis, N. N. R., & Perera, N. (2006, December). Energy Audit: A Case Study. *2006 International Conference on Information and Automation*. https://doi.org/10.1109/icinfa.2006.374149

Mills, A. J., Durepos, G., & Wiebe, E. (Eds.). (2010). *Encyclopedia of case study research*. Sage Publications.

Ministry of Industry and Commerce. (2015). *National policy framework for small & medium enterprise development*. http://www.industry.gov.lk/web/images/pdf/nateng.pdf

Mirza, J., & Ensign, P. C. (2021). New direction for a Sri Lankan apparel venture: Chasing a capitalist or cooperative dream. *Small Enterprise Research*, *28*(1), 83-94. https://doi.org/10.1080/13215906.2021.1872687

Morgan, D. L. (2002). Focus group interviewing. In J. F. Gubrium, & J. A. Holstein (Eds), *Handbook of interview research* (pp. 141–159). Sage Publications Inc. https://dx.doi.org/10.4135/9781412973588.n10

Morgan, D. L. (2014). Pragmatism as a paradigm for social research. *Qualitative Inquiry*, *20*(8), 1045–1053.

Morgan, D. L. (2019). *Basic and advanced focus groups*. Sage Publications.

Musonda, I., Lusenga, E., & Okoro, C. (2018). Rating and characterization of an organization's safety culture to improve performance. *International Journal of Construction Management*, 181–193. https://doi.org/10.1080/15623599.2018.1512030

Muthukumarana, T. T., Karunathilake, H. P., Punchihewa, H. K. G., Manthilake, M. M. I. D., & Hewage, K. N. (2018). Life cycle environmental impacts of the apparel industry in Sri Lanka: Analysis of the energy sources. *Journal of Cleaner Production*, *172*, 1346-1357. https://doi.org/10.1016/j.jclepro.2017.10.261

Namal, A. (2020) *Industrial energy efficiency, challenges and opportunities*. International Conference on Resource Efficiency and Circular Economy. Colombo, Sri Lanka.

Nath, S. D., Eweje, G., & Bathurst, R. (2019). The Invisible Side of Managing Sustainability in Global Supply Chains: Evidence from Multitier Apparel Suppliers. *Journal of Business Logistics*, *42*(2), 207–232. https://doi.org/10.1111/jbl.12230

Ngai, E. W. T., Chau, D. C. K., Poon, J. K. L., & To, C. K. M. (2013). Energy and utility management maturity model for sustainable manufacturing process.

International Journal of Production Economics, *146*(2), 453–464. https://doi.org/10.1016/j.ijpe.2012.12.018

Nie, H., Vasseur, V.,Fan, Y., & Xu, J. (2019). Exploring reasons behind careful-use, energy-saving behaviours in residential sector based on the theory of planned behaviour: Evidence from Changchun, China. *Journal of Cleaner Production*, *230*, 29–37. https://doi.org/10.1016/j.jclepro.2019.05.101

O'Brien, A. M., & Mc Guckin, C. (2016). *The systematic literature review method: Trials and tribulations of electronic database searching at doctoral level*. SAGE Publications, Ltd. https://dx.doi.org/10.4135/97814462730501559538l

Oksman, V., Reda, F., Karjalainen, S., & Fatima, Z. (2021). Towards sustainable energy culture in the industrial sector: Introducing an interdisciplinary method for understanding energy culture in business industries. *Energy, Sustainability and Society*, *11*(1), 1-13.

Pathirana, S., & Yarime, M. (2018). Introducing energy efficient technologies in small-and medium-sized enterprises in the apparel industry: A case study of Sri Lanka. *Journal of Cleaner Production*, *178*, 247–257. https://doi.org/10.1016/j.jclepro.2017.12.274

Paulk, M., Curtis, B., Chrissis, M., & Weber, C. (1993). Capability maturity model, version 1.1. *IEEE Software*, *10*(4), 18–27. https://doi.org/10.1109/52.219617

Patomäki, H., & Wight, C. (2002). After postpositivism? The promises of critical realism. *International Studies Quarterly*, *44*(2), 213–237. https://doi.org/10.1111/0020-8833.00156

Prashar, A. (2017). Energy efficiency maturity (EEM) assessment framework for energy-intensive SMEs: Proposal and evaluation. *Journal of Cleaner Production*, *166*, 1187–1201. https://doi.org/10.1016/j.jclepro.2017.08.116

Paulk, M. C., Curtis, B., Chrissis, M. B., & Weber, C. V. (1993). Capability maturity model, version 1.1. *IEEE Software*, *10*(4), 18–27.

Raggio, R.D., Ekman, P., & Thompson, S.M. (2020). Making energy metrics relevant to service firms: From energy conservation to energy productivity. *Journal of Cleaner Production*, *256*, 120493. https://doi.org/10.1016/j.jclepro.2020.120493

Rau, H., Moran, P., Manton, R., & Goggins, J. (2020). Changing energy cultures? Household energy use before and after a building energy efficiency retrofit. *Sustainable Cities and Society*, *54*, 101983. https://doi.org/10.1016/j.scs.2019.101983

Rotzek, J. N., Scope, C., & Günther, E. (2018). What energy management practice can learn from research on energy culture? *Sustainability Accounting, Management and Policy Journal*, *9*(4), 515–551. https://doi.org/10.1108/SAMPJ-07-2017-0067

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.) Harlow.

Saunders, M. N. K., & Tosey, P. C. (2013). The layers of research design. *Rapport*, (Winter), 58–59.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*. Prentice Hall.

Schein, E. H., & Schein, P. A. (2016). *Organizational culture and leadership (The Jossey-Bass business & management series)* (5th ed.). Wiley.

Schubert, R., & Stadelmann, M. (2015). Energy-using durables–why consumers refrain from economically optimal choices. *Frontiers in Energy Research*, *3*, 7. https://doi.org/10.3389/fenrg.2015.00007

Shah, D. S., & Shah, J. (2013). *Unconventional techniques for energy conservation in textile wet processing*. Semantic Scholar. *Engineering*. Retrieved April 8, 2022, from https://www.semanticscholar.org/paper/Unconventional-techniques-for-energy-conservation-Shah-Shah/09280c68b87f15e02284aaaa114854258c5478bd

Soorige, D., Karunasena, G., Kulatunga, U., Mahmood, M. N., & De Silva, L. (2022). An energy culture maturity conceptual framework on adopting energy-efficient technology innovations in buildings. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(2), 60. https://doi.org/10.3390/joitmc8020060.

Sovacool, B. K., & Griffiths, S. (2020). The cultural barriers to a low-carbon future: A review of six mobility and energy transitions across 28 countries. *Renewable and Sustainable Energy Reviews*, *119*, 109569. https://doi.org/10.1016/j.rser.2019.109569

Sovacool, B. K. (2014). What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research & Social Science*, *1*, 1–29. https://doi.org/10.1016/j.erss.2014.02.003

Sri Lanka Export Development Board (2021), *Export performance indicators – 2020.* https://www.srilankabusiness.com/exporters/export-performance-report.html

Sri Lanka Sustainable Energy Authority. (n.d.). *Energy consumption benchmark analysis*. http://www.energy.gov.lk/images/energy-management/energy-consumption-benchmark-analysis.pdf.

