MALAYSIA ESI: SUSTAINABILITY & TECHNOLOGY DISRUPTION

Loo Kok Seng
Senior General Manager
Sustainability & Corporate Asset Management, REAP
Tenaga Nasional Berhad

INTERNATIONAL FORUM ON GLOBAL ENERGY LANDSCAPE : ELECTRICITY & GAS MARKET LIBERALISATION & IT'S IMPLICATION TO MALAYSIAN ECONOMY
13th Feb 2018

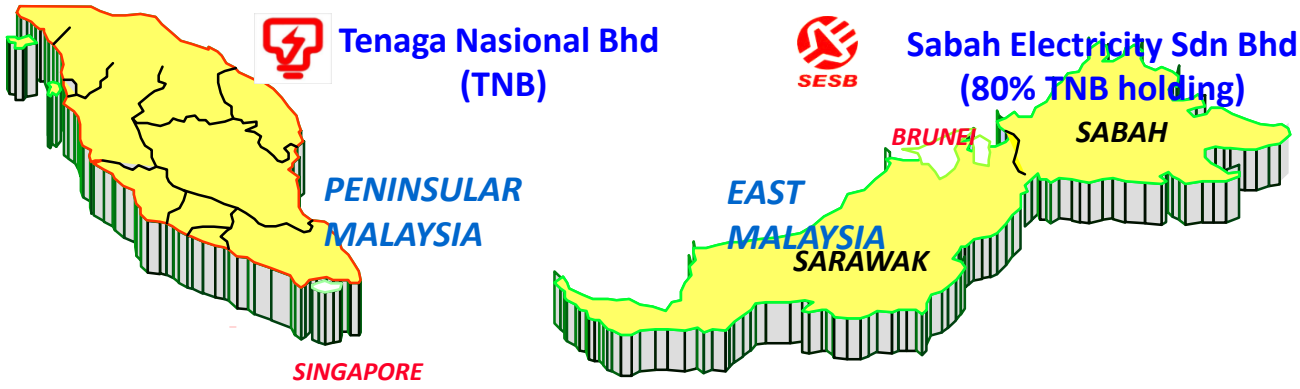
Content

- Overview of Electricity Supply Industry & TNB
- Challenges & Sustainability Initiatives
- Technology Disruption
- TNB & Future Utility
- Conclusion

Content

- Overview of Electricity Supply Industry & TNB
- Challenges & Sustainability Initiatives
- Technology Disruption
- TNB & Future Utility
- Conclusion

Tenaga Nasional Berhad (TNB) is the largest utility company undertaking the role of developing, managing and operating the Generation, Transmission and Distribution of Malaysia's ESI.

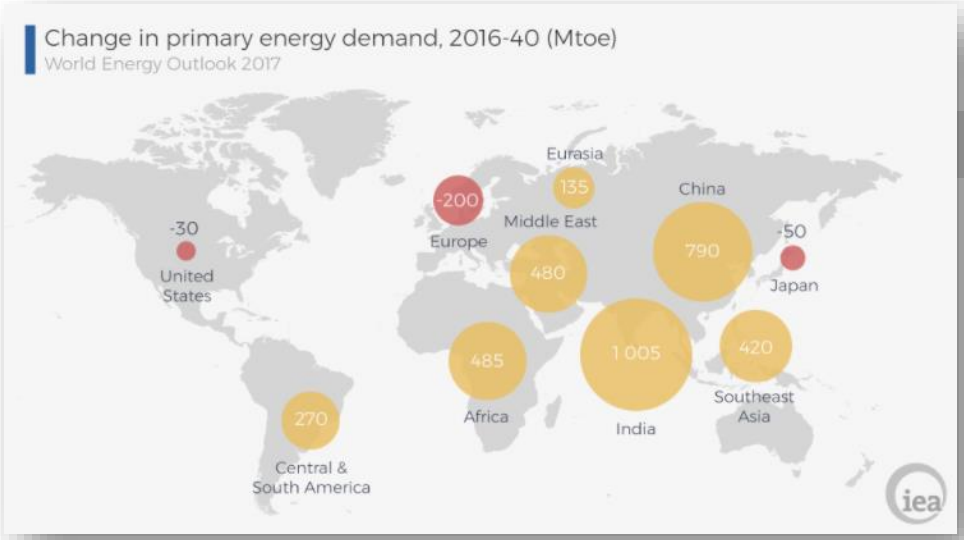


RESOURCES	**Employees** 35,009 people (TNB group,as of 2017)	**Assets** RM 142 billions (TNB group,as of 2017)	**Fuel Mix** GAS 42.2% · COAL 52.8% · HYDRO 4.7% · OTHERS 0.3% (as of 2017)
CAPACITY	**Customers** 9.08 mill accounts (Peninsula & Sabah/ Labuan)	**Maximum Demand** 17,788 MW (as of 2016)	**Installed Capacity** 14,510.9 MW (TNB) (as of 2017)
FINANCIAL	**CAPEX** RM12.1 Billion (FY 2017)	**Revenue** RM47.4 Billion (FY 2017)	**ROA** 5.4% (FY 2017)
PERFORMANCE	**Electrification** Peninsula 99.99% Sabah 90.81%	**SAIDI (Distr)** 50.24 mins (as of 2017)	**System Mins (Trans)** 0.2265 mins (as of 2017)

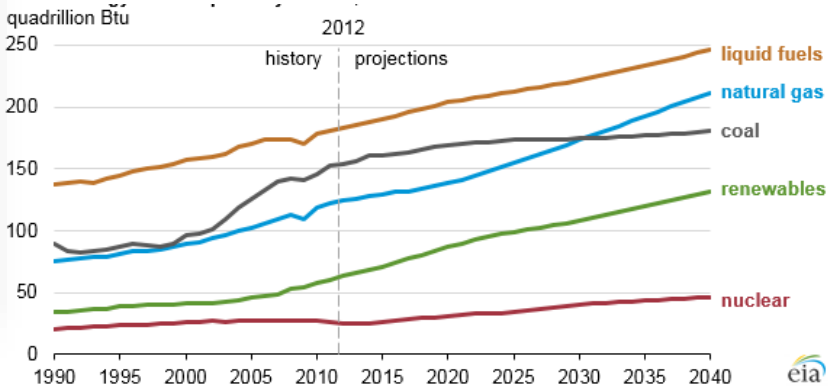
Globally, electricity demand growth will exceed the growth of energy demand

By 2040,

- International Energy Agency (IEA) forecasts that 30% increase in world energy consumption under New Policy Scenario, while the U.S. Energy Information Administration projects a 48% increase
- Bloomberg forecasts that electricity demand will grow by 58%, higher than the overall energy demand growth.



World energy consumption by source, 1990-2040



A reduction in electricity demand growth in Malaysia is expected, as well as its gradual decoupling from the GDP

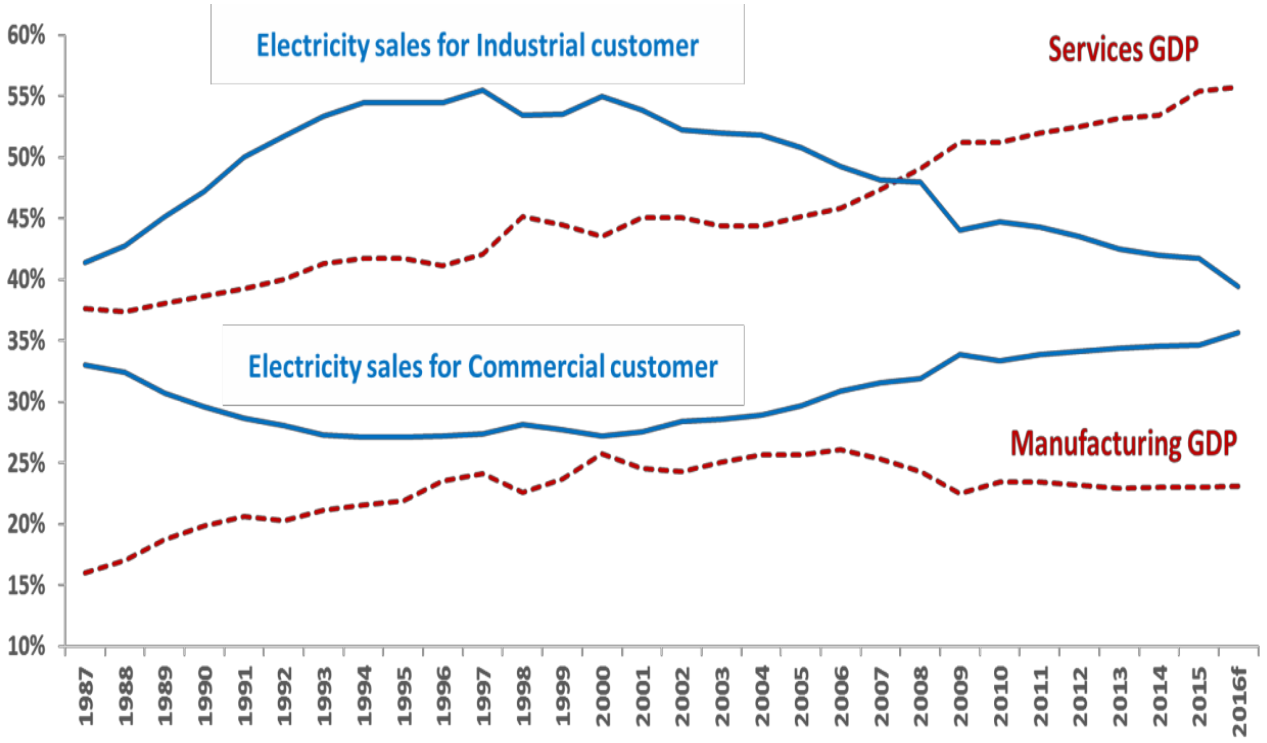
Reduced Demand Growth

Average forecasted growth rates of electricity demand between 2016-2035 is 1.53%.

