Suruhanjaya Tenaga
Energy Commission

Sabah Electricity Supply Industry Outlook 2015

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2014 REVIEW

The Government announced a tariff hike for Sabah and Labuan at an average tariff of 34.52 sen/kWh, a 5 sen/kWh or 16.9% increase from the previous 29.52 sen/kWh average rate. The new rate, which took effect starting 1st January 2014, was released together with the new average tariff price of 38.53 sen/kWh for Peninsular Malaysia. Specifically for Sabah, the tariff restructure aims to narrowing the escalating gaps between the electricity generation cost and the current tariff so as to support its state utility, Sabah Electricity Sdn. Bhd. (SESB) in providing a more reliable electricity supply. It is expected that the tariff increase will provide avenue for SESB to improve its supply performance.

However, just after the announcement, an unfortunate event struck the electricity supply system as early as January 2014 whereby the system experienced total collapse at 11.11 am on Friday, 17th of January 2014. Sequences of events that finally lead to the collapse were triggered by a flashover from the conductor of the 132kV transmission line to a tree. Against this chaotic chain of effect, Sabah experienced a state-wide electricity blackout for about ten hours, affected about 400,000 SESB customers who already saddled with earlier tariff hike announcement.

The impactful event as shown by a record System Average Interruption Duration Index (SAIDI) of 254.62 minutes/customer/year was made worse by several high impact interruptions throughout the year, caused by plant and fuel supply operational instability. The 350 minutes/customer/year target set for overall Sabah SAIDI for 2014 was exceeded by 122% to 777.26 minutes/customer/year and it was 83% higher compared to 2013.

The incident has triggered a more comprehensive and closely-monitored action plans to improve existing system infrastructure as well as operation and maintenance while addressing shortcoming identified as a result of the 17th January incident. Apart from speeding up the progress of the long list of on-going generation and transmission projects approved under the 10th Malaysian Plan, pressing issues identified post-17 January, for instance reliability of protection equipment, system defence, rentice management as well as SCADA-risation were also reviewed for improvement. In addition, a long term development plan for Labuan was commenced so as to reinforce the electricity supply to the Sabah mainland. These efforts were put forward aggressively to meet the 4,765GWh electricity demand recorded in the year.

Shifting the focus away from the 17th January incident, the much-needed capacities of 395MW from three new power plants were successfully installed into the state grid. With the new large capacity available in the network, the state's total dependable capacity as of year-end stood at 1,497MW, an increase of 28% from the previous year figure. However, the non-gas capacity in the West Coast area will be reduced in stages starting year 2015. The peak demand was recorded on 8th May 2014 at 907MW when the dependable capacity was at 1,097MW.

In terms of generation mix, natural gas and medium fuel oil/diesel fuel dominated the share with 76% and 15 respectively. With limitation of choice of fuel source particularly coal, heavy reliance to the natural gas is expected to continue. Other sources of energy are desperately needed to fulfil the state electricity demand. It is fortunate for Sabah as the state can still harness its remaining hydro potential and other renewable energy (RE) resources mainly from palm oil plantation. Starting 1st January 2014, RE developers in Sabah and Federal Territory Labuan are eligible to apply for participation in the Feed-in-Tariff (FiT) programme. Collectively, the FiT incentives as well as enormous RE potential in Sabah are designed to be an impetus for RE developers to contribute to the state's electricity generation. In 2014, approximately one-tenth of Sabah generation mix was from RE as large hydro generation is now defined as RE sources.

2015 OUTLOOK

Electricity demand is expected to remain relatively strong in 2015 with projected growth of 4.2%, 4.4% and 5.6% for Peak Demand, Generation and Sales respectively. The trend is expected to follow similar pattern with 2014 as Commercial segment continues to be the main driver followed by Residential and Industrial segments. Impacts of RM 44.5 billion investments in the Sabah Development Corridor and construction of Pan Borneo Highway to downstream economic activities are expected to be positive to overall electricity demand as well.

