



Sourcing The Power Required For GenAI: Transmission Infrastructure for Data Centers

Tenaga Nasional Berhad
26 March 2024

Grid Division, TNB

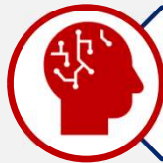
CONFIDENTIAL AND PROPRIETARY



Agenda



**OVERVIEW OF TENAGA NASIONAL
BERHAD (TNB)**



**ROLE OF DATA CENTRES IN GenAI
DEVELOPMENT**



**THE RISE OF DATA CENTRES IN
MALAYSIA**



**SOURCING POWER FOR DATA
CENTRES THROUGH TRANSMISSION
INFRASTRUCTURE**



**TNB'S INITIATIVES IN
ACCOMMODATING RAPID GROWTH OF
DATA CENTRES**

OVERVIEW OF TENAGA NASIONAL BERHAD (TNB)



2017

2016

OVERVIEW OF TENAGA NASIONAL BERHAD (TNB)



Tenaga Nasional Berhad (TNB) supports the energy industry across the value chain. For over 70 years, TNB has been powering Malaysia 24/7, maintaining a secure and resilient system.



Generation



Grid



Distribution Network

Domestic Commercial Industrial



Retail

Generates electricity. Least cost dispatch by ring-fenced Single Buyer and Grid System Operator

Transmits electricity over long distances. Operated by Grid Division

Connects customers to Grid and distributes electricity to customers

Provides services and solutions to customers



TNB market share **51.6%**



Length of domestic transmission Network
~26,000 KM



Length of domestic Distribution Network
~734,000 KM



Total number of customers in Peninsular ~ **10 million**



Current installed capacity¹
27,085 MW



Highest MD recorded²
19,716 MW



Substations (PMU)
~480 units



Substations (PPU, SSU, PE)
>87,000 units



Units Sold³
123,206 GWh

Peninsular Gen mix:



Thermal
Coal – **57.6%**
Gas & LNG – **36.1%**
Distillate – **0.2%**



Renewable Energy
Hydro – **4.5%**
Solar – **1.6%**



Interconnection
Malaysia – Thailand **386 MW**
Malaysia – Singapore **1,000 MW**
Voltage supply at **500 kV / 275 kV / 132 kV**

Voltage supply at **33 kV / 11 kV / 0.4 kV**



Rooftop Solar⁴
340 MWp secured

¹ 11 March 2024. Source from <https://www.singlebuyer.com.my/>

² 11 May 2023, 4:00PM. Source from <https://www.singlebuyer.com.my/>

³ Unit sold as of December 2023

⁴ Capacity secured as of December 2023

Regulated Entities

OVERVIEW OF TENAGA NASIONAL BERHAD (TNB)

We strive to future proof our business by expanding our RE footprint and establishing strategic partnerships with leading RE players in the world



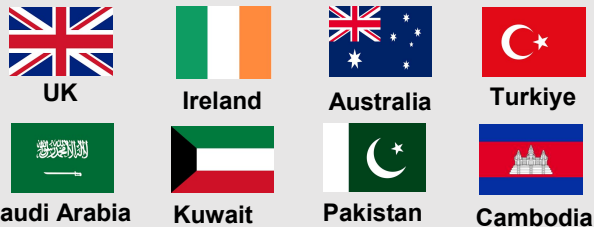
2021 VANTAGE RE

- **Equity stake:** 100%
- **Capacity:**
 - 123.9MW in onshore wind (100% equity)
 - 365.0MW in solar (55% equity)
 - 41.5MW in offshore wind (49% equity)
 - 276.0MW in solar (100% equity)

2016 GAMA ENERJİ A.Ş.

- **Equity stake:** 30%
- **Capacity:**
 - 1,151.5MW in gas, hydro and wind.
 - Water conveyance in Jordan