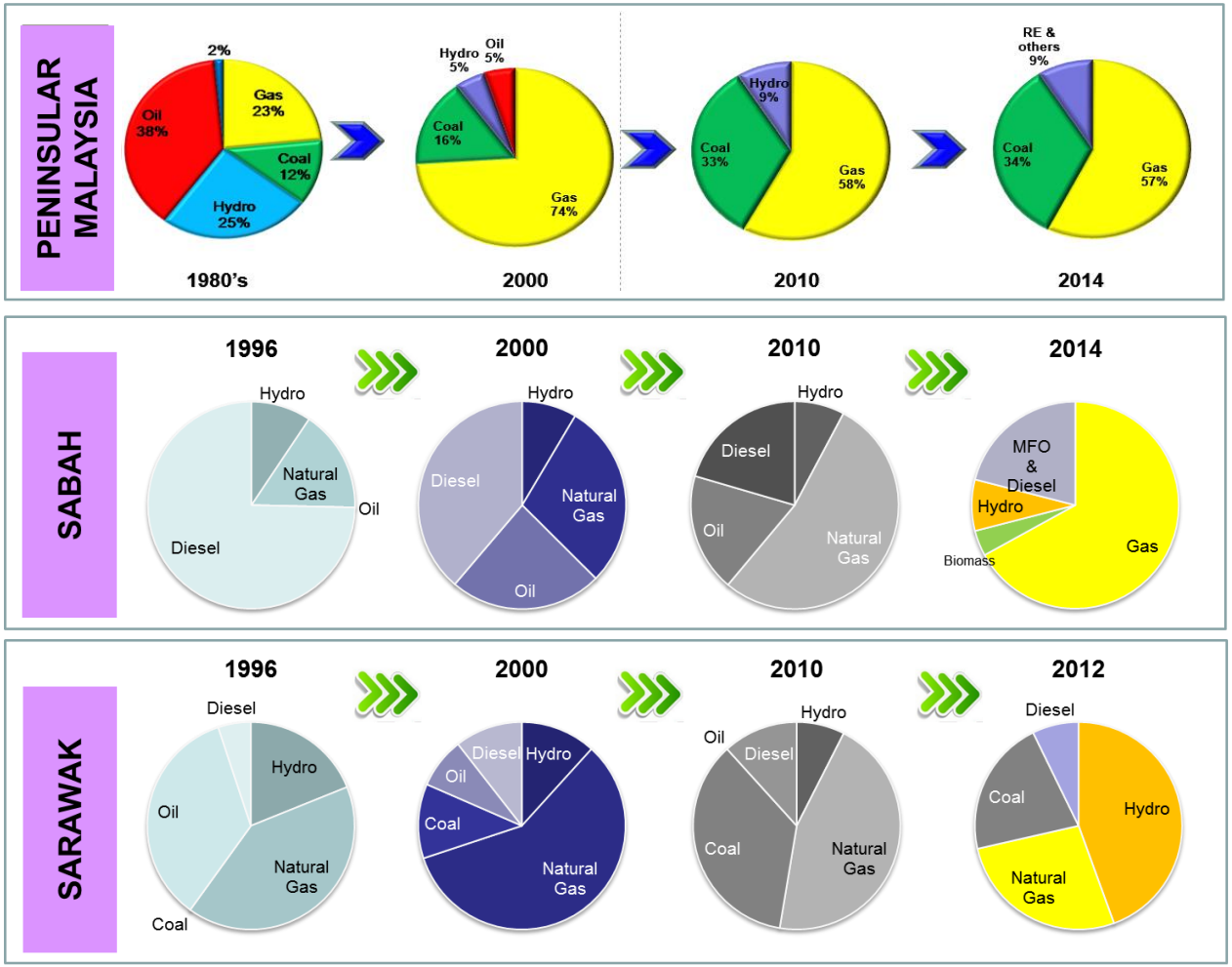
Decoupling from GDP

Shift towards a more service-oriented economy, as well as the decoupling of electricity demand from GDP.

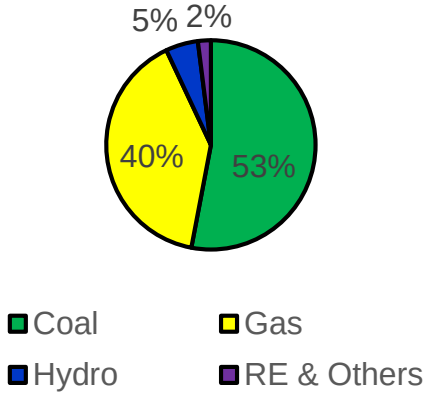
Impact of the structural changes in the economy towards electricity demand



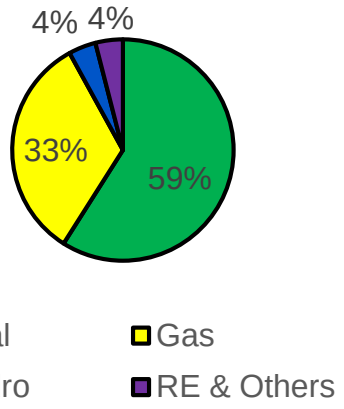
Generation Capacity Mix in Malaysia in the past few decades was determined by availability of energy resources which is mainly from fossil fuel (natural gas and coal) with RE played a role in the coming decades



Pen. Malaysia Fuel Mix 2017



Pen. Malaysia Fuel Mix Projection 2020

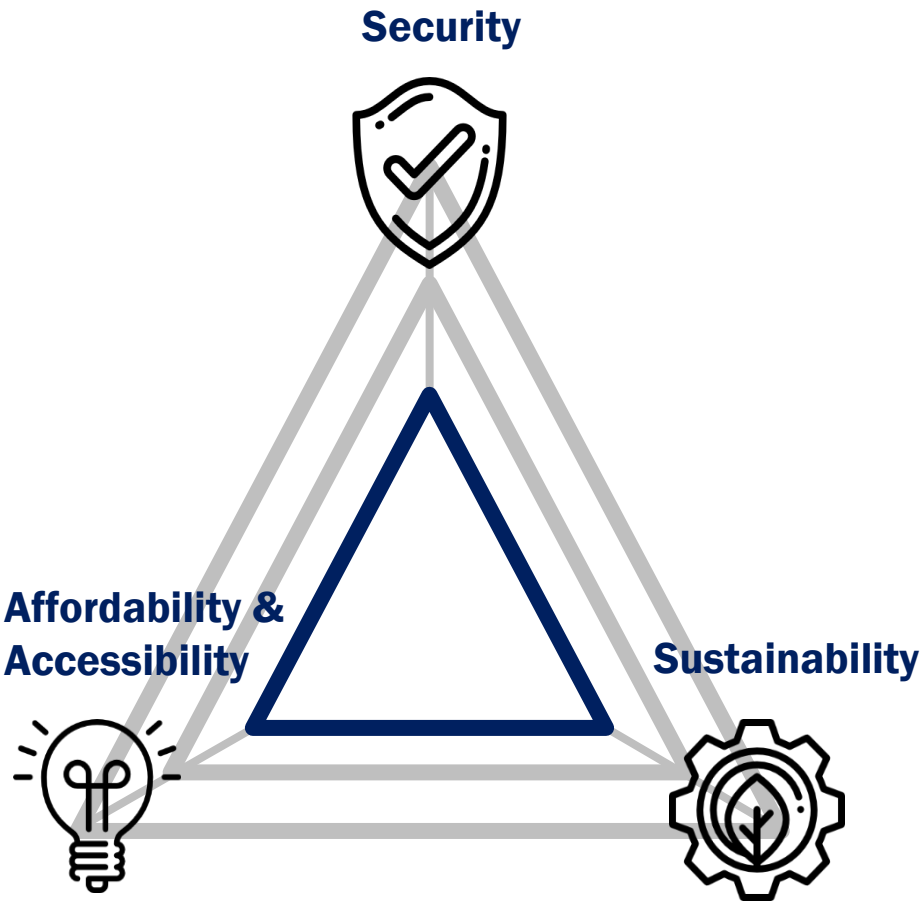


Source: Malaysia Energy Information Hub Statistic ,(ST)

Content

- Overview of Electricity Supply Industry & TNB
- Challenges & Sustainability Initiatives
- Technology Disruption
- TNB & Future Utility
- Conclusion

Energy Trilemma – In keeping up with buoyant economic and relatively high population growth, power utilities are facing a trilemma in balancing between security, economic and sustainability.