Sri Lanka Sustainable Energy Authority. (2020). *Guidebook for Sri Lanka national energy efficiency award.* http://www.energy.gov.lk/images/vidulka-energy-exhibition/guide-book-sri-lanka-national-energy-efficiency-award-2020.pdf

Stemn, E., Bofinger, C., Cliff, D., & Hassall, M. E. (2019). Examining the relationship between safety culture maturity and safety performance of the mining industry. *Safety Science*, *113*, 345–355. https://doi.org/10.1016/j.ssci.2018.12.008

Stephenson, J. (2018). Sustainability cultures and energy research: An actor-centred interpretation of cultural theory. *Energy Research & Social Science*, *44*, 242–249. https://doi.org/10.1016/j.erss.2018.05.034

Stephenson, J., Barton, B., Carrington, G., Doering, A., Ford, R., Hopkins, D., Lawson, R., McCarthy, A., Rees, D., Scott, M., Thorsnes, P., Walton, S., Williams, J., & Wooliscroft, B. (2015). The energy cultures framework: Exploring the role of norms, practices and material culture in shaping energy behaviour in New Zealand. *Energy Research & Social Science*, *7*, 117–123. https://doi.org/10.1016/j.erss.2015.03.005

Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., & Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. *Energy policy*, *38*(10), 6120–6129. https://doi.org/10.1016/j.enpol.2010.05.069

Stephenson, J. R., Sovacool, B. K., & Inderberg, T. H. J. (2021). Energy cultures and national decarbonisation pathways. *Renewable and Sustainable Energy Reviews*, *137*, 110592. https://doi.org/10.1016/j.rser.2020.110592

Stiles, S., Ryan, B., & Golightly, D. (2018, August). Readiness to change: Perceptions of safety culture up and down the supply chain. In S. Bagnara, R. Tartaglia, S. Albolino, T. Alexander, Y. Fujita. (Eds), *Advances in intelligent systems and computing* (213–223). Springer. https://doi.org/10.1007/978-3-319-96089-0_24

Taylor, M. (2019). *Sustainable development goal 7: Affordable and clean energy*. US Green Building Council. https://www.usgbc.org/sites/default/files/SDG-7-Final.pdf.

Tesfamichael, M., Bastille, C., & Leach, M. (2020). Eager to connect, cautious to consume: An integrated view of the drivers and motivations for electricity consumption among rural households in Kenya. *Energy Research & Social Science*, *63*, 101394. https://doi.org/10.1016/j.erss.2019.101394

Thai, T. T., Pham, T. T., Nguyen, K. T., Nguyen, P. M., & Derese, A. (2020). Can a family medicine rotation improve medical students' knowledge, skills and attitude towards primary care in Vietnam? A pre-test–post-test comparison and qualitative survey. *Tropical Medicine & International Health*, *25*(2), 264–275. https://doi.org/10.1111/tmi.13326

Torreglosa, J. P., Garcia-Triviño, P., Vera, D., & López-García, D. A. (2020). Analyzing the improvements of energy management systems for hybrid electric vehicles using a systematic literature review: How far are these controls from rule-based controls used in commercial vehicles? *Applied Sciences*, *10*(23), 8744. https://doi.org/10.3390/app10238744

United Nations. (2019*). SDG 7 Policy briefs in support of the high-level political forum 2019*. https://sustainabledevelopment.un.org/content/documents/22877UN_FINAL ONLINE 20190523.pdf

United Nations Framework Convention on Climate Change. (2021, June). *The Paris agreement*. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Valavanidis, A. (2018). The shift to diesel fuel engines and how the emission scandal of diesel vehicles unfolded. *World Energy Consumption of Transportation Sector. Scientific Reviews*, *1*, 1-26.

Walton, S., Zhang, A., & O'Kane, C. (2020). Energy eco-innovations for sustainable development: Exploring organizational strategic capabilities through an energy cultures framework. *Business Strategy and the Environment*, *29*(3), 812–826. doi.org/10.1002/bse.2399

Warasthe, R., Schulz, F., Enneking, R., & Brandenburg, M. (2020). Sustainability Prerequisites and Practices in Textile and Apparel Supply Chains. *Sustainability*, *12*(23), 9960. https://doi.org/10.3390/su12239960

Yin, R. K. (2018). *Case study research and applications: Design and methods*. Sage.

Yin, R. K. (2003). *Case study research: Design and methods*. Sage Publications, Inc.

York, R., & Bell, S. E. (2019). Energy transitions or additions?: Why a transition from fossil fuels requires more than the growth of renewable energy. *Energy Research & Social Science*, *51*, 40-43. https://doi.org/10.1016/j.erss.2019.01.008

Zhang, F., Zhang, Y., & Jun, L. (2013). Research on the maturity of real estate enterprises safety culture. *Journal of Applied Sciences*, *13*(11), 2039–2044. https://ui.adsabs.harvard.edu/link_gateway/2013JApSc..13.2039Z/doi:10.3923/jas.2013.2039.2044

Zardo, P., Lauro, A. R., & Mussi, A. Q. (2019). BIM and parametric design applications for buildings' energy efficiency: An analysis of practical applications. *Arquiteturarevista*, *15*(2), 238. https://doi.org/10.4013/arq.2019.152.02

Zimon, D., Madzik, P., & Sroufe, R. (2020). The Influence of ISO 9001 & ISO 14001 on Sustainable Supply Chain Management in the Textile Industry. *Sustainability*, *12*(10), 4282. https://doi.org/10.3390/su12104282

Zwetsloot, G. I. J. M., van Middelaar, D., & Van der Beek, D. (2020). Repeated assessment of process safety culture in major hazard industries in the Rotterdam region (Netherlands). *Journal of Cleaner Production*. *257*, 120540. https://doi.org/10.1016/j.jclepro.2020.120540

APPENDICES

Appendix 1: Step 1- Semi-structured interview guideline

Step 1 semi-structured interview guideline is focused on identifying energy culture maturity attributes and related Plan (P) Do (D) Check (C) Act (A) aspects relevant to large-scale textile and apparel industrial organisations. Please note that there will be a brief presentation (less than five (05) minutes) at the beginning of the interview to introduce, energy culture, maturity frameworks and PDCA aspects that relates to the data collection.

Section 1: Background details of the interviewee

- Designation :……..
- Academic and professional qualifications :……...
- Areas of expertise :…….
- Experience (number of years): …….

Section 2: Identification of energy culture maturity attributes and related PDCA aspects

Firstly, please indicate the suitability of following energy culture maturity attributes for large-scale textile and apparel industrial organisations in Sri Lanka.

Secondly, examine the suitability of the given attributes under norms, practices, and material culture. please discuss if there are any changes required

Thirdly, identify the PDCA aspects relating to each attribute

Finally, please indicate any other suitable attribute (apart from the attributes given) and related PDCA aspects for those attributes.

Table 1: energy culture maturity attributes and PDCA aspects

Attributes	**PDCA aspects**
Norms	
A1- Green values of owners and senior management	
A2- Energy policy	
A3- Employee interest for energy-related improvements	
A4- Focus on a green marketplace	
A5- Attention to investment analysis considering energy	
A6- Energy performance monitoring and management	
A7- Rewarding and recognition for energy-related improvements	
A8- Knowledge and training	

A9- Priority to energy efficiency in the procurement criteria	
A10- Internal politics	
Any other attributes and PDCA aspects	
Practices	
A11- Changing core business practices for energy-related improvements	
Any other attributes and PDCA aspects	
Material Culture	
A12- Availability of energy-efficient technologies	
Any other attributes and PDCA aspects	

Appendix 2: Step 2 semi-structured interview guideline

Step 2 semi structured interview guideline is focused on developing energy culture maturity attributes under five (05) maturity levels and verifying the identified attributes in Step1. Section 1 of the interview guideline focused on gathering the background details of the interviewee. Then, Section 2 focused on the data collection on energy culture maturity. Further, Plan (P) Do (D) Check (C) Act (A) structure that guides the development of the maturity descriptors is given in the Figure 1. Table 1 presents the interview guideline relevant for the data collection. Please note that there will be a brief presentation (less than five (05) minutes) at the beginning of the interview to introduce, energy culture, maturity frameworks and PDCA structure that relates to the data collection.