Our International Presence

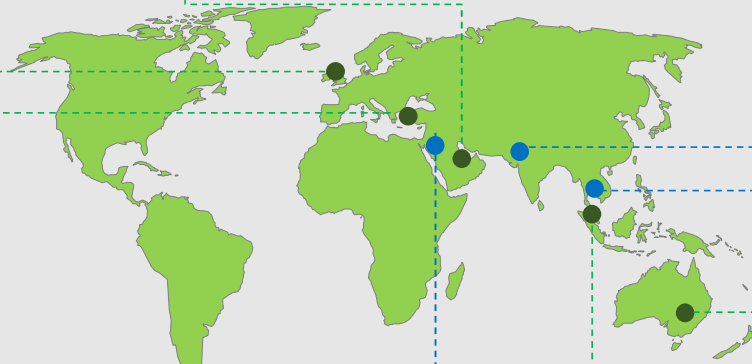


— New Energy Division — Remaco

INTERNATIONAL PORTFOLIO

2005 SEPSCO SWEC

- **Equity stake:** 6% effective equity stake
- **Capacity:**
 - 1,190.7MW in oil
 - Water desalination of 376 mcm p.a.



- **Operation & Management Services:**
 - Maintenance Services Agreement Mechanical Works (Doha West Plant)
 - Instrumentation & Control Systems (Shuwaikh Power Plant & Doha West Plant)



- **Operation & Management Services:**
 - TNB Remaco & Balloki Power Plant National Power Park Management Company Limited



- **Technical Advisory:**
 - Technical Advisory for Electricité du Cambodge (EDC) Heavy Fuel Oil Plant of 400MW

2023 Spark Renewables

- **Equity stake:** 100%
- **Capacity:**
 - 120.5MWp in Solar

2018 TNB RENEWABLES

- **Equity stake:** 100%
- **Capacity:**
 - 123.8MW Large Scale Solar (LSS) parks (100% equity)
 - 4.8MW in biogas (49% equity)

ROLE OF DATA CENTRES IN GenAI DEVELOPMENT



SURGE IN DEMAND OF DATA CENTRES & AI

2022

460 TWh

Estimated energy consumption, in Terawatt hour (TWh) of data centre, cryptocurrencies, and artificial intelligence (AI)

2%

Total global electricity demand

160 - 590 TWh increment
(Up to 130%)

