MINISTRY OF HUMAN RESOURCES

TalentCorp
GROUP OF COMPANIES

Impact Study of Artificial Intelligence, Digital, and Green Economy on the Malaysian Workforce Volume 2

Sector:
Energy and Power

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Preface by the Group Chief Executive Officer of TalentCorp

As Malaysia stands on the threshold of a transformative era, we find ourselves driven by the accelerating forces of Artificial Intelligence (AI), Digital, and Green Economy. These global trends are reshaping industries, redefining the future of work, and challenging us to navigate both the opportunities for job creation and the realities of evolving role redundancies.

With a median age of 31, Malaysia leads a youthful ASEAN region where the median age is just 30. This demographic advantage presents a unique opportunity—a vibrant, dynamic workforce ready to harness the opportunities of a Digital and Green Economy. Yet, it also poses challenges. Youth unemployment and underemployment remain persistent issues across ASEAN, with Malaysia facing a youth unemployment rate of 11% and 36.3% of tertiary-educated employees grappling with skill-related underemployment. These figures demand immediate action. Reskilling and upskilling are not just important—they are imperative as the landscape of jobs continues to evolve.

At TalentCorp, we are honoured to serve as a strategic think tank under the Ministry of Human Resources' (KESUMA) mandate. This critical role allows us to leverage our networks and initiatives, providing data-driven insights that strengthen the government's intelligence capacity and support national policy development, advocacy, and long-term strategic planning.

One of our foremost initiatives in this capacity is the **Impact Study of AI, Digital, and Green Economy on the Malaysian Workforce**. This study is designed to offer key guidance to policymakers and industries, equipping them with the knowledge to prepare the workforce for upcoming shifts. It highlights essential reskilling and upskilling programmes to assist Malaysians affected by job displacement, ensuring they transition smoothly into new roles, fostering sustainable growth, and ensuring no one is left behind.

Through insights gleaned from this study, TalentCorp's MyMAHIR Future Skills Talent Council (FSTC)—an industry-led body dedicated to addressing skills needs—will drive efforts to close critical skills gaps. MyMAHIR's collaboration with industry leaders enables us to identify priority competencies and shape training programmes to meet the evolving demands of their sectors. Aligned with the MADANI Economy framework's focus on lifelong learning and guided by best practices from the International Labour Organization (ILO), TalentCorp will continue working closely with key ministries, agencies, and industry players to develop forward-looking curricula that meet the workforce needs of the future.

As Malaysia navigates this new landscape, the findings from this study will serve as an indispensable resource—providing policymakers, industries, and the workforce with the insights and tools required to stay competitive and resilient in an ever-evolving global economy.

On behalf of TalentCorp, I extend our deepest gratitude to our industry partners, colleagues, and experts for their invaluable contributions to this study. Together, we have crafted a comprehensive and impactful report that will serve as a guide for Malaysia's future of work, ensuring that we are prepared for the challenges and opportunities ahead.

Thomas Mathew
Group Chief Executive Officer
Talent Corporation Malaysia Berhad

“As Malaysia navigates this new landscape, the findings from this study will serve as an indispensable resource— providing policymakers, industries, and the workforce with the insights and tools required to stay competitive and resilient in an ever-evolving global economy.”

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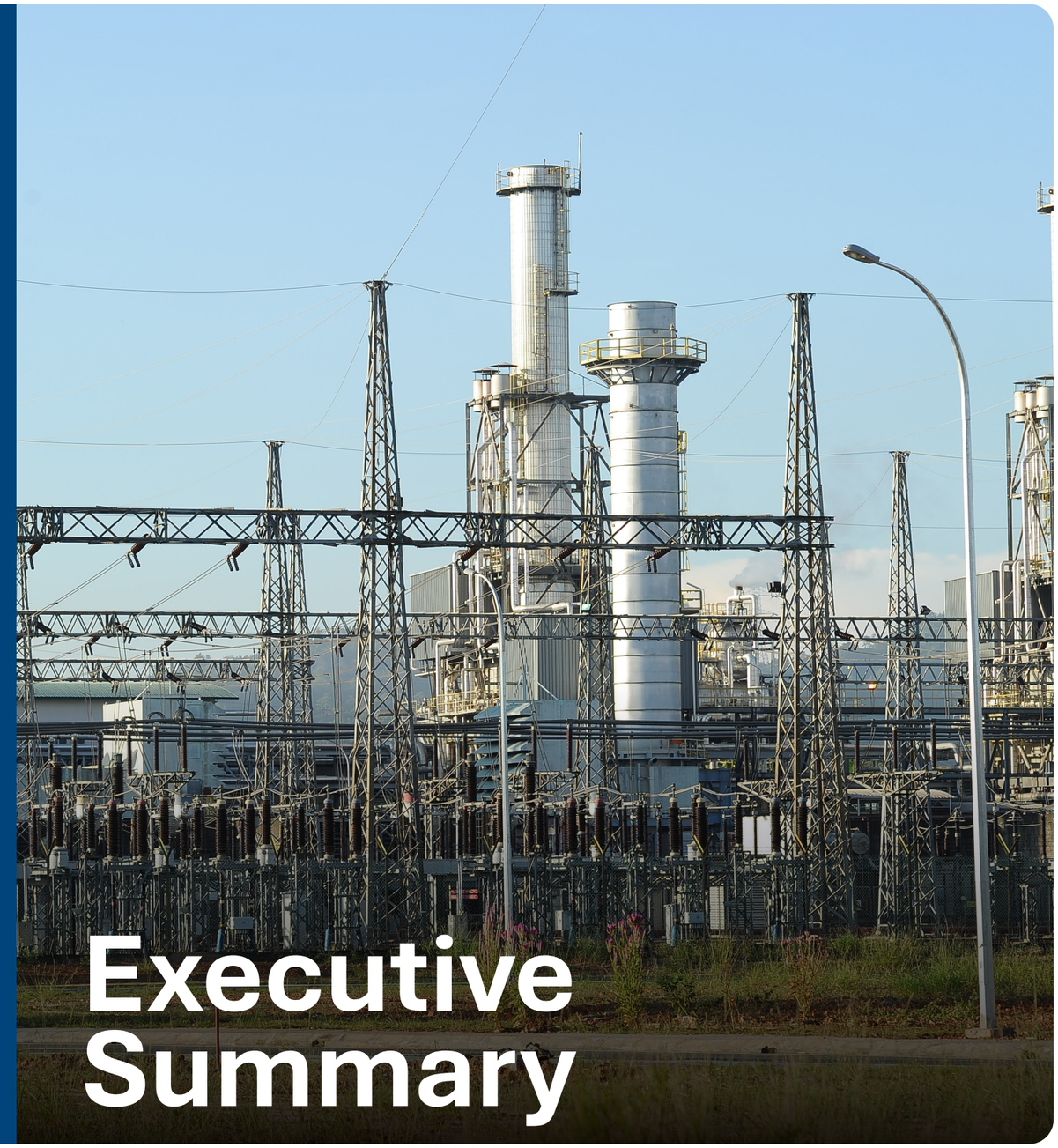


Executive Summary

Malaysia has successfully developed a substantial Energy and Power (E&P) sector that contributed RM26.7 billion to gross domestic product (GDP) in 2021 from electricity generation, transmission, and distribution across conventional power and renewable energy sources. While the sector still mainly relies on fossil fuels as a source of energy for electricity generation, renewable sources such as solar, hydropower, and biomass are gaining pace in powering the nation.

As Malaysia's GDP grows, the demand for electricity is rising in tandem with improved living standards. This demand is further driven by the establishment of data centres and the adoption of advanced technologies, such as Internet of Things (IoT) and Electric Vehicles (EVs).

Notwithstanding the key role that conventional power still plays in powering the nation, Malaysia has been gradually pivoting to cleaner sources of energy and power has been driven by the country's low carbon aspirations. Beginning with the country's signing of the Paris Agreement in 2015 to reduce carbon emissions, the Government has accelerated its commitments to address climate change by incorporating low carbon goals into its socio-economic development plans.

Critically, since 2022 the Government has introduced the National Energy Policy 2022-2040, the Mid-Term Review of the Twelfth Malaysia Plan (KSP RMKe-12) and the National Energy Transition Roadmap (NETR), making up the country's main policy documents currently informing its goal to achieve net zero carbon emissions by 2050.

These policy goals are aligned with stakeholders such as regulators, customers, investors, and financial institutions, which coerce the E&P sector to decarbonise and address climate change. This must be achieved while balancing the energy trilemma—ensuring electricity security and affordability amid growing demand, and meeting sustainability goals to address environmental sustainability, energy security, and energy equity.

These climate imperatives have, at the same time, converged with the emergence of Artificial Intelligence (AI), Digital, and Green Economy trends. This presents both opportunities and challenges for Malaysia's E&P sector and further creates implications for its workforce, requiring workers to review their readiness to serve and compete in a rapidly evolving landscape.

Thus, this impact study identified a total of 135 key roles, of which 126 are positions integral to maintaining sector standards and operational efficiency. The remaining nine (9) are emerging roles for the next three (3) to five (5) years needed to drive innovation and sustainability.

Although none of the critical roles were assessed to be impacted by AI, Digital, and Green Economy trends, 66 roles, or 52% of the roles were identified to be medium impacted roles, with the remaining 60, or 48%, consisting of low impacted roles. The medium impacted roles are made up of those which are affected by digital transformation and environmental sustainability. Low impacted roles, meanwhile, consist of managerial roles which usually involve complex decision-making, human capabilities, and an understanding of on-field tasks that AI/Digital cannot fully replicate. Finally, emerging roles are expected to arise from the growing recognition of the need to adopt emerging technology and sustainability practices.

In response to the impact of AI, Digital, and Green Economy on the E&P sector, 11 initiatives were identified across the E&P sector's talent ecosystem to drive a holistic response. The initiatives are also envisioned to drive innovation, skills development and sustainability in the sector, while ensuring the sector and its workforce strengthens its competitiveness.

The initiatives are grouped into four (4) categories based on the leading and enabling entities: **Government**, **Industry Players**, **Academia** and **Training Providers**:

GOVERNMENT	**IN1** Funding and Incentives **IN2** Regulations, Policy, and Initiatives **IN3** Talent Development
INDUSTRY PLAYERS	**IN4** Talent Development **IN5** Research and Innovation **IN6** Leadership and Organisation Strategy
ACADEMIA	**IN7** Curriculum Development **IN8** Internship and Work Readiness **IN9** Grants and Research Support
TRAINING PROVIDERS	**IN10** Training Ecosystem **IN11** Content Development and Delivery

Chapter 1:
Introduction of the Study

Introduction of the Study

Purpose of the Study

The increasing focus and adoption of AI, Digital, and Green Economy call for a transformative shift in global operating models and workforce, supported by the digitally enabled drive beyond Industrial Revolution 4.0. The study aims to help government, industry players, academia, training providers, and the public to prepare for future workforce demands. The output of this study will contribute to the Malaysia National Skills Registry (MyNSR), a skills taxonomy that will be integrated into the MyMAHIR platform. This platform offers comprehensive insights into industry trends, job roles, required skills, career pathways, and available training programmes across all sectors.

These research and studies cover several sectors, namely Information and Communications Technology (ICT); Food Manufacturing and Services; Pharmaceutical Manufacturing; Medical Devices; Aerospace; Electrical and Electronics; Wholesale and Retail Trade; Energy and Power; Chemical; and Global Business Services.

AI will increasingly impact the nature of work and the broader societal progress

Majority of industry players in Malaysia are conscious about AI and the benefits it brings to organisations. While some have leveraged AI to carry out tasks, many organisations have yet to fully embrace AI as it remains difficult for organisations to justify the expense and effort required to implement AI due to the uncertainty of Return on Investment (ROI). Organisations are also wrestling with how to address AI throughout their operations – not just from a technology perspective but also from the human perspective in terms of roles and skills readiness.

This is also consistent with an inaugural Cisco AI Readiness Index in 2023 where 86% of organisations worldwide are not fully ready to integrate AI into their businesses. Malaysia's AI Readiness tracks that of the Global level, standing at 87% with only 13% considered as "pacesetters".

With the rise of AI, the Malaysian government has launched the National AI Talent Roadmap 2024–2033 to cultivate a skilled workforce to unlock the potential of AI across various sectors. Adding to this momentum, tech giant Microsoft Corp announced a significant investment of RM10.5 billion in Malaysia's cloud and AI infrastructure. Additionally, global tech firms Google and ByteDance will invest RM9.4 billion and approximately RM10 billion to establish data centres and transform Malaysia into a regional AI hub.

Malaysia's digital transformation is key to enhance national competitiveness, empower industries and local enterprises to progress towards high-value added activities

Digital transformation has been a strategic imperative across many organisations for many years. By continuing to embrace digital technologies, Malaysia can significantly elevate the capabilities of its industries and local enterprises. This technological advancement is not just about automating existing processes to enhance productivity, but also about enabling a shift towards higher value activities.

Digital Economy is one of Malaysia's key economic pillars, contributing 22.6% to the country's gross domestic product (GDP).[4] This number is set to rise to 25.5% by 2025. To remain relevant and resilient, the Malaysia Digital Economy Blueprint overseen by MyDIGITAL outlines the efforts and initiatives taken to transform Malaysia into a high-income nation that is focused on digitalisation and a regional pioneer in the digital economy.

Malaysia is also making significant strides in Green Economy

When it comes to Green Economy, most organisations in Malaysia today are still driven by compliance to regulations. However, there has been growing awareness and willingness to drive the Environmental, Social and Governance (ESG) agenda at the forefront with concerted efforts from the government, private sector, and public. While progress is being made, ongoing commitment and collaboration across all industries are necessary to ensure a sustainable future for the country.

This is in line with the Twelfth Malaysia Plan (2021–2025) that outlines the nation's aspiration to achieve net-zero greenhouse gas (GHG) emissions as early as 2050. Complementing this, the National Energy Policy (2022–2040) sets the foundation for transforming the energy landscape towards sustainability. In line with these objectives, the Malaysian Government has also developed the National Energy Transition Roadmap (NETR) to accelerate the shift from a traditional fossil fuel-based economy to a high-value Green Economy. Malaysia's efforts are reflected in its leading position in the World Economic Forum Energy Transition Index, ranking 1st in ASEAN and 35th globally.[5]

It is imperative to future-proof Malaysia's workforce for the impact of AI, Digital, and Green Economy

This study aims to provide transformative and strategic inputs to complement the rapid growth of these areas. It will examine how these trends as a whole will reshape Malaysia's workforce in the upcoming three (3) to five (5) years and assess the impact of current and future trends of AI, Digital, and Green Economy; its implications for current and future job roles and skills; the nation's capacity to cater to future workforce demands and needs; and lastly, policy recommendations that the policy makers and agencies, industry players, academia and training providers as a whole can do in spurring the industry forward amidst flexible changes ahead.

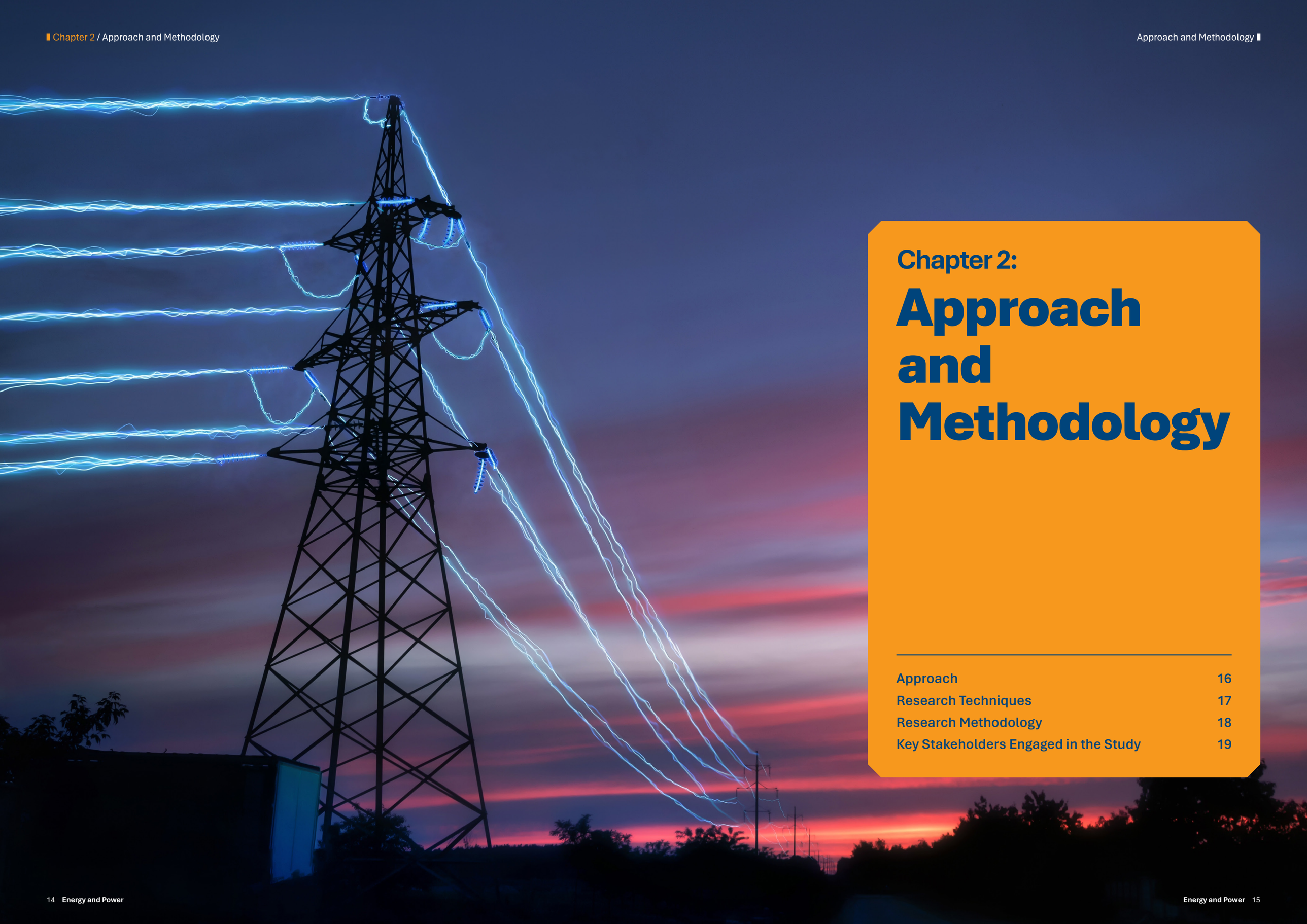
This report will provide an overview of the Energy and Power sector, including its related sub-segments, the key trends and developments relating to AI, Digital, and Green Economy.

More importantly, it will highlight the roles impacted as well as the skills needed to be future-ready for the Energy and Power sector. These findings are based on engagements with industry associations and key players as well as regulators and government agencies.

The report concludes with Recommended Initiatives for four (4) key stakeholder groups, namely: Government, Industry Players, Academia, and Training Providers.

> **"Microsoft's investments in digital infrastructure and skilling will help Malaysian businesses, communities, and developers apply the latest technology to drive inclusive economic growth and innovation across the country."**
>
> ***Satya Nadella, CEO of Microsoft***

1. Vanessa Gomes, *Catalysing Malaysia's Digital Economy*, September 2022, https://mdec.my/esg-mdcap/content-hub/catalysing-malaysia-digital-economy
2. MIDA, *Malaysia ranked first place in S-E Asia in WEF Energy Transition Index*, July 2030, <https://www.mida.gov.my/mida-news/malaysia-ranked-first-place-in-s-e-asia-in-wef-energy-transition-index/>



Chapter 2:
Approach and Methodology

Approach

A six-pronged approach entailed a blend of qualitative and quantitative research techniques that generated insights and met the objectives desired from this study. The study's outcomes reflect what is happening in each industry today and what is expected of each sector in the next three (3) to five (5) years.

Research Techniques

The qualitative and quantitative research techniques were as follows:

Research Methodology

The study focused on three (3) key trends shaping today's workforce: AI, Digital, and Green Economy. Their definition is outlined below:

01 Artificial Intelligence
Development and use of machine learning models capable of performing tasks that would have required human intelligence (deep learning, computer vision, Natural Language Processing (NLP), reinforcement learning, supervised and unsupervised learning).[3]

02 Digital
Activities and transactions driven by the public and various organisations to produce, adapt and innovate digital technologies and services for enhanced productivity and quality of life (big data analytics, cloud, Internet of Things (IoT), and robotic process automation).[4]

03 Green Economy
Employment growth and income driven by investment in low-carbon, resource-efficient, and socially inclusive economic activities, infrastructure, and assets.[5]

To effectively analyse how the key trends impact existing roles, four (4) key parameters have been defined in the assessment process, as stated below:

AI & Digital

1. **Opportunity to automate data-driven or low-creativity activities that are repetitive or rule-based via AI or other technology tools.**

2. **Human intervention is required despite some or most activities being automated or digitalised, as:**
   - Strategic thinking and problem-solving are vital to making decisions
   - Creative thinking is needed to generate new ideas or ways of working
   - Outcomes need to be communicated or socialised and regulated
   - High importance is placed on human emotions or physical involvement in performing the activity
   - Typically performed by a critical role that holds accountability or a role requiring certification

Green Economy

1. **Impact of the environment on jobs that depend on limited natural resources and produce outputs that are polluting or may pollute the environment.**

2. **Opportunity to diversify, requiring new skills to implement the organisation's Environmental, Social, and Governance (ESG) agenda, which includes:**
   - Environment: Areas for improvement in environmental sustainability
   - Social: Diversity, equity, inclusivity, ethics, and community engagement
   - Governance: Risk management, compliance, reporting, and corporate culture

3. World Economic Forum
4. Malaysia Digital Economy Corporation (MDEC)
5. United Nations Environment Programme (UNEP)

Based on the parameters above, the impact assessment of AI, Digital, and Green Economy on roles will result in one of the following outcomes:

HIGH

Roles at risk of convergence or displacement

Need to pivot to adjacent role and reskill

MEDIUM

Roles still relevant

Need to evolve and upskill to deliver beyond what would traditionally be expected

LOW

Roles not severely impacted

Require ongoing self-improvement to stay relevant

The impact assessment results inform individuals and organisations about the levels of risk faced by job roles in the industry. This information can aid in strategising career development and workforce planning, ensuring relevance amidst advancements in the three (3) key trends.