Section 1: Background details of the interviewee

- Designation :……..
- Academic and professional qualifications :……...
- Areas of expertise :…….
- Experience (number of years): …….

Section 2: development of the energy culture maturity descriptors

Figure 1 depicts the PDCA structure governing the development of energy culture maturity descriptors against the attributes identified in the Step 1. Accordingly, please provide your ideas for the attributes given in Table 1. Further, you are invited to add any new energy culture maturity attributes and related descriptors as well.

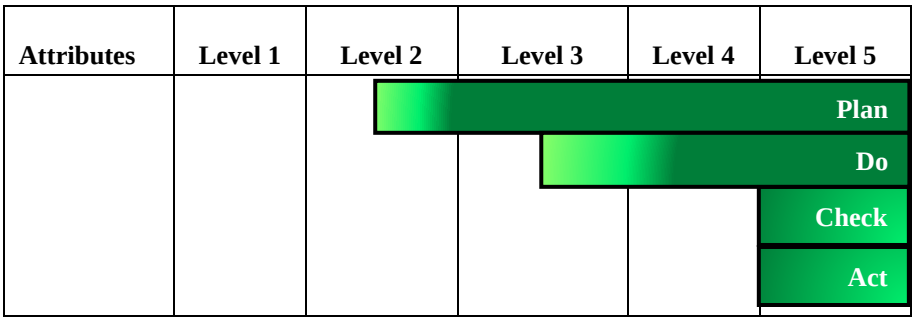


Figure 1: PDCA structure relates to development of maturity descriptors

Table 1: Guide for data collection

Attributes	Level 1	Level 2	Level 3	Level 4	Level 5
Norms					
Attribute 1: Green values of owners and senior management					
P: Availability of green values					
D: Green values' link with business strategies					
C: Review relationship between green values and business strategies					
A: Continual improvement of the relationship between green values and business strategies					
Any other descriptors to add?					
Attribute 2: Energy vision, mission, and policy statements					
P: Availability of documented energy vision, mission, and policy statements					
D: Level of acceptance of statements by owners and senior management					
C: Review statements					
A: Continual improvement of statements					
Any other descriptors to add?					
Attribute 3: Organisational public commitments to energy management					
P: Availability of energy-related public commitments					
D: Progress of investments on public commitments					
C: Review of public commitments					
A: Continual improvement of public commitments					
Any other descriptors to add?					
Attribute 4: Employee interest for energy-related improvements					
P: employee interest availability for energy related improvements					
D: employee engagement for energy related improvements					
C: Review employee engagement					

A: Continual improvement of employee engagement					
Any other descriptors to add?					
Attribute 5: Focus on energy sustainable products and customers					
P: Plans for energy sustainable products and customers					
D: Presence of energy sustainability focussed customers and product sustainability certificates					
C: Review focus for sustainable products and customers					
A: continual improvement of focus for sustainable products and customers					
Any other descriptors to add?					
Attribute 6: Attention to investment analysis considering energy					
P: Interested in basic investment analysis methods and lifecycle cost analysis					
D: Application of basic investment analysis methods and lifecycle cost analysis					
C: Review investment analysis approaches considering energy**.**					
A: Ensure continual improvement in the investment analysis approaches					
Any other descriptors to add?					
Practices					
Attribute 7: Changing core business practices for energy-related improvements					
P: Plans to change current business practices for energy management improvements					
D: Implementations of the planned changes					
C: Review need for changing business practices for energy related improvements					
A: Continual improvement of changing business practices for energy related improvements					
Any other descriptors to add?					
Attribute 8: Financing energy related improvements					
P: Availability of documented annual budget for energy-related improvements					
D: Actual finance allocation for budgeted items					
C: Review the energy budget					
A: Continual improvement of the energy budget					

Any other descriptors to add?					
Attribute 9: Assigning human resources and responsibilities					
P: Organisation structure with energy-related positions.					
D: Assigned energy responsibilities					
C: Review energy-related human resources and responsibilities					
A: Continual improvement of the energy-related human resources and responsibilities					
Any other descriptors to add?					
Attribute 10: Priority to energy efficiency in procurement practice					
P: Availability of energy-related procurement procedure					
D: Implementation of the procurement procedure					
C: Review procurement procedure					
A: Continual improvement of the procurement procedure					
Any other descriptors to add?					
Attribute 11: Internal and external communications supporting energy management					
P: Availability of energy-related internal and external communication plan					
D: Implementation of energy-related internal and external communication plan					
C: Review of energy-related internal and external communication					
A: Continual improvement of the energy-related internal and external communication					
Any other descriptors to add?					
Attribute 12: Rewarding and recognition for energy-related improvements					
P: Availability of formal rewarding and recognition mechanism					
D: Status of the rewarding and recognition practice					
C: Review rewarding and recognition mechanism					
A: Continual improvement of rewarding and recognition mechanism					
Any other descriptors to add?					
Attribute 13: Knowledge and training					
P: Availability of an annual training plan for energy-related training					
D: Providing training, energy-related knowledge availability					
C: Review of energy-related knowledge and training					

A: Continual improvement of energy-related knowledge and training					
Any other descriptors to add?					
Attribute 14: Deployment of energy goals and strategies					
P: Availability of long term and short-term energy goals, availability of multiyear and annual strategies					
D: KPIs are available and cascaded down					
C: Review energy-related goals, strategies and KPIs					
A: Continual improvement of energy-related goals, strategies and KPIs					
Any other descriptors to add?					
Attribute 15: Energy performance monitoring and management					
P: Availability of proper energy performance monitoring mechanisms					
D: Implementation of energy performance monitoring					
C: Review energy performance monitoring					
A: Continual improvement of energy performance monitoring					
Any other descriptors to add?					
Material Culture					
Attribute 16: Energy-efficient technologies and related supportive technologies					
P: Attention to energy-efficient technologies and related supportive technologies					
D: Availability of energy-efficient technologies, availability of energy management supportive technologies					
C: Review energy-efficient technologies and energy management supportive technologies					
A: Continual improvement of energy-efficient technologies and energy management supportive technologies					
Any other descriptors to add?					
Attribute 17: Renewable energy sources					
P: Plans to implement renewable energy sources					
D: Status of implementation of the planned renewable energy sources					
C: Review the use of renewable energy sources.					
A: Continual improvement of the use of renewable energy sources.					
Any other descriptors to add?					

Attribute 18: Low emission building design and construction					
P: Attention to low emission building design and construction					
D: Actual low emission building design and construction, related certifications					
C: Review the status of low-emission building design and construction					
D: Continual improvement in low-emission building design and construction					
Any other descriptors to add?					