Source: 2015 World Energy Council Energy Trilemma Index

Energy Security

The effective management of primary energy supply from domestic and external sources, reliability of infrastructure and the ability of energy providers to meet current and future demands.

Energy Affordability and Accessibility

Affordability and accessibility of energy supply across the population.

Sustainable Development

Encompasses the achievement of supply and demand side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

Global trends will disrupt the balance of energy trilemma and significantly impact the Electricity Industry

Major trends/shifts changing the landscape

2 Capital requirements

Expectations of shareholders are changing on returns and sustainability

3 Technology disruptions

Dramatically changing the power sector and the way companies work
EE, RE, EV & Battery Storage

1 Economic shifts

Moving growth towards Asia and middle weight cities

4 Regulations evolving

Increasing in pressure for cost efficiency and competitiveness in Malaysia and the world

Key challenges in delivering sustainable power supply to the nation amid challenging and evolving ESI outlook

Energy Sustainability/ Security

- Availability of fuel - gas & coal
- Limitation of alternative fuels – nuclear, hydro & RE
- Difficulty in securing Rights-of Way (ROW) for transmission line
- Limited sites for future power plants

Economic Sustainability

- Impact of global economic crisis
- Volatility (fluctuation) of fuel prices
- Regional Competitiveness /Multiplier Effect
- Electrification for very remote areas

Environment sustainability

- Climate change issue linked to burning of fossil fuel
- Stringent emission standard and global concerns on carbon emission
- NIMBY syndrome
- Renewable Energy

Renewable Energy (RE) is an innovative, sustainable and low carbon option. In Malaysia, FIT scheme is driving the RE growth, with Solar PV technology becoming the favorite among the developers.

TENAGA NASIONAL
Better. Brighter.

Biomass

Potential :
~1,340 MW by 2030

Mini-Hydro

Potential:
~490 MW by 2020

Solar

Potential:
~6,500 MW (BIPV)

Biogas

Potential:
~410 MW by 2028

Solid Waste

Potential:
~360 MW by 2022

Malaysia RE Resources

Renewable Energy Act 2011

National Renewable Energy Policy and Action Plan 2009

Sustainable Energy Development Authority Act 2011

- RE requires support and subsidy to move forward. As such new RE policy and Acts were introduced .
- **As of 2017**, over 500 MW of RE capacity (commissioned and in progress) has been achieved through FIT programme.

RE projects undertaken by TNB

Mini Hydro, Sg Bil, Perak

Capacity = 0.225MW

Biogas Plant at Flemington, Perak. JV with Sime Darby

Capacity = 1.6MW

SHS Sinulihan, Sabah

Capacity
Solar PV = 0.045Mwp
Generator = 0.015MW

Biogas Plant at Kulai, Johor. JV with Sime Darby

Capacity = 1.6MW

Landfill Gas Power Plant , JV in Puchong, Selangor

Capacity = 2MW

Wind & Solar, Pulau Perhentian

Wind = 0.2MW
Solar PV = 0.1Mwp
Generator = 0.32MW

SHS Banggi , Sabah

Capacity
Solar PV = 0.65Mwp
Generator set = 0.2MW

Biomass Plant, JV with Felda Palm Industry, Felda Jengka

Capacity = 10MW

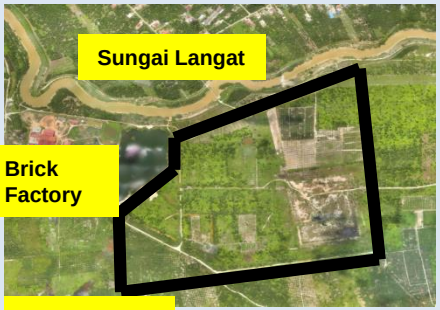
Rooftop Solar PV @ Carpark, TNB HQ, Bangsar

Capacity
Solar PV = 0.15Mwp

Solar Hybrid System (SHS) RPS Kemar, Perak

Capacity
Solar PV = 0.85Mwp
Generator set = 1.5MW

Building renewable energy capacity for Malaysia's sustainable future
TNB's latest RE development; Large Scale Solar and Floating Solar



Development of LSS PV for TNB after winning the LSS Bid in 2016

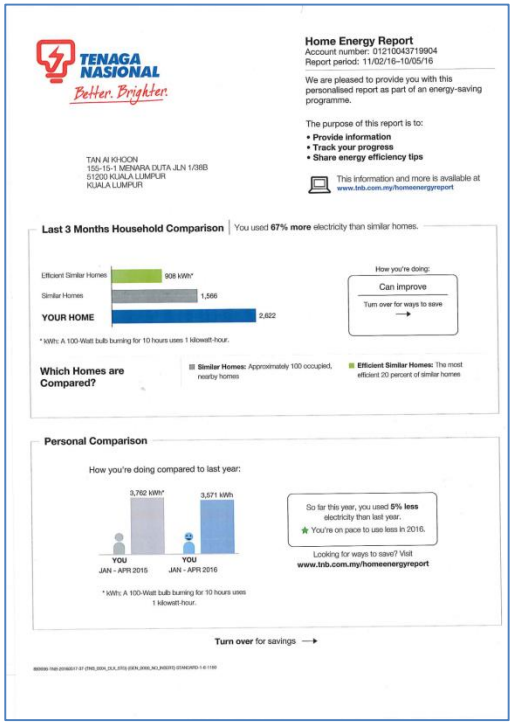
- TNB is committed to own 1.7 GW RE capacity by 2025. The 50 MW LSS Development:
  - Location : Lot 32888, Mukim Tanjung Dua Belas, Daerah Kuala Langat
  - Expected COD: end 2018
- TNB Sepang Solar Sdn. Bhd. (incorporated on 28 Dec 2016) as a Special Purpose Vehicle (SPV) company for this development.

Floating Solar Photovoltaic (FSPV) System (Pilot Project)

- The country's first floating solar project that is being undertaken in Sepang, Selangor utilising Malaysian Electricity Supply Industries Trust Account (MESITA) fund.
- The project was launched in March 2015 and has a capacity of 108 kWp, covering 1,000m2 on a 50 hectares lake in the Sungai Labu Water Treatment Plant (WTP).

Home Energy Report (HER) Phase 2

HER Phase 2 is a Demand Side Management (DSM) launched in 2017 as an initiative that engage and empowers domestic customers to understand their own energy consumption and becoming more energy efficient. HER phase 2 utilizes multiple platforms to communicate with our domestic customers.

