Universiti Teknologi MARA Cawangan Melaka

TENAGA NASIONAL

TENAGA NASIONAL BERHAD

FACULTY OF BUSINESS MANAGEMENT

BACHELOR OF BUSINESS ADMINISTRATION (HONS.)

INTERNATIONAL BUSINESS - BA246

MGT 666 INTERNSHIP - INDUSTRIAL TRAINING REPORT

PREPARED BY:

GROUP	STUDENT NAME	STUDENT ID
M1BA2465B	SYAZANA EZZATI BINTI HAIRI ANNUAR	2022942837

PREPARED FOR:

DR. NUR MELISSA BINTI MOHAMMAD FAISAL WEE

INTERNSHIP PERIOD:

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SURAT KEBENARAN

Tarikh : 14/1/2025

Kepada :

Penyelaras Latihan Praktikal
Fakulti Pengurusan Perniagaan
UiTM Kampus Bandaraya Melaka
110 Off Jalan Hang Tuah
75300 Melaka
No Tel : 06-285 7119 / 7190 / 7196
Email : praktikalfppmelaka@uitm.edu.my

Maklumbalas (/)

[✓] Setuju

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Tajuk Laporan	Industrial Training Report	**Nama Syarikat**	Tenaga Nasional Berhad

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.....
Nama Pegawai : DIANA SYAFIZA SAID
Jawatan : LEAD (STRATEGY)
No. Tel. :
No. Faks :

Cop jabatan/organisasi:

NEW ENERGY DIVISION
Tenaga Nasional Berhad
Level 11, Tower B, TNB Platinum
No. 3, Jalan Bukit Pantai, Bandar
59100 Kuala Lumpur

Executive Summary

This document outlines my four-month industrial training experience at Tenaga Nasional Berhad (TNB), where I held the position of Strategy Intern in the New Energy Division. The training emphasised market analysis, macroeconomic outlooks, and strategic growth opportunities in green energy, specifically in Malaysia, Australia, the UK, and Turkiye. My responsibilities involved the use of market intelligence tools including Bloomberg, S&P Capital IQ, and GlobalData to analyse trends in renewable energy, assess strategic partnerships, and generate insights for renewable energy initiatives.

A significant aspect of my role was my involvement in a deck preparation that outlined strategic growth opportunities. This required effective collaboration with various departments, such as asset management and merger and acquisition. Furthermore, I acquired insights into industry challenges, including the management of system stability during the integration of renewable energy and the adaptation to regulatory frameworks.

During this internship, I honed my skills in analytical research, preparing slides using Microsoft PowerPoint, and collaborating effectively within a team. This experience provided valuable insights into the renewable energy sector, emphasizing the critical importance of sustainable practices and innovative solutions in addressing the complex challenges posed by climate change and the global shift towards cleaner energy sources.

This industrial training enhanced my academic knowledge and bolstered my competencies, equipping me to make meaningful contributions to the evolving field of energy and sustainability.

Acknowledgement

I would like to express my sincere gratitude to God Almighty for His guidance, blessings, and strength throughout my industrial training journey at Tenaga Nasional Berhad (TNB). I have been able to persevere, learn, and grow during this significant chapter of my life thanks to his grace.

I am truly grateful to my academic internship advisor, Dr. Nur Melissa, whose guidance and support have been essential in achieving the successful completion of this training. Your guidance and support have maintained my focus and motivation. I express my deep gratitude to my family for their steadfast support, prayers, and understanding, which have served as my anchor during this time.

I am deeply appreciative of TNB for the significant opportunity to complete my industrial training in the New Energy Division. Collaborating with exceptional individuals has proven to be both motivating and fulfilling. I would like to express my sincere appreciation to Puan Diana Syafiza for her outstanding mentorship and leadership. Her thoughtful guidance, valuable insights, and ongoing appreciation for the team have inspired me to pursue excellence and enhance my performance consistently. Her guidance has been fundamental to my development both personally and in my career.

I would also like to express my deepest gratitude to my immediate team. Your expertise, patience, and readiness to share knowledge created an environment that fostered learning and growth. Working closely with such a dedicated and talented team has been an enriching experience. Your support, encouragement, and camaraderie made this journey both rewarding and enjoyable, and I will always cherish the bond we have formed.

I would like to express my gratitude to my colleagues, whose kindness and readiness to share their expertise created a truly welcoming environment. Their support and camaraderie fostered a collaborative environment that enhanced my learning experience. This internship has been a significant experience, and I sincerely appreciate everyone who contributed to its success.

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1.0 Student Profile

SYAZANA EZZATI HAIRI ANNUAR

EDUCATION

UITM CAWANGAN MELAKA KAMPUS BANDARAYA MELAKA
Bachelors of Business Administration (Hons.) International Business

PUSAT ASASAI UITM CAWANGAN SELANGOR KAMPUS DENGKIL
Foundation in Law

SKILLS

- Public Relations
- Branding Strategy
- Designing and Creativity
- Microsoft Office and Adobe
- Effective Communication
- Critical Thinking
- Report writing
- Excellent collaboration skills
- Srong interpersonal skills
- Proactive and self-motivated
- Exceptional organisational sk

LANGUAGES

- English: Proficient
- Bahasa Malaysia: Fluent

REFERENCES

Munirah Mohamed
Senior Lecturer
UiTM Cawangan Melaka Kampus Bandaraya Melaka

Wan Hasmat Wan Hasan
Senior Lecturer
UiTM Cawangan Melaka Kampus Bandaraya Melaka

PROFILE SUMMARY

Final-year Business Administration student specializing in International Business, with a strong passion for communications and public outreach. Skilled in crafting engaging, data-driven content and leveraging social media platforms to enhance brand visibility and audience engagement. Experienced in utilizing tools such as **Canva, CapCut, Bloomberg,** and **S&P Capital IQ** to develop creative campaigns and analyze trends. Adept at fostering collaboration, producing high-quality materials, and delivering measurable results in dynamic environments.

PROFESSIONAL EXPERIENCE

New Energy Division, Tenaga Nasional Berhad August 2024 - January 2025
Strategy Intern

- Conducted market analysis and macroeconomic outlooks for Malaysia, Australia, the UK, and Turkiye, focusing on the renewable energy sector.
- Supported strategic decision-making by leveraging market intelligence tools like Bloomberg, GlobalData, and S&P Capital IQ to generate actionable insights.
- Prepared presentations for board-level approval, including proposals for strategic growth opportunities in renewable energy and collaborations with key stakeholders such as Suruhanjaya Tenaga, Petronas, and the Ministry of Energy Transition and Water Transformation.
- Monitored global green energy trends, assessed competitors' strategies, and evaluated potential business opportunities in line with TNB's SP 2050 net-zero initiative.
- Acted as a liaison between team members, ensuring timely communication and progress updates to the team lead and analysts.

LEARDERSHIP EXPERIENCE

Corporate Social Responsibility Program at Padang, Indonesia
Secretary

- Scheduled meetings, prepared agendas, and took minutes during discussions and planning sessions.
- Scheduled meetings, prepared agendas, and took minutes during discussions and planning sessions.
- Coordinated logistics and administrative tasks for a one-week Corporate Social Responsibility program in collaboration with Universitas Negeri Padang at Panti Asuhan Aisyiyah Cabang Koto Tengah, Padang, Indonesia.
- Assisted in organizing travel arrangements, accommodations, and on-site arrangements for participants.
- Provided administrative support during the program, including managing documentation, handling inquiries, and resolving issues promptly.

2.0 Company Profile

This company profile provides an overview of Tenaga Nasional Berhad's (TNB) extensive history, beginning from its establishment as a public utility to its transformation into Malaysia's largest energy provider. It examines TNB's core services and products, encompassing electricity generation, transmission, and distribution. Additionally, the profile highlights TNB's strategic diversification into renewable energy, smart grid technologies, and international ventures, underscoring its dedication to innovation, sustainability, and driving the energy transition.

2.1 Company Background

Prior to its recognition as the esteemed Tenaga Nasional Berhad (TNB), the corporation was initially referred to as the National Electricity Board (NEB). The shift from NEB to TNB transpired two years subsequent to its privatisation. Tenaga Nasional Berhad (TNB) functions as the principal electricity utility provider in Peninsular Malaysia, managing generation, transmission, distribution, and retail operations. TNB serves as the principal electricity provider in Peninsular Malaysia and also transmits and distributes electricity in Sabah and the Federal Territory of Labuan through Sabah Electricity Sdn. Bhd. (SESB), an 80%-owned subsidiary of TNB, with the Sabah State Government holding the remaining 20% stake. TNB's headquarter is situated in a state-of-the-art facility at TNB Platinum, No. 3, Jalan Bukit Pantai, Bangsar, 59100 Kuala Lumpur.

Tenaga Nasional Berhad is a prominent Malaysian utility corporation in Asia, with an international footprint in the United Kingdom, Ireland, Australia, Turkey, Saudi Arabia, Kuwait, Pakistan, and Cambodia. TNB possesses a total gross renewable energy portfolio of 3,119MW in Peninsular Malaysia, which includes 2,536.1MW from large hydro, and 1,183MW across the UK, Ireland, Australia, and Turkiye, mostly consisting of solar, wind, and hydro energy producing assets. TNB provides power to more than 11 million clients.

Tenaga Nasional Berhad, as the primary electricity utility company and monopoly managing electricity supply in Peninsular Malaysia, operates under the **Malaysian Electricity Supply Industry (MESI)**. The key entities in the Malaysian Electricity Supply Industry (MESI) include **Suruhanjaya Tenaga (Energy Commission)** and **PETRA**

(Ministry of Energy Transition and Water Transformation), both of which play vital roles in regulating and shaping the sector. The current Malaysian energy sector framework is based on a **single-buyer market model** whereby Independent Power Producers (IPPs) and the power generation arm of TNB are responsible for generating electricity, which is sold to TNB (in Peninsular Malaysia), and SESB (in Sabah). These parties are then responsible for distributing and retailing electricity in their respective jurisdictions.