Key Stakeholders Engaged in the Study

Recognising the importance of on-the-ground perspectives, the impact study gathered insights from key stakeholders across the country, including Government, Associations, Industry Players, and Training Providers. The contributions from these four (4) groups enriched and fine-tuned the study's findings.

Stakeholders and their Contributions to the Study

Stakeholder Groups	Government Entities responsible for enforcing industry regulations and ensuring compliance with standards	Associations Organisations facilitating networking, advocacy, and knowledge exchange among industry players	Industry Players Companies actively involved in producing and distributing goods or services within the industry	Training Providers National and state-specific institutions that offer courses to develop skills and knowledge in various fields
Key Contributions	• Share inputs on industry trends • Validate high-level impact assessments • Recommend initiatives	• Identify selected industry players • Share inputs on industry trends • Validate high-level impact assessments • Recommend initiatives	• Validate industry trends • Validate detailed impact assessments • Identify future roles and skills requirement • Provide a view of capacity demand and number of highly impacted workforce • Recommend initiatives	• Recommend training providers and suitable programmes mapped to skills • Suggest new training programmes to close existing and future gaps • Recommend initiatives

Stakeholders' Selection Criteria

Selecting the right stakeholders ensures the impact study benefits from diverse perspectives and relevant expertise. The four (4) criteria used to identify stakeholders for engagement are:

01

HOLISTIC SECTOR COVERAGE

Comprehensive coverage of industry players across all sub-sectors and the entire value chain

02

STRONG BRAND PRESENCE

Widespread visibility and influence within the sector

03

SIZEABLE EMPLOYMENT COVERAGE

Comprehensive coverage and employee counts across all roles included in the assessment

04

SIGNIFICANT TURNOVER

Ensure a diverse mix of industry players, including large firms with high turnover

Over the course of the study (April - September 2024), a total of **40** experts from **12** organisations were consulted in the **22** engagements conducted.

Key Facts and Figures of Impact Study Stakeholder Engagements

In-Depth Interviews	Validation Workshops
Regulators : 4	Industry Players : 7

Chapter 3:

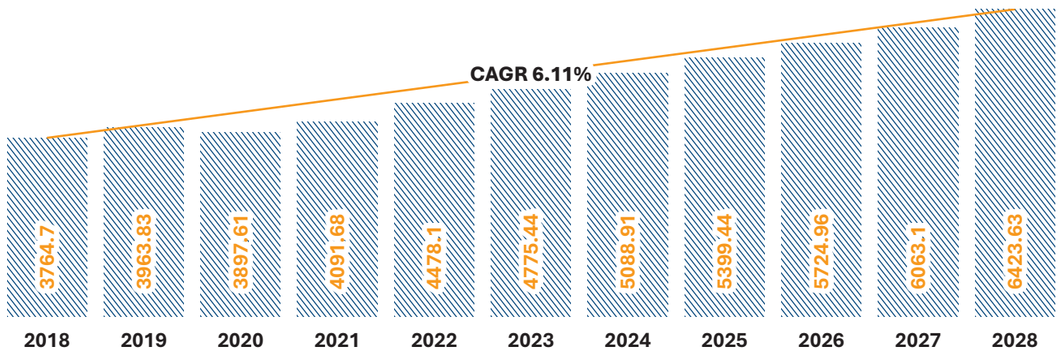
Sector Overview

The E&P sector is undergoing an urgent transition as the world faces climate change that puts pressure on the sector to lower emissions. This chapter discusses global and Malaysian trends shaping the E&P sector, showing how global and local macro trends influence the sector as well as the impact of AI, Digital, and Green Economy on the workforce.

Overview of Global Trends in the Energy and Power Sector

The global E&P sector continues to grow steadily, recording a Compound Annual Growth Rate (CAGR) of 4.87% from 2018 to 2023. The sector is also expected to continue growing, providing a positive outlook for E&P players globally for the next four years, growing at a CAGR of 6.11% to reach USD6.42 trillion (RM28.10 trillion) in 2028.[6]

Global Electric Power Generation, Transmission, and Distribution Market, Market Size, 2018-2028, USD Billion



In addition to the sector's steady growth, key market trends that have emerged in the global E&P sector include a growing emphasis on sustainability, a shift towards new energy ecosystems and the growing use of electricity in adjacent sectors.

Shift Towards New Energy Ecosystems

Changing consumer attitudes has moved the global energy landscape away from the traditional centralised model, dominated by fossil fuels and power utilities with a one-way energy flow, to a new decentralised renewable energy sources model. This has turned consumers into active "prosumers" who engage in two-way energy interactions where users are generating their own energy and selling excess energy back to the grid, such as in the example of home rooftop solar panels.[7] This decentralised or distributed power generation model, which puts power production closer to the point of use, also reduces costs and increases efficiency.[8]

This shift has been further sped up with utility-scale renewables becoming 86% cheaper than fossil fuels in 2021[9] and support from 89% of consumers in 18 global markets for the shift towards renewables to reduce the reliance on fossil fuels.[10]

Accelerating Demand in Key Sectors

Transportation and Information and Communications Technology (ICT) are two (2) sectors which rely heavily on energy, driving future demand for electricity.

6. The Business Research Company, *Global Electric Power Generation, Transmission, And Distribution Market Briefing 2024*, March 2024
7. Ibid
8. Ibid
9. Climate Action Tracker, <https://climateactiontracker.org/>
10. EY Energy Consumer Research 2023

In the transport sector, the drive for green mobility is influencing the electrification of railways, public transit systems and vehicles, boosting demand for electricity.[11] Global EV sales reached 14 million units in 2023, with China, Europe and the United States (US) making up 95% of the market and bringing the total number of EVs in the world to 40 million.[12] EV production is expected to further contribute to the 57% growth in global electricity demand by 2050.[13]

Meanwhile, the digital era and the booming data centre sector has made the ICT sector among the most energy intensive, creating new sources of electricity demand.[14] From 2024 to 2027, the global data centre market is expected to grow at a CAGR of 13.3% to USD731.7 billion (RM3.20 trillion)[15] from increasing global data creation, the surge of the AI industry and expansion of 5G usage.[16] Data centres now make up for around 3% of global electricity consumption, which is expected to reach 4% by 2030.[17] On average, hyperscale data centres consume 20-50 megawatts (MW) of electricity annually, equivalent to powering up to 37,000 homes.[18]

Growing Emphasis on Sustainability

The need to address climate change drives the E&P sector to achieve net zero emissions, with the sector increasingly looking to renewable energy sources to produce enough energy whilst minimising carbon emissions.[19] By 2050, 62% of power is expected to be generated from local renewables.[20] Retrofitting fossil fuel plants with carbon capture, utilisation and storage (CCUS) technologies in the near and medium term could help to tackle carbon emissions.[21] In the Sustainable Development Scenario, CCUS is expected to capture nearly 90% of carbon dioxide (CO_2) in heavy industries by 2030 and make up for 55% of cumulative capture by 2070.[22]

Around the world, 145 countries including Malaysia have committed to or are considering net zero targets.[23] In 2021 alone, energy transition investments had risen to USD755 billion (RM3.30 trillion), 27% higher than in 2020.[24] To this end, USD600 billion (RM2.63 trillion) is needed for global network investments annually to meet 2030 decarbonisation goals.[25]

Case Studies

1. In July 2024, global energy and services group ENGIE signed new Corporate Power Purchase Agreements (CPPAs) to supply over 118 MW of renewable power to Google's digital infrastructure in Belgium. These agreements include four (4) new onshore wind farms and an extension of a CPPA for an existing wind park.[26]
2. In November 2023, Enel, a green energy company, announced their 2024-2026 Strategic Plan, committing approximately EUR35.8 billion (RM174.26 billion) to enhance electricity grids. This investment, along with distributed generation, aims to improve the speed, quality, and resilience of the electrification process.[27]

11. The Business Research Company, *Global Electric Power Generation, Transmission, And Distribution Market Briefing 2024*, March 2024
12. EY Energy Consumer Research 2023
13. The Business Research Company, *Global Electric Power Generation, Transmission And Distribution Market Briefing 2024*
14. International Energy Agency (IEA), *Electricity 2024: Analysis and forecast to 2026*, May 2024
15. Technavio, *Data Center Market Analysis North America, APAC, Europe, South America, Middle East and Africa - US, Germany, UK, China, Canada - Size and Forecast 2024-2028*, May 2024, <https://www.technavio.com/report/data-center-market-industry-analysis?amp>
16. EY Energy Consumer Research 2023
17. Clifford Chance, *Data Centre Trends in 2023*, February 2023
18. Vertiv, *Vertiv 2023 Data Center Trends*, <https://www.vertiv.com/en-asia/about/news-and-insights/articles/pr-campaigns-reports/vertiv-2023-data-center-trends/>
19. EY Energy and Resources Transition Acceleration Report
20. Energy and Resources Transition Acceleration model
21. International Energy Agency (IEA), *How Carbon Capture Technologies Support the Power Transition*, <https://www.iea.org/reports/the-role-of-ccus-in-low-carbon-power-systems/how-carbon-capture-technologies-support-the-power-transition>
22. IEA Sustainable Development Scenario
23. Climate Action Tracker, <https://climateactiontracker.org/>
24. The Business Research Company, *Global Electric Power Generation, Transmission, And Distribution Market Briefing 2024*, March 2024
25. International Energy Agency (IEA), *Trends in electric cars*, <https://www.iea.org/reports/global-ev-outlook-2024/trends-in-electric-cars>
26. ENGIE, *Google and ENGIE sign five new cPPAs*, 3 July 2024, <https://www.engie.com/en/news/cPPA-signature-Google>
27. Enel, 2024-2026 Strategic Plan: flexibility, efficiency, sustainability, 27 November 2023, <https://corporate.enel.it/en/media/explore-news/news/2023/11/2024-2026-strategic-plan>

Overview of the Malaysian Trends in the Energy and Power Sector

A Snapshot of the E&P Sector in Malaysia[28]

GDP contribution*

2021
RM 26.7 billion

Nature of sector

- **Conventional energy power (fossil fuels): Concentrated**
  Dominated by few key regional players – Tenaga Nasional Berhad (TNB) in Peninsular Malaysia, Sabah Electricity in Sabah and Sarawak Energy in Sarawak
- **RE sources (solar, hydropower, biomass): Diverse**
  Comprising of local and international organisations with diverse revenue size

Number of Employees*

2021
43,465

This report covers the following segments of Malaysia's E&P sector:

Conventional Power and Renewable Energy

Generation	Transmission	Distribution
Process of generating electricity from primary energy sources (e.g., natural gas and coal) and renewable resources	Bulk movement of generated electricity from a generating site to an electrical substation	Delivery of electricity – receive power from transmission systems and distributing to customers

Note:
Scope of renewable resources is limited to solar, mini-hydropower/hydropower, and bioenergy
Retail is not covered in this phase but will be considered for coverage in subsequent phases

28. Department of Statistics Malaysia (DOSM): Annual Economic Statistics 2022

Malaysia's E&P Market Insights

Malaysia's total electricity generation reached 166,817 Gigawatt hours (GWh) in 2021, with Peninsular Malaysia accounting for the bulk of electricity generation at 128,046 GWh, followed by Sarawak at 0.0319299 GWh and Sabah at 0.006761 GWh.[29]

The E&P sector is a critical enabler for the country's economic growth, while the rise of data centres, push towards energy transition and advanced technologies providing further impetus for the sector's growth. These market trends will create major investments in the sector to meet new demand and future-proof its workforce and infrastructure.

Rise of Data Centres

Malaysia has been recognised as a top data centre investment destination, attracting billion-dollar investments from tech giants such as Google, Nvidia, and Microsoft. With the data centre market expected to keep growing, energy demand will surge. This will require significant investments in power infrastructure and renewable energy to ensure reliable power supply while minimising GHG emissions.

Race Towards Energy Transition

To achieve net-zero GHG emissions by 2050, Malaysia launched the NETR in 2023, targeting 70% renewable energy by 2050. The roadmap's initiatives, including energy efficiency, renewable energy, hydrogen, green mobility, and CCUS projects, aim to attract RM25 billion in investments annually, create 23,000 jobs, and cut over 10,000 Gigagrams (Gg) of carbon dioxide[30] equivalents. As the nation moves towards net zero, interim targets include a 35% reduction in emission intensity by 2035 and a complete retirement of coal-fired plants in 2044 as a marker of the nation's progress.[31] The Government has also pledged not to build new coal-fired power plants.[32]

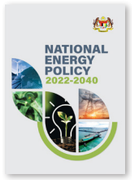
Adoption of Advanced Technologies

The Energy Commission (EC) has highlighted key trends such as electrification, digitalisation, and decentralisation reshaping Malaysia's E&P sector. The sector is adopting technologies such as EVs, smart grids, IoT, and microgrids.[33] Malaysia has installed 4 million smart metres, with plans to increase to 9.1 million by 2026.[34] Currently, there are 2,585 EV charging points installed nationwide as per June 2024 with the aim of installing 10,000 EC certified charging points by 2025.[35]

> **Malaysia's net zero goals are a significant focus of its National agenda, with renewable energy playing a key role in driving the Nation's commitment to a sustainable and resilient future**

29. EMIS, *An EMIS Insights Industry Report: Malaysia Electric Power Sector Report 2023-2024*
30. Ministry of Economy, *National Energy Transition Roadmap*, 2023
31. Tan Zhai Yun, *Fadillah: Malaysia aims for complete retirement of coal-fired power plants by 2044*, The Edge, 25 June 2024, <https://theedgemalaysia.com/node/716752>
32. Channel News Asia (CNA), *12th Malaysia Plan: What you need to know about the 2050 carbon neutral goal and other green measures*, 28 September 2021, <https://www.channelnewsasia.com/asia/malaysia-12th-plan-carbon-neutrality-2050-green-growth-ismail-sabri-2206756>
33. EMIS, *An EMIS Insights Industry Report: Malaysia Electric Power Sector Report 2023-2024*
34. Bernama, *Power smart meters in 9.1 million households by 2026*, 3 August 2024, <http://energy.bernama.com/news.php?id=1772429>
35. Malaysian Investment Development Authority (MIDA), *2,585 EV charging units installed as of June 25, 2024 – MITI*, 4 July 2024, <https://www.mida.gov.my/mida-news/2585-ev-charging-units-installed-as-of-june-25-2024-miti/>

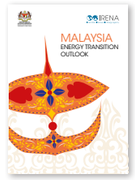
There are currently five (5) main documents which guide Malaysia's low carbon aspirations:



National Energy Policy 2022-2040
Promotes sustainable energy and emissions reduction in Malaysia

NETR
Accelerates renewable energy adoption and reduces fossil fuel reliance

Malaysia Renewable Energy Roadmap (MyRER)
Boosts renewable energy capacity and supports sustainable development



Malaysia Energy Transition Outlook (METO)
Guides Malaysia's sustainable energy transition and future energy planning

Twelfth Malaysia Plan Mid-Term Review
Promotes renewable energy and smart city infrastructure development

Energy-related targets driving the country's low-carbon goals include:

Increase **RE share** to 70% by 2050	Achieve **Net Zero Emission** by 2050	Improve **Energy Efficiency** by 30% by 2030	**EVs** to constitute 80% of vehicle sales by 2050	Five cities as **Smart City** early adopters by 2050

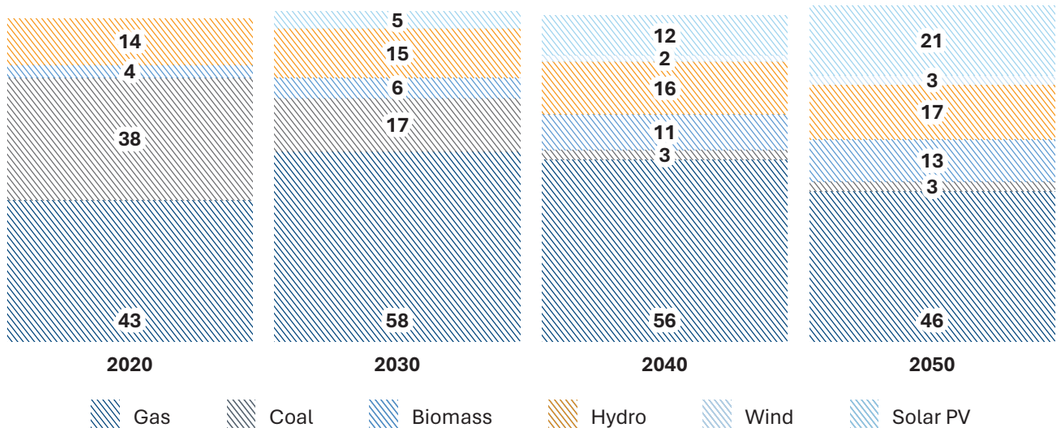
Malaysia's key sources of renewable energy comprise:

1. Solar energy
2. Bioenergy
3. Hydropower
4. Green mobility
5. Wind energy
6. Geothermal energy
7. Hydrogen
8. Energy storage
9. Off-grid
10. Smart green technologies

Malaysia is Undergoing Three (3) Tipping Points That Will Shift Its Energy System

In recent years, Malaysia's energy mix has demonstrated a gradual shift from fossil fuels to renewable sources. Due to the national agenda on energy transition, by 2050 fossil fuels are expected to be further displaced by solar, hydropower and bioenergy.[36]

Malaysia Energy Demand by Fuel Type (% of composition)



Malaysia's shift to a renewable energy system is being driven by three (3) tipping points:	
Tipping Point 1	In 2017, the cost of new distributed solar and its storage matched the retail price of grid electricity
Tipping Point 2	Within the period of 2025 to 2029, EVs are projected to match Internal Combustion Engines (ICE) vehicles in cost and performance
Tipping Point 3	By 2044, new distributed solar and its storage will match grid transmission and distribution

The Countdown Clock for Malaysia is Well on Its Way with Three (3) Tipping Points[37]

Tipping Point 1

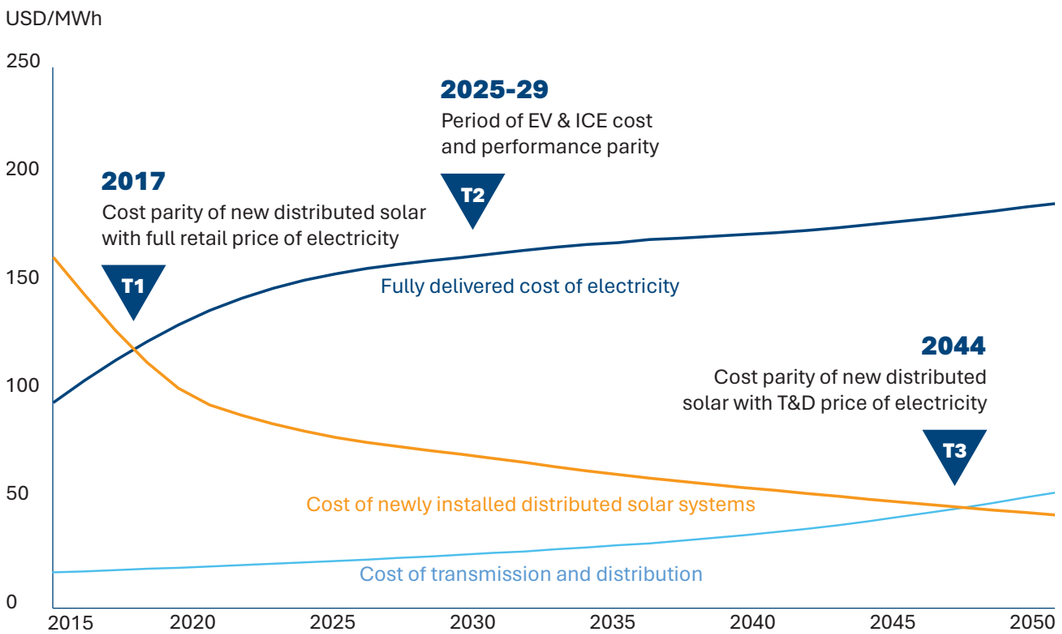
Solar plus storage matches grid electricity cost

Tipping Point 2

EVs match ICE vehicles in cost & performance

Tipping Point 3

Solar plus storage cheaper than grid T&D costs



36. EY Malaysia Tipping Point Analysis
37. Ibid

Impacts of AI, Digital, and Green Economy on the Energy and Power Sector

A Challenges and Opportunities

Challenges

The country must overcome several hurdles to achieve its energy efficiency ambitions, including:

Skills Gaps in Meeting Net Zero Emissions

Industry specialists recognise that energy companies face constraints in meeting the substantial demand for a skilled workforce. This includes finding individuals with expertise in renewable energy and retaining experienced professionals at existing gas power plants, all while encouraging them to transition. Attracting new talent to the renewable energy sector can be challenging, as it requires educating, reskilling, and transitioning from other industries.[38] The implementation of the TVET Competent Energy Commission (TVET-ST) programme will also establish a robust framework for competency development, certification and accreditation. By August 2024, 140 training institutions have received Energy Commission accreditation certificates to conduct competency courses across Malaysia, including public and private institutions.[39]

Energy Trilemma and its Socio-economic Impacts

The energy trilemma of balancing security and reliability of energy supply, affordability of energy and energy sustainability is a key challenge faced by E&P sector stakeholders, from government through to E&P providers. The transition to a low-carbon economy is expected to involve substantial investments, particularly in renewable energy infrastructure, energy efficiency improvements and cleaner technologies. These capital-intensive efforts may call for government subsidies, incentives or public-private partnerships to address the viability of green energy.