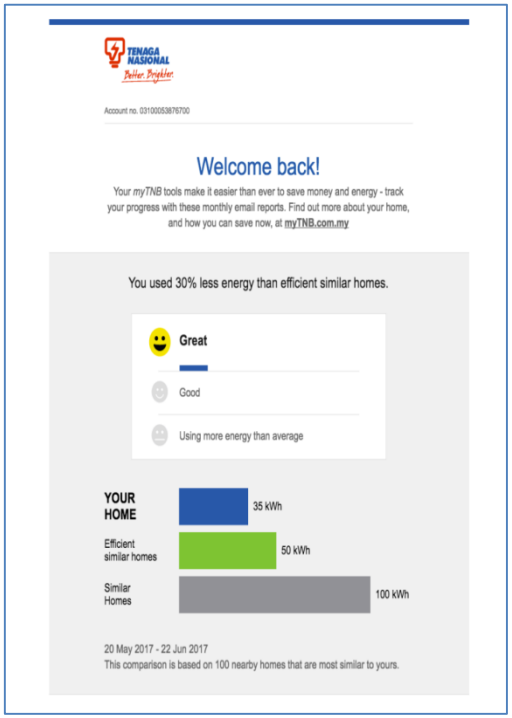


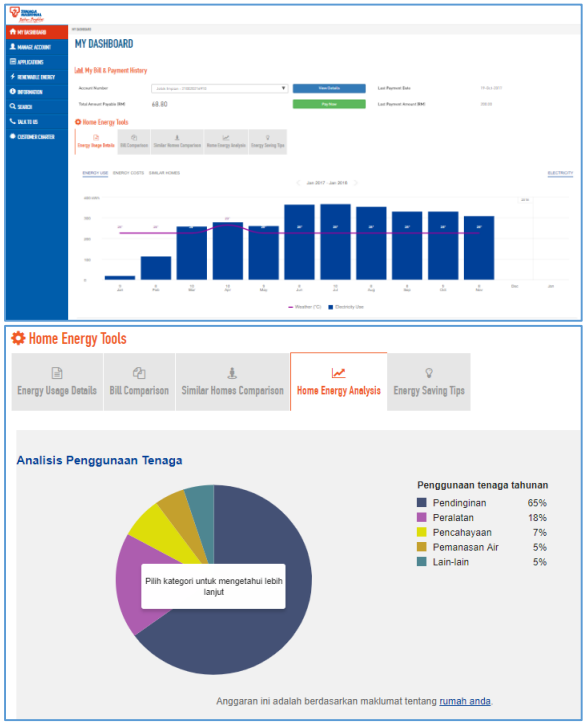
Print HER

over 450,000 selected customers received this communication

email HER

Over 450,000 selected customers received this communication





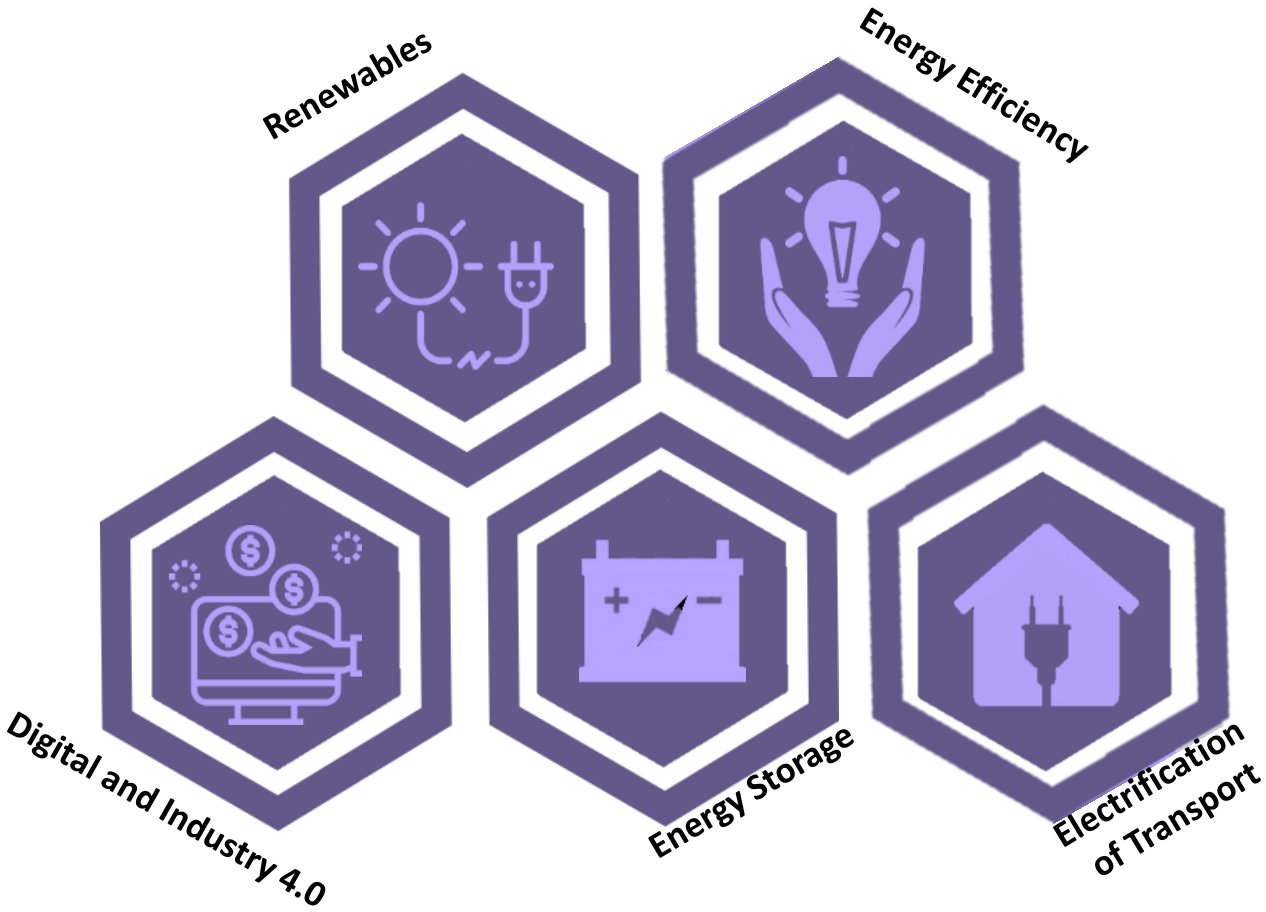
HER widgets (on myTNB)

Over 6.9 million domestic customers received this communication

Content

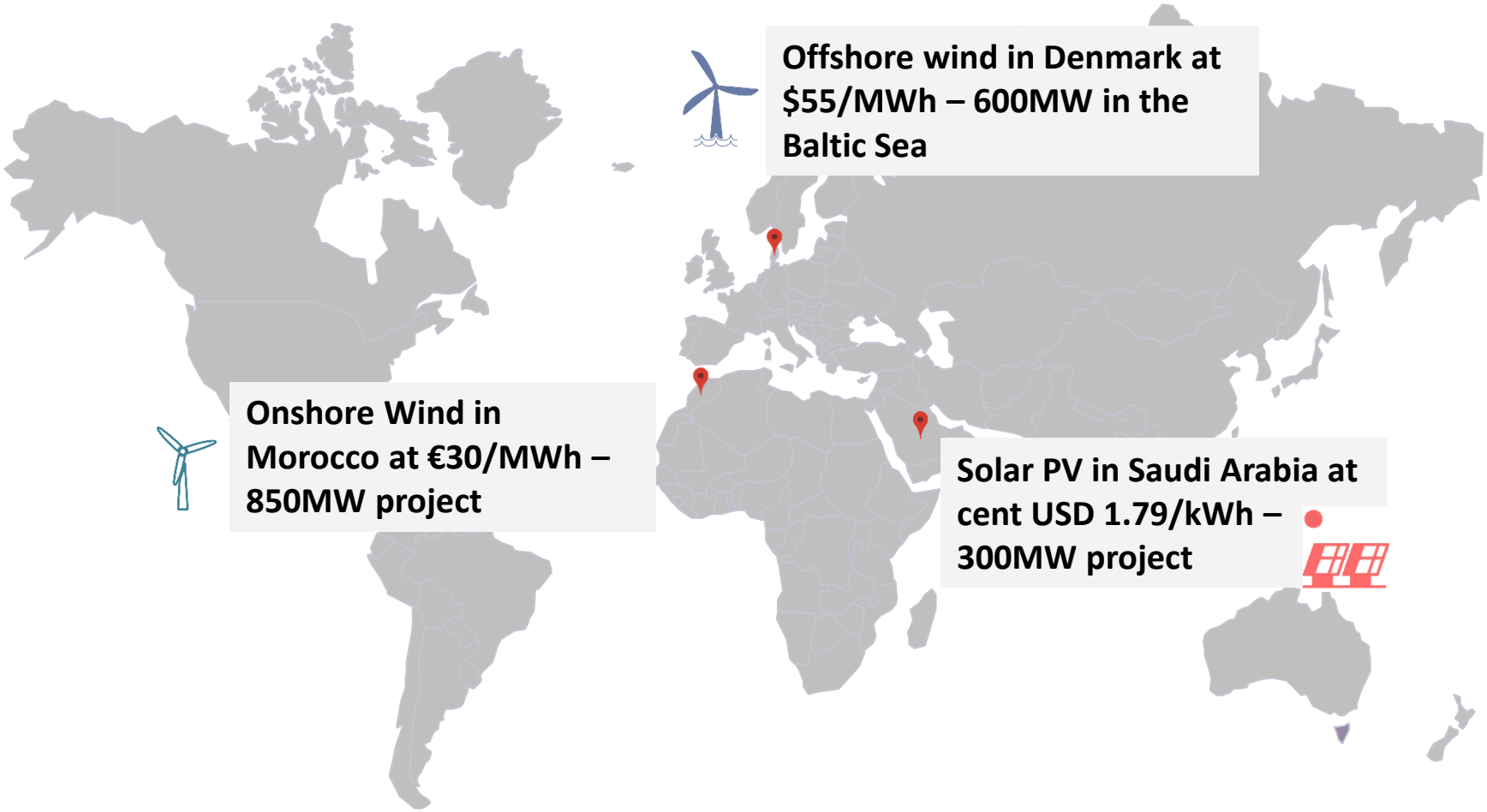
- Overview of Electricity Supply Industry & TNB
- Challenges & Sustainability Initiatives
- Technology Disruption
- TNB & Future Utility
- Conclusion