Appendix 3: Step 3 interview guideline for focus groups

This interview guideline is used to conduct focus groups to refine draft energy culture maturity framework developed from Step 2 of the study. Section 1 collects the background details of the interviewee. Then, Section 2 included draft energy culture maturity framework.

Section 1: Background details of the interviewee

- Designation :……..
- Academic and professional qualifications :……...
- Areas of expertise :…….
- Experience (number of years): …….

Section 2: Refining energy culture maturity conceptual framework

The draft energy culture maturity framework is given in Table 1. The focus group discussion will be conducted based on the draft energy culture maturity framework. Please provide your feedback to refine the framework considering the suitability of framework's energy culture maturity attributes and maturity descriptors under five (05) maturity levels.

Please note that there will be a brief presentation (less than five (05) minutes) at the beginning of the interview to introduce, energy culture, maturity frameworks and PDCA structure that relates to the given framework.

Table 1: Draft energy culture maturity framework

Attributes	Energy Culture Maturity Levels				
	Level 1 (None)	**Level 2 (Emerging)**	**Level 3 (Developing)**	**Level 4 (Advancing)**	**Level 5 (Leading)**
Norms					
1. Green values of owners and senior management	1.Owners or senior management are not interested in energy-related improvements	1. Owners and senior management have little interest in energy-related improvements. 2. The interest is not linked to the business strategies.	1. Owners and senior management have strong green values. 2. Green values are somewhat linked to the business strategies and some results are observed.	1. Owners and senior management have strong green values. 2. Green values are linked to the business strategies, and considerable results are observed. 3. Try to imitate the leading energy management organisations in the industry.	1. Owners and senior management have very strong green values. 2. Green values are very strongly linked to the business strategies, and results are clearly visible. 3. Need to become the pioneer in implementing new energy-related improvements. 4. Both parties display green values through the way they live. 5. Both parties timely review the effectiveness of the relationship between green values and business strategies to ensure continual improvement.

Note: Please note that only an extract of the draft framework (limited to attribute 1) was included here to comply with the word limit of the thesis. The content of the other attributes can be referred using tables from Table 4.4 to Table 4.21.

Appendix 4: Phase II - interview guideline for focus groups

This interview guideline is used to gather information about the organisation's energy culture. Section 1 gathers the background details of the focus group participants. Then, Section 2 identifies the details of the energy culture of your organisation based on the provisions in Table 1.

Section 1: Background details of the interviewee

- Designation :……..
- Academic and professional qualifications :……...
- Areas of expertise :…….
- Experience (number of years): …….

Section 2: understanding energy culture of the organisation

Table 1 consists of 19 attributes and related descriptors under five (05) types from Type A to Type E relating to energy cultures. Please discuss among yourselves and select descriptors that explain your organisation's energy culture.

In addition, please provide the documentary evidences and the possible observation evidences from your organisation that can support the selected descriptors under each attribute.

Table 1: Details about organisation's energy culture

Attributes	Type A	Type B	Type C	Type D	Type E
Norms					
1. Green values of owners and senior management	1. No green values with owners and senior management.	1. Some green values with owners and senior management. 2. However, the green values are not linked to business strategies	1. Owners and senior management have strong green values 2. Green values are somewhat linked to the business strategies, and some results are observed	1. Owners and senior management have strong green values 2. Green values are linked to the business strategies, and considerable results are observed. 3. Benchmarking the leading energy management organisations in the industry.	1. Owners and senior management have strong green values 2. Green values are strongly linked to the business strategies, and results are clearly visible. 3. Need to become the pioneer in implementing new energy-related improvements 4. Owners and senior management display green values through the way they live. 5. Owners and senior management timely review the effectiveness of the relationship between green values and business strategies to ensure continual improvement.

Note: Please note that only an extract of the proposed energy culture maturity framework for textile and apparel industrial organisations (limited to attribute 1) is given here to comply with the word limit allowed for the thesis. The content of the other attributes can be found in Table 4.22.

Appendix 5: Phase II - Case study focus groups (overall energy culture maturity summary statement)

This interview guideline focused on identifying the overall energy culture maturity preference about your organisation using the overall energy culture maturity summary statement given in Table 1. The overall energy culture maturity summary statement defines five (05) levels of energy culture maturity from Level 1 (none) to Level 5 (leading). Each level provides a summary description of five (05) energy culture maturity levels considering the nature of norms, practices, and material culture in each level. Please discuss among yourselves and propose the energy culture maturity level that best describes your organisation.

Table 1: Overall energy culture maturity summary statement

	Level 1 - None	Level 2 - Emerging	Level 3 - Developing	Level 4 - Advancing	Level 5 - Leading
THINK (Norms)	Supportiveness of the thinking for energy related improvements: • Thinking of the owners and senior management is **not supportive** • Thinking of the employees is **not supportive** • There is **no drive for actual implementations**	Supportiveness of the thinking for energy related improvements: • Thinking of the owners and senior management is **marginally supportive** • Thinking of the employees is also **marginally supportive** • However, there is **no drive for actual implementations**	Supportiveness of the thinking for energy related improvements: • Thinking of the owners and senior management is h**ighly supportive** • Thinking of the employees is **also highly supportive** • However, there are only **limited drive for actual implementations**	Supportiveness of the thinking for energy related improvements: • Thinking of the owners and senior management is **highly supportive** • Thinking of the employees is also highly **supportive** • There is considerable **drive for actual implementations**	Supportiveness of the thinking for energy related improvements: • Thinking of the owners and senior management is **always supportive at the best level** • Thinking of the employees is **always supportive at best level** • There is an **excellent and timely drive for improvements** • **Timely review and continual improvement** of thinking
DO (Practices)	• Energy related. improvements are **not** carried out for energy related business activities. • Required resource allocation (both financial and human) is **not provided** for energy related improvements. • Energy related business activities are **not monitored** for energy use.	• Only **less significant** and **convenient** energy related improvements are carried out for some of the energy related business activities. • **Limited** resource allocation (both financial and human) for energy related improvements is available. • Energy related business activities are **occasionally** monitored for energy use.	• Energy related improvements are carried out for **moderate** number of energy related business activities. • **Moderate amount** of required resource allocation (both financial and human) is provided for energy related improvements. • **Moderate monitoring** of the energy use of energy related business activities.	• Energy related improvements are carried out for **most** of the energy related business activities. • **Most** of the required resource allocation (both financial and human) for energy related improvements is available. • **Most** of the energy related business activities are monitored for energy use.	• Energy related improvements are carried out for **all** the energy related business activities. • Resource allocation (both financial and human) for energy related improvements is **always** provided **as and when required.** • **All** Energy related business activities are **continuously monitored and improved to** reduce energy use.
HAVE (Material culture)	• Energy-efficient technologies (active and passive) and related monitoring mechanisms are **not available.** • Renewable energy sources are **not available.** • Building design and construction is **not** certified for standards that reduce energy related emissions.	• Few **low-cost and less significant** energy-efficient technologies are available. Energy monitoring mechanisms **are not available.** • **Less** renewable energy sources are employed**.** • Building design and construction is **not certified (or follow)** for standards that reduce energy related emissions.	• Latest energy-efficient technologies and related monitoring mechanisms are **moderately available.** • **Moderate amount** of renewable energy sources is employed**.** • Building design and construction is **certified (or follow) for the threshold grades** of standards that reduce energy related emissions.	• Latest energy-efficient technologies and related monitoring mechanisms are **considerably available.** • **Considerable amount** of renewable energy sources is employed**.** Yet, there is a further potential. • Building design and construction is **certified (or follow) for the higher grades** of standards that reduce energy related emissions.	• Latest energy-efficient technologies and related monitoring mechanisms are **always available.** • Renewable energy sources are employed **at the maximum possible capacity**. • Building design and construction is **always certified (or follow) and maintained for the highest grading** of standards that reduce energy related emissions (ex: LEED platinum).