Workforce shortage for Competent Persons

Demand for Competent Persons such as chargemen, cable jointers, electrical engineers, electrical services engineers, electrical supervisors and wiremen surpassing available supply in the sector. To become Competent Persons, candidates are required to obtain certifications from the EC. To address the shortage, the workforce is being encouraged to become skilled professionals by pursuing the necessary training and certification to qualify as a Competent Person.

Opportunities

Despite the challenges, Malaysia's rich natural resources and its recent policy acceleration on the energy transition present opportunities for the country's E&P sector to leverage:

Opportunity as Regional Energy Hub

In April 2024, the government established Energy Exchange Malaysia (Enegem) for cross-border trading of green electricity. In setting up Enegem, the government introduced guidelines on green energy exports to Singapore and Thailand, with a pilot from 1 September 2024 to 31 August 2025 to export at least 100 MW of renewable energy to Singapore to test demand while ensuring there remains enough supply for the Malaysian market. Under Enegem, local solar plant owners will export renewable energy at rates agreed upon in power purchase agreements (PPAs) with Single Buyer, the government entity authorised to conduct electricity planning and manage electricity procurement services for Peninsular Malaysia. Single Buyer will then auction the electricity to interested buyers from Singapore or Thailand.

Job Creation in Green Technologies

The intersection of AI, Digital and Green Economy creates diverse opportunities for the workforce. AI and digital technologies enable advanced data analytics, predictive maintenance and optimisation of energy systems. There is a growing need for experts in smart grid management, cybersecurity and digital infrastructure, as well as specialists in AI-driven energy efficiency solutions. The transition to a Green Economy opens roles in sustainable infrastructure development and decarbonisation strategies. While the nature of many current roles will change, the core functions will remain, with an increased emphasis on integrating new technologies and supporting the transition to a sustainable energy future. More opportunities are also present in innovation and research and development (R&D) for emerging clean technologies, policy advocacy for sustainable practices and education and training to equip the workforce with the skills needed for this evolving landscape.

Development of the Renewable Energy workforce

To achieve the goal towards 70% renewable energy generation by 2050, the energy and power sector would require approximately 62,000 competent individuals. The Malaysian government has emphasised the vital role of Technical and Vocational Education and Training (TVET) programmes. Through this, the EC aims to ensure that graduates are not only proficient in theory but are also competent in practical applications.[40]

Safety as a Consideration within Renewable Energy

Opportunities in renewable energy safety are expanding due to the sector's growth. As Malaysia adopts more renewable energy sources, demand is rising for safety professionals to ensure compliance, manage risks, and protect workers. Key areas include safety management during project construction and operation, specialised expertise for different technologies such as solar, biomass, and hydropower, developing protocols for emerging technologies and future renewable energy sources and usage (hydrogen, EVs, nuclear) ensuring adherence to safety regulations, and providing safety training for workers.

38. Kirennesh Nair, *Experts: New talent needed for transition to renewable energy*, The Star, 29 June 2023, <https://www.thestar.com.my/news/nation/2023/06/29/experts-new-talent-needed-for-transition-to-renewable-energy>
39. The Sun, *Malaysia needs 62,000 competent individuals to drive re generation by 2050 - Fadillah*, 26 August 2024, <https://thesun.my/local-news/malaysia-needs-62000-competent-individuals-to-drive-re-generation-by-2050-fadillah-NK12909994>
40. The Sun, *Malaysia needs 62,000 competent individuals to drive re generation by 2050 - Fadillah*, 26 August 2024, <https://thesun.my/local-news/malaysia-needs-62000-competent-individuals-to-drive-re-generation-by-2050-fadillah-NK12909994>

B Impacts of AI, Digital, and Green Economy

Artificial Intelligence

AI Trends

AI technologies are expected to improve efficiency for the E&P sector, managing complex energy systems and automating repetitive tasks. Existing AI applications include data analysis and identifying cable maintenance using predictive machine learning.

For the E&P sector, a range of processes and AI-powered technologies could assist in controlling the flow of power into the network while assisting utility stakeholders to accurately monitor demand and supply. Hence, AI is poised to become a pivotal tool to accelerate Malaysia's transformation into a high-technology nation.

For example, the National Energy Policy 2022-2040 emphasised on capitalising on emerging technologies. In order to ensure an integrated and coordinated approach towards energy transition, technologies such as AI and machine learning were identified to create long-term competitive advantages and value creation for the country.

AI Impact

Adopting AI initiatives to modernise the existing grid is crucial to enable the transformation of Malaysia's E&P sector, as it will assist in enhancing maintenance measures, demand management and real-time monitoring.[41] However, the use of AI will create challenges related mainly to cybersecurity, policy and regulation, and the need to ensure the workforce is equipped with the skills needed to realise its full potential.

Operational Efficiency	**Predictive Maintenance:** AI implementation through predictive machine learning can assist the E&P sector with predicting machinery breakdown (e.g. cables, transformers). This predictive capability empowers the operations team to prioritise maintenance works based on the needs of the grid. For example, TNB expects predictive machine learning for cable maintenance to result in savings of over RM30 million over 5 years, contributing to the reduction in the System Average Interruption Duration Index (SAIDI).[42]
Improved Monitoring	**Real-Time Monitoring:** Usage of AI assists with continuous, real-time monitoring of the grid through sensor data analysis and other sources to detect abnormal behaviour. The AI system can then take corrective action or alert human operators to rectify any issues.
Demand Management	**Automation of Demand and Supply Analysis:** Peaks in energy can put a strain on the grid. The combination of AI and smart metre technology has helped the E&P sector with scheduling, planning, executing, and monitoring changes in energy demand.

41. SAP, *The smart grid: How AI is powering today's energy technologies*, <https://www.sap.com/sea/insights/smart-grid-ai-in-energy-technologies.html>; Vida Rosie, Jack Miller, et al., Why AI and energy are the new power couple, 2 November 2023, <https://www.iea.org/commentaries/why-ai-and-energy-are-the-new-power-couple>
42. Energy Watch, *Revolutionising Energy: The AI Catalyst for a Green Tomorrow*, 24 May 2024, <https://www.energywatch.com.my/blog/2024/05/24/revolutionising-energy-the-ai-catalyst-for-a-green-tomorrow/>

The application of AI algorithms is expected to improve operational performance in the 10%-25% range, with AI algorithms assisting to automate repetitive tasks, predict equipment failures, optimise supply chains and logistics and support other activities that enhance efficiency.[43] Furthermore, AI technologies already serve more than 50 different uses in the E&P sector with the market for the technology approximately worth up to USD13 billion (RM56.9 billion).[44]

> **"As a Senior Engineer, I have begun to embrace AI and digitalisation in my work, as it has become a key component in the field of engineering, enhancing efficiency and innovation in day-to-day tasks. I have integrated AI tools such as ChatGPT for idea generation. I am now actively developing an AI-powered intelligent system in my work."**
>
> ***Ir. Ts. Luqmaan bin Ahmad Zaidi, Senior Engineer, SIRIM Industrial Research***

Digital

Digital Trends

Digital technologies such as big data and IoT will be necessary to transform Malaysia's energy sector and achieve the nation's goals as outlined in the National Energy Policy (DTN 2022-2040) and NETR. Digital technology applications are already being applied (e.g. digital twin technologies) to enable real-time grid and network management (i.e. contingency analysis, monitoring voltage stability, ensuring optimal power flow).

Examples of utilisation of digital in the E&P sector include TNB's partnership with Siemens Energy to assist in accelerating the decarbonisation journey via sharing of cutting edge technologies (e.g. PSS®E , an industry-leading transmission planning and analysis software being used by grid planners to conduct analysis functions). In another example, Sarawak Energy has adopted the hybrid cloud strategy which enabled affordable data hosting, storage capacity and managed services beyond on-premise data centres. Cloud storage solutions are vital in future-proofing Sarawak Energy's growing database. Initiatives such as these will assist in propelling the E&P sector towards the goal of achieving a more innovative and advanced industry.

43. Judson Jacobs and Peter Gardett, *Energizing innovation: Exploring AI's impact on the energy industry, S&P Global*, 13 March 2024, <https://www.spglobal.com/en/research-insights/special-reports/look-forward/energizing-innovation-exploring-ai-s-impact-on-the-energy-industry>
44. Vida Rosie, Jack Miller, et al., *Why AI and energy are the new power couple*, 2 November 2023, <https://www.iea.org/commentaries/why-ai-and-energy-are-the-new-power-couple>

Digital Impact

Digitalisation forms a key enabler to support the Malaysian government's ambition to modernise the grid towards the energy transition. Leveraging digital technologies will create a resilient energy system which can facilitate the integration of renewable energy and empower consumers with better control over energy demand and supply. However, digitalisation will raise challenges related to privacy, regulatory compliance and drive talent demand.

Scenario Modelling	**Scenario Modelling:** Utilisation of digital tools (i.e. digital twins technology) enables engineers and planners to accurately predict the physical breakdown of existing and future assets.
Accurate Decision Making	**Monitoring of Data Systems:** In order to balance economic growth and environmental sustainability, the ability to monitor incoming data and patterns is crucial for performance management.
Grid Management and Operations	**Streamlined Management Systems:** Utilisation of systems such as Energy Management Systems (EMS) and Outage Management Systems (OMS) are essential towards assisting the E&P sector to optimise grid performance and improve outage management.

Green Economy

Green Economy Trends

Malaysia's drive towards net zero as outlined in its various policies and anchored on initiatives under the NETR provides clear direction on the role of renewable and low-carbon sources of energy to power the nation. RE is forecasted to become the dominant power generation source by 2038.[45] In the Malaysia Renewable Energy Roadmap (MyRER), it was highlighted that potential renewable energy resources that can assist to power the nation include solar PV, large hydropower, bioenergy, and geothermal.[46] Influenced by economic tipping points, renewable energy generation is expected to become more affordable over time compared with fossil fuels, making renewable energy the preferred source of energy. Malaysia's Energy Transition Outlook (METO) has also highlighted electrification and energy efficiency as key measures in Malaysia's net zero pathway.

This trend is supported by activities such as the introduction of the MyRER in 2021 to guide decarbonisation of Malaysia's electricity sector up to 2035. In Sarawak, Sarawak Energy has adopted the Hydropower Sustainability Assessment Protocol (HSAP) to enhance hydropower development and operation processes in Sarawak. Furthermore, renewable energy company Scatec Solar has developed solar power plants in Gurun, Kedah and Jasin, Melaka, connecting a total of 130 MW to the grid.

45. EY, *If every energy transition is different, which course will accelerate yours?*, 2024
46. Sustainable Energy Development Authority (SEDA) Malaysia, *Malaysia Renewable Energy Roadmap: Pathway Towards Low Carbon Energy System*, 2021

Green Economy Impact

The integration of green economy practices will be key to pivoting the E&P sector towards Malaysia's low carbon goals. Green economy practices will also enable the development of a future-proof energy system with the capability to provide reliable energy supply while in a sustainable way.

Increase in Bi-Directional Energy	**Large Scale Solar (LSS) and consumer-driven energy systems:** Systems such as the Feed-in Tariff (FiT) and the Net Energy Metering (NEM) scheme have played a vital role in enabling individuals and businesses to generate and sell excess renewable energy back to the grid. Through the Corporate Renewable Energy Supply Scheme (CRESS), eligible renewable energy generators and corporate companies can also arrange for green electricity supply with the agreed terms through the existing supply system. Corporate companies can acquire renewable energy electricity directly from the identified generators with third-party access (TPA) and these renewable energy generators can also supply renewable electricity to corporate consumers through the TNB grid network.[47]
Reduced Reliance on Conventional Power	**Demand for BESS:** Battery Energy Storage System (BESS) technology will be crucial in supporting the country's pivot to renewable energy, particularly solar power, by enabling reliable energy supply. This is to ensure electricity can be supplied around the clock, even when there is no solar energy being generated.
Investment in Local Renewable Resources	**Green Energy Tariff (GET):** Introduced by the Malaysian government in 2022, GET serves as a driver to allow consumers to purchase green electricity generated from renewable energy.

State of Trend Adoption

Artificial Intelligence

The transformation of the E&P sector due to AI can be seen in several ways:

- **Predictive Machine Learning:** AI predicts equipment failures before they can happen and continuously monitors asset health to enhance reliability and extend equipment lifespan.
- **Energy Optimisation:** AI optimises grid management and reduces energy consumption by improving efficiency for buildings and industrial processes.
- **Renewable Energy Production Forecasting:** AI could forecast renewable energy production and manage its variability, while dynamically adjusting grid operations to better integrate these sources.
- **Demand Response:** AI can predict peak load times and manage demand response programmes to balance the load on the grid, reducing the risk of blackouts.
- **Energy Trading:** AI can analyse energy market trends and predict changes in energy prices, helping companies and consumers make informed trading decisions.

47. Berita RTM, *Government introduce CRESS starting September, boost green electricity access for companies*, 26 Jul7 2024, <https://berita.rtm.gov.my/highlights/senarai-berita-highlights/senarai-artikel/government-introduce-cress-starting-september-boost-green-electricity-access-for-companies>

Global Case Studies

E.ON – AI-Powered Predictive Maintenance:
Global energy company E.ON developed a machine learning algorithm to predict when medium voltage cables in the grid need to be replaced. The programme used data from a variety of sources to identify patterns in electricity generation and alert abnormalities. E.ON's research suggests that this could reduce outages in the grid by up to 30%.[48]

GE Renewable Energy – Digital Wind Farm:
GE's Digital Wind Farm uses AI to optimise the performance of wind turbines through predictive maintenance and operational efficiency. AI has enabled the wind farm's energy production to boost by up to 20%, generating up to an estimated USD50 billion (RM206.12 billion) for the wind industry.[49]

Enel Energy – Machine Learning through Intelligent Infrastructure:
Enel is adopting AI-powered machine learning to develop an intelligent infrastructure that reduces power outages and energy losses as well as manage distributed generation assets proactively. This has allowed Enel to predict the power generated and optimise maintenance programme.[50]

Malaysian Case Studies

TNB – AI-Powered Boiler Failure Prediction:
TNB and Universiti Tenaga Nasional (UNITEN) have collaborated to develop an AI-powered model that predicts boiler tube failures in power plants. The model, as part of TNB's Predictive Maintenance initiative, aims to enhance the reliability and efficiency of power generation by forecasting potential disruptions. The AI model utilises historical data and machine learning algorithms to identify patterns that precede boiler tube leaks, allowing for preemptive maintenance and reducing unplanned outages.[51]

TNB – AI-Powered Preventative Maintenance:
TNB is currently implementing machine learning for preventative maintenance of underground cables. This has helped TNB ensure supply reliability by predicting approximately 30% of total annual breakdowns in Kuala Lumpur and Selangor, empowering the operations team to focus their efforts on prioritised areas and cable sections.[52]

48. E.ON, *Digitalisation*, <https://www.eon.com/en/ueber-uns/digitalisation.html>
49. GE, *GE Launches the Next Evolution of Wind Energy Making Renewables More Efficient, Economic: the Digital Wind Farm*, 19 May 2015, <https://www.ge.com/news/press-releases/ge-launches-next-evolution-wind-energy-making-renewables-more-efficient-economic>
50. Enel, *Sustainability Report 2019*, 2019
51. Assoc. Prof. Dr. Mohd Azree Idris, TNB, *UNITEN develops boiler failure prediction model using AI, Asia News Today*, 14 December 2023, <https://asianewstoday.com/tnb-uniten-develops-boiler-failure-prediction-model-using-ai/>
52. Splight, *Real-time Monitoring and Control: AI's Role in Grid Stability*, 10 November 2023, <https://content.splight-ai.com/blog/real-time-monitoring-and-control-ais-role-in-grid-stability>

Grid System Operator (GSO) – AI-Powered Monitoring:
GSO uses AI in day-to-day operations via real-time monitoring through a dashboard. This ensures the grid system is operating as intended with AI signalling any abnormalities for human intervention.[53] In ensuring a "Safe, Reliable and Economic" grid system, the usage of AI provides overall reliability of the grid system within the approved Transmission System Reliability Standards (TSRS) in compliance with Grid Code for Peninsular Malaysia.[54]

Digital

Digital technologies are transforming the E&P sector in the following ways:

- **Optimise Operations:** Digital technologies such as IoT devices can monitor and control the performance of power generation equipment, providing real-time data to optimise operations.
- **Simulation and Analysis:** Digital technologies such as digital twins allow for simulation and analysis of physical assets, helping to improve system design and process optimisation.
- **Secure and Transparent Transactions:** Digital technologies such as blockchain enable secure and transparent transactions for energy trading, which is especially useful for distributed energy resources like solar and hydropower.
- **Advanced Visualisation:** Digital tools including geographic information systems (GIS) and visualisation help operators and engineers to plan and manage transmission line routes and visualise grid infrastructure to make informed decisions.
- **Security Technologies:** Digital security tools protect grid operations from cyber threats, ensuring the integrity and reliability of energy systems.

Global Case Studies

Enel – IoT for Demand and Response:
Enel has deployed a vast network of smart metres using IoT to provide real-time data on energy consumption and improve grid management.[55] The usage of IoT in Demand and Response services enables the modulation of energy consumption, providing improved network flexibility and stability.

53. Splight, *Real-time Monitoring and Control: AI's Role in Grid Stability*, 10 November 2023, <https://content.splight-ai.com/blog/real-time-monitoring-and-control-ais-role-in-grid-stability>
54. Grid System Operator, *About Us*, <https://www.gso.org.my/Home/AboutUs.aspx>
55. Enel, *Internet of Things, everything is connected*, 30 November 2018, <https://www.enel.com/company/stories/articles/2018/11/enel-focus-on-internet-of-things-energy-bucharest>

Brooklyn Microgrid – Blockchain for Energy Trading:
New York-based Brooklyn Microgrid uses blockchain technology to enable a peer-to-peer energy trading platform for solar energy producers and consumers.[56] The permissioned data platform, Exergy, creates localised energy marketplaces for trading energy across existing grid infrastructure.

Schneider Electric – EMS:
EMS is designed to enhance the efficiency and reliability of electrical grids by providing utilities with advanced tools for monitoring, controlling and optimising their networks. The system offers real-time grid analytics, enabling operators to make real-time decisions.[57]

Malaysian Case Studies

TNB – Advanced Metering Infrastructure (AMI):
AMI is an integrated and intelligent system made up of smart metres equipped with digital features that provide near real-time data through the myTNB web portal and mobile app. This allows TNB and customers to closely monitor and manage electricity demand and supply efficiently. Smart metres play a pivotal role in driving productivity, fostering digital innovation and enhancing operational efficiency and form part of TNB's efforts to modernise the electricity grid.[58]

TNB – Implementing Digital Twin Technology for Asset Management:
As part of its strategy to maintain a reliable and sustainable electricity network, TNB has started using Digital Twin technology to enhance its asset management system. This initiative involves creating virtual models of physical assets for data integration, simulation and lifecycle management, which are crucial for proactive maintenance and network efficiency. The Digital Twin technology is a key component in TNB's strategy to maintain a reliable and sustainable electricity network.[59]

Sarawak Energy – Digitalisation Journey:
Sarawak Energy embarked on its digitalisation journey to transform into a world class utility by 2025. This includes revolutionising its generation, transformation, distribution & retail divisions to integrate remote monitoring and diagnostics, advanced metering infrastructure and smart asset performance management into existing operations to improve decision making.[60] Examples of initial moves towards this digitalisation journey is Sarawak Energy's graduation system automation upgrades such as that of the Batang Ai's hydroelectric plant.[61]

56. Brooklyn Microgrid, <https://www.brooklyn.energy/about>
57. Schneider Electric, *Energy management system (EMS)*, <https://www.se.com/my/en/work/solutions/for-business/electric-utilities/energy-management-system-ems/>
58. Tenaga Nasional Berhad (TNB), *Data Analytics*, <https://www.tnb.com.my/smart-grid/data-analytics>
59. Ibid
60. Sarawak Energy, *Digitalising Sarawak Energy*, 2021
61. Sarawak Energy, *Batang Ai Hydroelectric Plant Automation System Upgrade: Revised Dates Announced For Stage 2 And Stage 3*, 26 July 2024, <https://www.sarawakenergy.com/media-info/media-releases/2024/batang-ai-hydroelectric-plant-automation-system-upgrade-revised-dates-announced-for-stage-2-and-stage-3>

Green Economy

The impact of the Green Economy on the E&P sector can be seen in several ways:

- **Shift to Renewable Energy:** There is a significant move towards renewable energy sources like solar, wind, hydro, and biomass, reducing reliance on fossil fuels.
- **Decentralised Grid System:** Growth of distributed generation systems, such as rooftop solar panels, which reduce the need for centralised power plants.
- **Cross-Border Energy Trade:** Enhanced international connectivity to share renewable energy resources across borders.
- **Energy Storage Solutions:** Development of energy storage systems, such as batteries, to store excess energy generated from renewables for use during demand peaks or low-generation periods.
- **Regulatory Changes:** New policies and regulations to support the integration of renewables, energy efficiency, and emission reductions.