Furthermore, **the Single Buyer (SB)** and the **Grid System Operator (GSO)** departments were introduced into the MESI structure in 2012, both of which were carved out from TNB. At present, the Malaysian Electricity Industry adapts the single-buyer model where there is a single entity within the electricity industry that will buy the total electricity needed by the nation and the grid system operator will manage the distribution of the energy through the transmission network. Single Buyer is obligated to manage electricity procurement to meet demand in Peninsular Malaysia. Electricity generated is delivered to end consumers through the TNB grid network and retailers.

Figure 1: TNB Platinum Headquarter

2.2 Company Vision and Philosophy

TNB wants to lead the world in energy and be a major actor in the change towards it. Under the direction of its basic values—Integrity, Cooperation, Professionalism, Customer Centricity, Forward Thinking, and Mindfulness—it hopes to lead both locally and internationally in sustainable energy.

Vision

To be a global leader in energy and related businesses, and a key player in the global energy transition

Mission

To provide safe, reliable, and affordable energy to customers, while supporting Malaysia's economic and social development

Purpose

Together We Brighten Lives Through Innovative and Sustainable Solutions Towards a Better World

Aspiration

To Be a Leading Provider of Sustainable Energy Solutions in Malaysia and Internationally

TNB's Core Values

Integrity, Collaborative, Professionalism, Customer centricity, Forward thinking, and Mindfulness.

2.3 Organizational Structure

A thriving power company like Tenaga Nasional Berhad (TNB) operates with a well-structured organizational framework that aligns seamlessly with its strategic objectives, providing clear direction for future growth. Within this structure, the management team plays a pivotal role as the driving force behind TNB's progress, steering the company toward achieving its vision and goals.

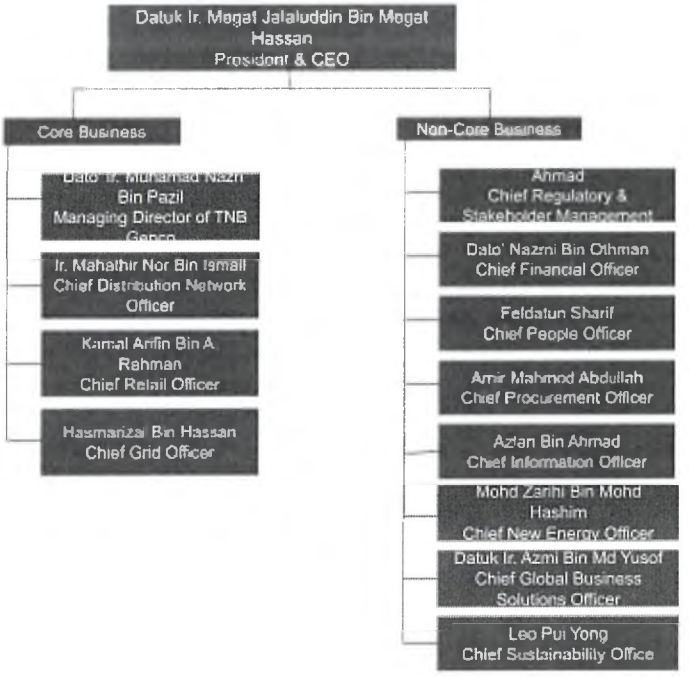

Figure 2: TNB Corporate Structure

Managing Team

2.4 Product and Services

For more than 75 years, TNB has been dedicated to supporting its industrial, commercial, and residential clients. TNB industrial clients comprise suppliers of products and services. Although they represent the smallest percentage of the clients, they constitute the largest portion of its electrical sales. TNB commercial clients primarily engage in economic activities that stimulate the nation's economy and constitute the largest portion of its electricity sales. Residential consumers constitute the predominant category, accounting for roughly 8.9 million of total 10.85 million clients. TNB enables customers to regulate their energy usage and promote the adoption of a more intelligent and environmentally sustainable lifestyle.

The business activities of TNB pertain to electricity generating, power plants, and associated divisions. TNB possesses a varied portfolio of subsidiaries and associates. TNB management services consist of a network of affiliated affiliates. Training and Development includes all training components. Operation and maintenance are crucial to the business, and TNB has specialised divisions that focus on this domain. Collectively, these enterprises encapsulate the quintessence of TNB.

Core Business

Tenaga Nasional Berhad (TNB) propels Malaysia's energy industry through its principal operations, encompassing power generation by TNB Power Generation Sdn Bhd (TNB Genco) and other essential divisions, guaranteeing dependable and sustainable energy provision across the nation.

Generation Business

TNB's primary activity is power generation, managed by TNB Power Generation Sdn Bhd, referred to as TNB Genco, a wholly owned subsidiary of TNB effective October 1, 2020.

TNB Power Generation Sdn Bhd (TNB Genco)

TNB Genco is tasked with leading TNB's power generation efforts to deliver secure, stable, dependable, and sustainable energy, addressing the country's long-term energy requirements through comprehensive E2E capabilities, including plant development, operations and maintenance, and end-of-life management.

TNB Genco currently possesses around 51% of Malaysia's power generation market share, with a total contractual capacity of 13.76 GW. TNB Genco owns thermal generation assets and significant hydroelectric projects in Peninsular Malaysia, along with maintenance and operation capabilities in Kuwait, Pakistan, and Cambodia, providing advanced innovation and specialised experience in:

- Asset Management
- Operation & Maintenance Management (O&M)
- Maintenance, Repair and Overhaul (MRO)
- Test & Diagnostics
- Engineering, Procurement, Construction and Commissioning (EPCC)

Supply Of Electricity

Customers get electricity from hydroelectric and thermal power plants via a network of transmission lines, substations and distribution lines. TNB regularly and continuously distributes power to consumers through this reliable infrastructure, while also maintaining a balance between demand and supply at all times.

Thermal Power Plant

TNB's Thermal Power Plant produces energy utilising coal and natural gas facilities. Coal power plants utilise steam turbines as the primary mover for electricity generation, whilst gas power plants employ both gas turbines and steam turbines in a combined cycle configuration for electricity production.

Hydroelectric Power Plants

Hydroelectric power generation involves harnessing energy from flowing water, converting potential energy into electrical energy. A hydroelectric power station necessitates a method for transporting water to generate the needed force to rotate a turbine connected to an electric generator, typically via a conduit such as a pipeline or tunnel leading to a turbine-generator driven by the flowing water. TNB's Hydroelectric Power plants are categorised as Storage, Run-of-River, or Pondage stations.

Safety, Health & Environment

TNB Genco is committed to sustainable growth, operational excellence, business synergies, and partnerships to expedite the transition from brown to green activities, aiming for Net Zero by 2050.

TNB Genco has implemented the World Class Occupational Safety & Health (OSH) policy through the TNB Safety & Excellence Management System (SEMS). It has also received several esteemed industry awards, demonstrating TNB Genco's ongoing dedication to sustainability and national improvement.

- 2021 POWER's Plant of the Year - Sultan Ibrahim Power Plant
- 2021 Asean Energy Award - Best Practices in Clean Coal Use and Technology Innovations: Tuanku Muhriz Power Station

Grid

In accordance with the Malaysian Grid Code, TNB's Grid Division aims to ensure a safe, reliable, and cost-effective functioning of the grid system. The Division oversees and runs the 132 kV, 275 kV, and 500 kV transmission network of TNB, referred to as the National Grid. The primary functions of the Grid Division encompass strategy formulation, system planning, engineering, project management, operational control, maintenance, wayleave management, and additional activities. The National Grid is linked to Thailand's transmission system, managed by the Electricity Generating Authority of Thailand (EGAT), in the North through an HVDC interconnection with a transmission capacity of 300 MW and

a 132 kV HVAC overhead line with a maximum transmission capacity of 80 MW. The National Grid is linked to Singapore's transmission system at Senoko in the south through two 230 kV submarine cables, possessing a firm transmission capacity of 200 MW.

Distribution Network

The Distribution Network division plans, constructs, runs, repairs, maintains, and manages the assets of the 33 kV, 22 kV, 11 kV, 6.6 kV, and 415/240 volts distribution network in Peninsular Malaysia.

Retail

The Retail Division was established in 2018 by TNB to provide value to its consumers, employees, and shareholders. TNB prioritises providing customer-centric experiences across all channels—Click, Call, and Visit—through 13 state offices, 125 Kedai Tenaga, and 3 CareLine offices countrywide. TNB mandate encompasses the development of energy solutions that extend beyond traditional energy services, providing a smart energy lifestyle to a diverse clientele, including large enterprises, SMEs, micro-businesses, and residential users.

Training and Development

TNB asserts that a skilled and professional workforce is crucial for achieving the Company's vision and objectives. Consequently, TNB is wholly committed to delivering high-quality training, education, and development programs for TNB and its affiliated companies.

TNB has initiated an Integrated Human Resource and Career Development program, wherein training, education, and development initiatives are intimately associated with the career trajectories and advancement of the workforce.

TNB Integrated Learning Solution Sdn Bhd (ILSAS)

TNB ILSAS is the top training institution in Malaysia. It serves as the official training institute for Tenaga Nasional Berhad (TNB). TNB ILSAS has cultivated the human capital of Malaysia's Electric Supply Industry (MESI) for more than 40 years.

TNB ILSAS, established in 1978 and incorporated as a subsidiary of TNB in 2008, benefits from its close association with Malaysia's major power utility, positioning it as a premier training provider and a sought-after expert for consultations and services by numerous organisations.

The training modules at ILSAS are accredited by City & Guilds UK for technical programs and the Institute of Leadership & Management (ILM) UK for leadership and management training modules.

Power Plant Operation & Maintenance (O&M)

In the contemporary globalised economy, diversification beyond a singular market is crucial for optimal growth. Consequently, TNB aims to utilise its repair and maintenance expertise through TNB Repair and Maintenance Sdn. Bhd. (REMACO) to enter lucrative international markets, particularly in the developing regions of the Middle East and Asia.