Appendix 6: Step 1 semi-structured interview transcript - sample

Energy culture maturity attributes	PDCA aspects
Norms	
A1- Green values of owners and senior management I do agree with green values of owners and senior management as an important attribute for energy culture maturity. Some owners and senior management want to be the best in terms of environmental sustainability. For example. Our CEO is so passionate about environment. He might not know anything about various energy-efficient technologies. But, since he is so passionate, he would want to look for it. He will guide to recruit experts in the area. So, the senior leadership's passion is really important to begin any of the related improvements. Sometimes they might not have the technical knowledge on environmental sustainability but because they are purely passionate about the environment, they are driving the things. They think like: "in the future, this business should be the most sustainable business in the country or region".	Presence of green values with senior leadership can be considered under "Plan" element. Driving the green values through implementations using business strategies can be identified as the Do element. Review and continual improvement of the green values and related business strategies can be identified under Check and Act elements
A2- Energy policy Setting vision, mission, policy relating to energy can be considered as this attribute instead of only considering energy policy. Energy policy, vision, mission comes from the leadership's commitment. Energy improvements are driven in an organisation because of the availability of such vision, mission, and policy. setting those statements is a function of the leadership of course. Those organisational policy development definitely supports and directs the energy related improvements in an organisation and energy culture	There should be energy vision, mission and policy statements are available as the Plan element. Further the senior management's acceptance is important as a deployment mechanism. When we take an energy vision, mission and policy, the things like focusses on continual improvement, frequently reviewed and signed by the top management can be considered as features.
A3- Employee interest for energy-related improvements	Employee interest and actual engagement can be the Plan and Do elements. Review and

This is a valid attribute. even though the energy management is not their key job role, the employees can commit to reducing the energy-related environmental impacts. Therefore, employees' concern on energy-related impacts of their activities is a factor to be considered	adjustment for the same can be identified as Check and Act elements.
A4- Focus on a green marketplace I agree with this attribute as well. You can add product sustainability also under this.	Organisations can have plans to reach green markets and sustainable products. Then there should be the implementations of such plans as Do element. Review and continual improvement will be the
A5- Attention to investment analysis considering energy ...of course, We can consider the investment return analysis. Under that the lifecycle cost analysis can be included because that relates more on energy-efficiency. if we say investment return that even can be the simple payback also. But going beyond that, it is better to consider the lifecycle cost analysis as well since it gives a good validity for the energy efficiency. sometimes we can say that the lower levels consider the simple payback but in the higher matured levels they go for the LCCA also. We, do the LCCA for the major investments like the chillers. We have a thing called energy minimum programme that also includes that.	Attention to do both simple investment return analysis and life cycle costing should be the Plan element. Then, Do, Check Act elements on the same can be considered.
A6- Energy performance monitoring and management I think this is an important attribute. But it should not come under norms. This one best suites under practices since energy performance monitoring directly relates with the day-to-day energy using activities.	Plan element under this can be the availability of energy performance monitoring mechanisms like energy KPIs. Then Do element comes as the actual monitoring. Check and Act elements refers to reviewing the status of energy performance and taking actions for continual improvement.
A7- Rewarding and recognition for energy-related improvements	There should be a rewarding and recognition plan and the

Similarly, the rewarding and recognition culture is important element of the energy culture maturity. But this one also should come under practices since it talks about the appreciation of employees based on their energy conscious behaviours.	other elements based on the plan.
A8- Knowledge and training This attribute also best suitable under practices section. However, it is an essential area for an organisation seeking energy culture maturity. Developing a knowledgeable team is important to handle energy management. So, whether the organisation have required technical knowledge on the energy management or not can be considered as a factor. Organisations can continuously research on the latest technology trends and trying to adopt. They may have a good understanding on the suitable energy efficient technologies. sometimes, the organisations research on the energy efficient technologies, do innovations and even go for the high-level international exhibitions. Furthermore, Organisations may provide energy related knowledge for employees using different mechanisms such as training. For example, organisations can send employees for energy-related exhibitions and local training programs. Further, some organisations even send the employees for energy-related foreign training. Accordingly, whether the organisation has required technical knowledge and energy management training can be considered an attribute for the framework.	Availability of training plans based on the areas of lack of knowledge, then providing training, reviewing the adequacy of energy related knowledge and take action to continual improvement of knowledge and training can be noted as the PDCA respectively under this attribute.
A9- Priority to energy efficiency in the procurement criteria It is important to consider the procurement aspect as well. We should have controlled the procurements considering the energy efficiency. Also, the availability of procurement guidelines focused on energy efficiency can be considered. I think the more matured organisations will have such. for example, there can be things like if you purchase motors that must be the IE3 which is written in the procurement guidelines as mandatory minimum requirements. Likewise, energy-efficiency is applied for all significant energy using equipment. However, I prefer	Availability of a procurement procedure that includes energy related criteria should be the Plan element. Other elements can be decided based on that.

this attribute also under practices since procurement is a practice in an organisation.	
A10- Internal politics I think this should not be considered as an attribute in an energy culture maturity framework. it will be difficult to examine about the internal politics. Hence, better to remove	Not considered
Any other attributes and PDCA aspects under norms	
Public Commitments of organisation I think better to integrate something on organisation's public commitments relating to energy management. Countries have nationally determined commitment (NDCs) based on Parries agreement. To ensure the global temperature rise is below the 1.5^{o}C to the preindustrial revolution temperature. Similarly, now the brands have commitments on Science Based Targets Initiative (SBTi) that focused on the global temperature reduction by reducing the absolute carbon emissions based on Scope 1, Scope 2 and Scope 3 emissions. Our organisation is also planning to commit for the whole three scopes of the SBTi as a business decision. Even though the customer is requesting only for the scope 1 and scope 2, we even go beyond the customer requirements due to our own willingness for sustainability.	Availability of such commitments, progress towards that, review, and continual improvement of the same can be identified as the PDCA for this respectively.
Practices	
A11- Changing core business practices for energy-related improvements This can be considered as a suitable attribute for energy culture maturity. We can think like this. Let's say the organisation invest for expensive and sophisticated energy technologies. Then, in case if there are no employees who can handle the energy efficiency is a problem. So, the organisation should develop the whole cycle. We must have a team that can operate such technologies. we might need to do the required skill development and process improvements etc. even; we might have to do a complete change in the conventional business processes in usual factories to cater for the new technologies. Likewise, the whole organisation might need such changes.	Plans are available to change core business practices for energy related improvements, implementation of the same and actions taken to review and continual improvement of the same can be identified as PDCA here.