Global Case Studies

Germany's Energiewende – Transition to Renewable Energy:
The Energiewende is a central component of Germany's strategy to combat climate change and is supported by a range of legal measures, research initiatives and incentive programmes. This policy aims to transform Germany's energy system into one that is based on renewable energies, energy efficiency and sustainable development.[62]

62. German Federal Ministry for Economic Affairs and Climate Action, *Our energy transition for an energy supply that is secure, clean, and affordable*, <https://www.bmwk.de/Redaktion/EN/Dossier/energy-transition.html>

Orsted – Offshore Wind Farms:
Orsted has developed several large offshore wind farms and is continuing to invest in offshore wind as a key part of its strategy to create a world that runs entirely on green energy.[63] 9.8 GW of offshore wind across Europe, the US and Asia have been installed – with the aim of reaching 20-22 GW by 2030.

Equinor – Carbon Capture and Storage (CCS):
Equinor is investing in carbon capture and storage projects to reduce carbon emissions from the energy sector.[64] For nearly 30 years, Equinor has established itself as one of the largest CCS operators in the world and aims to develop further infrastructure to reduce cost for CSS value chains.

Malaysian Case Studies

TNB and PETRONAS – CCS Technology for Gas-Fired Power Plants:
TNB and PETRONAS have signed a Memorandum of Understanding to explore CCS technology as part of commitments to the NETR.[65] As Malaysia transitions to a low-carbon economy, natural gas will begin playing an even larger role as an energy source for the country.

Battery Energy Storage System (BESS):
In an effort to address intermittency issues associated with RE, TNB has initiated a 400 MWh BESS pilot project, marking Malaysia's first utility-scale battery storage project.[66] TNB will also work with GSO and the EC as part of this initiative to strengthen the grid network.

Universiti Malaysia Perlis (UniMAP) – Installation of Solar Panels on Buildings:
In an effort to expose students to RE technology, UniMAP has become the first public university in Malaysia to receive a 1.0 MW tariff quota for solar panel installation at its Pauh Putra campus. The project was carried out in collaboration with GetSol Sdn. Bhd. It will also allow UniMAP to generate revenue through the sale of energy to TNB.

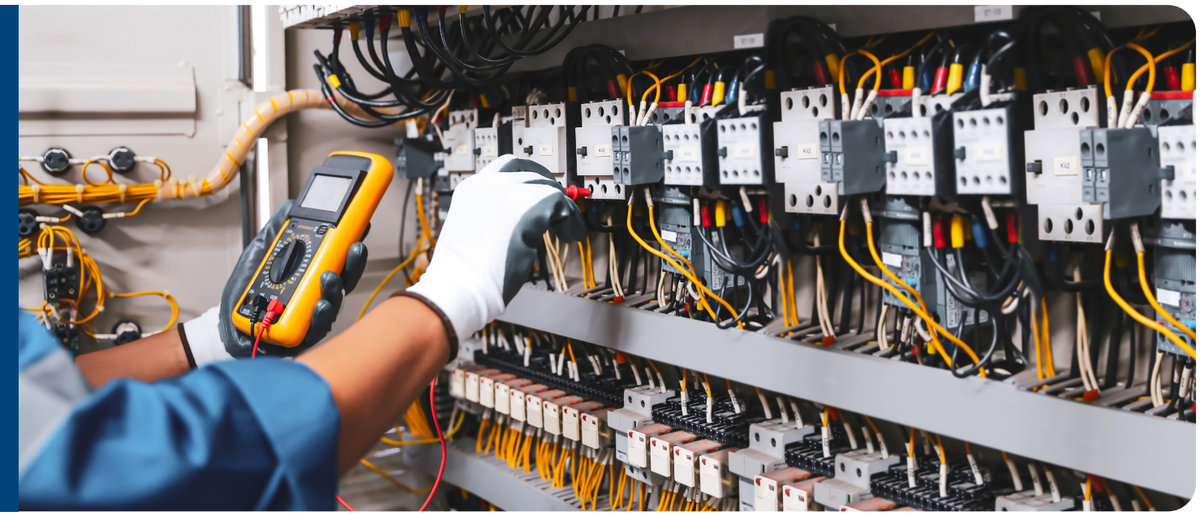
Sarawak Energy – Hydropower Development:
HSAP is a globally recognised framework for assessing hydropower projects against a comprehensive range of social, environmental, technical and economic considerations. Sarawak Energy uses HSAP to enhance hydropower development and operation processes in the region and has established an internal HSAP governing structure to incorporate sustainability into the hydropower development and operation processes.[67]

TNB – Transition to Reducing Coal-Fired Power Plants:
In line with TNB's Energy Transition Plan to achieve net zero emissions and coal-free plant operations by 2050, the national utility seeks to reduce emissions intensity by 35% by 2035 ahead of its 2050 milestone. Its decarbonisation efforts focus on the progressive expansion of low-carbon generation assets and the phasing down of its coal-fired generation capacity in stages.[68]

63. Orsted, *Renewable Energy Solutions*, <https://orsted.com/e/what-we-do/renewable-energy-solutions/offshore-wind >
64. Equinor, *CCS: Carbon capture and storage — making net zero possible*, <https://www.equinor.com/energy/carbon-capture-utilisation-and-storage>
65. https://www.tnb.com.my/announcements/tnb-and-petronas-forge-alliance-to-explore-ccs-technology
66. Adam Aziz, *TNB to undertake 400MWh battery storage project, says ministry, The Edge Malaysia*, 26 January 2024, <https://theedgemalaysia.com/node/698695>
67. Universiti Malaysia Perlis (UniMAP), *UniMAP First Public University To Have 1.0MW Solar Panels*, <https://news.unimap.edu.my/index.php/en/unimap-news/868-unimap-first-public-university-to-have-1-0mw-solar-panels>
68. Tenaga Nasional Berhad (TNB), *Strengthening Tnb's Carbon Management*, <https://www.tnb.com.my/sustainability/strengthening-tnb-carbon-management>

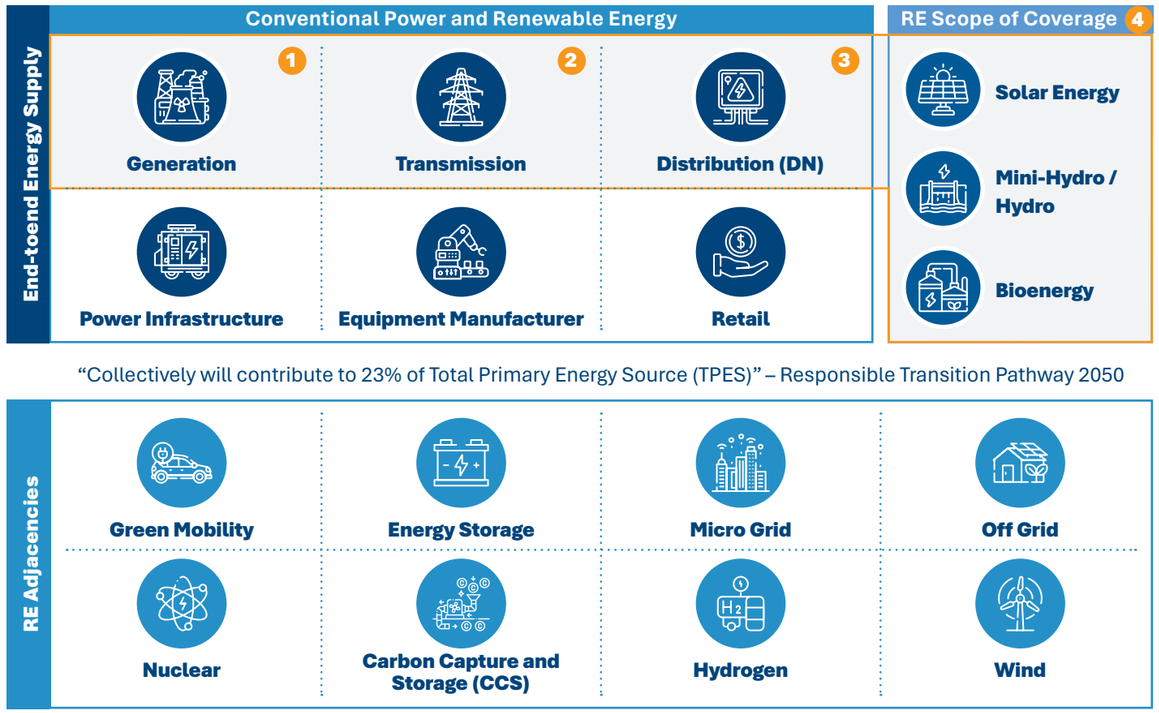
Chapter 4:
Key Findings

Overview of Roles and Skills



The scope of coverage of roles and skills analysed for the E&P Sector for this report covers Generation, Transmission and Distribution (DN) across both Conventional Power and Renewable Energy. RE only covers solar energy, mini-hydropower/ hydropower and bioenergy. Functions which are not covered and RE-adjacencies will be covered in subsequent phases of this study, subject to TalentCorp's plans.

Value Chain



"Collectively will contribute to 23% of Total Primary Energy Source (TPES)" – Responsible Transition Pathway 2050

Consolidated Job Clusters, Roles, and Skills in Energy and Power

55 Job Clusters

Plant Operation (1 Job Role*)	**Water Quality Control** (2 Job Roles*)	**Fuel Systems Operations** (4 Job Roles*)	**Grid / Network Planning** (4 Job Roles*)
Grid System Regulatory Compliance (1 Job Role*)	**Grid System Supervisory Control and Data Acquisition** (1 Job Role*)	**Grid Security Protection Management** (1 Job Role*)	**Grid Control** (1 Job Role*)
Metre Management (4 Job Roles*)	**Metering – NTL Management** (4 Job Roles*)	**Metering Data Intelligence** (1 Job Role*)	**Business Strategy & Regulatory** (2 Job Roles*)
Asset Management Strategy (2 Job Roles*)	**Asset Information** (5 Job Roles*)	**Asset Risk & Performance** (1 Job Role*)	**Asset Investment Portfolio** (3 Job Roles*)
Asset Technical Expert (1 Job Role*)	**Planning** (3 Job Roles*)	**Health, Safety & Environment** (3 Job Roles*)	**Design** (3 Job Roles*)
Construction – Electrical & Instrument (4 Job Roles*)	**Construction – Civil** (4 Job Roles*)	**Construction – Mechanical** (4 Job Roles*)	**Operations & Maintenance – Electrical & Instrument** (5 Job Roles*)
Operations & Maintenance – Civil (4 Job Roles*)	**Operation & Maintenance – Mechanical** (4 Job Roles*)	**Competent Person** (1 Job Role*)	**Shift Management** (1 Job Role*)
New Technology Project Management (4 Job Roles*)	**Quality Assurance** (2 Job Roles*)	**Business Development (BD)/ Strategy – Business Development & Project Financing** (2 Job Role*)	**Business Development/ Strategy – Land Acquisition** (1 Job Role*)
Asset Management - Asset Management and Strategy (2 Job Roles*)	**Asset Management – Asset Information** (2 Job Roles*)	**Asset Management – Asset Risk & Performance** (2 Job Roles*)	**Asset Management – Commercials & Billings** (2 Job Roles*)
Operations & Maintenance – Operations Management (2 Job Roles*)	**Operations & Maintenance – Sales Service** (1 Job Role*)	**Operations & Maintenance – Mechanical** (4 Job Roles*)	**Operations & Maintenance – Civil** (4 Job Roles*)
Operations & Maintenance – Electrical & Instrument (4 Job Roles*)	**Project Delivery – Design & Development (Project Design & Development)** (2 Job Roles*)	**Project Delivery – Design & Development (Technology Development)** (3 Job Roles*)	**Project Delivery – Design & Development (Draughtsman)** (1 Job Role*)
Project Delivery – Contracts/ Commercial/ Procurement/ Project Management (Project Management) (4 Job Roles*)	**Project Delivery – Contracts/ Commercial/ Procurement/ Project Management (Cost Controller)** (1 Job Role*)	**Project Delivery – Project/ Site Construction (Project Development)** (3 Job Roles*)	**Project Delivery – Project/ Site Construction (Site/Civil)** (2 Job Roles*)

Project Delivery – Project/ Site Construction (Interconnection Facility)
(4 Job Roles*)

Project Delivery – Authority Liaison & Regulatory (Liaison & Regulatory)
(2 Job Roles*)

Quality, Health, Safety, Environmental, Security – Workplace Safety Health/ HSE
(3 Job Roles*)

Quality, Health, Safety, Environmental, Security – Quality Assurance/ Quality Control
(1 Job Roles*)

Quality, Health, Safety, Environmental, Security – Site Safety
(1 Job Role*)

Grid Integration
(3 Job Roles*)

Sustainability
(1 Job Role*)

135 Job Roles
(*Including Emerging Roles)

23 Skills Clusters

(Categorised into two (2) Basic and 21 Specific skill clusters)

Specific Skills

Accounting and Finance Management
(5 skills)

Agile and Continuous Improvement
(1 skill)

Branding, Sales, and Marketing
(2 skills)

Business Development and Strategy
(2 skills)

Business Operation Management
(8 skills)

Customer Service and Experience
(1 skill)

Customer, Vendor, and Stakeholder Management
(5 skills)

Data Development and Implementation
(7 skills)

Engineering and Maintenance
(46 skills)

General Business Management
(7 skills)

Health, Safety, and Environment (HSE)
(24 skills)

People Management and Development
(2 skills)

Project and Process Management
(9 skills)

Quality Management
(12 skills)

Research and Development
(3 skills)

Risk Management, Compliance, and Governance
(16 skills)

Software Development and Implementation
(5 skills)

Supply Chain and Logistics Management
(3 skills)

Technical Design and Architecture
(2 skills)

Technology Management
(8 skills)

Warehouse and Inventory Management
(2 skills)

Basic Skills

Innovation and Delivery
(10 skills)

Social Intelligence
(6 skills)

186 Skills
Which comprises 170 Specific Skills and 16 Basic Skills

Job Clusters and Roles

AI, Digital, and Green Economy are significantly influencing the transformation of the E&P sector. 55 job clusters, 126 existing roles and nine (9) emerging roles identified in Malaysia's E&P sector.

Job Clusters	Roles	
Plant Operation	1. Operator, Plant Operation	
Water Quality Control	1. Chemist, Water Quality Control	2. Technician, Water Quality Control
Fuel Systems Operations	1. Engineer, Fuel Systems Operations 2. Foreman, Fuel Systems Operations	3. Technician, Fuel Systems Operations 4. Supervisor, Fuel Systems Operations
Grid/Network Planning	1. Engineer, Grid/ Network Planning 2. Foreman, Grid/ Network Planning	3. Technician, Grid/ Network Planning 4. Supervisor, Grid/ Network Planning
Grid System Regulatory Compliance	1. Engineer, Grid System Regulatory Compliance	
Grid System Supervisory Control & Data Acquisition	1. Engineer, Grid System Supervisory Control and Data Acquisition	
Grid Security Protection Management	1. Engineer, Grid Security Protection Management	
Grid Control	1. Engineer, Grid Control	
Metre Management	1. Engineer, Metre Management 2. Foreman, Metre Management	3. Technician, Metre Management 4. Supervisor, Metre Management
Metering - NTL Management	1. Engineer, Metering – NTL Management 2. Foreman, Metering – NTL Management	3. Technician, Metering – NTL Management 4. Supervisor, Metering – NTL Management
Metering Data Intelligence	1. Engineer, Metering Data Intelligence	

Job Clusters	Roles	
Water Quality Control	1. Chemist, Water Quality Control	2. Technician, Water Quality Control
Business Strategy & Regulatory	1. General Manager, Business Strategy and Regulatory	2. Manager, Business Strategy and Regulatory
Asset Management Strategy	1. General Manager, Asset Management Strategy	2. Engineer, Asset Management Strategy
Asset Information	1. General Manager, Asset Information 2. Engineer, Asset Information 3. Data Analyst (Emerging Role)	4. Data Architect (Emerging Role) 5. Data Scientist (Emerging Role)
Asset Risk & Performance	1. Engineer, Asset Risk and Performance	
Asset Investment Portfolio	1. General Manager, Asset Investment Portfolio 2. Engineer, Asset Investment Portfolio	3. Energy Economist (Emerging Role)
Asset Technical Expert	1. Asset Technical Expert	
Planning	1. Engineer, Planning 2. Foreman, Planning	3. Technician, Planning
Health, Safety & Environment	1. Engineer, Health, Safety and Environment 2. Foreman/ Technician, Health, Safety and Environment	3. Supervisor, Health, Safety and Environment
Design	1. Engineer, Design 2. Foreman/ Technician, Design	3. Draughtsman, Design
Construction – Electrical & Instrument	1. Engineer, Construction - E&I 2. Foreman, Construction - E&I	3. Technician, Construction - E&I 4. Supervisor, Construction - E&I
Construction – Civil	1. Engineer, Construction - Civil 2. Foreman, Construction - Civil	3. Technician, Construction - Civil 4. Supervisor, Construction - Civil
Construction – Mechanical	1. Engineer, Construction - Mechanical 2. Foreman, Construction - Mechanical	3. Technician, Construction - Mechanical 4. Supervisor, Construction - Mechanical
Operations & Maintenance – Electrical & Instrument	1. Engineer, O&M – Electrical & Instrument 2. Foreman, O&M – Electrical & Instrument 3. Technician, O&M – Electrical & Instrument	4. Supervisor, O&M – Electrical & Instrument 5. Wireman, O&M – Electrical & Instrument
Operations & Maintenance – Civil	1. Engineer, O&M – Civil 2. Foreman, O&M – Civil	3. Technician, O&M – Civil 4. Supervisor, O&M – Civil

Job Clusters	Roles	
Operations & Maintenance – Mechanical	1. Engineer, O&M – Mechanical 2. Foreman, O&M – Mechanical	3.Technician, O&M – Mechanical 4.Supervisor, O&M – Mechanical
Competent Person	1. Competent Person	
Shift Management	1. Shift Manager	
New Technology Project Management	1. Manager, New Technology Project Management 2. Engineer, New Technology Project Management	3. Technician, New Technology Project Management 4. Supervisor, New Technology Project Management
Quality Assurance	1. Engineer, Quality Assurance	2. Technician, Quality Assurance
Business Development (BD)/ Strategy – Business Development & Project Financing	1. Manager/ Assistant Manager, BD	2. Senior Executive/ Executive, BD
Business Development/ Strategy – Land Acquisition	1. Manager, Land Acquisition	
Asset Management – Asset Management and Strategy	1. General Manager, Asset Management and Strategy 2. Executive, Asset Management and Strategy	3. Energy Economist (Emerging Role)
Asset Management – Asset Transformation	1. General Manager, Asset Information 2. Executive, Asset Information 3. Data Analyst (Emerging Role)	4. Data Architect (Emerging Role) 5. Data Scientist (Emerging Role)
Asset Management – Asset Risk & Transformation	1. General Manager, Risk and Performance	2. Executive, Risk and Performance
Asset Management – Commercials & Billings	1. General Manager, Commercials & Billings	2. Executive, Commercials & Billings
Operations & Maintenance – Operations Management	1. Plant Manager	2. Shift Manager
Operations & Maintenance – Sales Service	1. Engineer, O&M – Sales Service	

Job Clusters	Roles	
Operations & Maintenance – Mechanical	1. Engineer, O&M – Mechanical 2. Foreman, O&M – Mechanical	3. Technician, O&M – Mechanical 4. Supervisor, O&M – Mechanical
Operations & Maintenance – Civil	1. Engineer, O&M – Civil 2. Foreman, O&M – Civil	3. Technician, O&M – Civil 4. Supervisor, O&M – Civil
Operations & Maintenance – Electrical & Instrument	1. Engineer, O&M – Electrical & Instrument 2. Foreman, O&M – Electrical & Instrument	3. Technician, O&M – Electrical & Instrument 4. Supervisor, O&M – Electrical & Instrument
Project Delivery – Design & Development (Project Design & Development)	1. Manager, Project Design & Development	2. Engineer, Project Design & Development
Project Delivery – Design & Development (Technology & Development)	1. Manager, Technology Development 2. Engineer, Technology Development	3. IoT 'Smart' Engineer (Emerging Role)
Project Delivery – Design & Development (Draughtsman)	1. Draughtsman	
Project Delivery – Contracts/ Commercial/ Procurement/ Project Management (Project Management)	1. Manager, Project Management 2. Assistant Manager, Project Management	3. Senior Executive, Project Management 4. Junior Executive, Project Management
Project Delivery – Contracts/ Commercial/ Procurement/ Project Management (Cost Controller)	1. Cost Controller	
Project Delivery – Project/ Site Construction (Project Development)	1. Senior Engineer, Project Development 2. Engineer, Project Development	3. Site Supervisor, Project Development
Project Delivery – Project/ Site Construction (Site/Civil)	1. Senior Engineer, Site/Civil	2. Engineer, Site/Civil
Project Delivery – Project/ Site Construction (Interconnection Facility)	1. Engineer, Interconnection Facility	2. Technician, Interconnection Facility

Job Clusters	Roles	
Project Delivery – Authority Liaison & Regulatory (Liaison & Regulatory)	1. Manager, Liaison & Regulatory	2. Executive, Liaison & Regulatory
Quality, Health, Safety, Environmental, Security – Workplace Safety Health/ HSE	1. Engineer, Health, Safety and Environment 2. Foreman / Technician, Health, Safety and Environment	3.Supervisor, Health, Safety and Environment
Quality, Health, Safety, Environmental, Security – Quality Assurance/ Quality Control	1. Engineer, Quality Assurance/ Quality Control	
Grid Integration	1. Energy Manager (Emerging Role) 2. Energy Solutions Integrator (Emerging Role)	3. Energy Trader (Emerging Role)
Sustainability	1. Sustainability Specialist (Emerging Role)	

The study revealed a total of 135 key roles, of which 126 are positions integral to maintaining sector standards and operational efficiency, while the remaining nine (9) are emerging roles needed to drive innovation and sustainability.