As the share of on-grid biomass and biogas power plants is expected to double from 33MW in 2013 to 64MW by the end of year 2016, four biogas and biomass plants with total capacity of 17MW are slated for commercial operation in 2015. In addition to Cash Horse that was commissioned on 5th November 2014, TSH Bio Gas with installed capacity of 3MW was successfully commissioned to the grid on 22nd April 2015. Rehabilitation works in Tenom Pangi Hydroelectric Power Plant is also expected to complete by 2016, which, in addition to enhancing plant reliability, will result in increase of capacity. To date, works on one of the three turbines already completed with capacity increase from 22MW to 25MW.

Expansion of transmission network continues with expected completion of 275kV lines from Kimanis to Kolopis by the end of the year. Meanwhile, works has started on the new 275kV lines connecting Kimanis with Mengalong that will further enhance network reliability in the West Coast while providing pathway to realisation of Trans Borneo Power Grid Interconnection. In the East Coast, network upgrading are currently undergoing for two new 132kV lines from Segaluid to Seguntor and Sandakan-Elopura-Seguntor. These new lines are expected to complete by end 2017 prior to commissioning of the new diesel/gas-fired power plants in Sandakan from 2017 to 2020.

Announcement of the much-required new capacity in the East Coast has further reaffirmed government's commitment in ensuring continuous and uninterrupted supply of electricity. The 390MW new diesel/gas plants will provide enough capacity until 2025, in which combined with improvements in other industrial needs and new Trans-Sabah Gas Pipeline, can act as catalyst to development of high-impact industry in the East Coast region.

The importance of Labuan as the international business and financial centre requires reliable supply of electricity at all time. In this respect, study to improve Labuan supply system is currently undergoing, which includes facets of supply components such as life assessment studies of Patau-Patau power station and Labuan-Beaufort Interconnection and improvement of distribution system in the island. The study which is scheduled to complete by the end of the year will provide a comprehensive review of the state of electricity supply system in Labuan.

11th Malaysia Plan has set electrification target of 99% in 2020; an increase from 84% in 2010 and 95% in 2015. Reaching the very last mile of population requires significant investment in terms of overall network. Therefore, the bulk of RM 2.3 billion allocation is expected to be use for strengthening existing transmission and distribution system while new lines will be connected to the main grid. Sabah Special Project and Delivery Unit (SAPADU) under the Ministry of Energy, Green Technology and Water is established to implement 81 electricity supply projects for a period of five years. SAPADU will consist of officers from various government departments and SESB with source of funding from Federal Government grants.

The principle of Incentive-Based Regulation (IBR) mechanism will be introduced in SESB starting this year, three years after its introduction in TNB. The mechanism will generally follow the same template as in Peninsula to allow for seamless transition from highly integrated to more transparent and accountable individual profit centres within SESB. For that purpose, a ring-fenced Single Buyer and Grid System Operator will be formed while Service Level Agreements for SESB-owned power plants will be put into effect starting next year.

PERFORMANCE REVIEW

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PERFORMANCE REVIEW

ECONOMIC PERFORMANCE

Sabah's GDP grew by 3.3% in 2013, declining from the growth rate of 4.4% from the previous year. Apart from its services sector which took the lead at nearly 50% share in 2013, the economy was also driven by agriculture and mining sectors - each contributed around 20%, manufacturing sector at 8% and construction sector at 3%. Major export commodities include crude petroleum (mining), palm kernel oil (agriculture), methanol and plywood & timber (manufacturing).