We can also say that the organisation does not fear for the process changes. Instead, they take that as opportunities for improvement of the processes. For example, we are replacing the conventionnel cutters using auto cutters. When, we do a new plant let's say organisation design the plants for the auto cutters. And the considering the required skills of the operators, now we do not need cutting skills of the operators and much needed is the auto cutter operation skills. So then, there is a need for such training and skill development as well.	
Any other attributes and PDCA aspects under practices	
<u>Availability of human resources</u> I think the need for considering availability of required human resources as an essential attribute for energy culture maturity. There should be designated positions in the organisation structure those responsible for the energy management.	Availability of the planned job structure responsible for energy management, actual assigning of those responsibilities to suitable employees, review the adequacy of the human resources and takin action for continual improvement can be considered respectively as PDCA aspects.
<u>Internal and external communication</u> I proposed energy related communication as an important area under practices. Communication is essential to establish a matured energy culture in an organisation. In addition, external communications also can be considered. For instance, the organisation is publishing carbon disclosure reports to public or providing relevant data to Sri Lanka Sustainable energy authority can be identified as examples.	Communication planning, implementation as per the plans, reviewing the progress and continually improving the communication can be identified as PDCA aspects.
Material Culture	
<u>A12- Availability of energy-efficient technologies</u> We can consider the availability of energy-efficient technologies in the organisation as an attribute. We can consider the organisations going for energy-efficient technologies. for example, there is not much value if we operate very inefficient chiller which consume huge amount of energy and promoting the	Plan for energy efficient technologies, adopting energy efficient technologies, reviewing the adequacy of existing technologies and ensure the continual improvement can be identified

minor LED projects. So better to consider the availability of significant energy efficient technologies as an attribute. Further, we can see some textile and apparel organisations do not much consider about the energy efficiency of the building and related services. They more concerns on the production technologies. they know the impact of the energy efficiency of the production machinery for the operational energy cost. So better to cover all areas. Including the related supportive technologies such as building management systems.	as the PDCA aspects respectively under this attribute.
Any other attributes and PDCA aspects under material culture	
<u>Renewable energy sources</u> We can consider the plans for going renewable energy sources as an attribute. It might not be limited to rooftop solar panels. We may go for other options like constructing a mini-hydro powerplant somewhere and offsetting our energy use with that or power purchasing agreements etc. Likewise, we can check whether the organisations have worked to increase the use of the renewable energy sources.	PDCA aspects would be: Organisations plans for renewable energy projects, implementation of the plans, review and continual improvement of renewable energy sourcing respectively.

Appendix 7: Step 2 semi-structured interview transcript – sample

Attributes	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Norms					
1. Green values of owners and senior management	I think level 1 can't have any green vales with owners or senior management since the there is no any PDCA belongs to this level.	In emerging organisations, they might have some green values but those are less strong. So, no actual implementations in the business strategies.	I can say the Level 3 have strong green values but at the same time limited drive for actual implementations considering the PDCA structure	I agree that Level 4 also have strong green values. Actual results of implementations should be considerable at this level	Level 5 as the most matured level should have the strong green values and related strategic deployments in the business. Here I can highlight that the owners are senior management are highly passionate about the energy related improvements. And also, the industry pioneering mindset for implementing latest energy related initiatives. For example. We want to be the first in Asia to do this sustainability initiative. Also, we can say that there are measures in the business that ensure the timely review and continual improvement.
2. Energy vision, mission, and policy statements	There can't be such statements in this level	There can be such energy vision mission and policy statements prepared for facing external audits by relevant employees But owners and senior management do not pay attention to those. Let's say the statements only fulfil	I propose availability of properly documented energy vision mission, and policy here But there might be limited connection of the same with business strategies for actual implementations.	There should be properly documented statements at this level. Not only that the statements are highly accepted by the senior leadership. I mean, the owners and senior management. So, the connection to business strategies is high.	Level 5 as the topmost matured level have everything of the PDCA structure. So not only they have proper statements. Nut also those are much supported in implementations using business strategies due to strong acceptance by senior leadership. Also, the last two elements of PDCA are available here. So, the organisations timely check and take corrective actions and

		the documentation purpose and will be kept with the person responsible for managing external audits.		That shows strong signs of implementation of the statements	preventive actions to ensure the continual improvements of the statements.
3. Organisational public commitments to energy management	There is nothing in the first level	Let's say there is minor interest. But due to the absence of "Do" element. there can't be any implementations towards public commitments.	Here we can say the organisation is publicly committed since they have the Plan element of PDCA strongly. However, due less strong Do element we can say that lack of initiatives and investments towards achieving the public commitments.	We can add availability of energy related public commitments here as well similar to level 3. But the implementations are stronger in this level comparing to level 3. So, they have investment plans and are actually investing on the public commitments. For instance: adopting both energy efficiency and renewable energy	The highest level would also have public commitments to reduce the environmental impacts of energy use. Examples like commitment to schemes like Science Based Targets Initiative (SBTi). They have investment plan towards achieving that. But beyond other organisations, there progress toward the commitment is excellent. Also, there is Check and Adjust practices always to ensure continual improvement of the implementation of public commitments.

Note: Please note that only an extract of the transcript is provided to comply with the word limit allowed for the thesis.

Appendix 8: Step 3 Focus group transcript - sample

NORMS

Attribute 1: Green values of owners and senior management

FG1-TAEE 1: What do you mean by both parties? Better to specify that as owners and senior management

All participants agreed with rest of the content

Attribute 2: Energy vision, mission, and policy statements

FG1-TAEE1: it says owners and senior management do not care about statements. Can you reword it? Because the statement is a bit casual. Something like owners and senior management don't see its value.

FG1-AE1: If there is any situation where the energy vision mission and policy statements are linked with energy management strategies and energy culture but not linked with the corporate strategies and corporate culture. If there is such, where it goes? Better to add for the other high levels. FG1-TAEE1: I also feel it is better to add relationship. Let's say energy vision, mission and policy has become a part of the corporate vision and mission. Because without only focusing on the energy strategies, it is better to consider the business's strategic alignment as well. Better start from level 3 and gradually increases to level 5.

All participants agreed with rest of the content

Attribute 3: Organisational public commitments to energy management

Agreed with the content

Attribute 4: Employee interest for energy-related improvements

FG1-TEE1: Companies have energy management best practices, programs, and projects. We can say the employees have different levels of acceptance for those best practices, projects, and programs as per the maturity levels. I think better to replace term *energy related improvements* using "energy management best practices, programs and projects.

All participants agreed with rest of the content

Attribute 5: Focus on energy sustainable products and customers

FG1-TEE1: Product carbon footprint can be considered under this. Therefore, it can be carbon neutral products or product carbon footprint has been assessed and verified by third parties

FG1-TAEE1: I also think it is better to go with the term carbon neutral or low carbon products rather than relating this with customers. Because customers have a range of products, some of the products are low carbon, and some of them are not. So better put the product category than the customer.

All participants agreed with rest of the content

Attribute 6: Attention to investment analysis considering energy

Agreed with the content

PRACTICES

Attribute 7: Changing core business practices for energy-related improvements

Agreed with the content

Attribute 8: Financing energy-related improvements

FG1-TEE1: energy expenses represent the energy-related attributes of a company. Hence, percentage out of that as the annual operational energy budget is ideal than the percentage from profit.

FG1-TAEE1: Instead of considering a percentage of the profits what about consider a percentage from expenditure

All participants agreed with rest of the content

Attribute 9: Assigning human resources and responsibilities

FG1-TEE1: When talking about energy related qualifications, are they hiring an engineer or a diploma holder or whatever like that for the energy management jobs? That matters a lot".

All participants agreed with rest of the content

Attribute 10: Priority to energy efficiency in procurement practice

FG1-TEE1: Need to make organisation's supply chain partners aware of the energy-related procurement requirements.