Nonetheless, an assessment of the sector's 126 roles showed that none of the roles are highly impacted by AI, Digital, and Green Economy trends due to the sector's highly regulated nature, where it is overseen by the Energy Commission (EC) in Peninsular Malaysia, the Energy Commission of Sabah (ECoS) and the Ministry of Utilities and Telecommunication Sarawak. Zero high-impact Roles were identified in this sector due to the nature of the sector that requires high human intervention, where AI and Digital serve as supplementary tools to improve productivity.

Of the 126 roles, 66 (or 52%) were identified as medium impacted roles, primarily affected by digital transformation and environmental sustainability initiatives currently underway in the E&P sector.

The remaining 60 of 126 roles, or 48%, comprise low impacted roles consisting of managerial roles which often involve complex decision-making that requires human judgement, empathy and understanding of the on-field tasks, which AI/ Digital cannot fully replicate. Technical roles that require groundwork were also categorised as low impacted roles for Green Economy, especially in renewable energy.

While automation and digital tools can enhance efficiency, emerging roles were also identified to accommodate the environment sustainability goals as well as drive innovation and efficiency within this sector.

Despite the moderate impact of AI, Digital, and Green Economy on the sector's workforce, there remains a need for the sector to undertake upskilling, reskilling, and strategic workforce planning to maintain its competitiveness and strengthen its sustainability against changing market forces.

Skills Clusters and Skills

Skills Category	Skills Clusters	
BASIC SKILLS Essential skills required for a person to be fit for a job	**Innovation and Delivery**	
	• Adaptability and Resiliency	• Digital and AI Fluency
	• Business Acumen	• Innovative Thinking
	• Change Management	• Learning Agility
	• Cognitive Skills	• Sustainability Awareness
	• Critical Thinking	• Planning and Organising
	Social Intelligence	
	• Coaching and Mentoring	• Empathy
	• Communication	• Influencing and Negotiation
	• Conflict Management	• Teamwork and Collaboration
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Accounting and Finance Management**	
	• Capital Expenditure and Investment Evaluation	• Financial Modelling
	• Financial Analysis	• Economic Modelling
		• Algorithmic Trading
	Agile and Continuous Improvement	
	• Continuous Improvement	
	Branding, Sales, and Marketing	
	• Market Profiling	• Market Research and Analytics
	Business Development and Strategy	
	• Strategy Development and Implementation Management	
	Business Operation Management	
	• Chemical Reagent Management	• Grid Monitoring and Control Management
	• Distributed Generation System Monitoring Management	• Operations Management
	• Fuel Terminal Operations Management	• Operations Reporting Protocol
		• Power Plant Operations Management
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Customer, Vendor, and Stakeholder Management**	
	• Account Management	• Stakeholder Management
	• Customer Challenges Management	• Vendor Management
	• Customer Relationship Management	
	Engineering and Maintenance	
	• Asset Management	• Equipment and Systems Repair
	• Asset Management Best Practices	• Equipment Maintenance
	• Asset Preventive Maintenance Management	• Inspection Engineering Management
	• Automated Equipment and Control Systems Configuration	• Instrumentation and Control Design Engineering
	• Civil and Structural Engineering Management	• Instrumentation and Control Field Maintenance
	• Civil Emergency Management	• Instrumentation and Control Maintenance
	• Civil Structure Maintenance	• Instrumentation and Control System Maintenance
	• Computer-aided Design	• Instrumentation Fitting Work
	• Condition Monitoring	• Maintenance Planning and Scheduling
	• Corrective Maintenance Management	• Maintenance Strategy Management
	• Electrical Engineering	• Mechanical Engineering Management
	• Electrical Field Maintenance	• Mechanical Field Maintenance
	• Electrical Grid Design Development	• Mechanical Rotating Equipment Engineering
	• Electrical Measurement Devices Operations	• Mechanical Static Equipment Engineering
	• Electricity Grid Performance Monitoring Management	• Meter and Associated Equipment Maintenance Management
	• Electricity Grid Planning	• Preventive Maintenance
	• Electricity Incident Management	• Reliability Centred Maintenance
	• Electricity Meter and Associated Equipment Installation and Commissioning	• Reliability Engineering
	• Electricity Operations Management	• Technology Road Mapping
	• Electricity Service Connections Planning	• Green Energy Integration
	• Engineering Drawing and Design Specifications	• Interconnection Facility Design Development
	• Engineering Drawing Interpretation	• Interconnection Facility Performance Monitoring Management
	• Engineering, Procurement and Construction Management	
	• Equipment and Systems Installation and Commissioning Management	

Skills Clusters and Skills (Continue)

Skills Category	Skills Clusters
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Customer Service and Experience** • Customer Experience Design
	Data Development and Implementation • Big Data Analytics • Data Engineering • Data Management • Data Mining and Modelling • Electricity Metering Data Management • Internet of Things Management • Data Visualisation
	General Business Management • Budget Management • Business Networking • Cost Management • Organisational Analysis Management • Organisational Awareness • Resource Management • Transition Management
	Health, Safety, and Environment (HSE) • Design for Safety, Standards and Specification • Eco-Design Principles • Emergency Response • Emergency Shut-down and Restart • Energy Management and Audit • Engineering Safety Standards Interpretation • Environment, Health and Safety • Environmental Awareness • Environmental Remediation • Hazards and Risk Identification and Management • Incident and Accident Investigation • Incident Investigation • Inclement Weather Operations and Planning • Power Plant Inspection Management • Process Safety Management • Safe System of Work Development and Implementation • Sustainability Management • Workplace Safety and Health Incident Management • Workplace Safety and Health Performance Management • Workplace Safety and Health System Management • Workplace Safety, Health and Culture Framework Development and Implementation • Behavioural Safety Management • Waste Management • Workplace Safety and Health
	People Management and Development • Organisational Change Management • People and Performance Management

Skills Category	Skills Clusters
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Project and Process Management** • Asset Integrity Management • Business Process Automation • Engineering Project Management • Permit Management • Power Generation Process Control and Monitoring • Process Optimisation • Project Feasibility Assessment • Project Management • Site Assessment and Analysis
	Quality Management • Audit and Compliance Strategy Development • Audit Compliance • Power Quality Management • Operations Troubleshooting • Project Quality Management • Quality Assurance Management • Quality Control Management • Root Cause Analysis (RCA) • Root Cause Corrective Action (RCCA) • Site and Factory Acceptance Testing Management • Steam and Water Quality Control Management • Technical Inspection
	Research and Development • Research and Information Synthesis • Technical Presentation • Technical Report Writing
	Risk Management, Compliance, and Governance • Business Risk Management • Corporate Governance • Crisis and Disaster Recovery Management • Cyber Incident Management • Cyber Risk Management • Engineering Management of Change • Operational Technology Security Design • Policy Implementation and Revision • Portfolio and Investment Risk Management • Project Risk Management • Regulatory Compliance • Regulatory Risk Assessment • Risk Governance • Threat Intelligence and Detection • Workplace Safety and Health Hazard Identification and Risk Control Management • Data Ethics
	Software Development and Implementation • Applications Development • Software Testing • System Integration and Configuration • Programming, Coding and Scripting • Quality Engineering

Skills Clusters and Skills (Continue)

Skills Category	Skills Clusters	
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, or techniques	**Supply Chain and Logistics Management**	
	• Contract Management	• Supplier Management
	• Procurement Management	
	Technical Design and Architecture	
	• New Product Introduction	• Computer Engineering
	Technology Management	
	• Construction Technology	• Technology Adoption and Innovation
	• Emerging Technology Synthesis	• Technology and Systems Application
	• IT Asset Management	• Advanced Technology Integration
	• Systems Integration	• Cybersecurity Management
	Warehouse and Inventory Management	
	• Asset and Inventory Management	• Equipment and Inventory Management

In-Demand Skills

The in-demand skills in the E&P sector include:

Areas	Skills
AI & DIGITAL	• Big Data Analytics • Internet of Things Management • Technology and Systems Application • Application Development • Data Mining and Modelling
GREEN ECONOMY	• Sustainability Management • Eco-Design Principles • Environmental Awareness • Environment and Social Governance • Energy Management and Audit • Environment, Health, and Safety

Role and Skills Analysis by Impact Level

AI, Digital and Green Economy are significantly influencing the transformation of the E&P sector. Nonetheless, an assessment of the sector's 126 roles showed that none of the roles are highly impacted by the emerging trends. This is mainly due to the hands-on nature of electricity-related tasks which also require strict adherence to safety regulations. This, in turn, sustains the need for human intervention.

Meanwhile, 52% of roles face a medium level of impact, where the introduction of AI and digital tools and sustainable practices is improving productivity and changing skills and responsibilities.

The remaining 48% of roles are considered to be low impacted, where the transformation are less pronounced. These roles are either more specialised or less susceptible to current technological and environmental trends.

Despite the moderate impact of AI, Digital and Green Economy on the sector's workforce, there remains a need for the sector to undertake upskilling, reskilling, and strategic workforce planning to maintain its competitiveness and strengthen its sustainability against changing market forces.

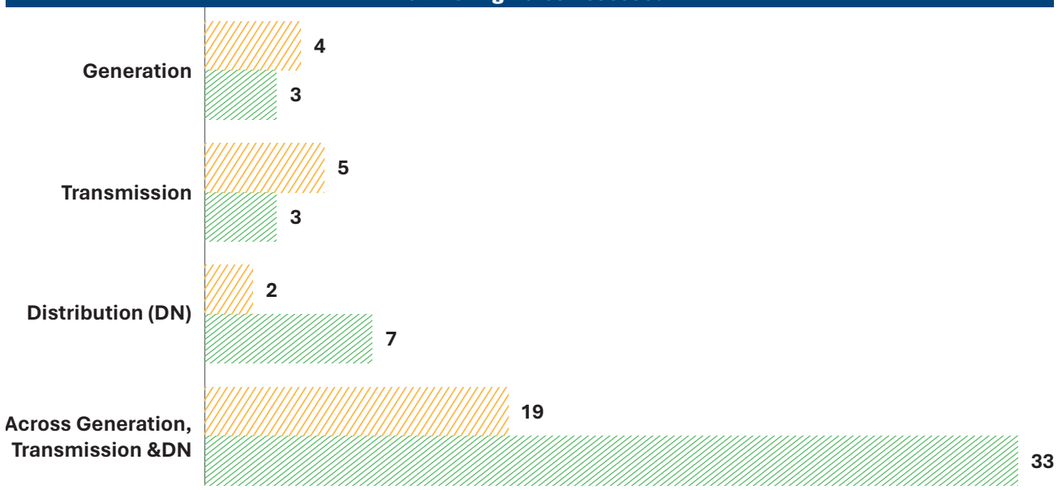
Impact Assessment on 135 roles in Energy and Power Sector

	High	Medium	Low	Emerging
AI/Digital	• **High opportunity** to **automate** • **Low human intervention**	• **High opportunity** to **automate** • **High human intervention**	• **Low opportunity** to **automate** • **High or low human intervention**	
Green Economy	• **Job no longer required** due to impact on the environment • **May or may not** have **opportunity to diversify**	• **Job still required** despite impact on the environment • **Opportunity to diversify exist**	• **Job still required** despite impact on the environment • **No opportunity to diversify**	New job positions created due to technological advancements, sector trends, and societal changes help organisations drive innovation, adopt sustainable practices, and stay competitive and compliant with evolving regulations and market demands.
Outcome	**Roles facing convergence or displacement** Need to pivot to adjacent role and reskill	**Roles are evolving** Need to upskill to deliver beyond what would traditionally be expected	**Roles not severely impacted** Need to continue improving to keep self relevant	
	0 Roles	66 Roles	60 Roles	9 Roles
Proportion of Roles	0%	52%	48%	

126 Existing Roles Assesed

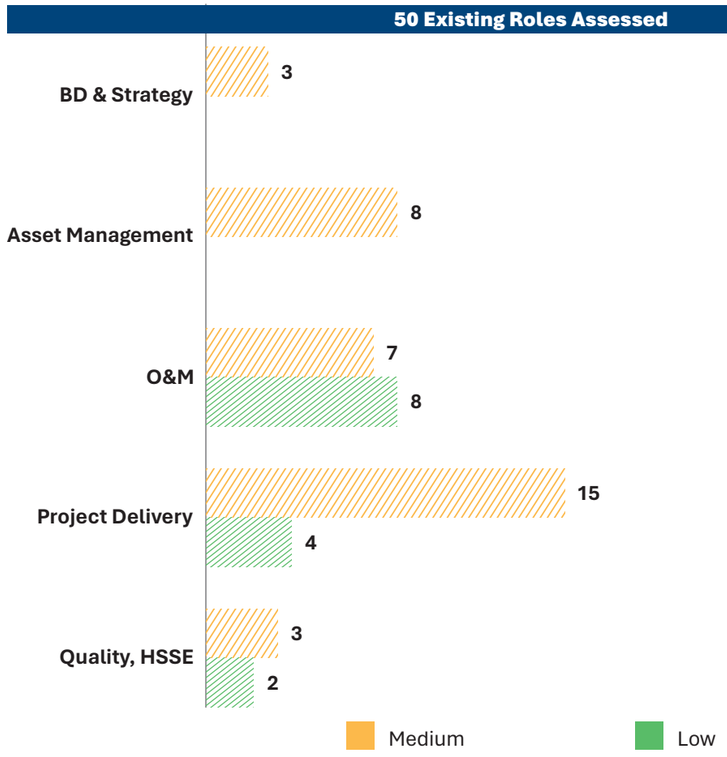
Overview of Conventional Power

76 Existing Roles Assessed



Overview of Renewable Energy

50 Existing Roles Assessed



66 MIR **Roles are evolving :** need to upskill to deliver beyond what would traditionally be expected

60 LIR **Roles not severely impacted :** need to continue improving to keep self relevant

9 Emerging Roles Observed

Roles that currently exist in other industries and / or not commonly seen across sector in Malaysia today

- **Data Analyst**
- **Data Architect**
- **Data Scientist**
- **Energy Economist**
- **IoT 'Smart' Engineer**
- **Energy Manager**
- **Sustainability Specialist**
- **Energy Solutions Integrator**
- **Energy Trader**

Findings

1. Job roles in the E&P sector are not severely impacted by AI, Digital, and Green Economy trends because **this sector is highly regulated by statutory bodies** (i.e. Energy Commission, Energy Commission of Sabah, Ministry of Utilities and Telecommunication Sarawak). Therefore, there are **zero (0/126) highly impacted roles** identified in this sector.
2. Of the **126 roles, 66 (or 52%) are medium impacted roles**, mostly affected by digital transformation and environmental sustainability initiatives within the sector.
3. Of the **126 roles, 60 LIR (48%)** are classified as **low impacted roles**, typically managerial positions involving complex decision-making that relies on human judgement, empathy, and a deep understanding of on-field tasks—attributes that AI/Digital cannot fully replicate. Additionally, technical roles requiring groundwork are also considered low-impact for the Green Economy, particularly within the renewable energy sector.
4. Additionally, while automation and digital tools can **enhance efficiency in obtaining information, there are emerging roles to accommodate the environment sustainability goals** within this sector.

Overview of roles by Impact Level

Conventional Power

MEDIUM

30 Roles

Generation

Fuel Systems Operations
1. Engineer
2. Foreman
3. Technician
4. Supervisor

Transmission

Grid Planning and Strategy
5. Engineer
6. Supervisor

Grid System Supervisory Control and Data Acquisition
7. Engineer

Grid Security Protection Management
8. Engineer

Grid Control
9. Engineer

Distribution

Metering – NTL Management
10. Supervisor

Metering Data Intelligence
11. Engineer

Generation, Transmission, Distribution

Asset Technical Expertise
12. Asset Technical Expert

Planning
13. Engineer
14. Foreman
15. Technician

Design
16. Engineer
17. Foreman / Technician

Construction – Electrical & Instrument
18. Engineer

Construction – Civil
19. Engineer

Construction – Mechanical
20. Engineer

Operations & Maintenance – Electrical & Instrument
21. Engineer (SCADA)
22. Engineer
23. Supervisor

Operations & Maintenance – Civil
24. Engineer
25. Supervisor

Operations & Maintenance – Mechanical
26. Engineer
27. Supervisor

Shift Management
28. Shift Manager

Quality Assurance
29. Engineer
30. Technician

LOW

46 Roles

Generation

Plant Operation
1. Operator

Water Quality Control
2. Chemist
3. Technician

Transmission

Grid Planning and Strategy
4. Foreman
5. Technician

Grid System Regulatory Compliance
6. Engineer

Distribution

Metre Management
7. Engineer
8. Foreman
9. Technician
10. Supervisor

Metering – NTL Management
11. Engineer
12. Foreman
13. Technician

Generation, Transmission, Distribution

Business Strategy and Regulatory
14. General Manager
15. Manager

Asset Management Strategy
16. General Manager
17. Engineer

Asset Information
18. General Manager
19. Engineer

Asset Risk and Performance
20. Engineer

Asset Investment Portfolio
21. General Manager
22. Engineer

Asset Technical Expertise
23. Draughtsman

Health, Safety and Environment
24. Engineer
25. Foreman/ Technician
26. Supervisor

Construction – Electrical & Instrument
27. Foreman
28. Technician
29. Supervisor

Construction – Civil
30. Foreman
31. Technician
32. Supervisor

Construction – Mechanical
33. Foreman
34. Technician
35. Supervisor

Operations & Maintenance – Electrical & Instrument
36. Foreman
37. Technician

Operations & Maintenance – Civil
38. Foreman
39. Technician

Operations & Maintenance – Mechanical
40. Foreman
41. Technician

Competent Person
42. Competent Person

New Technology Project Management
43. Manager
44. Engineer
45. Technician
46. Supervisor

Renewable Energy

MEDIUM

36 Roles

Business Development / Strategy

Business Development and Project Financing (BD)
1. Manager
2. Executive

Land Acquisition
3. Manager

Asset Management

Asset Management Strategy
4. General Manager
5. Executive

Asset Information
6. General Manager
7. Executive

Asset Risk and Performance
8. General Manager
9. Executive

Commercials & Billings
10. General Manager
11. Executive

Operations & Maintenance

Operations Management
12. Plant Manager
13. Shift Manager

Sales Service
14. Engineer

Mechanical
15. Engineer
16. Foreman
17. Technician
18. Supervisor

Project Delivery

Design & Development
Project Design & Development
19. Manager
20. Engineer

Technology Development
21. Manager
22. Engineer
23. Draughtsman

Contracts / Commercial / Procurement / Project Management
Project Management
24. Manager
25. Assistant Manager
26. Senior Executive
27. Junior Executive
28. **Cost Controller**

Project / Site Construction
Project Development
29. Senior Engineer
30. Engineer
31. Site Supervisor

Interconnection Facility
32. Engineer
33. Technicia

Quality, Health, Safety, Environmental, Security

Workplace Safety Health / HSE
34. Engineer
35. Foreman / Technician
36. Supervisor

LOW

14 Roles

Operations & Maintenance

Civil
1. Engineer
2. Foreman
3. Technician
4. Supervisor

Electrical & Instrument
5. Engineer
6. Foreman
7. Technician
8. Supervisor

Project Delivery

Project / Site Construction
Site / Civil
9. Senior Engineer
10. Engineer

Authority Liaison & Regulatory
Liaison & Regulatory
11. Manager
12. Executive

Quality, Health, Safety, Environmental, Security

Quality Assurance / Quality Control
13. Engineer

Site Safety
14. Site Supervisor

EMERGING

9 Roles

1. Data Analyst
2. Data Architect
3. Energy Economist
4. Data Scientist
5. IoT 'Smart' Engineer
6. Energy Manager
7. Energy Solutions Integrator
8. Sustainability Specialist
9. Energy Trader

Nine (9) Emerging Roles across the Energy and Power Sector

Highly Impacted Roles Analysis

As established, based on engagements with industry players, no highly impacted roles by AI, Digital and Green Economy were identified due to stringent regulations. The nature of the sector also necessitates human supervision for the work done on the ground.

Medium and Low Impacted Roles

Medium Impacted Roles Analysis

Medium impacted roles revolve mainly around roles that are impacted by technological advancements in the E&P sector. These roles will need some upskilling to ensure the workforce stays updated with AI/digital skills.