First wave of technology innovations are reshaping the power industry



Source: McKinsey, GlobalData, IEA WEO 2016, Bloomberg New Energy Finance – Outlook 2015

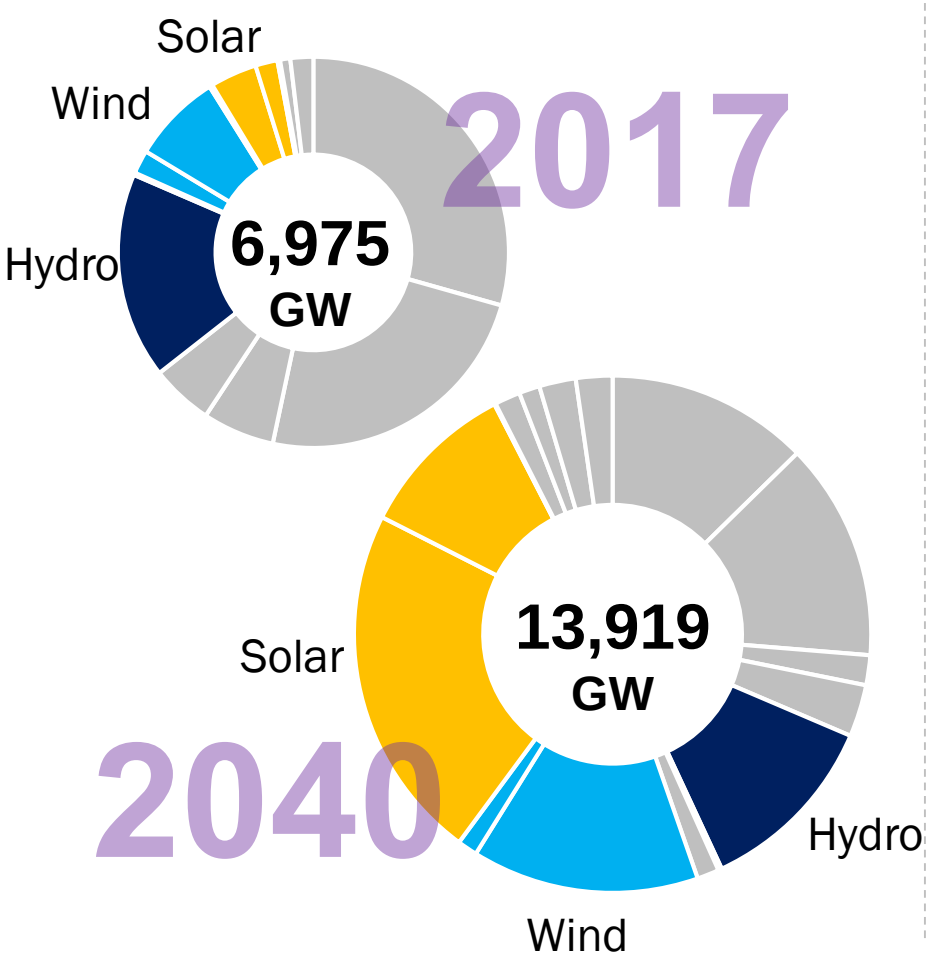
The price of renewables have decreased dramatically, especially at locations with high potential and strong support



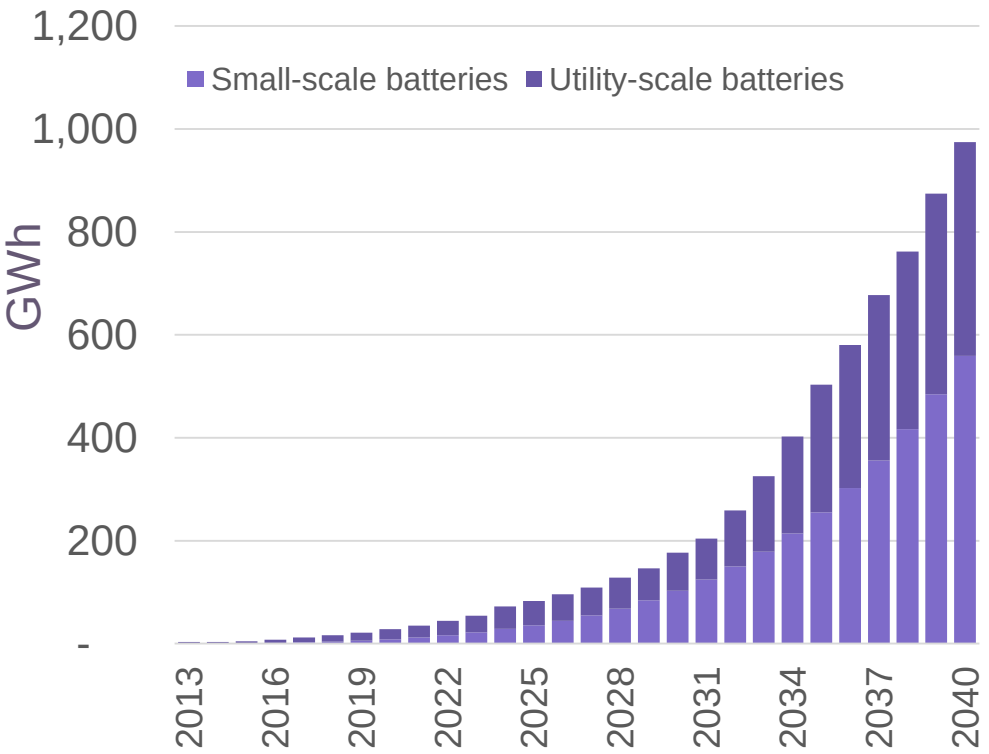
Source: McKinsey, Bloomberg New Energy Finance

Global cumulative installed capacity of renewable energy and battery storage are forecasted to grow significantly

TOTAL cumulative installed capacity (GW)



Utility- and small-scale batteries cumulative installed capacity (GWh)

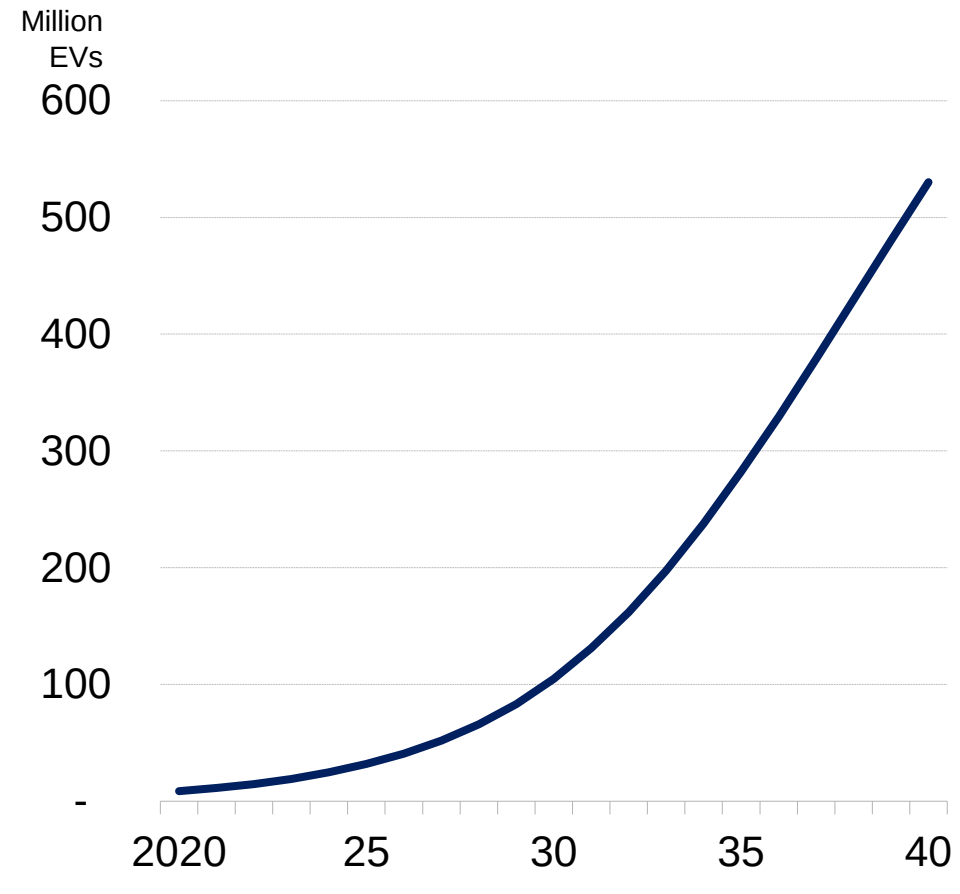


Source: Bloomberg New Energy Finance

The number of electric vehicles (EVs) on the road will have major implications for electric utilities

TENAGA NASIONAL
Better. Brighter.