TNB Repair & Maintenance Sdn. Bhd. (REMACO)

TNB Remaco (TNB Repair & Maintenance Sdn. Bhd.), a completely owned subsidiary of TNB Power Generation, was created in 1995. TNB Remaco specialises in operation and maintenance (O&M), overhaul, and repair and maintenance (R&M) services in the energy sector, concentrating on power plants, including gas, steam, and hydro turbines, boilers, generators, and additional equipment. TNB Remaco has successfully expanded internationally, establishing a presence in other markets, including power plants in Saudi Arabia, Pakistan, and Kuwait.

3.0 Industrial Training Reflection

The Industrial Training Reflection section highlights the insights, experiences, and personal growth gained during my internship. It provides a comprehensive account of the practical knowledge acquired, challenges encountered, and skills developed while working in a professional environment. This reflection also emphasizes how the training has contributed to my academic and career aspirations, shaping my understanding of industry dynamics and reinforcing my commitment to professional excellence.

3.1 Working Hours and Task Assigned

I had the honor of working closely with the Strategy Team, led by Puan Diana, in the New Energy Division (NED) during my industrial training at Tenaga Nasional Berhad (TNB). This event was a turning point in my career since it gave me important knowledge about the renewable energy sector and influenced how I saw chances for strategic growth in the green energy sector. I worked every day from 8:00 AM to 5:15 PM as a Strategy Intern, doing duties that helped me advance my career and hone my talents.

One could describe my experience with NED as the "valley of disappointment" that often precedes new beginnings; initially, development seemed slow and daunting, but persistence ultimately led to mastery. When I first started, navigating tools and activities like S&P Capital IQ, Bloomberg, and Global Data felt overwhelming. But as my confidence and critical thinking skills increased, I began to see the fruits of my labor. I was reminded by this small gain that while growth requires time and effort, the benefits are often well worth the effort.

My main responsibility as a Strategy Intern was to perform macroeconomic forecasts and market evaluations for Malaysia, Australia, the UK, and Turkey, with an emphasis on renewable energy projects. I prepared the NED monthly market update, summarized the Enerji IQ subscription, and recorded meeting minutes for conversations with clients and partners like S&P Capital IQ, PLEXOS, and Energy Exemplar, among other important deliverables.

With an emphasis on green energy projects, I carried out market research and macroeconomic projections for areas including Malaysia, Australia, the UK, and Turkey. Preparing the NED monthly market update, summarizing the Enerji IQ subscription, and taking minutes at client meetings with companies like PLEXOS, S&P Capital IQ, and Energy Exemplar were among my routine tasks. Making a delegation deck for Prime Minister Datuk Seri Anwar Ibrahim's trips to Brazil, Egypt, and Peru was one of the high-profile projects I also worked on.

Other important responsibilities included producing the onboarding deck for the new CFO, helping with slide deck editing, and developing slides for possible collaborations with Turkish businesses such as SOCAR and Isbank Enerji. Additionally, I frequently utilized Bloomberg to get macroeconomic updates for nations like Malaysia, the UK, Australia, and Turkey. With the use of sophisticated tools like Bloomberg, Global Data, and S&P Capital IQ, I was able to refine my analytical abilities through these tasks, which improved my ability to assess market intelligence and industry trends.

Beyond my core responsibilities, I had the opportunity to participate in several notable events and activities that enriched my industrial training experience. I joined the P&SC Exhibition Conference and attended TNB's 75th Anniversary celebration, where Prime Minister Datuk Seri Anwar Ibrahim visited TNB. I was featured in The Star's news article media coverage video, with a glimpse of me appearing in the footage. Additionally, I took part in the New Energy Division's wellness video shoot during a badminton day event, which fostered team spirit and camaraderie.

Furthermore, I had the privilege of attending a sharing session with Datuk Ir. Megat Jalaluddin Megat Hassan, CEO of TNB, during an NED meeting. This session provided valuable insights into TNB's strategic vision and leadership, inspiring me to aspire for excellence in my professional journey.

Overall, my industrial training at TNB's New Energy Division was a transformative experience that not only enhanced my technical and analytical skills but also broadened my perspective on the renewable energy sector and strategic growth opportunities in the green energy industry.

4.0 SWOT Analysis

The SWOT framework provides an **in-depth** SWOT analysis of Tenaga Nasional Berhad (TNB) and helps identify a strategic evaluation of its **internal strengths** and **weaknesses**, as well as **external opportunities** and **threats**. The analysis aims to deliver a comprehensive understanding of TNB's position within the energy sector, emphasizing its competitive advantages, areas requiring improvement, potential growth prospects, and challenges in navigating an increasingly dynamic and competitive energy landscape.

4.1 Strength

Over the years, Tenaga Nasional Berhad (TNB) has established itself as a **trusted leader** in Malaysia's power sector, garnering worldwide praise for its steadfast dedication to providing the country with dependable and effective electricity. Since its founding, TNB and the government have maintained a solid public-private partnership, cooperating to meet Malaysia's changing energy needs and further the country's development objectives.

By coordinating its initiatives with the Malaysia Sustainability Pathway 2050 (SP2050) Net Zero Target, TNB has further solidified its commitment to sustainability in recent years. TNB's dedication to its corporate aim of guiding Malaysia towards a more sustainable and greener future is demonstrated by this aspiring goal. TNB's operational accomplishments and aggressive efforts to help government measures aimed at lowering carbon emissions are reflected in the numerous outstanding accolades it has received for its unwavering pursuit of excellence. These programs are essential for mitigating the long-term environmental and economic threats posed by climate change, solidifying TNB's position as a major force behind sustainable development in Malaysia.

4.1.1 Longstanding Commitment to Strong Environmental, Social, and Governance (ESG)

Environmental, social, and governance (ESG) concepts have been incorporated into TNB's operations, strategies, and objectives with unshakeable dedication. ESG is a framework that assists businesses in managing the possibilities and risks related to corporate

governance, social responsibility, and environmental sustainability. Addressing global issues like social equity, climate change, and transparency governance is becoming more and more dependent on an all-encompassing strategy. TNB's long-term strategy is heavily influenced by its ESG activities, which also highlight the company's goal of guiding the energy industry towards a sustainable and inclusive future.

i. Phasing Out Coal and Achieving Zero Carbon Emissions

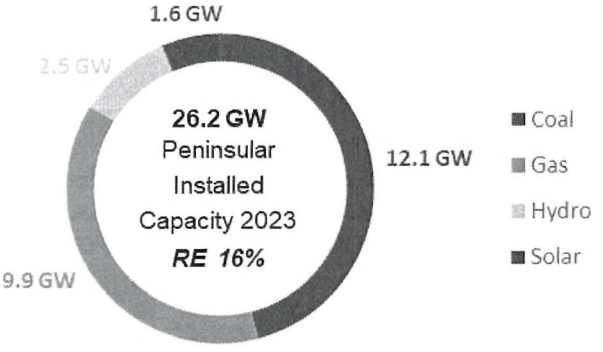

Figure 3: Energy Fuel Mix in The System

In recent years, TNB has taken bold steps to address environmental challenges by committing to reduce its reliance on coal as a fuel source. The company is aiming to completely eliminate coal from its energy mix by 2050, in line with its vision of a cleaner energy future. The **majority of the electricity** generated by TNB still **comes from coal** and natural gas, with **coal accounting** for **46%** of its fuel generation mix, followed by natural gas at 38%.

TNB also intends to **cut its reliance on coal** by **14%** by **2030** and another **50%** by **2035**. By **retiring current coal plants** before their Power Purchase Agreements (PPAs) expire, it intends to achieve this. Regarding that, TNB has already been investigating the viability of coal plants co firing with biomass and ammonia for the Janamanjung plant, Jimah East Power plant, and Kapar Energy Ventures project. This calculated move demonstrates TNB's recognition of the detrimental effects coal-based electricity has on the environment, particularly greenhouse gas emissions that fuel global warming.

Additionally, TNB wants to cut its CO2 emissions by 35% by 2035 and 100% by 2050. Green and renewable energy are becoming increasingly crucial to TNB's attempts to achieve this aim as they transition away from coal. They project that it could achieve Earnings Before Interest and Taxes (EBIT) of RM19 billion, with 58% of this income coming from new green businesses and future generation sources. Overall, they hope to increase the amount of money they make from renewable energy and GoTF.

TNB intends to use more green and renewable energy sources in order to phase out coal and lessen its reliance on it. This entails modernising current facilities with greener technologies and retiring coal plants early. To solve the energy trilemma, TNB has made calculated investments in renewable energy (RE) during the last 12 months. One of TNB's initiatives is spearheading large-scale solar (LSS) as part of the National Energy Transition Roadmap (NETR). These include the 50MWac and 30MWac plants in Bukit Selambau, Kedah, both completed ahead of schedule in 2024 and 2020, respectively, and currently under TNEC supervision. The 50MWac LSS in Kuala Langat, completed in 2018, stands as the nation's largest solar farm, transmitting electricity to the national grid.

ii. Promoting Gender Diversity and Inclusion

Figure 4: TNB ESG Report Summary 2023

The majority of TNB's workforce is male (about 78.6%), despite the fact that the company is actively working to increase gender diversity and inclusivity within its workforce. The **percentage** of **women** in TNB's workforce **improved** from **21.0%** in **2019** to **21.4%** in **2022**, primarily due to an **increase** in the number of **women in senior management** and **executive** levels, with the proportion of women in senior management rising from 24.3% in 2022 to 26.3% in 2023 and the percentage of women in executive levels becoming more equal at roughly 41% at the moment. The reason that the majority of TNB's workforce is still heavily male-dominated is primarily due to the non-executive level (mostly contractors and technicians), where women make up only about 14.8% of the non-executive workforce. TNB's board diversity is quite inclusive, with men making up just 54.55% of the board in 2022, with the remaining 45.45% being women.

TNB's endeavours to provide **equal opportunity** for **women** in technical and leadership areas demonstrate this steady but slow effort. TNB is advancing gender equality in society at large by dismantling barriers and challenging industry conventions through the development of a more inclusive corporate culture. Diversity is advantageous for businesses and portray good morals. TNB may provide new viewpoints, encourage creativity, and improve decision-making processes with a more diverse staff.