The study found that industry players have started to leverage AI for predictive maintenance and for operational tasks. Employers have also embedded digital transformation by integrating IoT, cloud computing and advanced data analytics into operations which enable real-time monitoring, improves decision-making and enhances operational efficiency. Furthermore, the roles will need upskilling in AI, Digital, and Green Economy capabilities to ensure Malaysia achieves its net zero ambitions by 2050.[69]

Job Clusters	Roles	Skills
Fuel Systems Operations ●	• Engineer, Fuel Systems Operations • Foreman, Fuel Systems Operations • Technician, Fuel Systems Operations • Supervisor, Fuel Systems Operations	**Specific Skills** • Fuel Terminal Operations Management • Equipment and Inventory Management • Safe System of Work Development and Implementation **Basic Skills** • Digital and AI Fluency • Critical Thinking • Innovative Thinking • Sustainability Awareness
Grid Network Planning ●	• Engineer, Grid Network Planning • Supervisor, Grid Network Planning	**Specific Skills** • Electricity Grid Performance Monitoring Management **Basic Skills** • Conflict Management • Coaching and Mentoring
Grid System Supervisory Control and Data Acquisition ●	• Engineer, Grid System Supervisory Control and Data Acquisition	**Specific Skills** • Electricity Grid Performance Monitoring Management • Emergency Response Management **Basic Skills** • Innovative Thinking • Sustainability Awareness • Adaptability and Resiliency

● (Conventional) Power ● Renewable Energy (RE)

69. National Energy Transition Roadmap, Ministry of Natural Resources, Environment and Climate Change, Malaysia, 2024

Job Clusters	Roles	Skills
Grid Security Protection Management ●	• Engineer, Grid Security Protection Management	**Specific Skills** • Instrumentation and Control System Maintenance **Basic Skills** • Adaptability and Resiliency • Communication
Metering – NTL Management ●	• Supervisor, Metering – NTL Management	**Specific Skills** • Electricity Metering Data Management • Electricity Incident Management **Basic Skills** • Influencing and Negotiation
Metering Data Intelligence ●	• Engineer, Metering Data Intelligence	**Specific Skills** • Technology Adoption and Innovation • Technology Road Mapping **Basic Skills** • Adaptability and Resiliency • Communication
Asset Technical Expertise ●	• Asset Technical Expert	**Specific Skills** • Asset Management Best Practices • Emerging Technology Synthesis **Basic Skills** • Innovative Thinking • Teamwork and Collaboration
Planning ●	• Engineer, Planning • Foreman, Planning • Technician, Planning	**Specific Skills** • Civil and Structural Engineering Management • Mechanical Engineering Management **Basic Skills** • Sustainability Awareness • Adaptability and Resiliency • Communication

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Design ●	• Engineer, Design • Foreman / Technician, Design	**Specific Skills** • Computer-aided Design • Eco-Design Principles **Basic Skills** • Cognitive Skills • Innovative Thinking
Construction – Electrical & Instrument ●	• Engineer, Construction – Electrical & Instrument	**Specific Skills** • Electrical Engineering Management • Big Data Analytics **Basic Skills** • Critical Thinking • Planning and Organising
Construction – Civil ●	• Engineer, Construction – Civil	**Specific Skills** • Civil and Structural Engineering Management • Engineering, Procurement and Construction Management **Basic Skills** • Sustainability Awareness • Digital and AI Fluency • Conflict Management • Sustainability Awareness
Construction – Mechanical ●	• Engineer, Construction – Mechanical	**Specific Skills** • Mechanical Engineering Management • Environmental Remediation **Basic Skills** • Innovative Thinking • Learning Agility
Operations & Maintenance – Electrical & Instrument ●	• Engineer (SCADA), O&M – Electrical & Instrument • Engineer, O&M – Electrical & Instrument • Supervisor, O&M – Electrical & Instrument	**Specific Skills** • Threat and Vulnerability Management • Electrical Measurement Devices Operations • Condition Monitoring **Basic Skills** • Threat and Vulnerability Management • Electrical Measurement Devices Operations • Condition Monitoring

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Operations & Maintenance – Civil ● (Conventional) Power	• Engineer, O&M – Civil • Supervisor, O&M – Civil	**Specific Skills** • Civil Structure Maintenance • Crisis and Disaster Recovery Management **Basic Skills** • Communication • Cognitive Skills • Critical Thinking
Operations & Maintenance – Mechanical ● (Conventional) Power	• Engineer, O&M – Mechanical • Supervisor, O&M – Mechanical	**Specific Skills** • Mechanical Field Maintenance • Mechanical Static Equipment Engineering **Basic Skills** • Innovative Thinking • Conflict Management • Planning and Organising
Shift Management ● (Conventional) Power	• Shift Manager	**Specific Skills** • Operations Management Protocol Application • Risk Governance **Basic Skills** • Planning and Organising • Critical Thinking • Empathy
Quality Assurance ● (Conventional) Power	• Engineer, Quality Assurance • Supervisor, Quality Assurance	**Specific Skills** • Quality Control Management • Quality Assurance Management **Basic Skills** • Learning Agility • Digital and AI Fluency
Business Development/ Strategy – Business Development and Project Financing (BD) ● Renewable Energy (RE)	• Manager/ Assistant Manager, BD • Senior Executive/ Executive, BD	**Specific Skills** • Strategy Development and Implementation Management • Business Risk Governance • Customer Experience Design **Basic Skills** • Business Acumen • Coaching and Mentoring • Influencing and Negotiation • Conflict Management
Business Development/ Strategy – Landing Acquisition ● Renewable Energy (RE)	• Manager, Land Acquisition	**Specific Skills** • Capital Expenditure and Investment Evaluation • Permit Management **Basic Skills** • Business Acumen • Influencing and Negotiation • Communication
Asset Management – Asset Information ● Renewable Energy (RE)	• General Manager, Asset Information • Executive, Asset Information	**Specific Skills** • Asset Management • Audit and Compliance **Basic Skills** • Digital and AI Fluency • Change Management
Asset Management – Asset Risk and Performance ● Renewable Energy (RE)	• General Manager, Asset Risk and Performance • Executive, Asset Risk and Performance	**Specific Skills** • Audit and Compliance • Audit and Review Management • Business Risk Governance **Basic Skills** • Critical Thinking • Innovative Thinking • Adaptability and Resiliency

Job Clusters	Roles	Skills
Asset Management – Commercial & Billings ●	• General Manager, Commercials & Billings • Executive, Commercials & Billings	**Specific Skills** • Account Management • Asset and Inventory Management **Basic Skills** • Planning and Organising • Cognitive Skills
Operations & Maintenance – Operations Management ●	• Plant Manager • Shift Manager	**Specific Skills** • Applications Development • Budget Management • Business Risk Governance **Basic Skills** • Critical Thinking • Teamwork and Collaboration • Planning and Organising
Operations & Maintenance – Sales Service ●	• Engineer, O&M – Sales Service	**Specific Skills** • Customer Feedback and Relationship Management **Basic Skills** • Communication • Empathy
Operations & Maintenance – Mechanical ●	• Engineer, O&M – Mechanical • Foreman, O&M – Mechanical • Technician, O&M – Mechanical • Supervisor, O&M – Mechanical	**Specific Skills** • Access Control Management • Applications Development • Business Performance Management • Behavioural Safety Management **Basic Skills** • Learning Agility • Innovative Thinking • Cognitive Skills • Planning and Organising

Job Clusters	Roles	Skills
Project Delivery – Design & Development (Project Design & Development) ●	• Manager, Project Design & Development • Engineer, Project Design & Development	**Specific Skills** • Computer-aided Design • Eco-Design Principles • Financial Modelling • Engineering Project Management **Basic Skills** • Digital and AI Fluency • Innovative Thinking • Sustainability Awareness • Cognitive Skills
Project Delivery – Design & Development (Technology Development) ●	• Manager, Technology Development • Engineer, Technology Development	**Specific Skills** • Computer-aided Design • Eco-Design Principles • Financial Modelling • Technology Road Mapping **Basic Skills** • Digital and AI Fluency • Sustainability Awareness • Innovative Thinking • Planning and Organising
Project Delivery – Design & Development (Draughtsman) ●	• Draughtsman, Design & Development	**Specific Skills** • Computer-aided Design • Engineering Drawing and Design Specifications **Basic Skills** • Learning Agility • Digital and AI Fluency • Innovative Thinking

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Project Delivery – Contracts/ Commercial/ Procurement/ Project Management (Project Management) ●	• Manager, Project Management • Assistant Manager, Project Management • Senior Executive, Project Management • Junior Executive, Project Management	**Specific Skills** • Budget Management • Civil and Structural Engineering Management • Contract Management • Vendor Management **Basic Skills** • Critical Thinking • Communication • Business Acumen • Planning and Organising
Project Delivery – Contracts/ Commercial/ Procurement/ Project Management (Cost Controller) ●	• Cost Controller	**Specific Skills** • Audit and Compliance • Cost Management • Procurement Management • Supplier and Capability Development • Financial Modelling **Basic Skills** • Digital and AI Fluency • Critical Thinking • Communication • Cognitive Skills • Planning and Organising
Project Delivery – Project/ Site Construction (Project Development) ●	• Senior Engineer, Project Development • Engineer, Project Development • Site Supervisor, Project Development	**Specific Skills** • Civil and Structural Engineering Management • Energy Management and Audit • Engineering Project Management **Basic Skills** • Critical Thinking • Adaptability and Resiliency • Teamwork and Collaboration • Influencing and Negotiation

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Project Delivery – Project/ Site Construction (Interconnection Facility) ●	• Engineer, Interconnection Facility • Technician, Interconnection Facility	**Specific Skills** • Electricity Service Connections Planning • Asset Management • Internet of Things Management **Basic Skills** • Digital and AI Fluency • Conflict Management • Coaching and Mentoring • Critical Thinking
Quality, Health, Safety, Environmental, Security – Workplace Safety Health/ HSE ●	• Engineer, Health, Safety and Environment • Foreman / Technician, Health, Safety and Environment • Supervisor, Health, Safety and Environment	**Specific Skills** • Workplace Safety, Health and Culture Framework Development and Implementation • Workplace Safety and Health Performance Management **Basic Skills** • Learning Agility • Critical Thinking • Communication • Empathy • Conflict Management

● (Conventional) Power ● Renewable Energy (RE)

Low Impacted Roles Analysis

Low impacted roles mainly focus on key activities that require hands-on involvement and strategic decision-making. These roles also leverage technical expertise in executing daily work. While they are influenced by the three (3) key pillars, the tasks themselves call for significant human involvement, especially in areas such as data interpretation, stakeholder management and strategic thinking.

In view of the trends faced by the E&P sector, in addressing low impacted roles industry players should embrace sustainability initiatives and forums to share best practices and collaborate with regulators to achieve the environmental sustainability goals that support the national agenda. They should also adopt a forward-thinking mindset to embrace technological advancements to improve efficiency and better solutions for the environment. IoT has been adopted for real-time monitoring of equipment and environmental conditions, enabling proactive maintenance and resource efficiency.

Job Clusters	Roles	Skills
Plant Operation ●	• Operator, Plant Operation	**Specific Skills** • Power Plant Operations Management • Equipment and Inventory Management **Basic Skills** • Critical Thinking • Conflict Management
Water Quality Control ●	• Chemist, Water Quality Control • Technician, Water Quality Control	**Specific Skills** • Chemical Reagent Management • Steam and Water Quality Control Management **Basic Skills** • Critical Thinking • Cognitive Skills • Coaching and Mentoring
Grid/Network Planning ●	• Foreman, Grid/ Network Planning • Technician, Grid/ Network Planning	**Specific Skills** • Electricity Grid Planning • Electricity Grid Design Development **Basic Skills** • Critical Thinking • Innovative Thinking
Grid System Regulatory Compliance ●	• Engineer, Grid System Regulatory Compliance	**Specific Skills** • Audit and Review Management • Regulatory Compliance **Basic Skills** • Audit and Review Management • Regulatory Compliance
Metre Management ●	• Engineer, Metre Management • Foreman, Metre Management • Technician, Metre Management • Supervisor, Metre Management	**Specific Skills** • Metre and Associated Equipment Maintenance Management • Big Data Analytics • Advanced Technology Integration **Basic Skills** • Digital and AI Fluency • Innovative Thinking • Learning Agility • Teamwork and Collaboration
Metering – NTL Management ●	• Engineer, Metering – NTL Management • Foreman, Metering – NTL Management • Technician, Metering – NTL Management	**Specific Skills** • Detection and Monitoring Application • Operational Technology Security Design **Basic Skills** • Digital and AI Fluency • Critical Thinking • Planning and Organising
Business Strategy and Regulatory ●	• General Manager, Business Strategy and Regulatory • Manager, Business Strategy and Regulatory	**Specific Skills** • Strategy Development and Implementation Management • Sustainability Management **Basic Skills** • Sustainability Awareness • Influencing and Negotiation • Conflict Management

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Asset Management Strategy ●	• General Manager, Asset Management Strategy • Engineer, Asset Management Strategy	**Specific Skills** • Asset Management Best Practices • Asset Integrity Management **Basic Skills** • Critical Thinking • Planning and Organising
Asset Information ●	• General Manager, Asset Information • Engineer, Asset Information	**Specific Skills** • System Integration and Configuration • Business Process Automation **Basic Skills** • Digital and AI Fluency • Innovative Thinking
Asset Risk and Performance ●	• Engineer, Asset Risk and Performance	**Specific Skills** • Big Data Analytics • Business Performance Management **Basic Skills** • Digital and AI Fluency • Conflict Management
Asset Investment Portfolio ●	• General Manager, Asset Investment Portfolio • Engineer, Asset Investment Portfolio	**Specific Skills** • Portfolio and Investment Risk Management **Basic Skills** • Critical Thinking • Learning Agility
Design ●	• Draughtsman, Design	**Specific Skills** • Computer-aided Design • Eco-Design Principles **Basic Skills** • Digital and AI Fluency • Sustainability Awareness
Health, Safety, and Environment ●	• Engineer, Health, Safety and Environment • Foreman/ Technician, Health, Safety and Environment • Supervisor, Health, Safety and Environment	**Specific Skills** • Workplace Safety and Health System Management • Regulatory Compliance • Environmental Remediation **Basic Skills** • Sustainability Awareness • Influencing and Negotiation • Critical Thinking • Communication
Construction – Electrical & Instrument ●	• Foreman, Construction – Electrical & Instrument • Technician, Construction – Electrical & Instrument • Supervisor, Construction – Electrical & Instrument	**Specific Skills** • Electrical Engineering Management • Engineering Drawing Interpretation and Management **Basic Skills** • Critical Thinking • Adaptability and Resiliency • Planning and Organising
Construction – Civil ●	• Foreman, Construction – Civil • Technician, Construction – Civil • Supervisor, Construction – Civil	**Specific Skills** • Civil and Structural Engineering Management • Construction Technology **Basic Skills** • Digital and AI Fluency • Critical Thinking • Cognitive Skills
Construction – Mechanical ●	• Foreman, Construction – Mechanical • Technician, Construction – Mechanical • Supervisor, Construction – Mechanical	**Specific Skills** • Mechanical Engineering Management • Engineering, Procurement and Construction Management **Basic Skills** • Critical Thinking • Innovative Thinking • Planning and Organising

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Operations & Maintenance – Electrical & Instrument ●	• Foreman, O&M – Electrical & Instrument • Technician, O&M – Electrical & Instrument • Wireman, O&M – Electrical & Instrument	**Specific Skills** • Internet of Things Management • Electrical Measurement Devices Operation **Basic Skills** • Digital and AI Fluency • Critical Thinking • Adaptability and Resiliency
Operations & Maintenance – Civil ●	• Foreman, O&M – Civil • Technician, O&M – Civil	**Specific Skills** • Civil Structure Maintenance • Preventative Maintenance **Basic Skills** • Digital and AI Fluency • Critical Thinking
Operations & Maintenance – Mechanical ●	• Foreman, O&M – Mechanical • Technician, O&M – Mechanical	**Specific Skills** • Hazard and Risk Identification and Management **Basic Skills** • Critical Thinking • Communication
New Technology Project Management ●	• Manager, New Technology Project Management • Engineer, New Technology Project Management • Technician, New Technology Project Management	**Specific Skills** • Technology Road Mapping • Advanced Technology Integration • Big Data Analytics • Software Testing **Basic Skills** • Digital and AI Fluency • Innovative Thinking • Change Management • Influencing and Negotiation
Operations & Maintenance – Civil ●	• Engineer, O&M – Civil • Foreman, O&M – Civil • Technician, O&M – Civil • Supervisor, O&M – Civil	**Specific Skills** • Access Control Management • Big Data Analytics • Engineering Project Management • Marketing Profiling **Basic Skills** • Digital and AI Fluency • Critical Thinking • Cognitive Skills • Conflict Management
Operation & Maintenance – Electrical & Instrument ●	• Engineer, O&M – Electrical & Instrument • Foreman, O&M – Electrical & Instrument • Technician, O&M – Electrical & Instrument • Supervisor, O&M – Electrical & Instrument	**Specific Skills** • Big Data Analytics • Preventative Maintenance Management • Continuous Improvement **Basic Skills** • Digital and AI Fluency • Critical Thinking • Adaptability and Resiliency • Teamwork and Collaboration
Project Delivery – Authority Liaison & Regulatory (Liaison & Regulatory) ●	• Manager, Liaison & Regulatory • Executive, Liaison & Regulatory	**Specific Skills** • Audit and Compliance • Corporate Governance • Engineering Project Management **Basic Skills** • Communication • Conflict Management • Influencing and Negotiation • Critical Thinking

● (Conventional) Power ● Renewable Energy (RE)

Job Clusters	Roles	Skills
Quality, Health, Safety, Environmental, Security – Quality Assurance/ Quality Control	• Engineer, Quality Assurance/ Quality Control	**Specific Skills** • Environment, Health, and Safety • Incident Investigation Management • Quality Assurance Management • Technical Inspection **Basic Skills** • Sustainability Awareness • Cognitive Skills • Adaptability and Resiliency • Critical Thinking
Quality, Health, Safety, Environmental, Security – Site Safety	• Supervisor, Site Safety	**Specific Skills** • Site and Factory Acceptance Testing Management • Emergency Shut-down and Restart • Environment, Health, and Safety **Basic Skills** • Sustainability Awareness • Critical Thinking • Conflict Management • Teamwork and Collaboration

(Conventional) Power

Renewable Energy (RE)

Projected Numbers of Medium and Low Impacted Employees

Employees in the medium impacted roles and low impacted roles categories need AI, Digital, and Green Economy-related upskilling. This upskilling will be crucial for those in medium impacted roles to allow these workers to progress and perform beyond traditional expectations.

Although upskilling is not seen as necessary for those in low impacted roles, these workers are encouraged to seek continuous self-improvement and learning to maintain their relevance and support informed decision-making, especially in facing emerging trends.

Based on assessment and industry feedback, 16 basic and 170 specific skills were identified for E&P sector, in which 16% are AI/Digital skills, and 5% are Green skills.

In-Demand Skills for AI, Digital, and Green Economy

AI/ Digital Skills

AI/Digital skills that are essential for roles to adopt for business operations enhancements and overall workforce productivity improvements

- Big Data Analytics
- Internet of Things Management
- Data Mining and Modelling
- Technology and Systems Application
- Applications Development

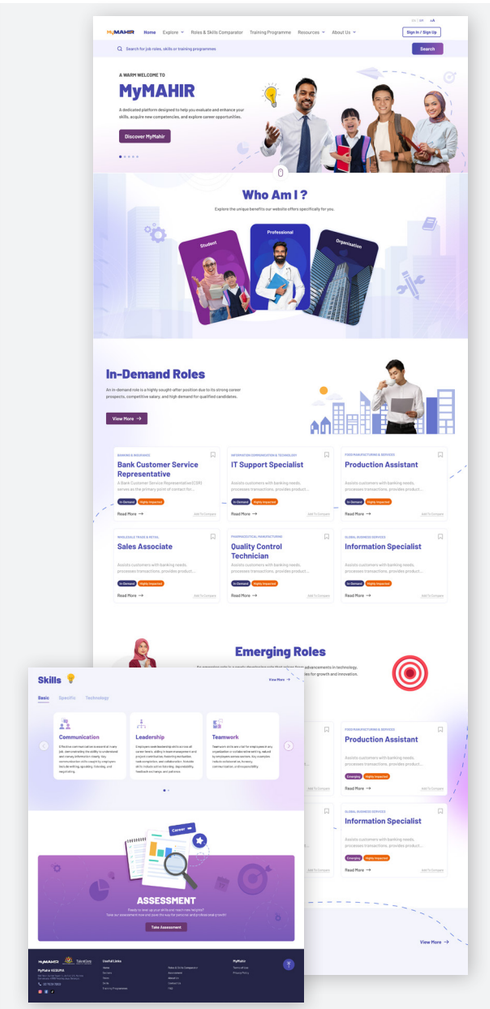
Green Skills

Green skills that are needed for roles to integrate sustainability efforts and initiatives into business operations

- Sustainability Management
- Energy Management and Audit
- Environment, Health, and Safety
- Sustainability Management
- Environmental Remediation
- Eco-Design Principles
- Environmental Awareness
- Green Energy Integration and Waste Management

Training Programmes Available

List of proposed training programmes is accessible on the **MyMAHIR platform**.



Emerging Roles

Findings

Data Analyst
The role is key in optimising energy production, improving grid efficiency, and driving sustainable energy practices through insightful data interpretation.

Data Architect
The role is key in designing robust, scalable data systems that enable advanced analytics, and optimise operations.

Data Scientist
The role is crucial in providing insights from electricity consumption and operational data to enhance efficiency, predict demand, inform infrastructure development and thus support sustainable energy practices through resource optimisation.

Energy Economist
The role is key in developing financial modelling, forecasting future energy prices and assessing financial risks associated with energy investments.

IoT 'Smart' Manager
IoT engineers integrate edge computing in renewable energy IoT solutions to enhance real-time processing, smart grid integration, predictive analytics, cybersecurity, and technical support.

Energy Manager
The role entails advancing green energy grid integration, formulating bi-directional flow policies, optimising operations for cost and reliability, managing energy systems for demand-supply balance, and ensuring regulatory compliance.