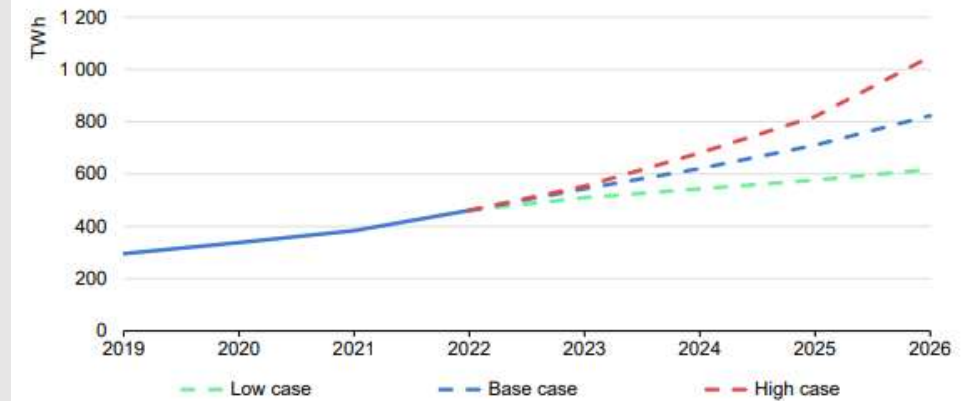
2026

620 - 1050 TWh

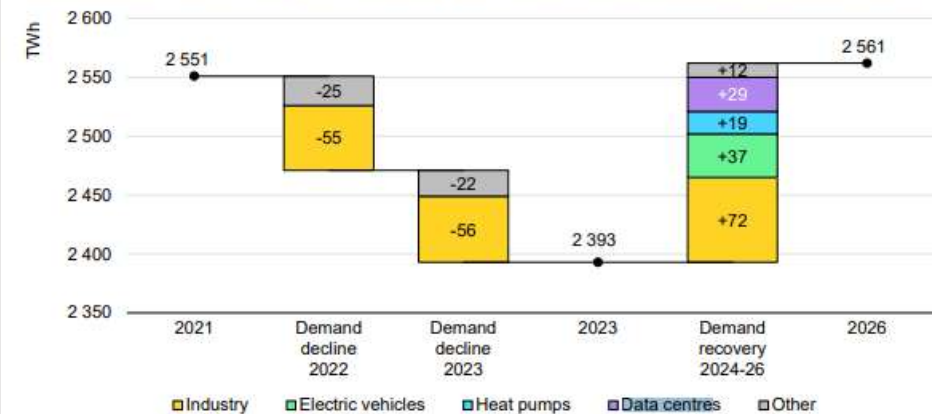
Expected global electricity consumption of data centres, cryptocurrencies and artificial intelligence.

**Depending on the pace of deployment, range of efficiency improvements as well as artificial intelligence and cryptocurrency trends.

Global electricity demand from data centres, AI, and cryptocurrencies, 2019-2026



Estimated drivers of change in electricity demand in the European Union, 2021-2026



Source: International Energy Agency (IEA)

ROLE OF DATA CENTRES IN DEVELOPMENT OF GenAI

- Data centres provide the necessary high-performance computing infrastructure to handle complex AI workloads. efficiently

Compute Power



- Data centres offer robust storage solutions to store and manage large datasets securely.

Data Storage



- Data centres utilize virtualization and cloud computing technologies to provide scalable computing resources, enabling GenAI developers to adjust resource allocation dynamically as needed.

Scalability



- Data centres are equipped with high-bandwidth network infrastructure and low-latency connections to support seamless communication between AI components.

Connectivity



- Training - data centres perform intensive computational tasks to train AI models on large datasets.
- Inference stage - data centres deploy trained models to process incoming data and generate AI-generated outputs in real-time.

Training and Inference



- Data centres serve as collaboration hubs where GenAI researchers and developers can access shared resources, collaborate on projects, and exchange knowledge and expertise.

Collaboration and Sharing



- Data centres are increasingly focusing on energy efficiency to minimize their environmental footprint and operational costs.

Energy Efficiency



THE RISE OF DATA CENTRES IN MALAYSIA



**TENAGA
NASIONAL**

Better. Brighter.