By improving gender diversity, TNB strengthens its social impact while aligning with global standards for equitable workplace practices. TNB has also created Reimagining Culture (RC) to define its core values and culture. Through TNB's RC, the workforce will integrate respect and have compassion towards others and the world. This includes ensuring the safety and advocating the well-being of its employees.

iii. Strengthened Governance Sustainability and Transparency

TNB is unwavering in its dedication to overseeing and openly disclosing ESG issues. TNB has worked hard to guarantee better disclosures, hoping that the hard work will result in higher ratings. TNB uses **rating agencies' assessments** to enhance its operational frameworks and sustainability approach. TNB also creates focused action plans to successfully solve ESG issues by interacting with a variety of business processes throughout TNB. TNB kept improving its ESG performance and management in 2023. When compared

to the prior year, TNB rating scores in well-known ESG indices and organisations showed an upward trend.

TNB is aware of how crucial strong governance frameworks are to preserving stakeholder trust. In order to guarantee sustainable growth, its ESG strategy places a strong emphasis on accountability, ethics, and openness. TNB exhibits its dedication to transparent communication with investors, authorities, and the general public by upholding global governance standards and disseminating thorough ESG reports. By facilitating unbiased and open Board reviews, this strategic approach seeks to promote an open and accountable culture within the company.

TNB's capacity to manage the challenges of the energy transition while preserving its financial stability and stakeholder trust is further supported by sound governance processes. The company's commitment to governance excellence guarantees the credibility, quantifiability, and impact of its ESG initiatives. With an overall score of 4.3, which indicates good effectiveness across essential governance areas, TNB's Board and Committees performed well according to the 2023 BEA findings. The 2023 findings show a significant improvement in leadership dynamics and performance when compared to the 2022 report, in which the Board and its Committees received a score of 4.

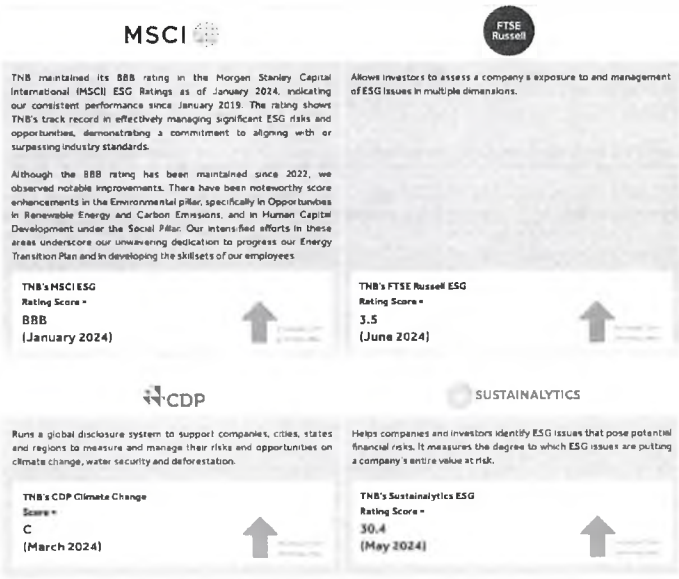

Figure 5: TNB ESG Ratings Score 2023

Recommendation

TNB has established itself as a pioneer in sustainable energy thanks to its longstanding adherence to Environmental, Social, and Governance (ESG) principles. The following recommendations are put out to address new issues and increase its ESG effect. Prioritising investments in cutting-edge renewable technologies such as **green hydrogen, battery storage systems,** and **offshore wind** should be TNB's top priority. These technologies can diversify its portfolio of renewable energy sources by enhancing its current hydropower and solar initiatives. Additionally, increasing its capacity for renewable energy to 14,000 MW by 2050 would solidify its standing as a pioneer in green energy. Early adoption of cutting-edge renewable technologies like carbon capture and storage (CCS) can greatly improve decarbonisation efforts and generate economic opportunities, according to the International Renewable Energy Agency (IRENA). TNB can reach or surpass its carbon reduction goals by implementing such technologies.

Even though the sector is dominated by men, TNB has made significant strides towards increasing gender diversity. Women now make up 21.4% of the workforce, and they are more prevalent in upper management. Nonetheless, women continue to be under-represented in technical and non-executive positions. TNB should start mentoring and leadership development programs designed especially for women in technical and managerial positions in order to close this gap. By enabling women to succeed in fields that have historically been dominated by males, these initiatives would promote more diversity at all levels of the workforce. According to McKinsey's Women in the Workplace report, companies with gender-diverse leadership have higher financial performance and encourage greater creativity. In addition to meeting international standards for gender equality, TNB strengthens its competitive position by expanding opportunities for women.

The foundation of TNB's ESG strategy has been its governance procedures, which place a strong emphasis on responsibility, ethics, and openness. Effective leadership is demonstrated by the Board's strong performance, which is mirrored in the 2023 BEA outcomes. However, TNB can improve its governance structures even further to keep stakeholders' confidence and legitimacy. An independent ESG advisory board should be established by TNB to assess developments, offer recommendations, and guarantee compliance with global norms. To offer unbiased opinions on TNB's ESG performance, this

board might include academics, industry professionals, and regulators. According to the Harvard Business Review, independent ESG boards increase responsibility and governance while building stakeholder and investor trust. By taking this step, TNB would reaffirm its dedication to openness and guarantee that its ESG initiatives continue to be significant and credible.

4.1.2 TNB's Industry Awards and Recognition

Apart from its superior environmental, social, and governance (ESG) principles, TNB has recently stepped up its efforts to modernise and improve its core business, with an emphasis on power plant upgrades. TNB has solidified its position as a power industry leader. TNB has won multiple important accolades thanks to its subsidiaries, GENCO, which have helped it demonstrate creative problem-solving, a dedication to sustainability, and an emphasis on operational excellence. These honours highlight the company's commitment to upholding strict guidelines for energy generation, environmental protection, and technological development.

POWER's Plant of the Year Award: Track 4A's Global Recognition

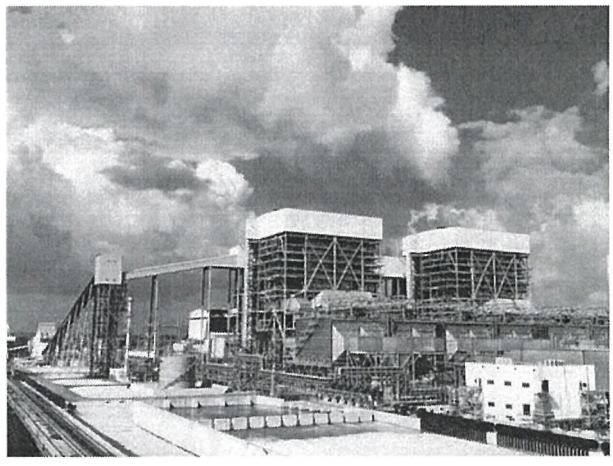

Figure 6: Track 4A Power Plant

TNB's **Track 4A** power plant was awarded **POWER's Plant of the Year Award**, a distinguished accolade in the energy sector. The project exemplifies advanced technology

integration and serves as a significant paradigm for integrating climate awareness, energy affordability, and reliability in energy-intensive Southeast Asia. In 2014, Malaysia's Energy Commission (EC) granted SIPP Energy, a private entity, a fast-track project tender "Track 4A" to construct two 720-MW combined cycle gas turbine (CCGT) power plants in Pasir Gudang by 2018, utilising its special purpose vehicle Southern Power Generation (SPG). TNB augmented its ownership in Southern Power Generation (SPG) to 70% in September 2020, thereby becoming the predominant portion in the project.

Southern Power Generation's 1.4-GW natural gas–fired power facility in southern Malaysia, Track 4A, is renowned for its installation of the first commercial GE 9HA.02 gas turbines, which are among the most efficient and vast power-generating models in the world. Track 4A is a significant milestone in TNB's commitment to providing sustainable and dependable energy solutions. In June, Rizal Nordin, the managing director of SPG, informed POWER that the commercial operation of Track 4A had increased Peninsular Malaysia's generating capacity to 25,962 MW.

Currently, REMACO, a subsidiary of TNB Power Generation, is responsible for the complete operation and maintenance of both Track 4A plants. REMACO is responsible for the development, operation, and maintenance of TNB Power Generation's portfolio of power generating units. This recognition underscores TNB's accomplishments in the implementation of state-of-the-art technology and the attainment of exceptional operational standards. TNB's capacity to compete on an international scale was demonstrated by its receipt of this accolade, which demonstrated Malaysia's potential in leading energy infrastructure projects. This also serves to bolster TNB's reputation for prioritising innovation and reliability, which are essential in meeting the increasing global demand for sustainable and efficient energy.

ASEAN Energy Award for Clean Coal Technology

Additionally, TNB was recently recognised on a regional scale. **Jimah East Power** emerged victorious in the **Clean Coal Technology Utilisation for Large Power Generation** category of the **ASEAN Energy Awards 2021**, a testament to TNB's leadership in sustainable practices. This award recognised TNB's best practices of cleaner and sustainable coal use and the transition towards a more sustainable and lower carbon emission, as Southeast Asia's preeminent platform for acknowledging excellence in energy development.

The ASEAN Energy Award is the most prestigious award in Southeast Asia, designed to recognise and encourage all stakeholders in the energy development of the ASEAN region. JEP has two Ultra-supercritical (USC) plants with a total generation capacity of 2,000MW in Port Dickson, which are TNB's third and fourth plants to employ the technology. The other two USC plants are Manjung 4 and Manjung 5 in Lumut, which are among the first USC coal plants in the ASEAN region. USC technology is a highly efficient technology, boasting a 40% efficiency compared to 36% in conventional plants.

Dato' Nor Azman Mufti, the Managing Director of TNB Power Generation Sdn Bhd, further stated that TNB is investigating various methods of generating power at JEP using coal alternatives to reduce emissions in order to support JEP and TNB Genco's initiatives in ESG aspects. The strategic focus of TNB on harmonising energy demands with environmental responsibility is underscored by this recognition, which serves as a model for other regional power producers. This is consistent with TNB's objective of attaining net-zero emissions by 2050, which is supported by a pledge to decrease 35% of its emissions intensity and 50% of its coal generation capacity by 2035.