Global EV fleet size forecasts



Source: Bloomberg New Energy Finance

Electric car sales volume
2012: around **30,000**
2016: **>200,000**
2 million cars on the road (2016)

Malaysia Electric Mobility Blueprint targets by 2020

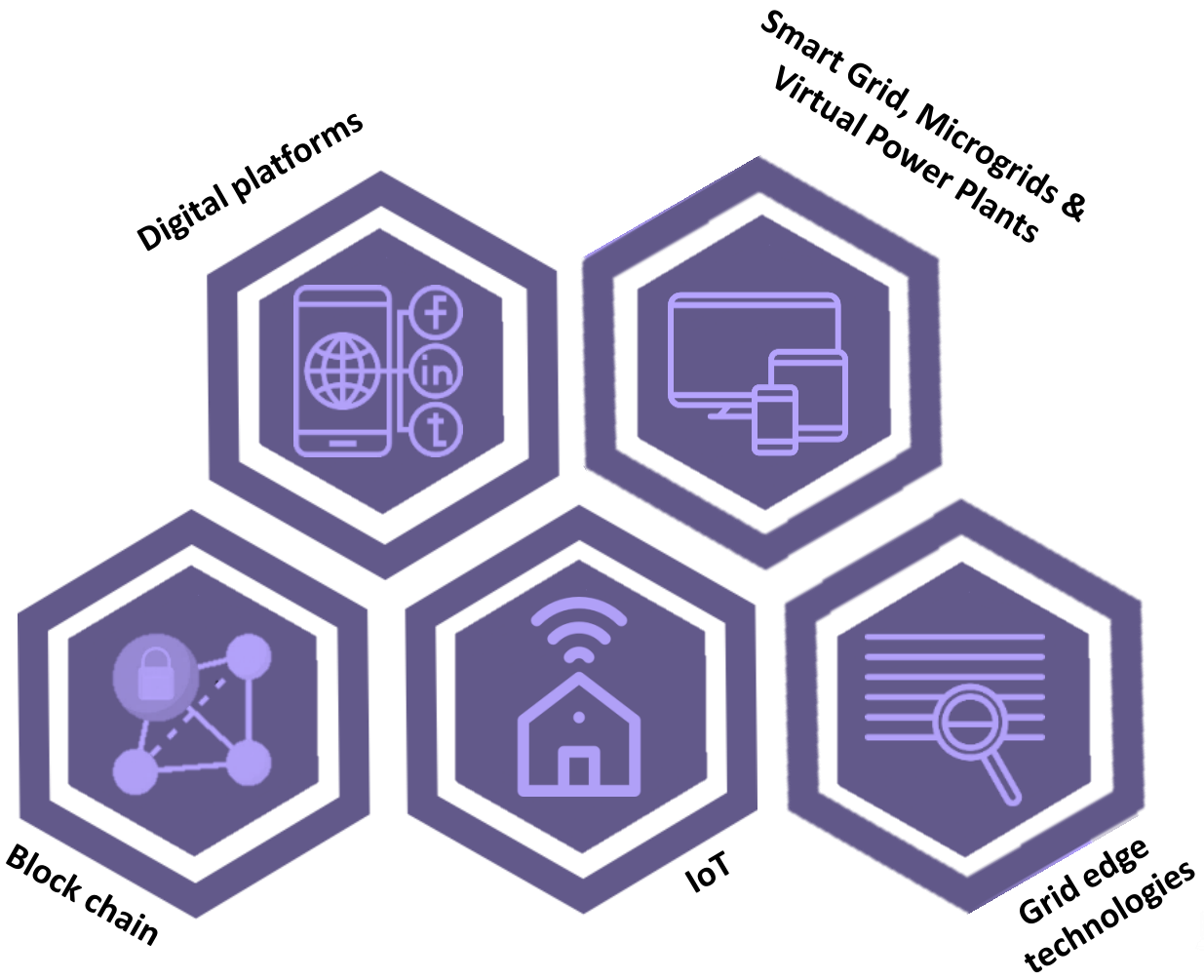
100,000 Electric cars

125,000 Charging stations

2,000 Electric buses

100,000 Electric motorcycles

A new wave of disruptive technologies is coming…



Source: McKinsey

Content

- Overview of Electricity Supply Industry & TNB
- Challenges & Sustainability Initiatives
- Technology Disruption
- TNB & Future Utility
- Conclusion

Reimagining TNB pinpoints four strategic areas for utility transformation

Future Generation

- Focused on solar in partnership with the Government
- Repowering of Generation Power Plant to increase efficiency
- Increasing RE generation mix

Grid of the Future

- Grid operations will be different with bi**-directional energy flow**, and an increasingly **digital automated grid**
- **The Grid** of the Future is divided into following areas, i.e, **Smart Grid, AMI , Grid Edge, and Advanced Analytics**
- All the areas of strategy are supported by enabling **robust communication infrastructure**
- Enable integration of RE, EV, battery storage, etc.

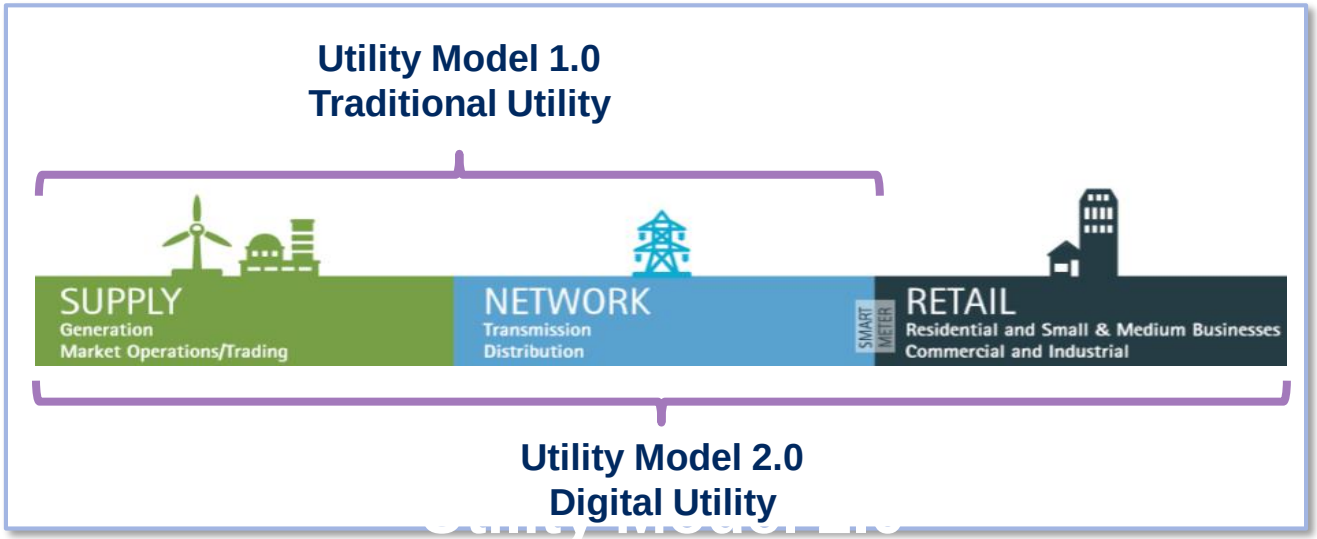
Winning the Customer

- **Energy industry pioneer** in a rapidly growing anchored on customer values
- To deliver customer solutions in partnership with national/state govt, GLCs, developers and businesses
- **Customers digitally connected** – with opportunity to offer enhance services and customized products

Evolving Regulations

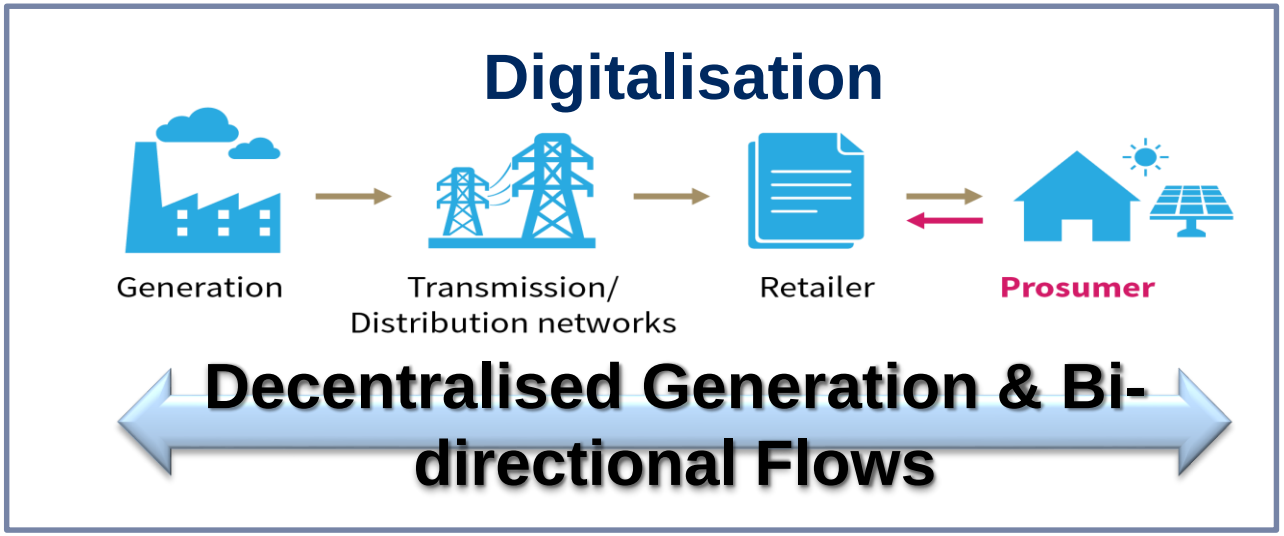
- Regulatory management development and system inline with evolving regulation