MALAYSIA AS A DATA CENTRE POWERHOUSE IN ASIA PACIFIC

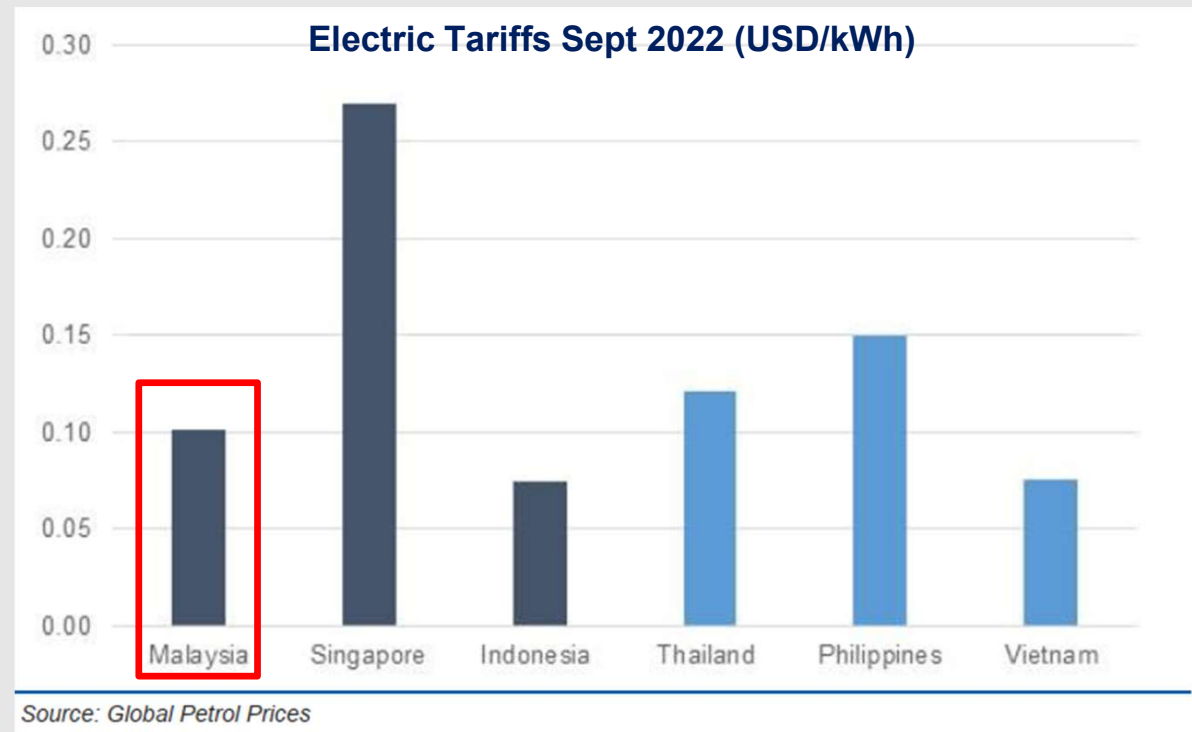
With the growing importance placed on the sustainability agenda and the national target for RE (31% of the power capacity mix by 2025 & 40% by 2035), Malaysia is a choice location for hyperscalers due to:

AMPLE & LOWER
COST OF LAND

RELIABLE POWER
INFRASTRUCTURE
WITH LOW
ELECTRICITY
TARIFFS

READY ACCESS TO
SKILLED
WORKFORCE

PRO-BUSINESS AND
FAVOURABLE



Source: Malaysia Digital Economy Corporation

The Data Centre business in Malaysia is experiencing exponential growth due to the increasing demand for cloud storage, digitalization, and the accelerating development of 5G



Amazon's cloud unit to invest \$6 bln in Malaysia by 2031

Reuters
March 2, 2023 10:49 AM GMT+8 · Updated 5 mo

28 MARCH 2022
Yondr Group Launches 200MW Hyperscale Data Center Project in JCorp's Sedenak Tech Park, Malaysia



Princeton Digital Group invests RM2bil to develop data centre in Johor

By Azanis Shahila Aman · May 22, 2023 @ 5:03pm



Bersama Malaysia: Microsoft Commits US\$1 Billion Investment to Establish Data Center in Malaysia



Macquarie's AirTrunk enters Malaysia with 150+MW hyperscale data centre in Johor Bahru

By Digital News Asia January 24



to skill an additional one million Malaysians for IT, artificial 2030.

GDS to build 54MW data center in Johor, Malaysia

Company building hyperscale campus close to Singapore, across the Johore Strait



YTL Power to invest RM15bil on developing data centre park in Johor

Bridge Data Centres launches new facility in Johor, Malaysia

ByteDance to be anchor tenant

October 20, 2022 By: Dan Swinhoe · Have your say



Data centre operator NEXTDC announces major investment in Malaysian digital economy

8 June 2023

THE RISE OF DATA CENTRES IN MALAYSIA

Malaysia has experienced remarkable growth, driven significantly by its diverse development initiatives, particularly in the realm of digital transformation as TNB have received 74 supply applications from Data Centre Customers with total maximum demand more than 11,000MW prominently from Johor and Klang Valley.