All participants agreed with rest of the content

Attribute 11: Internal and external communications supporting energy management

FG1-TEE1: energy vision, mission, and policy related communications also can be included under this attribute.

Attribute 12: Rewarding and recognition for energy-related improvements

FG1-AE1: good energy behaviours are appreciated and rewarded. For example, an employee is doing something not because that is a job duty but a voluntary energy saving behaviour. Encouraging them using a simple appreciation like "job well done" matters a lot.

All participants agreed with rest of the content

Attribute 13: Knowledge and training

Agreed with the content

Attribute 14: Deployment of energy goals and strategies

FG1-TAEE1: Energy goals strategies and KPIs should be linked with the energy vision and missions and policy.

Attribute 15: Energy performance monitoring and management

FG1-TEE1: real-time data monitoring systems are available in leading organisations. When the data is collected, that comes to your computer. Further, most matured organisations daily calculate KPIs and communicate to employees.

FG1-TEE1: Further, energy performance is discussed in monthly management meetings /weekly production meetings. Also, the internal and external energy audits are conducted

FG1-TAEE1: Have you consider the real-time data monitoring? There are programs now that itself calculate the KPI from the system.

All participants agreed with rest of the content

New addition

Attribute 16: Maintenance management supporting energy performance

FG1-TEE1: Preventive maintenance is very important to maintain the expected energy-efficiency of equipment. Therefore, availability of a preventive maintenance program is very important.

FG1-TEE1: a preventive maintenance program should be available in level 3.

FG1-TEE1: Maintenance program should be timely reviewed and continual improvement of energy performance must be ensured in Level 5 organisations.

FG1-TAEE1: Yes, you include the aspects from total productive maintenance under the maturity levels

MATERIAL CULTURE

Attribute 17: Energy-efficient technologies and related supportive technologies

Agreed with the content

Attribute 18: Renewable energy sources

FG1-TAEE1: considers going for renewable energy credits and market based systems like this when available.

All participants agreed with rest of the content

Attribute 19: Low emission building design and construction

Agreed with the content

Appendix 9: Case study Focus group transcript – sample (Case B)

Attribute 1: Green values of owners and senior management

CSB-P2: "Appointing the owner's son as the Head of Sustainability in the whole group of companies itself shows the strength of the green values of owners and senior management in our organisation. Further, we have a separate position called Sustainability Director at the board level to look after the sustainability aspects at the group level".

CSB-P1: "We are a pioneering organisation in the industry who has committed to the full scope of SBTi based on the Paris Agreement".

Documentary evidence shared: sustainable business policy and objective matrix

CSB-P1: so, we can go for Type E, (All agreed)

Attribute 2: Energy vision, mission, and policy statements

CSB-P3: "We have our energy vision, mission and policy statements documented in the long-term energy plan. The long-term energy plan clearly provides the time-bound nature for the statements".

CSB-P1: "We can clearly see that the energy goals and strategies are derived based on the energy vision, mission and policy statements when looking at our long-term energy plan. In addition, the energy vision, mission, and policy are integrated as part of the corporate vision and mission. This is clearly visible from using the term "sustainability" in corporate vision, mission, and value statements".

Documentary evidence shared: Energy vision, mission, and policy statements; corporate vision, mission, and value statements; long-term energy plan; and sustainable business policy and objective matrix

CSB-P1: This one also fits to Type E (all agreed)

Attribute 3: Organisational public commitments to energy management

CSB-P2: "When it comes to public commitments, we have committed for the Scope 1, 2 and 3 emissions under the SBTi. Considering the current progress, we have achieved the required progress at this point as per the plan. Further, we are working with the suppliers to take the required commitment from their side for the public commitments as well".

CSB-P1: "We have strong actions taken in the organisation to reduce absolute emissions in our business and beyond that as we have committed for all three scopes which is even beyond what customers looking for".

Documentary evidence shared: Organisation's SBTi commitment shown in the SBTi website

CSB-P2: Overall it is Type E best describes our situation (All agreed)

Attribute 4: Employee interest for energy-related improvements

CSB–P3: "We observe employees' commitment for energy conservation in their day-to-day activities. For instance, they actively engaged in using a tag called Fuguai tags when they see a compressed air leakage".

CSB–P2 :"We also have a feedback mechanism called Kizen suggestions, and under that, both individual employees and groups are actively providing their suggestions for the energy-related improvements. Further, employees' acceptance of the available energy management programs, projects, and best practices".

observation evidence: Use of Fuguai tags by employees

CSB-P2: Overall it is Type D (All agreed)

Attribute 5: Promoting product carbon footprint reduction

CSB-P2: We have strong initiatives to reduce the carbon footprint of the products. We have recently made a huge change to our strategies that significantly improve the business's product sustainability and general sustainability aspects. Because of that change, most of our product innovations are now focused on product sustainability. For example, we are supplying garments for one of the world's leading brands. We are one of the top suppliers for them. Let us say we are one of the top three suppliers for them. So, our organisation has been given such importance in their supply chain. For instance, we received an order to produce a low carbon product designed for Olympic athletes of a leading country in the Olympic games. Our commitment to sustainability is one of the major reasons for receiving that.

CSB-P3: However, under this one we can see mixed results. we fit to one, two (02), five (05), and six (06) descriptors of Type E and three and four (04) descriptors of Type D

Documentary evidence shared: Low carbon product catalogues and new business strategy supporting low carbon products

CSB-P3: Overall it is Type E and Type D (All agreed)

Attribute 6: Approach to energy in investment analysis

CSB-P2: We usually practice basic investment analysis methods in all investments. Further, we practice life cycle cost analysis for all significant energy-consuming equipment in the organisation".

Documentary evidence shared: Procurement procedure with provisions for investment analysis using life cycle cost analysis.

CSB-P2: overall its Type E (All agreed)

Attribute 7: Changing core business practices for energy-related improvements

CSB-P2: We have a team responsible for innovations in the organisation. We are discussing with them to look for energy-related innovations based on the autonomation for energy saving. However, still, it is not fully functioning. We have a change management procedure that assesses the energy impact of any changes to business practices. However, this attribute focuses on the other way around. Considerations for changing business practices due to energy impact, is limited. So, overall, I feel Type C is a more appropriate maturity status under this attribute. (All participants agreed on the suitability of Type C)

Attribute 8: Financing energy-related improvements

CSB-P1: I think we would probably be somewhere between Type D and Type E here. We have budgets, and most energy-related expenses will be covered under engineering budgets. Further, an additional sustainability budget is allocated for special projects focusing on energy and other environmental projects. There is a capex and OPEX focusing on sustainability. Furthermore, most of the operational requirements like maintenance which, of course, is part of energy management, would be covered under the plant engineering budgets. So those are there. However, to be honest, yet to sort out some of the financing matters. (All participants agreed on mixed results representing Type D and Type E)

Documentary evidence shared: no documentary evidence could be provided due to organisation's restrictions on financial information sharing.

Attribute 9: Assigning human resources and responsibilities

CSB-P2: "energy management responsibilities are assigned to both energy-related technical employees and senior management" in this plant

CSB-P1: "We have an annual sustainability index for KPIs, and energy KPIs are a part of it. KPIs cascade down from the general manager to the relevant people, such as the technical team. Further, responsibility wise, there is a cross-functional energy team representing different departments. Then, the sustainability champion and the factory engineer have energy-related job responsibilities in their job descriptions from the factory's end. For them, energy targets are set at the beginning of every year and reviewed at the end of the year. Every year, a learning and development plan is prepared, and training is provided based on that. Further, the human resource (HR) management system assesses the skills and competencies. HR learning and

development system includes the relevant training based on the goals of different employees".