Figure 7: Jimah East Power Plant

Recommendation

Recent awards from TNB, such as the ASEAN Energy Award for Clean Coal Technology and the POWER Plant of the Year Award for Track 4A, are noteworthy achievements that demonstrate the company's leadership, innovation, and dedication to

sustainability. These honours offer TNB a rare chance to enhance its standing as a reliable and progressive energy supplier, further cement stakeholder relationships, and establish itself as a world leader in the energy industry.

Enhance Stakeholder Communication

To get the most out of these successes, TNB can use focused strategies to improve communication with stakeholders. Successfully working with a wide range of people, such as investors, regulators, customers, and business partners, can make these awards more valuable by encouraging teamwork, trust, and unity around common goals. The steps that TNB can take to use its awards and recognition to improve contact with stakeholders and move its strategic goals forward are outlined below.

First and foremost, being open is important for building trust and getting people involved in a project to help it succeed. TNB should keep the lines of communication open about all of its projects so that all stakeholders are fully aware. Stakeholders will be able to do their jobs well if they are given important information in an honest and regular way. Additionally, being open and honest makes partnerships stronger and encourages everyone to take responsibility.

Additionally, TNB should let partners choose the meeting times and ways of communicating that work best for them. For example, clients may want to get project updates once a week through video meetings, but they may need urgent updates over the phone. Giving people choices in how they want to communicate can help them work together better, get things done faster, and form stronger bonds with each other. This method makes sure that communication meets the needs of all stakeholders while still meeting project deadlines and quality standards.

Third, stakeholders need to be kept up to date on project progress and any important changes through regular updates. TNB should make sure that regular communication routes, like daily or weekly meetings for routine matters and emails or calls for urgent updates, are used to send out updates on time. To keep things clear, only tell people who will be directly touched by updates what changes have been made. Communication that is clear and constant

cuts down on misunderstandings and makes sure that everyone is working together to reach the project goals.

The company should use its successes and awards to improve communication with investors, customers, and lawmakers, among others. These awards can help TNB's reputation as a reliable and forward-thinking energy provider if they are mentioned in annual reports, news releases, and marketing campaigns. By using these awards in their branding, TNB can improve their image, get more foreign partnerships, and get an edge when bidding on and investing in renewable energy projects.

4.2 Weakness

Some of the biggest problems Tenaga Nasional Berhad (TNB) has to deal with are not having enough electricity in remote areas, which makes it hard for people who do not have access to it, and relying too much on coal to make electricity. This reliance on coal causes a lot of carbon pollution and puts TNB at risk in the market and with regulators as the world's energy sector moves toward cleaner options.

4.2.1 Limited Electricity coverage in rural areas

Despite the fact that electricity is necessary for modern living, about one billion people lack access to it (International Energy Agency, 2022). **Electricity** is frequently **unstable** in many **rural** and **isolated places** farther from the main grid around the world, and there are enormous barriers to connecting these locations to the main grid, which typically take a long time and a large financial investment to install. Communities are **negatively impacted** by this energy shortage, which restricts access to modern healthcare, clean water, high-quality education, and employment possibilities. The absence of electricity is a major obstacle to growth in today's interconnected world, as it is the basis for both technological breakthroughs and higher living standards.

Tenaga Nasional Berhad (TNB), Peninsular Malaysia's main energy supplier, has a difficult time getting its services to **isolated** and **underdeveloped areas**, especially in Sabah and Sarawak, as well as Orang Asli Villages. Many rural villages in Malaysia still lack access to dependable power, despite its prominence in the country's energy sector. The fact that these places, which are frequently in remote coastal or forested locations, depend on old **diesel generators** for their **limited electricity** supplies exposes weaknesses in TNB's energy inclusion initiatives. Such places need expensive and difficult boat and off-road transport, which is made more difficult by unfavourable weather. In addition to raising implementation costs, this logistical inaccessibility forces communities to **rely on non-sustainable energy sources**, hence sustaining socioeconomic disparity.

Within the country alone, almost **285,000** homes **do not have access to electricity**. Power is off for many **Orang Asli** who reside in remote communities. Electricity is still

unavailable in at least 137 Orang Asli communities around the nation. Plus, they're spending more than the typical individual even though they use very little power. The shortage of electricity not only hinders the provision of basic requirements but also looms large over their lives, both now and in the future.

Extremely isolated communities like **Pos Gob** in **Nenggiri** State, **Kelantan** are an example of people who live without access to electricity. It takes a long time to get to these places, usually several hours of driving through rough terrain in 4WD vehicles. Additional difficulties might arise from heavy rain, which can trap travellers for more than a day in the trees, where they run the danger of slipping on the muddy terrain and cars becoming trapped. These factors make it difficult for the **Orang Asli** people who live in these villages to communicate with others and keep them isolated from the outside world. For many years, the Temiar Orang Asli people of Pos Gob, Gua Musang, Kelantan have been surviving without even the most fundamental forms of infrastructure. Almost a thousand people in twelve different villages don't have access to electricity, so they have to **spend hundreds of ringgit** every month on **candles** to **keep warm at night**.

Challenges of Living Without Electricity in Rural Areas

Many Orang Asli have simplified their lifestyles in order to survive without power. Not only do the orang Asli have a tough time getting to their location, but they also have to survive on **unsustainable energy sources** like candles, kerosene lamps, wood fires and bonfires made of dried palm kernels to keep warm and light. At the same time, these may cause fires and have long-term detrimental effects on their health. Diesel generators, automobile batteries, and heavy-duty 6V batteries are the power sources for some homes. The locals must depend on age-old practices like dry preservation and salting to keep perishable foods like fish and meat fresh because there is insufficient electricity to run refrigerators. Because they could not focus on their studies when it is dark outside, kids lag behind in class and eventually quit altogether. There is less time for women to get things done, and they are more likely to damage themselves while doing housework because they have poor night vision.

People in these areas still live in a traditional way and are proud of being self-sufficient, but they still want to have access to modern conveniences. Orang Asli people,

like those in Pos Gob, have said they want to use electricity for everything, even for things that need higher voltage power sources, like TVs and washing machines. Their story shows resilience and ingenuity of Orang Asli people, and it also shows how important it is to bring electricity to rural areas so that cities and rural areas can both grow.

Recommendation

To address the issues encountered by rural populations, TNB should establish renewable energy **mini-grid** systems to provide electricity to these villages. Global warming has prompted a global transition to sustainable technologies, leading to the introduction of numerous alternative strategies to mitigate the significant emissions of greenhouse gases (GHG) produced by these materials. A burgeoning technology increasingly adopted in small communities is the tiny grid, primarily powered by accessible renewable resources.

A mini grid is an integrated energy infrastructure including interconnected loads and distributed energy resources, including generators and energy storage devices, that can function either in conjunction with the main grid or in a deliberate islanding mode. This system can operate on solar energy, micro-hydro power, or a combination of both, enabling it to be self-sustaining with minimal environmental impact. These properties render small grids significantly cost-effective over the long term.

The World Bank asserts that small grids can successfully eliminate energy poverty, with the industry anticipated to expand considerably, supplying electricity to as many as 500 million individuals by 2030. Mini grids provide a feasible option for the 13% of the global population, predominantly in sub-Saharan Africa and South Asia, who are without electrical access. By supplying economical energy to rural regions, they facilitate sustainable economic growth.

In Sabah, which houses 72% of un-electrified rural Malaysians, small grid initiatives have proven to be remarkably successful. In partnership with organisations such as TONIBUNG and CREATE, these initiatives employ local resources to provide renewable energy solutions to indigenous communities. The SabahRE2 program, financed by the UK Government's Malaysia-UK PACT, seeks to establish small grids in 200 rural villages, facilitating cleaner, more affordable, and equitable energy access.

4.2.2 High reliance on coal as the primary source for electricity generation

Tenaga Nasional Berhad (TNB) is exclusively in charge of producing power in Malaysia and still mostly depends on coal. Coal use has skyrocketed during the previous 20 years; today, it makes up 44% of Malaysia's total electricity generation from just 6% in 2000. This reliance stands in sharp contrast to nearby nations in the region that are sharply lowering their reliance on coal. Malaysia's development of coal-fired power generation in recent years can help to explain the rising coal use (Daiss, 2023).

The great reliance on coal adds greatly to carbon emissions, therefore highlighting a fundamental flaw in TNB's energy plan. Deputy Prime Minister Datuk Seri Fadillah Yusof highlights that the International Energy Agency (IEA, 2022) reports that the main cause of carbon emissions globally is power generation; the energy sector accounts for over 80% of the total greenhouse gas (GHG) emissions in the nation. The biggest causes of climate change are fossil fuels, which include coal, oil, and gas; about 75% of world greenhouse gas emissions and almost 90% of carbon dioxide emissions come from them (Nor et al., 2016; UNFCCC, 2020). The reliance of TNB on coal not only compromises Malaysia's ecological objectives but also makes the corporation seem behind regional rivals switching to greener energy sources.

Burning coal creates harmful pollution

Core to TNB's power generation, burning coal produces detrimental pollution with major effects on the environment and human health. Coal is used in fossil fuel power plants—including those run by TNB—to produce heat, which is then used to generate steam driving turbines and producing electricity. Although these plants are reasonably cheap to build and dependable, they are a main cause of carbon dioxide (CO2) emissions, which greatly influence world climate change. Apart from CO2, coal-fired power plants spew dangerous pollutants including oxides of sulfur and nitrogen, which produce acid rain, and particulate matter, therefore aggravating major health problems.

The dependence on coal increases public health hazards since emissions from coal-burning plants generate particulate matter that can aggravate heart ailments, respiratory conditions, and other medical issues. Communities around power plants bear

disproportionately these health effects, which is a crucial factor for TNB as it keeps growing its activities. Moreover, a considerable amount of mercury emissions and other harmful pollutants including sulfur dioxide and soot come from coal-fired power plants, therefore compromising not just air quality but also vital life systems.