74 Data Centre Projects
Supply Applications in
Klang Valley and Johor
>11,000MW



PDG



aws



Microsoft

GDS 万国数据

yondr

VANTAGE
DATA CENTERS

BRIDGE DATA CENTRES

AIRTRUNK

SIPP-YTL
SINCE 1955

edgeconnex

SUNWAY

*Klang Valley (comprises of Selangor , Kuala Lumpur and Negeri Sembilan)

** Comprises of HV Supply and MV based on declaration by consultant/customer as of Dec 23

CURRENT STATUS OF HIGH VOLTAGE DATA CENTRES IN MALAYSIA



55 HV Data
Centers

Projects have engaged
with TNB
(as of 29 Feb 2024)



5 HV Data
Centers

Projects has been
commissioned



6 HV Data
Centers

Projects under
construction



8 HV Data
Centers






Projects under
planning stage



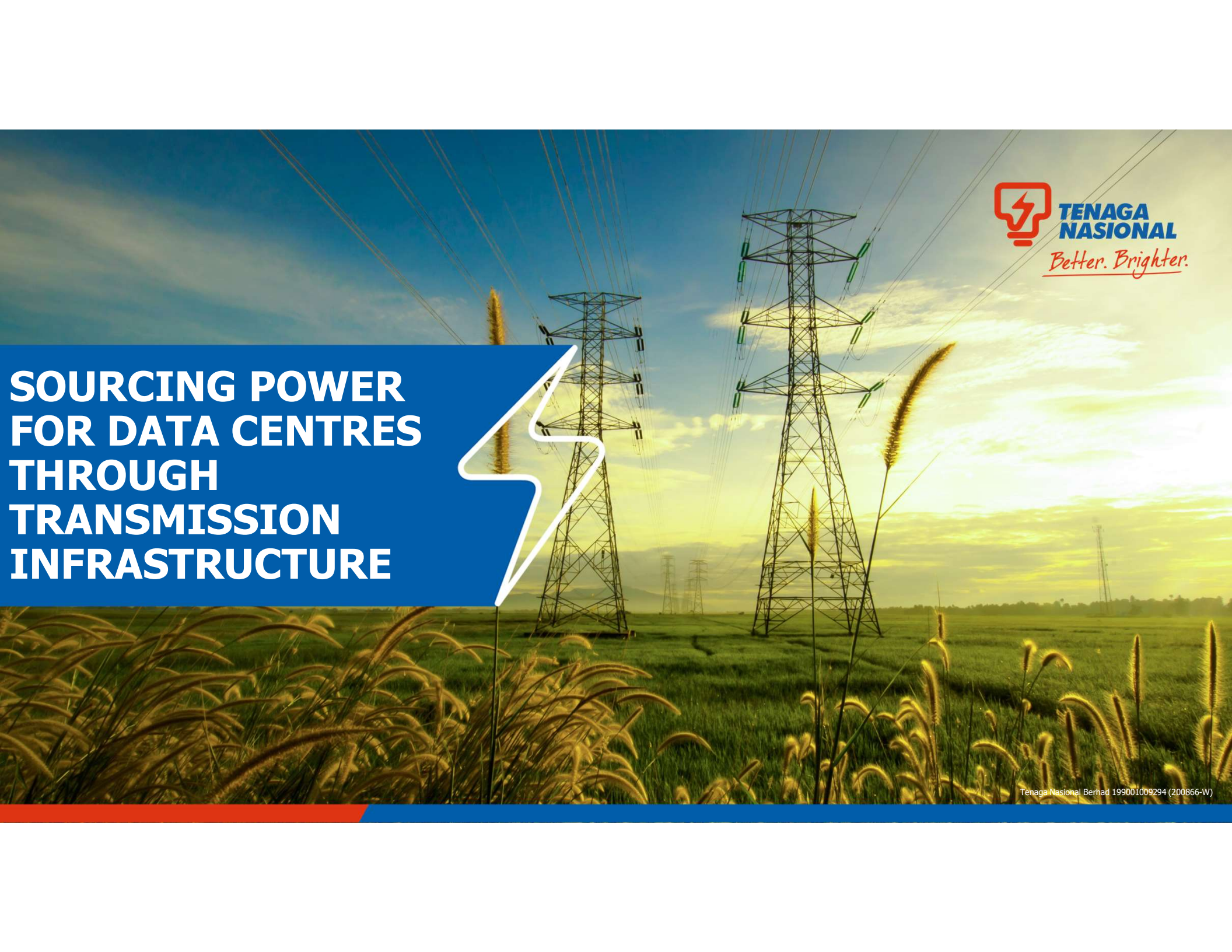