Sustainability Specialist
The role involves setting ESG KPIs, leading sustainability reporting and reviews, supporting performance improvement programme, coordinating cross-departmental data analysis for ESG initiatives, and liaising with stakeholders on regulatory compliance.

Energy Solutions Integrator
The role is pivotal in modernising the grid to accommodate bi-directional flow, integrating diverse energy sources, including renewables, to improve reliability and address intermittency, and advising on BESS installation and optimisation.

Demand Projection for Emerging Roles

The demand for emerging roles is expected to grow as companies increasingly recognise the benefits of emerging technology and sustainability practices in a dynamic market environment. Based on input collected from industry players during the impact assessment workshop, the headcount of organisations varies according to company type. Public Listed Companies (PLCs) reported headcounts ranging from 900 to 950 employees. Government-linked Companies (GLCs) reported headcounts ranging from 100 to 130 employees. Multinational Corporations (MNCs) and small and medium-sized enterprises (SMEs) were not analysed due to unavailability of data.

As Malaysia's E&P sector evolves with the increasing influence of AI, Digital, and Green Economy, nine (9) emerging roles have been identified as key drivers of this transformation, namely **Data Analyst, Data Architect, Data Scientist, Energy Economist, IoT 'Smart' Manager, Energy Manager, Sustainability Specialist, Energy Solutions Integrator, and Energy Trader**. These roles have emerged in response to technological advancements, industry trends, and societal shifts, positioning organisations to excel in innovation, adopt sustainable practices, and navigate evolving regulations and market demands.

The demand for such emerging specialists is expected to grow as companies increasingly recognise the benefits of emerging technology and sustainability practices in a dynamic market environment.[70]

Based on a survey conducted during the study, the headcount of organisations based on company type ranges from

Public Listed Companies (PLCs): **900 - 950**

Government-linked Companies (GLCs): **100 - 130**

Projected Demand for Emerging Roles for each organisation in the next three (3) to five (5) years

	Public Listed Companies (PLCs)	Government Linked Companies (GLCs)
Data Analyst	2	1
Data Architect	2	Not applicable
Data Scientist	2	Not applicable
Energy Economist	1	1
IoT 'Smart' Manager	Not applicable	Not applicable
Energy Manager	Not applicable	1
Sustainability Specialist	1	Not applicable
Energy Solutions Integrator	Not applicable	Not applicable
Energy Trader	Not applicable	Not applicable

70. Talentcorp sector survey on Impact Study Validation Workshop

In addition to the nine (9) emerging roles, 20 future emerging roles have been identified for beyond the next five (5) years, driven by the unprecedented growth of the renewable energy segment as a result of initiatives from the NETR, as well as Malaysia's other low-carbon policies. This growth is expected to create new job roles, expanding workforce demands.

Over the next five (5) years and beyond, this evolving ecosystem will not only transform the way energy is generated and consumed but will also redefine the global job market with a surge in specialised roles and opportunities.

Projected future emerging roles beyond the next five (5) years

Future roles	Description
Solar Photovoltaic (PV) Technician	Installs, maintains, and repairs solar panel systems.
Solar Thermal Engineer	Specialises in the design, development, and maintenance of systems that capture and use solar energy to generate heat, typically for applications such as water heating, space heating, or industrial processes.
Solar Thermal Safety Technician	Oversees temperature regulation in solar thermal systems by monitoring heat sensors, preventing overheating, maintaining cooling systems, and ensuring compliance through safety inspections.
Wind Turbine Technician	Specialises in the installation, maintenance, and repair of wind turbines.
Energy Storage Specialist	Focuses on developing and managing energy storage solutions like batteries to ensure a stable energy supply.
Electric Vehicle Infrastructure Engineer	Designs and implements charging infrastructure for electric vehicles.
Microgrid Engineer	Develops and manages small-scale power grids that can operate independently or in conjunction with the main grid.
Smart Grid Engineer	Develops and maintains smart grids that use AI to manage and distribute energy more efficiently.
Renewable Energy Data Scientist	Analyses large datasets from renewable energy sources to improve efficiency and predict maintenance needs.
Energy Management System (EMS) Developer	Designs and implements AI-driven systems to manage energy usage in real-time.
Virtual Power Plant (VPP) Manager	Manages VPPs that use AI to aggregate and optimise distributed energy resources.
Robotics Engineer for Renewable Energy	Develops and maintains robots that assist in the installation and maintenance of renewable energy infrastructure.
Cybersecurity Specialist for Smart Grids	Ensures the security of AI-driven smart grids and protects them from cyber threats.
Carbon Credit Analyst	Evaluates and verifies carbon credit projects to ensure they meet regulatory standards and generate valid credits.
Carbon Trading Specialist	Manages the buying and selling of carbon credits in various markets to help companies meet their emission reduction targets.
Environmental Economist	Analyses the economic impacts of carbon trading and helps design policies to promote carbon reduction.
Carbon Accounting Specialist	Tracks and reports on carbon emissions and credits, ensuring compliance with regulatory requirements.
Renewable Energy Policy Advisor	Develops policies and strategies to promote the use of renewable energy and carbon credit.
Climate Change Risk Analyst	Assesses the financial risks associated with climate change and carbon regulations for businesses.
Carbon Finance Manager	Manages financial aspects of carbon credit projects, including funding and investment.

Chapter 5:

Recommended Initiatives

The impact study assessment identified 11 initiatives across the talent ecosystem to adapt to AI, Digital, and Green Economy trends within Malaysia's E&P sector. These plans will leverage opportunities while addressing challenges posed by the trends shaping the sector. The initiatives also considered the needs and aspirations of each stakeholder group within the sector to foster innovation, promote skill development and ensure sustainable growth of Malaysia's E&P sector. As shown in the table below, initiatives are grouped into four (4) categories based on the leading and enabling entities: **Government**, **Industry Players**, **Academia** and **Training Providers**.

Summary of 11 Recommended Initiatives

Government

IN1 Fundings and Incentives

IN2 Regulations, Policy, and Initiatives

IN3 Talent Development

Industry Players

IN4 Talent Development

IN5 Research and Innovation

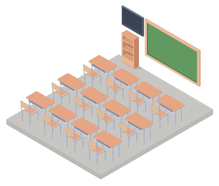
IN6 Leadership and Organisation Strategy

Academia

IN7 Curriculum Development

IN8 Internship and Work Readiness

IN9 Grants and Research Support



Training Providers

IN10 Training Ecosystem

IN11 Content Development and Delivery

Government

IN1 Funding and Incentives

Financial support and rewards from the government, including grants, loans and tax credits have demonstrated effectiveness in spurring investments in innovation and R&D. Governments also use funding and incentives to shape the implementation of strategic initiatives which are aligned with policy goals or business objectives, which, in turn, lead to workforce development.

Initiatives	Case Studies
IN1.1 **Government to offer tax relief to companies that invest in their employees' training and development programmes on AI, Digital, and Green Economy,** providing financial relief for companies to engage in workforce development in new technologies such as AI, IoT, machine learning, and predictive maintenance. This simultaneously reduces overall cost and encourages upskilling in the E&P sector.	Singapore's '**Enterprise Innovation Scheme (EIS)**', provides qualified businesses with a 400% tax deduction up to the first SGD400,000 (RM1.29 million) of qualifying training expenditure per year for courses approved by SkillsFuture Singapore and aligned with the Skills Framework.[71] In the United Kingdom (UK), the **AI Upskilling Fund** offers GBP6.4 million (RM36.49 million) of government support to help SME staff boost their AI skills. Under this scheme, SMEs are required to apply online for a grant to cover up to 50% of the cost of the employees' AI training. This training supports employees to develop their technical skills and understanding of AI, helping them develop, deploy, or use AI in their role.[72]
IN1.2 **Government to sponsor certification programmes for emerging roles** to develop skilled professionals for E&P sector emerging roles. Focused topics include AI, Digital, and energy transition. For individuals and companies, this can assist the E&P sector in upskilling and reskilling with no additional cost.	Western Australia's '**Digital Workplace Job Ready Programme**', established in 2024, is a government-funded initiative aimed at equipping job seekers and career changers with essential digital skills, preparing them to confidently enter the digital workforce. The programme focuses on building participants' digital competencies, enhancing their confidence, and ensuring they are ready to thrive in a rapidly evolving job market.[73]

Benefits

- Government support and investment in upskilling human capital can drive competitiveness within the E&P sector on AI, Digital, and energy transition for a sustainable future.
- Increased accessibility to specialised upskilling programmes will ensure the E&P sector's workforce is equipped with internationally recognised skills, nurturing innovation within the industry.
- The initiatives also align with industry needs by ensuring the E&P workforce have the correct skill sets to meet the nation's AI, Digital, and energy transition ambitions.

71. Inland Revenue Authority of Singapore, Enterprise Innovation Scheme, <https://www.iras.gov.sg/schemes/disbursement-schemes/enterprise-innovation-scheme-(eis)>
72. UK Government, AI Upskilling fund, 22 August 2024, <https://www.gov.uk/government/publications/flexible-ai-upskilling-fund>
73. Government of Western Australia: Department of Training and Workforce Development, Free Digital Skills Training Added To Job Ready Network, <https://www.jobsandskills.wa.gov.au/news/free-digital-skills-training-added-job-ready-network>

IN2 Regulations, Policy, and Initiatives

These measures aim to regulate industry-wide use of AI-powered tools in the E&P sector while also educating the public on the advantages of emerging technologies such as AI, IoT, machine learning, and natural language processing.

Initiatives	Case Studies
IN2.1 **Government to create thorough regulation and policies of AI governance, policies and code of ethics** to govern the usage of AI implementation in the E&P sector by establishing clear ethical guidelines to govern the development and deployment of AI. This will set industry-wide standards for the responsible use of AI that respects privacy of public data and ensure that AI systems are trained on high-quality, unbiased data sets.	Singapore's '**Model Artificial Intelligence Governance Framework**' provides detailed and readily-implementable guidance to private sector organisations to address key ethical and governance issues when deploying AI solutions. The Model Framework aims to promote public understanding and trust in technologies alongside ensuring clear guidelines on its usage.[74]
IN2.2 **Continually update strategic master plans for all key industry stakeholders to follow in terms of developing AI, Digital, and Green Economy.** Industry stakeholders can ensure a cohesive approach to the development of AI, Digital, and Green Economy, positioning themselves for success in a rapidly evolving global landscape.	France's '**Digital and Environment Roadmap**' outlines 15 measures to guide the country towards responsible Digital technologies while supporting sustainable development goals. The measures aim to improve transparency around environmental impacts of digitalisation, to reduce these impacts, and to support innovative solutions that harness digitalisation for environmental benefit.[75]
IN2.3 **Promote the importance of AI, Digital and Green Economy for economic development via campaigns.** Awareness campaigns could provide a strong foundation of knowledge and support for the adoption of AI, Digital and Green Economy practices in the E&P sector, assisting to ensure the benefits of these technologies are widely understood in the context of national economic development.	The '**Scottish AI Alliance**' is a partnership with the Scottish Government aimed at empowering individuals with AI literacy by engaging with local communities, organisations and businesses. This is to ensure a responsible and ethical AI development in Scotland while addressing societal concerns and challenges that may arise.[76]

Benefits

- Establishing regulations and policies for AI ensures its use is equitable and transparent, while also safeguarding privacy. Such measures would promote the utilisation of unbiased data and guarantee the ethical and responsible application of AI tools.
- Continuous updating of existing strategic master plans will ensure guidelines meet international standards for E&P industry players to achieve targeted transformation in AI, Digital, and Green Economy.
- The initiatives also foster trust surrounding the use of AI and Digital technologies among the general public to ensure its usage supports the nation's goal towards a more sustainable future.

> **"Industry-government collaboration is vital in the renewable energy sector. Industries should provide the government with accurate market data to help shape policies that meet the emerging needs in renewable energy, such as the growing demand for IoT managers and data analytics experts. AI will also drive efficiency in sectors such as agriculture, helping to boost Malaysia's GDP while reshaping the labour market."**
>
> ***En Hanafi bin Roseli, Project Engineer of Sabah Energy***

74. Info-communications Media Development Authority (IMDA) and Personal Data Protection Commission (PDPC), Model Artificial Intelligence Governance Framework Second Edition, 2020
75. International Energy Agency, Digital and Environment Roadmap, 5 April 2022, <https://www.iea.org/policies/12910-digital-and-environment-roadmap>
76. Scottish AI Alliance, Empowering People, <https://www.scottishai.com/empowering-people>

IN3 Talent Development

This initiative ensures that the E&P sector's demand for specialised skills are met. This is essential for the adoption of AI, Digital, and Green Economy among key E&P stakeholders by ensuring that the local workforce is equipped with the needed skill sets.

Initiatives	Case Studies
IN3.1 **Government to encourage and facilitate certification of employees hired within emerging roles** to ensure that the local workforce is qualified and adept at handling the complexity of AI and digitally powered tools. Facilitating talent development for emerging roles also ensures industry safety standards are met nation-wide.	Singapore's '**MySkillsFuture**' is a one-stop portal for the general public to upskill in their interested areas and topics. Individuals are able to learn about the latest in-demand skills and view more than 20,000 courses on the Course Directory. This portal assists to facilitate the learning journey of those seeking to pivot according to their chosen interests.[77]

Benefits

- Encouraging certification for roles in the E&P sector nurtures local talent to support the nation's goals in alignment with Malaysia's National AI Roadmap, Digital Economy Blueprint, and NETR.
- Facilitating workforce accreditation ensures the E&P sector aligns with international standards, accelerating the transformation towards AI, Digital, and Green Economy.

77. MySkillsFuture, What is MySkillsFuture, <https://www.myskillsfuture.gov.sg/content/portal/en/about/about-myskillsfuture.html>

Industry Players

IN4 Talent Development

These initiatives are focused on developing a skilled workforce that can adapt rapidly to the evolving E&P landscape. This includes initiating upskilling and reskilling programmes, particularly in areas of AI, Digital, and Green Economy.

Initiatives	Case Studies
IN4.1 **Collaborate with other industry players to establish skills exchange initiatives** to facilitate skill knowledge transfer through cross-industry collaboration in order to leverage on shared technical and specialised knowledge.	Australia's Department of Treasury '**Secondment Programme**' enables temporary exchange of staff between the Treasury and other Australian and international organisations. This assists with exposing staff to new ideas, diverse approaches to policy-making, and to new innovative ideas.[78]
IN4.2 **Initiate upskilling/reskilling initiatives and programmes for existing workforce in terms of AI, Digital, and Green Economy-related skills.** Industry players can offer ongoing training and development programmes for existing workforce in order to stay up-to-date with emerging technologies and the changing industry requirements. Continual evaluation of relevant skill sets and new technologies are critical to ensure the necessary skills are obtained for professional development. Additionally, industry players can establish clear career progression frameworks for employees to drive professional growth.	Singapore's '**SkillsFuture**' initiative partners with tech companies such as Microsoft to offer AI-related upskilling programmes for workers in various industries, including energy. These programmes provide certifications and hands-on training to ensure the workforce is prepared for the digital economy.[79]

78. Australian Government: The Treasury, Secondment program, <https://treasury.gov.au/the-department/recruitment-and-careers/secondment-program>
79. SkillsFuture, <https://www.skillsfuture.gov.sg/>

Initiatives	Case Studies
IN4.3 **Collaborate with tertiary education providers to initiate courses for emerging AI, Digital, and Green Economy roles.** This can entail partnering with universities and other educational institutions to develop and offer courses that address the growing demand for skills in AI, Digital and Green Economy. These collaborations will help ensure that new graduates are equipped with the relevant knowledge and skills needed to fill emerging roles and support the sector's transition.	**General Electric (GE) and Massachusetts Institute of Technology (MIT)** have collaborated to assist the MIT faculty and students by connecting the industry directly to current students. Benefits will include direct connections to the energy industry, sponsorship of research programmes and participation in conferences and learning opportunities.[80]

Benefits

- Collaboration with other industry players can pave the way for the development of new technologies, more efficient processes and innovative solutions. The enhanced skills and knowledge shared through secondment programmes and upskilling initiatives will encourage growth of a mature AI, Digital, and Green Economy E&P sector in Malaysia.
- Initiating upskilling and reskilling programmes ensures that the workforce remains relevant and capable of handling the demands of the rapidly evolving energy landscape. As AI, digital technologies, and goals towards sustainability continue to advance, these programmes will help the sector avoid skill gaps, reduce dependency on external expertise and ensure that employees can contribute effectively to new projects and initiatives.

> **"Upskilling and reskilling are crucial for Malaysia's energy sector as it transitions to a more sustainable and digital economy. With national policies such as the NETR, new roles such as Chief Impact Officer and Chief Innovation Officer are emerging, combining sustainability with technology. Both the private and public sectors will need to prepare their workforce for these changes."**
>
> ***Pn. Shahila Ismail, Head of Strategic Coordination & Communication of MyPOWER***

80. Massachusetts Institute of Technology, GE joins MIT Energy Initiative to develop advanced technology solutions for transforming global energy systems, 30 August 2016, <https://news.mit.edu/2016/ge-joins-mit-energy-initiative-develop-advanced-technology-solutions-transforming-global-energy-0830>

IN5 Research and Innovation

Continuous investment in research and innovation is crucial for staying competitive in the E&P sector. It is recommended that companies collaborate with research institutions and other industry players to explore new technologies, such as renewable energy solutions, smart grids, and AI-driven energy management systems.

Initiatives	Case Studies
IN5.1 **Investment in research and collaboration with the government to explore and pilot new AI, Digital, and sustainable technologies.** Industry players are encouraged to invest in research aimed at developing new technologies that promote sustainability and energy efficiency. Close collaboration with government agencies to design and implement pilot programmes will foster innovation within the E&P sector. This includes exploring advancements in renewable energy, energy storage solutions, and smart grid technology.	**Japan** has invested heavily in researching energy-saving technologies, particularly in the development of smart grids. The collaboration between the government, universities, and companies like Toshiba and Hitachi has led to advancements in energy management systems, reducing energy consumption, and improving grid efficiency.[81] **Shell Netherlands** has collaborated with the government to conduct pilot programmes testing hydrogen as an emerging energy source. This initiative involves multiple stakeholders and aims to integrate hydrogen into the national energy grid, contributing to the country's sustainability goals.[82]
IN5.2 **Research global players and best practices implemented for AI, Digital, and Green Economy to benchmark performance and innovation.** Companies are encouraged to study the strategies and best practices of leading global players in AI, Digital, and Green Economy to enhance its own innovation capabilities, improve operational efficiency, and accelerate the adoption of cutting-edge technologies that support sustainable development.	Produced by BP, the '**Statistical Review of World Energy**' analyses data on world energy markets and trends from the prior year. Data is collected from governments and statistical agencies, outlining the trends, strategies, and movements occurring within the E&P sector.[83]

Benefits

- Collaborating with the government to conduct pilot programmes for emerging technologies enables the sector to rapidly test, refine, and implement new solutions. This proactive approach reduces the time and risk associated with adopting innovative technologies, ensuring that the sector remains at the forefront of technological advancements.
- Researching global players and adopting best practices in AI, Digital, and Green Economy allows the sector to stay competitive on a global scale. By integrating cutting-edge technologies and practices, companies in the E&P sector can enhance their operational efficiency, drive innovation, and stay ahead of industry trends.

81. The International Energy Agency (IEA), Japan 2021: Energy Policy Review, May 2021, <https://www.iea.org/reports/japan-2021>
82. Shell, Hydrogen, <https://www.shell.com/energy-and-innovation/new-energies/hydrogen.html>
83. Bp, bp Statistical Review of World Energy 2022: 71st edition, 2022, <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf>

IN6 Leadership and Organisation Strategy

Strong leadership and a forward-thinking organisational strategy are essential for navigating the complexities of the energy transition. Industry players are recommended to create a culture that embraces innovation and adapts to emerging trends by launching in-house initiatives.

Initiatives	Case Studies
IN6.1 **Industry players to develop initiatives to support in-house development on AI, Digital, and Green Economy.** This could include enhancing and upgrading internal energy management systems to incorporate advanced technologies such as AI and IoT. Companies are also encouraged to implement corporate social responsibility (CSR) campaigns which emphasise sustainability and the Green Economy. These initiatives can include community outreach, education on energy conservation, and support for renewable energy projects. Furthermore, companies are encouraged to focus on developing new initiatives which support Green Economy and energy transition such as energy efficiency and smart metre management to drive innovation, and strategic focus in these areas.	**RWE**, one of Germany's leading energy companies, has upgraded its energy management systems by incorporating renewable energy sources and advanced data analytics. This system allows for better forecasting, load management, and integration of wind and solar energy, contributing to a more resilient and sustainable energy grid.[84] In Italy, **Enel** has launched several CSR campaigns focused on sustainability and Green Economy. These initiatives include investments in renewable energy projects, educational programmes on sustainability, and community engagement activities that promote environmental responsibility.[85] Spain's **Iberdrola**, a leading global energy provider, has created a new department focused on energy efficiency and smart energy management. This department leads initiatives in smart grid technology, energy storage solutions, and customer energy efficiency programmes, making the company a leader in the transition to a sustainable energy future.[86]

Benefits

- Enhancing and upgrading existing energy management systems leads to more efficient use of energy resources, reducing wastage and operational costs. By integrating advanced technologies into energy management, companies can better monitor, control, and optimise their energy consumption
- Developing a new department dedicated to energy efficiency and smart energy management positions companies to become lead in innovation and sustainable practices. This proactive approach allows organisations to stay ahead of industry trends, adopt cutting-edge technologies, and drive the transition toward a more sustainable energy future.