TNB's reliance on coal also reflects world trends; in 2017, fossil fuels produced 64.5% of all the power consumed. Still, this reliance has great costs. For instance, coal burning fuels an estimated 670,000 early deaths yearly from air pollution in nations like China. Being the main supplier of electricity for Malaysia, TNB has to deal with the social and environmental repercussions of its coal-intensive energy plan in order to match sustainability objectives and minimize negative impacts on public health and the surroundings.

In this regard, TNB's present dependence on coal emphasizes the need of diversifying its energy source. TNB can not only improve air quality but also lower its carbon footprint by spending less on coal and investing in greener, renewable energy sources, therefore guaranteeing a more sustainable and environmentally responsible energy future.

Recommendation

In an effort to reduce high levels of air pollution while also trying to reach net zero 2050 goals, TNB should invest in carbon capture and storage (CCS). Carbon capture and storage (CCS) refers to a collection of technologies that can combat climate change by reducing carbon dioxide (CO2) emissions. The idea behind CCS is to capture the CO2 generated by burning fossil fuels before it is released to the atmosphere. The question is then: What to do with the captured CO2? Most current CCS strategies call for the injection of CO2 deep underground. This forms a "closed loop", where the carbon is extracted from the Earth as fossil fuels and then is returned to the Earth as CO2.

Currently, CCS projects worldwide capture and store approximately 45 million tons of CO2 annually, equivalent to the emissions generated by 10 million passenger cars. By integrating CCS into its coal-fired power plants, TNB can reduce its carbon footprint while maintaining energy security and reliability. Moreover, leveraging CCS will enable TNB to

comply with increasingly stringent environmental regulations and support Malaysia's commitments under the Paris Agreement.

Incorporating CCS also provides a pathway to extend the utility of existing coal infrastructure while transitioning to renewable energy. By prioritizing investments in CCS, TNB can position itself as a leader in sustainable energy innovation within the Southeast Asian region and bolster its reputation as a socially and environmentally responsible corporation. This approach ensures a balanced strategy to decarbonize Malaysia's energy sector without jeopardizing economic development and energy reliability.

4.3 Opportunities

In order to cut its greenhouse gas emissions by 2050, Malaysia has set high goals. Tenaga Nasional Berhad, Malaysia's main electrical supplier, is working to create a more sustainable and clean future. To achieve SP50 Net Zero Emission, TNB has worked together to make sure that theur mission aligns with governmental goals. For these reasons, TNB is expanding into fields including opting to alternative renewable sources and battery energy storage systems (BESS) in order to investigate prospects in green technology. When Mlaaysia will take over as ASEAN chairperson next year, Prime MInister Datuk Seri Anwar Ibrahim urged TNB to establish itself ready as a main electricity hub among ASEAN nations (The Star, 2024)

4.3.1 Opting to Alternatives Renewables Sources

Renewable energy sources like solar and wind are essential for lowering dependency on fossil fuels and minimizing environmental effects as the world economy strives for sustainable growth. In the energy industry, solar energy has the potential to become the dominant force. **Solar energy** will overtake coal as the **world's primary power source** by **2035**. In terms of M&A transactions, venture capital activity, and patent filings, solar is the renewable energy source that is drawing the greatest investment from corporations and investors. Large companies like Google and Microsoft are making significant investments in renewable energy.

The majority of TNB's solar projects in Malaysia are currently under construction and have not yet operated. These renewable energy (RE) programs put TNB in a position to capitalize on the rising demand for RE sources and support the country's sustainable energy transition. Renewable sources like **ammonia** and **biomass, hydro** and **solar**, emit little to no CO2 during combustion and become one of the effective generation sources to combat global warming. In addition to lowering reliance on fossil fuels, these sources support Malaysia's pledge to achieve net-zero emissions by 2050 and TNB's long-term sustainability objectives. TNB can maintain its position as the region's leader in renewable energy by making investments in a wide range of renewable technologies.

By integrating **ammonia** and **biomass** co-firing technology in its power plants, TNB has a strategic chance to quicken its path toward reaching its 2050 net-zero carbon emission targets. Maintaining energy dependability, this creative method presents a scalable and pragmatic path to decarbonize coal-fired power generation. TNB may greatly lower carbon intensity by including ammonia into the co-firing system, therefore offsetting emissions equivalent to 71,000 passenger cars yearly. Ammonia co-firing not only fits with world patterns in energy transition but also enhances TNB's leadership in creative sustainability. Taking advantage of this chance will help TNB to show its dedication to a better future by leading first in using new technologies to solve environmental issues.

Green hydrogen signifies a pivotal chance for TNB to adopt the future of clean energy. Green hydrogen is **hydro-based power generation** and is generated via water **electrolysis** and using **RE sources** like pumped **hydro and solar**. Utilising this renewable option would allow TNB to decarbonise sectors that are heavily reliant on fossil fuels, including transportation, heavy industries, and power generation. Integrating green hydrogen into its energy portfolio might enable TNB to emerge as a significant exporter of clean energy to adjacent nations, thereby establishing Malaysia as a regional centre for hydrogen production. Investing in green hydrogen technology would diversify TNB's energy portfolio and facilitate the development of expertise in developing energy markets, thereby enhancing its global competitiveness and aiding Malaysia's transition to a low-carbon economy.

Through the strategic investment in alternative renewable energy sources, TNB may diminish its dependence on fossil fuels, alleviate the environmental consequences of electricity production, and strengthen its status as a leader in sustainable energy innovation. These projects would enhance Malaysia's clean energy transition and reinforce TNB's dedication to providing reliable, affordable, and ecologically sustainable electricity to its customers.

Recommendation

TNB should invest more in research and development on renewable energy technologies, including biomass, and green hydrogen. For example, the conversion of agricultural refuse into energy can reduce waste and provide a sustainable power source by utilising Malaysia's palm oil industry. Research activities can be aligned with global energy

objectives through partnerships with organisations such as the Ministry of Energy and international agencies like the International Renewable Energy Agency (IRENA).

TNB must establish strategic partnerships in order to gain access to advanced technologies and expertise. For instance, TNB may establish green hydrogen initiatives domestically through partnerships with Petronas or Sarawak Energy. Similarly, TNB could facilitate the joint research with IHS Japan who has pioneered ammonia coal-firing technology and has been the longest in developing this technology. Through these endeavours, TNB will be able to broaden its renewable portfolio and facilitate Malaysia's transition to sustainable energy alternatives.

TNB can facilitate innovation, broaden its renewable energy portfolio, and guide Malaysia towards net-zero emissions by bolstering its research and development initiatives and pursing global partnerships and funding. These measures will establish TNB as a critical participant in the global energy transition, while simultaneously promoting economic and environmental sustainability.

4.3.2 Battery Energy Storage System (BESS) Technology

Figure 8: Battery Energy Storage System

Battery Energy Storage System (BESS) offers a consistent, effective way to store and distribute green energy from **intermittent renewable sources** including **solar** and **wind** as

Malaysia aims to **lower its carbon footprint** and **achieve green energy targets**. A BESS is an energy storage system where it uses batteries to store and distribute energy in the form of electricity. Common uses for these systems include smart homes, solar power plants, electric vehicles, and power grids. Rising use of renewable energy, better grid stability, and technical developments are likely to fuel fast worldwide Battery Energy Storage System (BESS) market growth in recent years. With the US and China dominating, providing 54% of worldwide installations, Bloomberg New Energy Finance (BloombergNEF) projects the market to rise from 27GW in 2021 to 411 GW by 2030.

BESS is a state-of-art technology that allows the storage of electrical energy, usually derived from renewable sources such as solar or wind, for later use. This energy is usually obtained from renewable energy sources like solar or wind. **BESS** is essential for guaranteeing **steady power availability** for utilities, businesses, and homes in a time when the energy supply can be unpredictable for a number of reasons, including shifting weather patterns and unplanned power outages. BESS is made to convert and store electricity, which is typically generated from renewable sources and stored during times when demand is low and electricity prices are lower. The BESS releases stored energy back into the power grid during periods of high energy demand or when the input from renewable sources, like solar electricity at night, declines. TNB can decrease greenhouse gas emissions and cater intermittent RE by utilizing this technology.

Furthermore, Malaysia's energy sector has grown significantly this year because of federal incentives that hasten the implementation of new green energy projects, especially solar systems. The Large Scale Solar (LSS) initiative, for example, has installed **1,492.12 megawatts (MW)** of solar capacity in Malaysia as of August 2023, and an **additional 949.09 MW** of solar capacity has been awarded. In order to meet the **high integration solar capacity** under renewable energy methods, BESS is essential. In theory, BESS will enable solar power to consistently provide Malaysia's daytime demand, while hydropower and the gradual construction of more storage facilities might handle the demand during non-solar hours.

TNB should tap into Battery Energy Storage System (BESS) technology as a game-changing chance to quicken Malaysia's energy transition and bolster its position as a leader in the green energy industry. By addressing major issues with renewable energy, like

intermittency and grid stability, BESS gives TNB the opportunity to integrate solar, wind, and other green energy sources into the national grid more effectively. TNB can establish itself as a leader in sustainable energy solutions while lowering grid congestion, improving dependability, and assisting with peak demand management by utilizing BESS. Investigating BESS not only supports TNB's SP 2050 net zero goals, but it also opens up new opportunities for collaborations, income sources, and smart grid system developments, enhancing its position in constructing Malaysia's resilient, low-carbon energy future.Purchasing energy storage devices, including battery energy storage systems (BESS), is essential even though they are expensive. Modernizing the current grid infrastructure is necessary to effectively manage the growing solar demands.

Recommendation

Despite the **high initial cost** of implementing Battery Energy Storage Systems (BESS), it is crucial to acknowledge the long-term benefits that surpass these initial expenditures. Factors such as battery manufacturing, installation, and integration with existing utility infrastructure are the primary drivers of the substantial capital investment. However, the global BESS market's increased competition, economies of scale, and technological advancements are gradually reducing the cost of this technology, thereby making it more accessible. The investment in BESS by Tenaga Nasional Berhad (TNB) should be regarded as a strategic move to enhance Malaysia's energy resilience and future-proof its operations.