36 HV Data
Centers

Projects under
Pre-Consultation stage

COMMISSIONED HIGH VOLTAGE DATA CENTRES IN MALAYSIA

-  Bridge Data Centre, Johor
-  GDS Date Centre Plot 1, Johor
-  Yellwood Data Centre, Johor
-  SIPP YTL Data Centre, Johor
-  PDG Data Centre, Johor





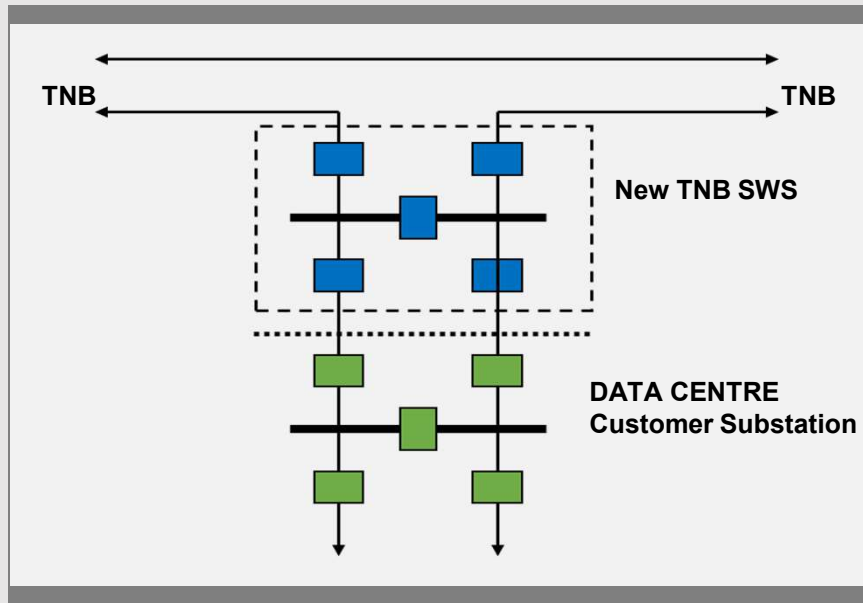
SOURCING POWER FOR DATA CENTRES THROUGH TRANSMISSION INFRASTRUCTURE



TYPES OF DATA CENTRE'S CONNECTION SCHEME

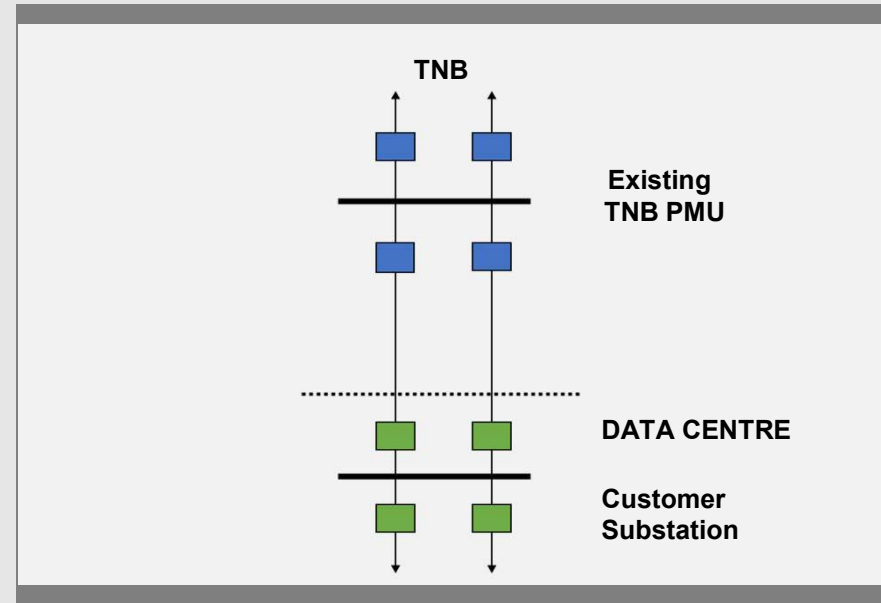
Currently, there are 2 types of connection schemes from TNB substation into Data Centre's substation. Decision will be based on the need for Grid Network expansion at the proposed location and the outcome of TNB's feasibility study.