Transformation in Utility- Towards Digitalization



- Looking at the trends of shaping power industry worldwide, there is a pressing need to change the business model from traditional utility to digital utility

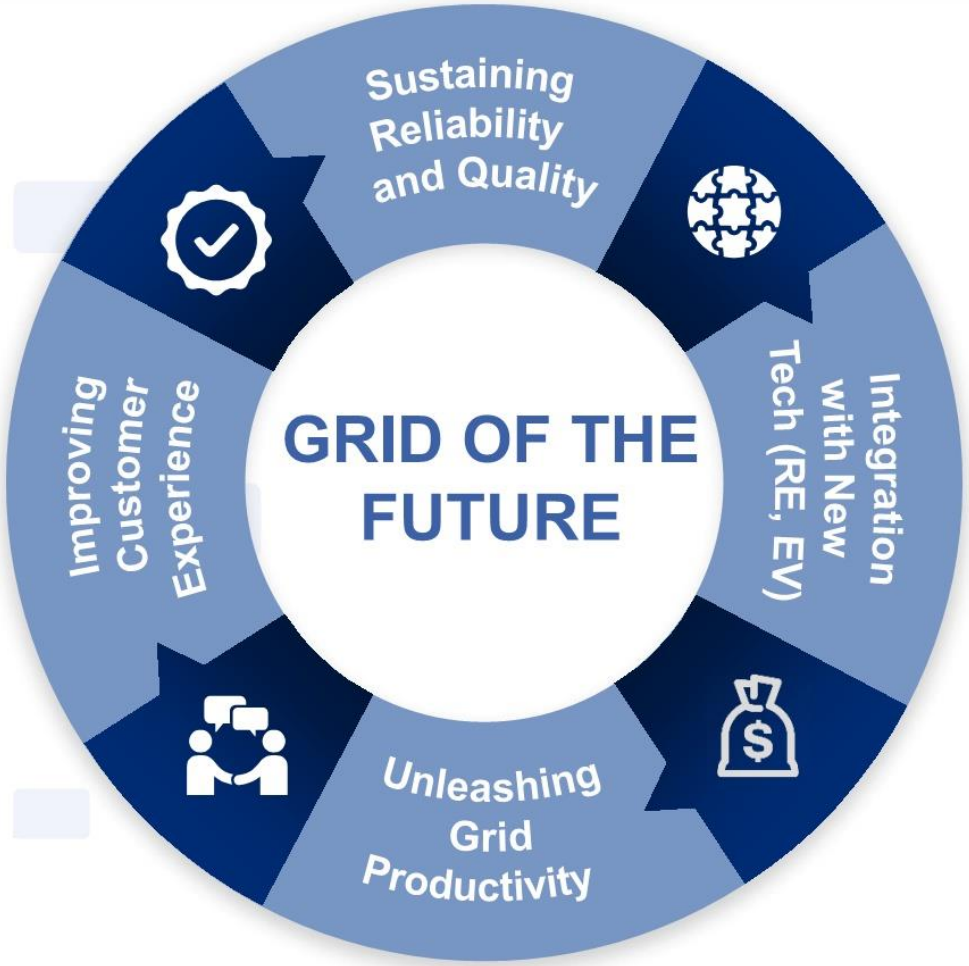
- We acknowledge communication infrastructure is the key enabler in Digital Utility Transformation



TNB is gearing towards building the necessary infrastructure to enhance the integration of future technology

TENAGA NASIONAL
Better. Brighter.

Grid investments are driven by 4 key objectives



A Deliver a **resilient, reliable** and high **power quality grid**

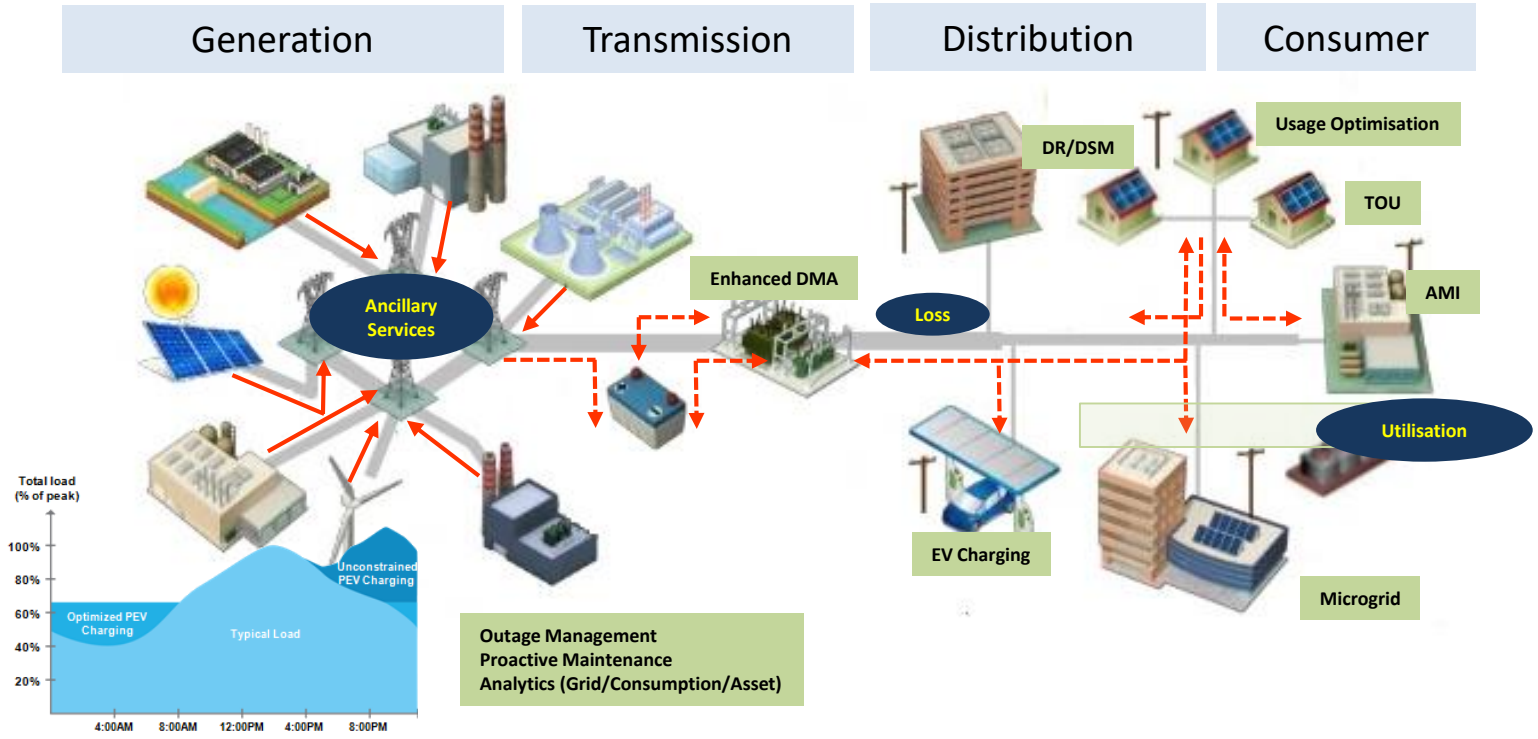
B **Accommodate intermittent RE generation, EV and distributed generation**

C Deliver **'value for money' –** optimized TOTEX for the service provided

D Enable a seamless digital **customer experience and new products** – e.g. energy efficiency, smart home

SMART GRID

A Smart Grid incorporates information and communications technology into every aspect of electricity generation, delivery and consumption in order to minimize environmental impact, enhance markets, improve reliability and service, and reduce costs and improve efficiency. */(EPRI)*