84. RWE, Research and Development, <https://www.rwe.com/en/research-and-development/>
85. Enel, <https://www.enel.com/company/stories/articles/2019/11/sustainability-strategy-enel>
86. Iberdrola España, Smart Grids In Spain, <https://www.iberdrolaespana.com/about-us/business-lines/smart-grids-spain>

Academia

IN7 Curriculum Development

Academia can play a role in revising and expanding curriculum to include emerging topics in energy, AI, Digital, and Green Economy. This involves integrating the latest advancements in renewable energy, smart grid technologies, and energy management systems into academic programmes. By aligning education with industry needs, universities can better prepare students for future roles in the evolving energy sector.

Initiatives	Case Studies
IN7.1 **Review and update existing courses and programmes to include AI, Digital, and Green Economy.** It is crucial for institutions to regularly assess and revise their existing courses and programmes to ensure they reflect the latest developments in AI, Digital, and Green Economy. Incorporating these emerging fields into the curriculum will enable universities to provide students with the knowledge and skills necessary to meet the demands of modern energy industries, ensuring that graduates are well-prepared for the evolving job market.	The **National University of Singapore (NUS)** offers integrated AI, Digital, and Green Economy concepts in its energy-related programmes, where it has developed courses that focus on AI applications in energy management, digital transformation in the power sector, and sustainability practices. These updated programmes prepare students for emerging roles in the energy sector, ensuring they have the necessary skills to drive innovation and sustainability.[87] **Stanford University** has established an AI Lab that focuses on fostering interest and innovation in AI-powered technologies. This centre supports R&D in AI applications, including those relevant to the E&P sector, such as smart grid technologies and AI-driven energy management systems. The lab also offers resources and opportunities for students to engage in AI projects, helping to cultivate the next generation of AI experts.[88]
IN7.2 **Creation of an AI centre to foster interest in AI-powered technology and tools among students.** It is recommended that universities establish dedicated AI centres to promote the study and application of AI-powered technologies and tools. These centres would serve as hubs for research, innovation, and collaboration, encouraging students to explore the potential of AI in the energy sector.	

Benefits

- **Developing a future-ready workforce:** Updating courses to include AI, Digital and Green Economy concepts ensures that graduates are equipped with the skills needed to drive innovation and sustainability in the Energy and Power sector.
- **Promoting innovation through AI research:** Establishing an AI centre fosters a culture of innovation, encouraging students to engage with cutting-edge technologies, leading to new solutions and advancements in energy efficiency and renewable energy integration.

87. National University of Singapore (NUS), Electrical and Computer Engineering, <https://cde.nus.edu.sg/ece/>
88. Stanford Artificial Intelligence, Stanford AI Lab, <https://ai.stanford.edu>

IN8 Internship and Work Readiness

Universities have the opportunity to strengthen their partnerships with industry players to offer more knowledge sharing for students. This initiative will provide universities with access to industry expertise, allowing students to apply theoretical knowledge in real-world settings.

Initiatives	Case Studies
IN8.1 **Collaborate with industry players to undertake knowledge sharing events to deepen the understanding of AI, Digital and Green Economy among students.** Under this effort, universities should work with industry players to create programmes where professionals from the E&P sector are invited to share expert knowledge with graduating students. These sessions would provide valuable insights into current industry trends, technological advancements, and career opportunities, helping students bridge the gap between academic learning and real-world applications. Furthermore, this initiative would not only enhance students' understanding of the industry but also foster networking opportunities that can be crucial for their career development in AI, Digital, and Green Economy.	The '**Energy Transition Hub**', a collaboration between Australian universities and industry players, regularly organises talks, workshops, and seminars where industry experts share their knowledge with students. This initiative focuses on preparing students for careers in the rapidly evolving energy sector by providing them with insights into current industry trends, challenges, and innovations in renewable energy and sustainable practices.[89] Further, the '**UK Energy Research Centre' (UKERC)** works with major energy companies and academic institutions to conduct a series of lectures and knowledge-sharing sessions for graduating students in the energy sector. These programmes involve industry professionals discussing the latest advancements in energy technologies, policy developments, and the future of the energy market. This helps bridge the gap between academic learning and industry needs, enhancing students' readiness for the workforce.[90]

Benefits

- This initiative aims to increase employability and career readiness, with direct interactions with industry experts providing students with valuable insights into career pathways, required skills, and industry expectations. This guidance helps students better prepare for the job market, enhancing their employability and readiness to contribute effectively from the start of their careers.

89. Energy Transition Hub, Creating energy transition opportunities through Australian-German collaboration, <https://www.energy-transition-hub.org>
90. Energy Transition Hub, Creating energy transition opportunities through Australian-German collaboration, <https://www.energy-transition-hub.org>

IN9 Grants and Research Support

Academia should actively seek and provide grants and research support for projects focused on innovation in energy technologies. By collaborating with government bodies, industry, and international organisations, universities could be positioned to drive research that contributes to sustainable energy solutions.

Initiatives	Case Studies
IN9 .1 **Collaborate with industry players driving research towards AI, Digital, and Green Economy to support commercialisation.** Academic institutions should collaborate with industry players to research on the topics of AI, Digital and Green Economy towards the E&P sector. This involves working hand-in-hand to support the commercialisation and innovation in advancing the E&P sector.	**The US Department of Energy (DOE)** has been a strong advocate for funding research in Green Economy, particularly focusing on the impacts of green technologies in the E&P sector. Through various grant programmes, the DOE supports research on renewable energy, energy efficiency, and sustainable technologies, helping to drive innovation and reduce the environmental impact of the energy sector.[91] The UK's Research Councils, including the '**Economic and Social Research Council' (ESRC)**, have been instrumental in supporting academic research on Green Economy. They provide grants and funding for research projects and also offer additional support for the dissemination of research findings through publications, conferences, and seminars. This support has led to the widespread publication of academic papers that influence policy and practice in the Green Economy.[92]
IN9.2 **Provide further support for academic papers published on the topic of Green Economy.** Universities have the opportunity to offer additional support to researchers and academics who publish papers on Green Economy, particularly those focusing on its relevance to the E&P sector. This support can include funding for research, access to publishing platforms, and opportunities for presenting findings at conferences and seminars.	

Benefits

- Increased funding allows for more comprehensive and in-depth research, leading to the development of new technologies and practices that reduce environmental impact and promote sustainability. This not only advances academic knowledge but also positions the energy sector to lead in global sustainability efforts.
- Well-supported academic publications can shape the direction of the Green Economy by informing decision-makers, guiding sustainable development strategies, and attracting additional funding and collaboration opportunities.

91. Office of Energy Efficiency & Renewable Energy, Energy Efficiency: Buildings and Industry, <https://www.energy.gov/eere/energy-efficiency-buildings-and-industry>
92. UK Research and Innovation (UKRI), Economic and Social Research Council (ESRC), <https://www.ukri.org/councils/esrc/>

Training Providers

IN10 Training Ecosystem

This initiative focuses on encouraging and generating interest for AI and Digital knowledge through readily available learning opportunities. Efforts to improve the existing training ecosystem are key towards ensuring the opportunity to upskill and reskill are available for all.

Initiatives	Case Studies
IN10 .1 **Initiate upfront investment to improve enrollments in AI, Digital, and Green Economy training programmes.** Training providers are encouraged to initiate upfront investment to improve enrolment rate of AI, Digital, and Green Economy courses (e.g. offer trial sessions). This would benefit both industry players and the E&P workforce, simultaneously providing upskilling opportunities for E&P workforce on AI, Digital, and Green Economy while increasing potential uptake of courses of training providers.	In partnership with more than 300 leading universities, **Coursera** offers companies flexible, affordable, and job-relevant online learning to individuals and organisations worldwide. These courses are usually provided at no cost, offering a range of learning opportunities – from hands-on projects and courses to job-ready certificates and degree programmes.[93] Since 2011, **General Assembly** has provided tech bootcamps and courses for individuals and companies alike, aimings to close the global tech skills gap and connect tech talent with top companies across the globe.[94]

Benefits

- This initiative encourages those in the E&P workforce to develop an interest in specialised topics, providing clarity on AI, Digital, and Green Economy in the E&P sector.
- It also aims to improve programme uptake as E&P professionals are able to sample the training content prior to committing.
- Ultimately, this initiative could generate a highly specialised and technical E&P workforce through accessible training opportunities.

93. IMDA, <https://www.imda.gov.sg/regulations-and-licences/regulations/consultations>
94. J. Angelo Racoma, Estonia's Education Minister Kristina Kallas on the challenges and opportunities of AI in learning and empowerment [Q&A], 17 May 2024, <https://technode.global/2024/05/17/estonias-education-minister-kristina-kallas-on-the-challenges-and-opportunities-of-ai-in-learning-and-empowerment-qa/>

IN11 Content Development and Delivery

This initiative enhances the current skill set of the workforce and aligns them with the evolving demands of the E&P sector, particularly in the areas of AI, Digital, and Green Economy. This includes an examination of the potential impacts these initiatives may have on the E&P sector.

Initiatives	Case Studies
IN11 .1 **Training Providers to develop a range of technical and specialised training modules for AI, Digital, and Green Economy** to ensure the workforce is capable of leveraging these advanced technologies. This builds a robust, future-ready, and competitive workforce. Knowledge in these areas can drive innovation, driving further development in the E&P sector in areas such as International Organisation for Standardisation (ISO) standards, BESS, and CCUS.	**EnergyEdge** provides up-to-date training services specifically for energy industry professionals. The courses are competency-based and cover areas such as engineering, science, business, renewable energy, and strategy development, among others. The comprehensive list of courses reflect the different level of skills required.[95] '**Upskilled Australia**' provides a wide range of competency learning and certificates on AI and Digital ranging from Level I Certificates to Level IV Certificates. These training programmes cater to a range of employees whether they are aiming to upskill, reskill, or pivot to a new industry.[96]
IN11.2 **Providers to provide end-to-end training on carbon management and carbon trading to ensure the workforce is internationally certified in conducting carbon management and trading.** This certification is a critical component in the global effort to reduce carbon emissions and achieve net-zero. Knowledge in this area is essential to prepare the workforce to participate effectively in carbon trading within the E&P sector.	Verra, a non-profit organisation that develops and manages standards for sustainable development, climate action and responsible business practices, conducts a **'Verified Carbon Standard' (VCS) Programme**, a GHG crediting programme. It is important for the E&P workforce to upskill their knowledge by understanding rules and requirements of VCS.[97]

Benefits

- Specialised training modules in AI and Digital directly contributes to upskilling the E&P workforce, ensuring proficiency in the latest technologies and industry practices.
- Additionally, knowledge in advanced technologies and sustainable practices fosters innovation towards the goals as set out in the NETR.
- This initiative also encourages development and innovation by nurturing local E&P workforce talent, driving the ambition towards a developed AI, Digital, and Green Economy E&P sector.

95. EnergyEdge, About Us, <https://petroedgeasia.net/about-us/>
96. Upskilled, Information Technology & Operations, <https://www.upskilled.edu.au/information-technology-operations>
97. Verra, Verified Carbon Standard, <https://verra.org/programs/verified-carbon-standard/>

Taking into account the Initiatives proposed, moving forward, these are the

Top 5 Initiatives

needed to kickstart the workforce transformation towards AI, Digital, and Green Economy to ensure their successful implementation

1 GOVERNMENT

The government to continuously update and refine comprehensive strategic master plans designed for all key industry stakeholders to follow, ensuring alignment with the latest advancements in AI, Digital, and Green Economy, thereby fostering sustainable growth, innovation, and competitive advantage across the sector.

2 INDUSTRY PLAYERS

Launch National Upskilling Fund to provide grants or subsidies for training providers to develop and deliver courses in collaboration with industry experts, focusing on AI, Digital, and Green Economy.

3 INDUSTRY PLAYERS

Industry players to conduct thorough research into global industry leaders and analyse the best practices they have implemented in AI, Digital, and Green Economy, using these insights as benchmarks for enhancing performance, driving innovation, and setting new standards within their organisations.

4 ACADEMIA

The academia to review and update existing courses and programmes to incorporate comprehensive content on AI, Digital, and Green Economy, ensuring that the curriculum remains relevant, forward-thinking, and aligned with industry trends and future workforce needs.

5 TRAINING PROVIDERS

Training providers to develop a comprehensive range of technical and specialised training modules focused on AI, Digital, and Green Economy, designed to equip participants with the advanced skills and knowledge required to excel in these rapidly evolving fields.

Conclusion

The global and Malaysia E&P sectors continue to **record steady** growth in line with economic development needs. From 2024 to 2028, the **global E&P sector** is expected to grow at a **CAGR of 6.11% to reach USD6.42 trillion** (RM28.10 trillion).[98] In Malaysia, the sector contributed **RM26.7 billion to GDP** in 2021, employing a workforce of **43,465 employees**.[99]

Climate change and global transition to renewable energy are pushing the E&P sector to pivot from relying on conventional sources. The demand to reduce carbon emissions and improve environmental sustainability to this highly regulated sector has created a strong growth in power generation from renewable sources such as solar, hydropower, and biomass.

In tandem with this shift, the E&P sector also faces trends in **AI, Digital, and Green Economy, which creates further drivers** for the sector's transformation. This, in turn, impacts its workforce, which must upskill and learn new skills to secure continued relevance, competitiveness and operational efficiency.

Although none of the **126 critical roles** identified in the E&P sector through this impact study will be highly impacted by AI, Digital, and Green Economy trends, **52% and 48% will see medium and low impacted**, respectively. Another **nine (9) emerging roles** were also identified in view of the growing requirements for innovation and sustainability among E&P companies.

In response to the impacts of AI, Digital, and Green Economy on E&P workforce roles, this recommended **11 initiatives** to be implemented across the sector's government, industry players, academia and talent provider stakeholders aimed at **empowering a future-ready, competitive and sustainable workforce**.

Looking ahead, embarking on this journey of continuous adaptation and innovation will be vital in preparing the E&P workforce for ongoing advancements in AI, Digital, and Green Economy. To achieve this, the **MyMAHIR Future Skills Talent Council (FSTC)** will conduct regular needs assessments to identify immediate and future workforce skills gaps, analyse talent demands by sector and educational level, propose strategies, determine essential sector-specific skills, and periodically update these skills in response to technological advancements and evolving operating environments. Additionally, the council will align the educational system with the sector's needs while actively **fostering collaboration among government**, **industry**, **academia**, and **training providers** to enhance Malaysia's competitiveness and **promote sustainable growth** in the E&P sector.

Key trends impacting existing roles:

- **Artificial Intelligence**
- **Digital**
- **Green Economy**

The study identified 126 critical roles that will be highly impacted by these trends, along with 9 emerging roles, were highlighted due to the growing relevance.

11 Initiatives

to be implemented across the sector aimed at empowering a future-ready, competitive and sustainable worksorce

MyMAHIR Future Skills Talent Council (FSTC) has been set up to prepare for these changes

98. The Business Research Company, Global Electric Power Generation, *Transmission, And Distribution Market Briefing 2024*, March 2024
99. Department of Statistics Malaysia (DOSM): *Annual Economic Statistics 2022*

Validation Workshop

Validation Workshop





















Abbreviations

Abbreviations

AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
APAC	Asia Pacific
BESS	Battery Energy Storage System
CAGR	Compound Annual Growth Rate
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CO2	Carbon Dioxide
CRESS	Corporate Renewable Energy Supply Scheme
CSR	Corporate Social Responsibility
DOE	Department of Energy (US)
DN	Distribution
DTN	Dasar Tenaga Negara - National Energy Policy 2022-2040
E&P	Energy and Power
EC	Energy Commission
EIS	Enterprise Innovation Scheme - Singapore
EMS	Energy Management Systems
ESG	Environmental, Social and Governance
ESRC	Economic and Social Research Council - UK
EVs	Electric Vehicles
FiT	Feed-in Tariff
FSTC	Future Skills Talent Council
GE	General Electric
GET	Green Energy Tariff
Gg	Gigagrams
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GLCs	Government-linked Companies
GSO	Grid System Operator
GWh	Gigawatt Hours
HSAP	Hydropower Sustainability Assessment Protocol
HSE	Health, Safety and Environment
ICE	Internal Combustion Engines
ICT	Information Communication and Technology
IoT	Internet of Things
IR4.0	The Fourth Industrial Revolution
ISO	International Organisation for Standardisation
KESUMA	Ministry of Human Resources
KSP RMKe-12	Mid-Term Review of the 12th Malaysia Plan
LSS	Large Scale Solar
MDEC	Malaysia Digital Economy Corporation
METO	Malaysia Energy Transition Outlook
MIT	Massachusetts Institute of Technology
MNCs	Multinational Corporations
MW	Megawatt
MWh	Megawatt hour
MDEB	Malaysia Digital Economy Blueprint
MyNSR	Malaysia National Skills Registry
MyRER	Malaysia Renewable Energy Roadmap
NETR	National Energy Transition Roadmap
NIMP	New Industrial Master Plan 2030
NUS	National University of Singapore
OMS	Outage Management Systems
PLCs	Public Listed Companies
PPA	Power Purchase Agreement
PV	Photovoltaic
RCA	Root Cause Analysis
RCCA	Root Cause Corrective Action
RE	Renewable Energy
RMKe-12	Twelfth Malaysia Plan
ROI	Return on Investment
SAIDI	System Average Interruption Duration Index
SMEs	Small and Medium-sized Enterprises
TNB	Tenaga Nasional Berhad
TPA	Third Party Access
TSRS	Transmission System Reliability Standards
TVET	Technical and Vocational Education and Training
UK	United Kingdom
UKERC	UK Energy Research Centre
UniMAP	Universiti Malaysia Perlis
UNITEN	Universiti Tenaga Nasional
US	United States
VCS	Verified Carbon Standard
VPP	Virtual Power Plant

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Sabah Energy

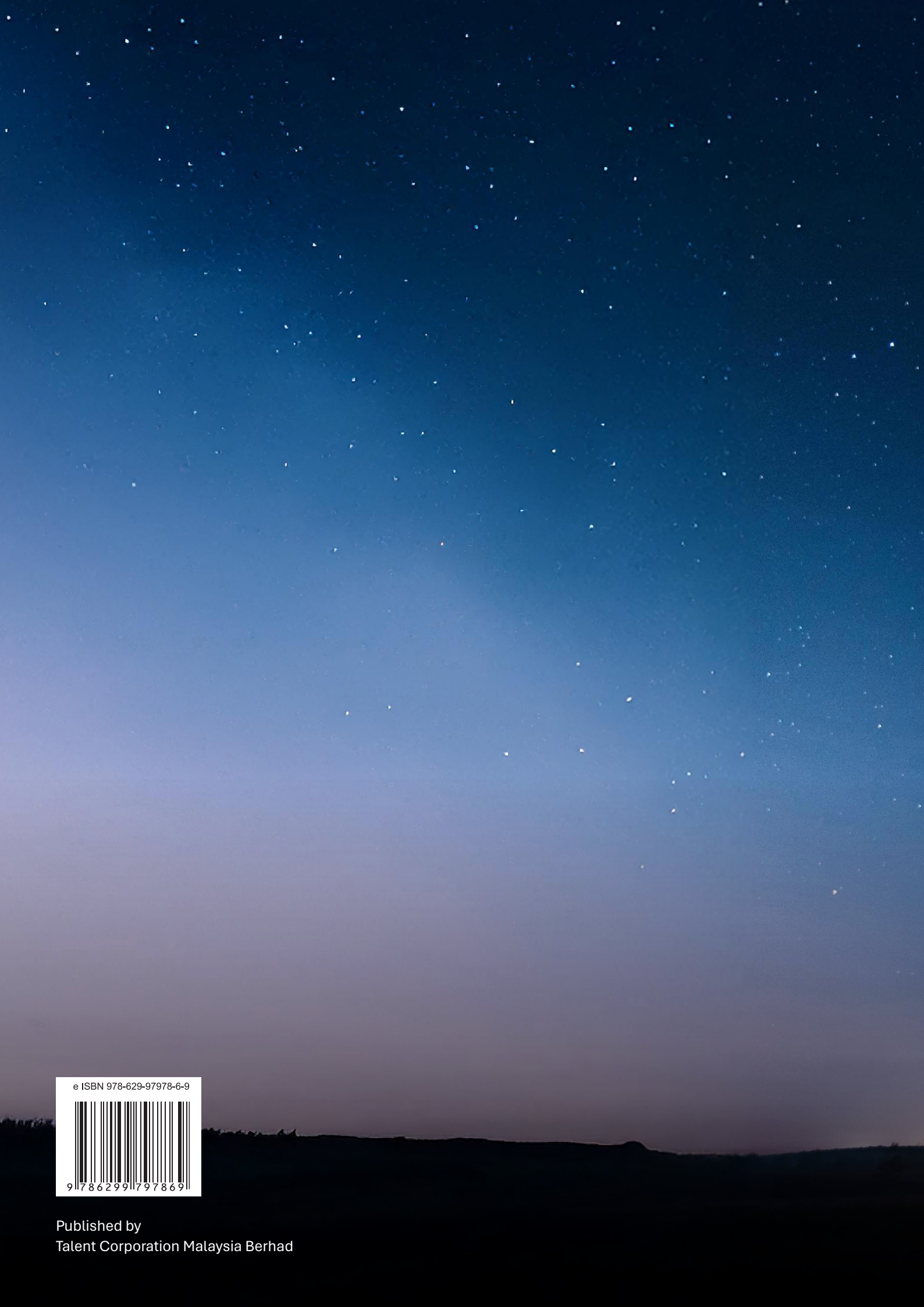
Sarawak Economic Development Corporation

Sarawak Energy

SIRIM

Tenaga Nasional Berhad

TNB Renewables Sdn. Bhd.



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