SPUR OHL/UGC FROM NEW TNB SWITCHING STATION



Typical Configuration with Spur Double Circuit OHL/UGC (or SC/DC LILO) from New TNB Switching Station

SPUR OHL/UGC FROM EXISTING TNB SUBSTATION



Typical Configuration with Spur Double Circuit OHL/UGC from Existing PMU (for area with no future Grid Network expansion)

..... Ownership & Maintenance Boundary



TNB'S INITIATIVES IN ACCOMMODATING RAPID GROWTH OF DATA CENTRES

TNB'S GREEN LANE SUPPLY & STRATEGIC OFFERINGS FOR DATA CENTRES IN MALAYSIA



Exclusive pathway and strategic offering for Malaysia's data centre market to provide efficient and environmentally responsible solutions for data centre operators



Streamlined on-boarding process for data centres, expedite approvals and facilitate a smooth setup of data centre operations in Malaysia



Establishment of the One-Stop-Centre (OSC) will fulfil all data centres' requirements.

Normal HV Bulk Supply Process

36
MONTHS

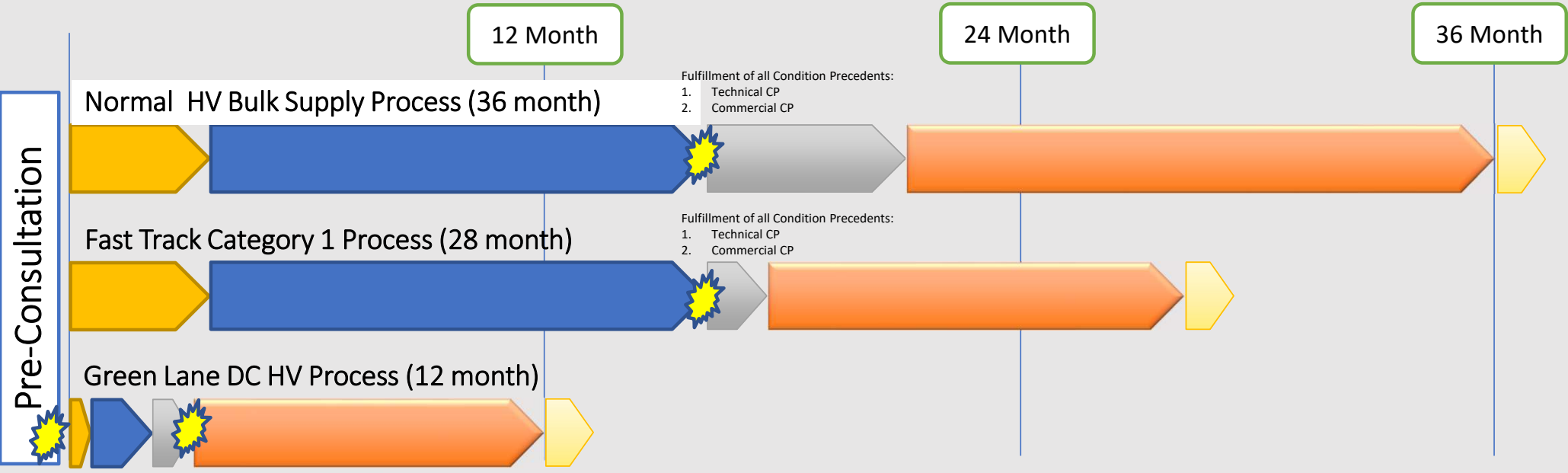


Green Lane DC HV Process

12
MONTHS



PROJECT TIMELINE COMPARISON (NORMAL HV, FAST TRACK CATEGORY 1 AND GREEN LANE DC HV PROCESS)

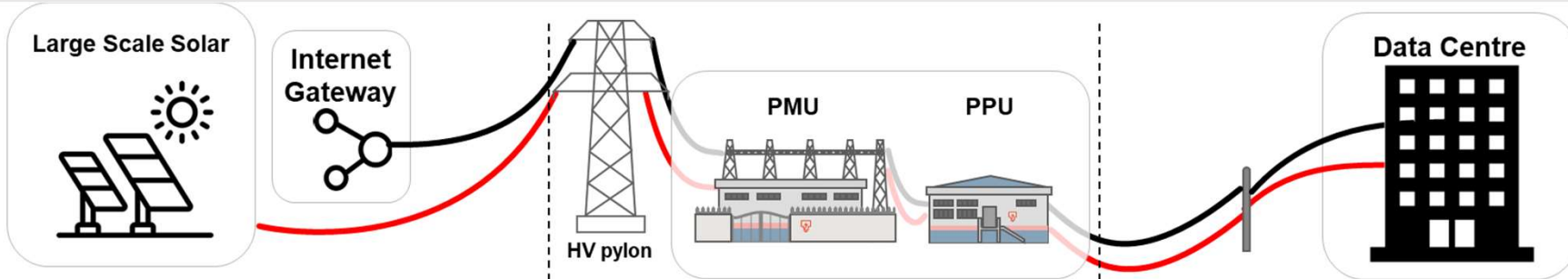


Fulfillment of Technical CP
Fulfillment of Commercial CP

Fulfillment of all Condition Precedents:
1. Technical CP
2. Commercial CP

	Normal HV Bulk Supply Process	Fast Track (Category 1)	Green Lane DC HV Process
Application and Study	3.5 Month	3.5 Month	0.5 Month