In order to alleviate the effects of high initial costs, TNB may pursue **strategic partnerships** with technology providers, capitalise on government incentives, and utilise green financing alternatives, including sustainability-linked bonds or grants from international energy transition funds. Furthermore, while permitting TNB to progressively expand, piloting BESS projects in high-demand regions or renewable energy hubs can serve to illustrate their value. TNB can ensure a sustainable and economically viable pathway towards achieving its SP 2050 net zero aspirations by effectively integrating BESS and collaborating with stakeholders through the adoption of a phased approach.

In the United Kingdom, the Battery Energy Storage System (BESS) sector has experienced significant growth as a result of government and private investments, which have

served as a model for Tenaga Nasional Berhad (TNB). **InterGen's Gateway Energy Centre project,** for instance, was granted a Capacity Market award in February 2022, which enabled the construction of the UK's largest BESS facility. Phase 1, which is scheduled to initiate operations in October 2025 and has an initial capacity of 320 MW, was made feasible by a combination of private financing and government incentives. The significance of aligning large-scale energy projects with financial mechanisms such as capacity market awards to attract financing is underscored by this project, which will expand to 1GW in later phases.

In the same vein, TNB may pursue financiers for its BESS projects by utilising green financing instruments, such as government-backed incentives, sustainability-linked bonds, and partnerships with international energy funds. TNB can ensure a financially viable pathway to advancing Malaysia's energy transition by exhibiting the long-term economic and environmental benefits of BESS projects to both domestic and international investors.

4.4 Threats

Malaysia is a developing nation that is currently gaining ground due to its growing population and GDP. Manufacturing, agriculture, healthcare, and transportation all rely largely on a consistent supply of energy in Malaysia. Reliable electricity supply is essential for determining industrial productivity and, consequently, profitability as well as the macroeconomic performance of Malaysia as it enters a period of urbanization. TNB is the nation's foremost electricity provider, and its position is essential in guaranteeing a consistent and dependable supply throughout the entire energy value chain, which encompasses generation, transmission, distribution, and retail. Nevertheless, the most significant threat to TNB is **climate change**. The **business of electricity utilities is disrupted** by extreme weather events that are driven by climate. Malaysia is confronted with climate-related hazards, including intensified rainfall, more severe flooding, and a gradual increase in temperatures, as a result of the climate system's shift caused by global warming.

Furthermore, Malaysia's energy and water resources are under a lot of strain as a result of its development as a regional center for **energy-intensive data centers**. Major international tech companies are making significant investments in data center infrastructure, which presents problems for grid capacity and resource sustainability due to the sharp increase in electricity demand. Data centers are putting more and more pressure on TNB to maintain a consistent, sustainable, and efficient energy supply to accommodate this rapidly expanding industry while balancing the country's overall energy needs.

4.4.1 Coping with the growing demand for energy

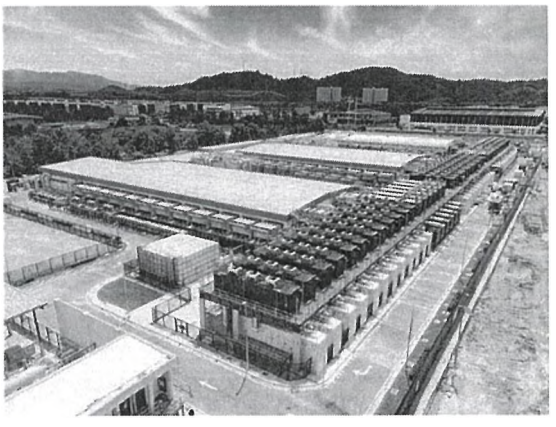

Figure 9: AirTrunk Data Centre in Johor

Southeast Asia's energy market is growing faster than expected. The total demand for energy has increased by 80% since 2000 as a result of millions of new consumers having access to it. Energy systems are under strain as a result, and the demand has been mostly met by tripling the use of fossil fuels, which has raised CO2 emissions. The need for energy has a big impact on both the home and industrial sectors. The populations of many Southeast Asian nations are growing faster than those of China, the United States, and the United Kingdom.

Major tech giants including Microsoft Corp, Google LLC, Amazon, Nvidia Inc., and Alibaba have been interested in Malaysia's data centres in recent years and are eager to invest in the region's growing need for artificial intelligence and cloud computing. With an estimated 850 MW of potential electricity demand announced in the first half of 2024, Malaysia is growing its data centre capacity at the fastest rate in the Asia-Pacific region. About 50 data centre initiatives, including those from Microsoft and ByteDance, have been drawn to Johor in the last three years. According to research firm DC Byte, the total capacity of data centres in Johor has grown 100 times over the last five years, including those that are presently being built or are in the planning stages.

Although the data centre surge has created some 40,000 jobs in Malaysia, concerns persist regarding the availability of electricity and water. The extensive environmental repercussions of data centres, together with the heightened energy and water demands for their cooling, are facing escalating global criticism. The data centres, tasked with the collecting, storage, and transmission of data that underpins services ranging from social media to ChatGPT, consume a substantial amount of electricity. The heat generated requires cooling, which can be accomplished by employing more energy for air conditioning systems or utilising hundreds of gallons of water, contingent upon their position.

Data Centre Map reports that Malaysia presently operates 87 data centres. DC Byte's 2024 Global Data Centre Index projects an energy capacity of 1.6 gigawatts (GW) for these data centres, adequate to supply power to 750,000 to one million residences. Tenaga Nasional Berhad projects that power demand from data centres may exceed 5GW by 2035, representing approximately one-fifth of the installed capacity of Peninsular Malaysia, where Johor is located.

News reports state that Tenaga Nasional Bhd currently has about 27GW of installed electrical capacity in Malaysia. In terms of power usage, Johor's data processing centres' capacity has grown from 10 megawatts in 2021 to 1.3 gigawatts at now, with a projected increase to 2.7 gigawatts by 2027. The southern Malaysian state is currently home to 13 data centres covering 153,000 square meters, according to some estimates, making it the ninth-largest data centre market in Asia-Pacific. Over the next two years, Malaysian data centres would require three times as much power, or around 500 megawatts, according to a forecast by Moody's Ratings.

Recommendation

The primary factor fuelling the increasing energy demand is the accelerated expansion of data centres, which TNB is proactively addressing. The annual increase in electricity demand is expected to be between 3% and 4%, in contrast to the 2.5% to 3% growth rates that were previously observed. As a consequence of data centre load utilisation, TNB generated approximately RM100 million in sales in June. Through initiatives such as the Corporate RE Supply Scheme (CRESS), Large-Scale Solar 5 (LSS5), and the Corporate Green Power Programme (CGPP), TNB aims to meet this growing demand by incorporating an additional 5GW of renewable energy (RE) into the grid (The Star, 2024).

TNB's progress in developing the country's power infrastructure to support the growth of data centres and a deeper integration of renewable energy is helping to ease this transition. The business has committed RM35 billion for energy transition-related grid projects between 2025 and 2030, which would supplement the RM54 billion allotted for non-energy transition grid enhancements over the same time period. In order to ensure a consistent energy supply and meet sustainability goals, these investments aim to modernise Malaysia's utility infrastructure (Izzul Ikram & Adam Aziz, 2023).

Furthermore, TNB is fortifying regional collaboration in order to sustainably address the increasing energy demands. The objective of **strategic partnerships** with key energy players in Vietnam and Laos is to improve the **ASEAN Power Grid interconnectivity**, thereby accelerating regional decarbonization efforts and establishing Malaysia as the Renewable Energy (RE) hub for ASEAN. In addition, these partnerships are intended to broaden TNB's renewable energy portfolio and expedite the expansion of its wholly-owned

subsidiaries, TNB Power Generation Sdn Bhd (TNB Genco) and the New Energy Division, throughout Southeast Asia (TNB, 2023).

Global partners have acknowledged TNB's exceptional performance in providing energy solutions of exceptional quality. For instance, Mr. Eric Fan of BDC underscored the critical role of TNB in guaranteeing a dependable power supply by referencing agreements such as the MY07 Electricity Supply Agreement. This partnership facilitates the incorporation of renewable energy through the Green Energy Partnership and supports BDC's hyperscale data center services. TNB is bolstering Malaysia's status as a premier data center operations hub in the region by promoting sustainable development in the digital infrastructure sector (Moises, 2024).

4.4.2 Climate Change

Climate change, as defined by UNFCCC, is any alteration in the climate that is directly or indirectly caused by human activity and that affects the composition of the global atmosphere, in addition to the natural climate variability that has been observed over comparable periods. The sun heat is trapped as greenhouse gas emissions cover the Earth. This results in climate change and global warming. The current rate of global warming surpasses that of any other period in recorded history. The typical equilibrium of nature is being disrupted and weather patterns are changing as a result of the increasing temperatures which presents numerous hazards to all living organisms on Earth, including humans.

Worldwide, the planet progressive warming has had a noticeable impact on numerous locations. Insights from METMalaysia indicate that the surface temperature would rise by 0.24°C for Peninsular Malaysia, 0.14°C for Sabah, and 0.13°C for Sarawak per ten years between 1969 and 2023. The effects of global warming and climate change are serious for Malaysia and should not be taken lightly. Malaysia is the top emitter of carbon emissions that contribute to climate change among ASEAN nations. The high density of carbon emissions from burning charcoal has a detrimental effect on the environment and raises global temperatures (IEA, 2021).

The earth is enveloped by greenhouse gases that are emitted into the atmosphere, which act as a blanket, **trapping heat** and **causing temperatures to rise**. This results in a more **rapid evaporation of water** on land and at sea, which means that there is a greater amount of water to be released when it showers. And **flooding** can result when an immense quantity of precipitation is released onto the earth in a brief period of time. One estimate suggests that climate change is responsible for an average of one in four record rainfall extremes in the past decade. Malaysia is experiencing an increase in the frequency of **intense rainfall**. The country experiences more intense rainfall during the **monsoon season**, particularly in November or December and can stretch out until early January, which results in enormous floods, as a result of the physical impacts of climate change.