Documentary evidence shared: organisation structure with energy-related positions (including cross-functional teams), job descriptions with energy-specific duties and related skills, competencies, and qualifications.

Overall, Type E was agreed by all participants

Attribute 10: Priority to energy efficiency in procurement practice

CSB-P3: We have a procurement procedure for energy-critical machines. The procedure considers the energy aspects when procuring energy-consuming machinery. We practice this in the energy significant procurements. For example, the recent air conditioner was purchased following this procedure".

CSB-P2: Our procurement officer is a member in the energy team, and he is actively engaged in ensuring the supply chain awareness of the procedure. Further the procedure is timely review and continual improvement is facilitated.

Documentary evidence shared: Procurement procedure, actual procurement evaluation reports, environmental sustainability calibration tool (for specifying minimum energy performance of equipment)

Overall, Type E was agreed by all participants

Note: Details for the other attributes are not presented to comply with the word limit of the thesis

Appendix 10: Step 1 findings - Attributes and PDCA aspects

Norms	
Attribute 1: Green values of owners and senior management	
P: Availability of green values	**D:** Green values' link with business strategies
C: Review relationship between green values and business strategies	**A:** Continual improvement of the relationship between green values and business strategies
Attribute 2: Energy vision, mission, and policy statements	
P: Availability of documented energy vision, mission, and policy statements	**D:** Level of acceptance of statements by owners and senior management
C: Review statements	**A:** Continual improvement of statements
Attribute 3: Organisational public commitments to energy management	
P: Availability of energy-related public commitments	**D:** Progress of investments on public commitments
C: Review of public commitments	**A:** Continual improvement of public commitments
Attribute 4: Employee interest for energy-related improvements	
Plan: employee interest availability for energy related improvements	**Do:** Employee engagement for energy related improvements
Check Review employee engagement	**Act:** continual improvement of employee engagement
Attribute 5: Focus on energy sustainable products and customers	
Plan: Plans for energy sustainable products and customers	**Do:** Presence of energy sustainability focussed customers and product sustainability certificates
Check: Review focus for sustainable products and customers	**Act:** continual improvement of focus for sustainable products and customers
Attribute 6: Attention to investment analysis considering energy	
Plan: Interested in basic investment analysis methods and lifecycle cost analysis	**Do:** Application of basic investment analysis methods and lifecycle cost analysis
Check: Review investment analysis approaches considering energy.	**Act:** Ensure continual improvement in the investment analysis approaches
Practices	
Attribute 7: Changing core business practices for energy-related improvements	
Plan: Plans to change current business practices for energy management improvements	**Do:** Implementations of the planned changes
Check: Review need for changing business practices for energy related improvements	**Act:** continual improvement of changing business practices for energy related improvements
Attribute 8: Financing energy related improvements	
Plan: Availability of documented annual budget for energy-related improvements	**Do:** Actual finance allocation for budgeted items
Check: Review the energy budget	**Act:** Continual improvement of the energy budget
Attribute 9: Assigning human resources and responsibilities	
Plan: Organisation structure with energy-related positions.	**Do:** Assigned energy responsibilities
Check: Review energy-related human resources and responsibilities	**Act:** Continual improvement of the energy-related human resources and responsibilities
Attribute 10: Priority to energy efficiency in procurement practice	
Plan: Availability of energy-related procurement procedure	**Do:** Implementation of the procurement procedure

Check: Review procurement procedure	**Act:** Continual improvement of the procurement procedure
Attribute 11: Internal and external communications supporting energy management	
Plan: Availability of energy-related internal and external communication plan	**Do:** Implementation of energy-related internal and external communication plan
Check: Review of energy-related internal and external communication	**Act:** Continual improvement of the energy-related internal and external communication
Attribute 12: Rewarding and recognition for energy-related improvements	
Plan: Availability of formal rewarding and recognition mechanism	**Do:** Status of the rewarding and recognition practice
Check: Review rewarding and recognition mechanism	**Act:** Continual improvement of rewarding and recognition mechanism
Attribute 13: Knowledge and training	
Plan: Availability of an annual training plan for energy-related training	**Do:** Providing training, energy-related knowledge availability
Check: Review of energy-related knowledge and training	**Act:** Continual improvement of energy-related knowledge and training
Attribute 14: Deployment of energy goals and strategies	
Plan: Availability of long term and short-term energy goals, availability of multiyear and annual strategies	**Do:** KPIs are available and cascaded down
Check: Review energy-related goals, strategies and KPIs	**Act:** Continual improvement of energy-related goals, strategies and KPIs
Attribute 15: Energy performance monitoring and management	
P: Availability of proper energy performance monitoring mechanisms	**D**: Implementation of energy performance monitoring
Check: Review energy performance monitoring	**Act:** Continual improvement of energy performance monitoring
Material Culture	
Attribute 16: Energy-efficient technologies and related supportive technologies	
Plan: Attention to energy-efficient technologies and related supportive technologies	**Do:** Availability of energy-efficient technologies, availability of energy management supportive technologies
Check: Review energy-efficient technologies and energy management supportive technologies	**Act:** Continual improvement of energy-efficient technologies and energy management supportive technologies
Attribute 17: Renewable energy sources	
Plan: Plans to implement renewable energy sources	**Do:** Status of implementation of the planned renewable energy sources
Check: Review the use of renewable energy sources.	**Act:** Continual improvement of the use of renewable energy sources.
Attribute 18: Low emission building design and construction	
Plan: Attention to low-emission building design and construction	**Do:** Actual low-emission building design and construction, related certifications
Check: Review the status of low-emission building design and construction	**Act:** Continual improvement in low-emission building design and construction

Appendix 11: Ethics Approval

Gayani Karunasena, Nateque Mahmood and
Dumindu Soorige
School of Architecture & Built Environment (F)

25 September 2020

Dear Gayani and research team

Re: SEBE-2020-39 - titled **"Energy culture and energy efficient technology adoption in apparel buildings"**

Thank you for submitting the above project for consideration by the Faculty Human Ethics Advisory Group (HEAG). The HEAG recognises that the project complies with the National Statement on Ethical Conduct in Human Research 2007 (updated 2018) and has approved it.

Please note: if you have indicated that your project will be conducted while CoVID-19 restrictions are in place, approval has been granted in line with the current restrictions. It is the responsibility of the principal investigator to remain aware of any changes to the restrictions and in the event that such changes make the approved research non-compliant with the restrictions, to either seek approval for a further modification to the project, or postpone the research until the restrictions are lifted.

The approval period is for three years until **25/09/2023**. You are required to submit a report on the progress of your project once a year and/or a final report when complete. Please forward your first annual report on **25/09/2021** Failure to do so may result in the termination of the project

It is your responsibility to contact the Faculty HEAG immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any changes to the research team or changes to contact details
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion.

To avoid delay include the project number in any communication with the HEAG and direct to sciethic@deakin.edu.au

The Faculty HEAG and/or Deakin University Human Research Ethics Committee (HREC) may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research

We wish you well with your research.

Kind regards

Teresa Treffry

Teresa Treffry
Senior Research Administration officer
Secretariat, Human Ethics Advisory Group (HEAG)
Faculty of Science Engineering & Built Environment