Technical & Commercial Approval	12.5 Month	12.5 Month	1.5 Month
Awarding (Procurement & Letter award)	5 Month	1.5 Month	1 Month
Implementation & Construction	15 Month	10.5 Month	9 Month
Commission and Energization			

COMPREHENSIVE SOLUTIONS AND PRODUCTS OFFERED BY TNB'S SUBSIDIARIES



Large Scale Solar

Transborder **Internet Gateway** **Data Centre Connectivity**

Transformer

MVPS

Cables

Energy Efficiency

Solar Rooftop

District Cooling System

Digital Connectivity



Compact Substation Unit

EV Charger

Charge Point Operator


mREC

GET



COMPREHENSIVE SOLUTIONS AND PRODUCTS OFFERED BY TNB'S SUBSIDIARIES



Manufacturing	Services, EPC and Consultancy	Power	Research & Education
<p>Manufacturing of transformers, switchgears, EV chargers and cables</p> 	<p>Provides consultancy and technical solutions for the development, operation and maintenance of RE (LSS and solar rooftop), energy efficiency and telecommunications projects</p> 	<p>Develops, operates and maintains generation assets such thermal power plants, large scale solar and wind projects</p> 	<p>R&D, reskilling and upskilling development programs and nurturing future leaders</p> 

Non-Regulated Entities

The background of the slide is a long, perspective view of a tunnel. The walls and ceiling are lined with lights that create a strong sense of motion and depth, with light trails in shades of blue and white. The floor is dark, and the overall atmosphere is futuristic and high-tech.

Thank You