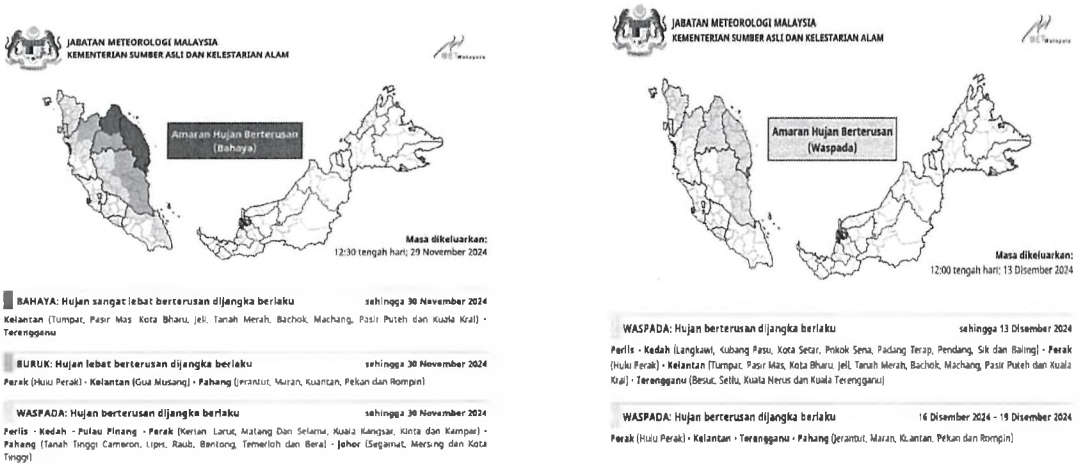

Figure 10: The Malaysian Meteorological Department (MetMalaysia)'s Heavy Rains Forecast

Recent Natural Disasters in Malaysia

The occurrence and cost of flash floods in Malaysia have increased over the past three decades, frequently resulting in **electricity outages**, **water shortages**, **infrastructure damage**, and **displacement**, as a result of the increased intensity of rainfall. For example, in response to flooding and subsequent heavy rainfall, 230 electrical substations in eight districts of Kelantan were recently disconnected to guarantee public safety. Pasir Mas, Machang, Kota Baru, Tanah Merah, Pasir Puteh, Tumpat, Bachok, and Kuala Krai comprise the eight districts (New Straits Times, 2024).

Extreme weather events can cause considerable **losses** for businesses owing to **power outages**, such as lost production, spoilage of goods, and the costs of restarting industrial activities. In light of the ongoing **northeast monsoon season**, Energy Transition and Water Transformation Minister Fadillah (PETRA) emphasised the importance of public safety and announced that Tenaga Nasional Berhad (TNB) will **provide equipment** such as **generators** to **ensure uninterrupted power** at evacuation centres. This was underlined at a flood preparedness briefing conducted by TNB's Chief Distribution Network Officer, Mahathir Nor Ismail, at the company's flood 'war room' in Wisma TNB.

Climate change is having a **physical impact** on the **energy sector**. In the wake of climate change, extreme weather events have resulted in infrastructure damage, power disruptions, and modifications to planning and maintenance. For safety considerations, 455 electrical substations in flood-affected areas were closed within the past week. Out of these, 344 have been reactivated, while 111 are still closed in high-water areas, such as Pasir Mas, Kelantan, and Rantau Panjang. According to The New Straits Times (2024), Kelantan had the highest number of evacuees, with over 146,611 consumers experiencing power disruptions as a result of the recent floods.

Furthermore, Mahathir Nor emphasised that 1,977 TNB employees are currently **on standby** throughout the country to assist with disaster response operations. In spite of these endeavours, the electricity system, which encompasses fuel transportation networks, power facilities, and transmission and distribution lines, continues to be **susceptible to extreme weather circumstances**. As indicated by reports from the Government Accountability Office (2014) and the Department of Energy (2013), the grid capacity to withstand the escalating frequency and intensity of such events is at risk by the fact that a number of components are old and in poor condition.

Consequently, natural disasters, such as floods, **disrupt critical lifelines**, including electricity networks, with far-reaching consequences that extend beyond the direct losses experienced by utilities or system administrators. Electricity is essential for the maintenance of emergency services and other essential systems, including water supply, fuel distribution, and communications, as well as for the economic stability of communities. Malaysia is

particularly **susceptible to flooding** due to climate change-induced disasters such as flash floods and intense rainfall.

Flash floods are among the most significant weather-related events, resulting in pervasive power outages and severe damage to critical infrastructure, such as power systems, water and gas networks, healthcare facilities, communication systems, and transportation networks. The current practice of **shutting down power substations** during floods results in extensive outages, which are further exacerbated by the **lack of climate-resilient infrastructure** in vulnerable areas, thereby adding to the expanding risks.

Figure 11: Recent Flooding in Jitra, Kedah

Recommendation: Enhancing Power Grid Resilience with Microgrids

Power and heat production are the primary sources of **carbon emissions,** as per Nor et al. (2016). The **energy sector** has been identified as the **biggest emitter** in the UNFCCC Biennial Report (2020). Tenaga Nasional Berhad (TNB) is the primary electrical provider in Malaysia because of its monopoly on electricity generation. According to the IEA (2022), the main source of carbon emissions is power generation. Nearly 80% of Malaysia's total greenhouse gas (GHG) emissions come from the energy industry, which includes the electricity supply sector, according to Deputy Prime Minister Datuk Seri Fadillah Yusof. With over 75% of global greenhouse gas emissions and approximately 90% of all carbon dioxide emissions coming from fossil fuels like coal, oil, and gas, fossil fuels are by far the biggest

cause of climate change. TNB must therefore address these emissions and spearhead the shift to sustainable energy solutions as the country's top power utility.

TNB must both adapt to and minimise climate-related risks in order to lessen the energy system's vulnerabilities today and provide dependable electricity in the future. TNB's energy decisions will have a significant impact on lowering greenhouse gas emissions and strengthening the electrical system's resilience. As a result, the government has given adequate thought to strengthening the resilience of energy-related infrastructure against possible climate change consequences under the Eleventh Malaysia Plan (2016-2020). In this regard, the project's goal is to strengthen Malaysia's electrical grid system's resistance to flash floods and lightning strikes. It is anticipated that the new technique will reduce the effects of flash floods on the supply of energy, hence improving the resilience of the power system.

Microgrids offer a viable solution for improving the resilience of TNB's power grid, as Malaysia encounters an increasing number of challenges from lightning strikes and flash floods. Microgrids are electricity systems that are localised and can **operate independently from the main grid**, thereby **guaranteeing a dependable power supply** in the event of an emergency. A solitary building, such as a hospital or police station, or a collection of buildings, such as an industrial park, university campus, military base, or neighbourhood, can be powered by microgrids. Additionally, larger areas, such as villages or cities, can be powered by groups of microgrids that are interconnected. TNB can advance low-carbon and cost-effective energy solutions while simultaneously addressing vulnerabilities in traditional infrastructures through the adoption of microgrid technology.

Microgrids provide resilience against extreme weather by integrating **islanding** capabilities, which enable them to **disconnect from the primary grid** and maintain power supply for critical facilities during outages caused by lightning or floods. This capability mitigates disruptions to essential services, businesses, and residences, notably in disaster-prone or isolated regions. Furthermore, microgrids support the integration of renewable energy sources such as solar and wind, which is consistent with TNB's sustainability objectives and promotes Malaysia's low-carbon transition. Microgrids guarantee a consistent power supply and rapid restoration by utilising mobile energy generators and energy storage systems, thereby reducing the duration of outages.

By strategically deploying microgrids at critical customer sites and vulnerable locations, TNB can further enhance grid resilience. These systems, coupled with optimised infrastructure hardening and prepositioned resources, offer a proactive approach to managing weather-related risks. Additionally, microgrid solutions are a cost-effective solution for the long-term sustainability of the power grid due to their potential for energy independence and their affordability. TNB can not only fortify the Malaysian power grid against natural disasters but also facilitate the country's transition to a more resilient, environmentally friendly energy future by investing in microgrids..

5.0 Conclusion

Ultimately, TNB has been making steady progress and adapting to the changing energy landscape by focussing on strategic partnerships, technological innovation, and renewable energy initiatives. My industrial training experience with TNB has afforded me invaluable insights into the company's operations, strategies, and dedication to accomplishing its net-zero objectives. This internship has not only improved my understanding of the energy sector but has also refined my communication, analytical, and teamwork abilities. These skills will doubtlessly be advantageous in my future professional pursuits. The exposure to real-world challenges and dynamic initiatives has bolstered my comprehension of corporate practices, reaffirmed my professional aspirations, and instilled a more profound appreciation for the role of sustainability in influencing the future of energy.

Appendices

Figure 12: New Energy Division Deepavali Celebration

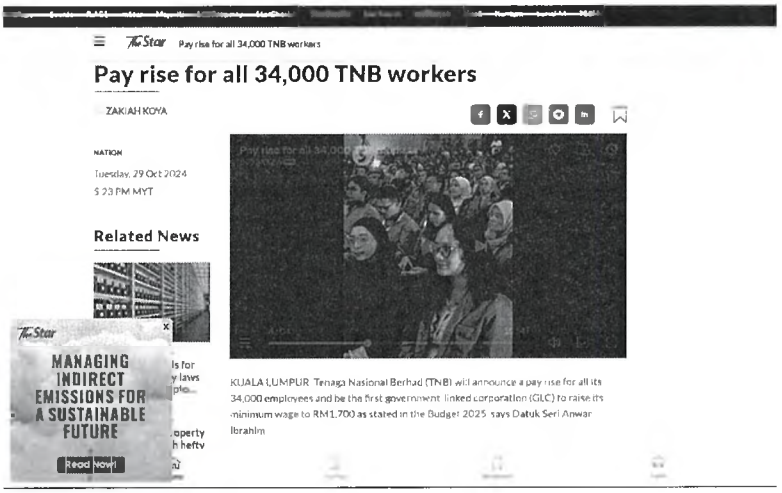

Figure 13: 75th anniversary celebrations of TNB. The Star.

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