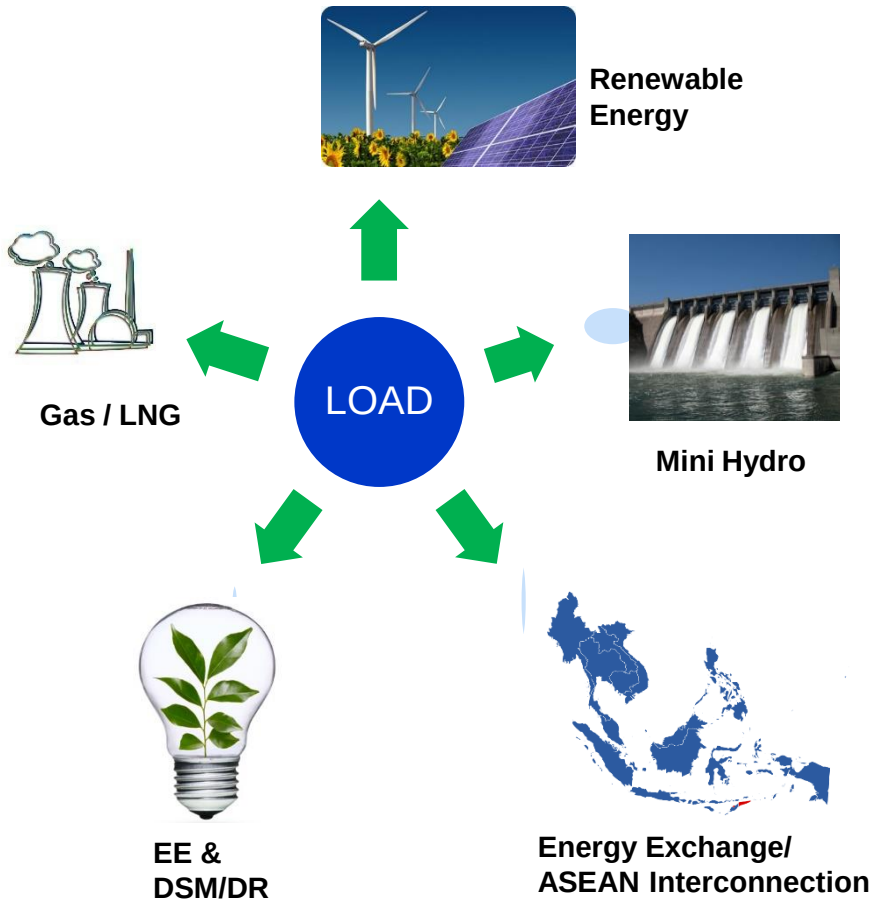


Future Sustainable, Green & Smart Energy, Smart Grid options for Malaysia Electricity Supply to complement the conventional system

2020 and beyond **Proliferation of Renewable Energy, EE & DSM/DR and "alternative supply option" plus "More Distributed Generation"**

DSM : Demand Side Management
EE: Energy Efficiency
DR: Demand Response

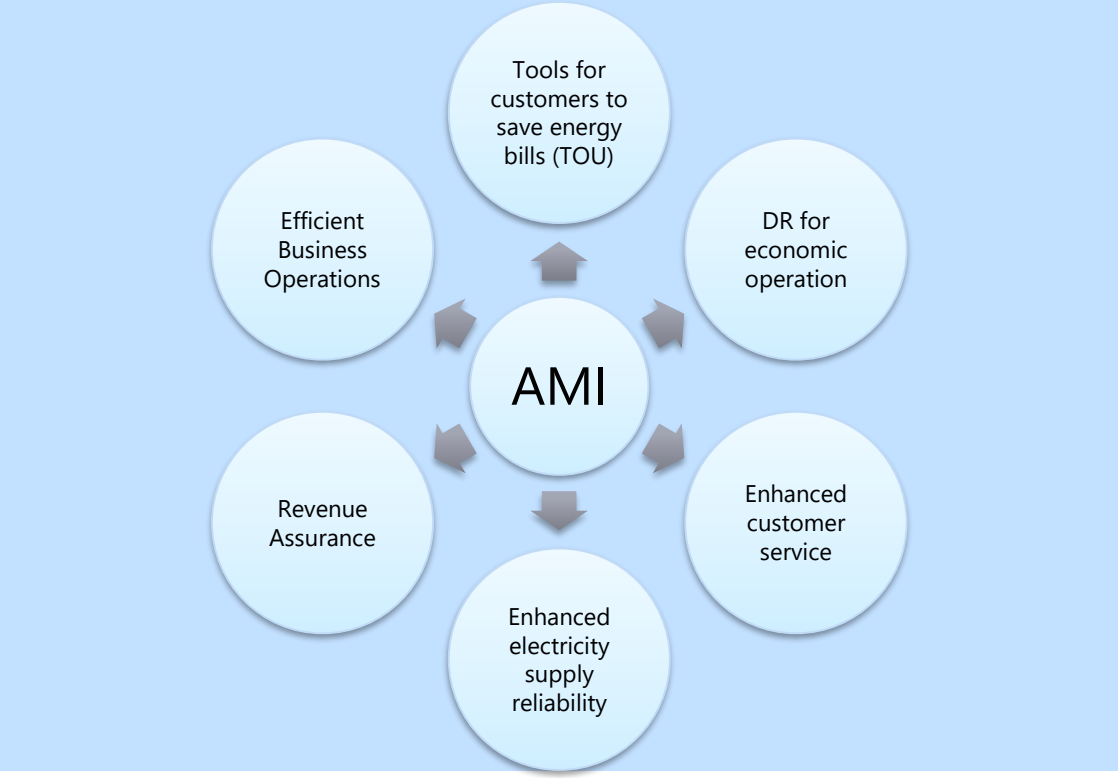
Smart Grid/ Advanced Data Analytics
(enabler for optimization and integration of demand and energy supply options RE, EV, ESS etc)

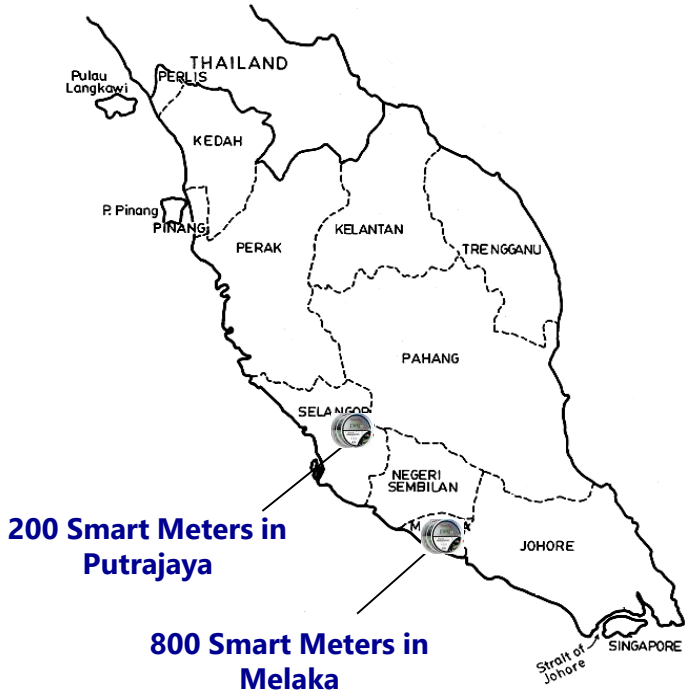


AMI Pilot Project

Business Case Driven by TNB and Government Objectives

- TNB decided to implement a small scale AMI Pilot project to test its benefits.
- Funding was obtained from the Malaysian Government (AAIBE/MESITA Fund).
- Implementation for 1,000 smart meters in Melaka and Putrajaya.
- The project is part of TNB's smart grid plan.





Content

- Overview of Electricity Supply Industry & TNB
- Challenges & Sustainability Initiatives
- Technology Disruption
- TNB & Future Utility
- Conclusion

29

Conclusion

- TNB as the main utility in Malaysia plays a major role in modernising Malaysia ESI in line with the national sustainability goal and the advent of technology disruption.

- We are embarking on the journey in the digitalization age where connectivity gaps are becoming closer, through emergence and convergence of disruptive technologies and megatrends.

- The power sector is an important sector that underpin the growth of nations. Embracing sustainability and digitalization will help the power industry to stay relevant and keep up with the changing industry trend and customer requirement.

- The ESI landscape in Malaysia is constantly changing and presenting key challenges; Energy Security, Economic Sustainability, and Environment Sustainability. Malaysian ESI is aware of the shifting landscape, and TNB has taken initiatives to address the future scenario under " Reimagining TNB" that leverages on sustainability and digitalization.

- TNB is developing many RE and EE initiatives related to the subject of clean and sustainable, energy such as;
    a. RE power plant; Solar Hybrid, Biomass, Biogas, Mini Hydro
    b. Smart Meter pilot project
    c. Grid of the Future (DA, Mobility, GIS, VVO, etc.)
    d. EE & Home Energy Report

TENAGA NASIONAL

Better. Brighter.