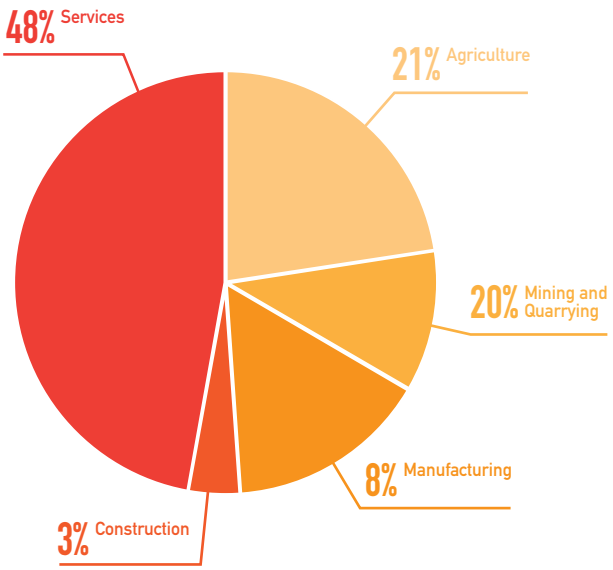
For 2014, the Malaysia economy grew by 6.0% with domestic demand, through private sector spending, took command as the main anchor of growth. As forecasted by the Central Bank of Malaysia, the country's economy is expected to remain on a steady growth path of 4.5 to 5.5% in 2015 - a less sanguine outlook as compared to the earlier 5 to 6% Gross Domestic Products (GDP) growth. This is owing to the waning prospects of the global economy, relatively low commodity prices and softer domestic demand expected for this year.

Sabah GDP is projected to grow at more than 4%[1] for 2014. By type of economic activity, the state's GDP is strongly dominated by services sector particularly through tourism-related activities including accommodation and restaurants as well as wholesale and retail trade. In 2014, the total number of visitors that came to Sabah decreased by 4.5% with a higher percentage reduction share was from international tourist's portion compared to locals, possibly due to the tragic double incident befell the airline industry. Nevertheless, even with that course of event, the share of services sector which remained strong at more than 40% since 2005 is expected to be resilient and continue to be the bedrock of Sabah's economy.

Sabah, which for the past ten years contributed to around 6.2 to 6.4% of the country's GDP, is expected to maintain its percentage share at the same level for the year 2015. Based on the strong relationship between historical GDP trends of Sabah and Malaysia, the state GDP is projected to growth at annual average of around 4.7% within the next 10 year window.

1. Actual state GDP is not available at the time of writing and expected to be published in Quarter 3 2015.

Figure 1: Sabah GDP 2013 by type of activity



For 2014, the Malaysia economy grew by 6.0% with domestic demand, through private sector spending, took command as the main anchor of growth. As forecasted by the Central Bank of Malaysia, the country's economy is expected to remain on a steady growth path of 4.5 to 5.5% in 2015.

SYSTEM PERFORMANCE

System Average Interruption Duration Index (SAIDI)

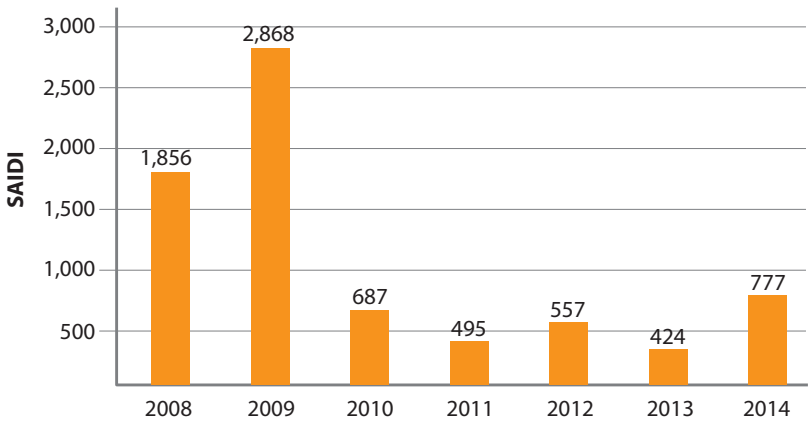
The performance level of electricity supply can be measured through System Average Interruption Duration Index (SAIDI) - an indicator applied to access the average rate of supply interuption experienced by each customer in a year.

Sabah expericenced a lot of supply interuption incidents but the occurance rate is decreasing especially in the past 6 years. Statistically, SAIDI record in 2009 was at 2,867 minutes/customer/year. Through various initiatives undertaken by SESB with the financial support from the Government, the SAIDI rate has continually reducing to 687 minutes/customer/year in 2010, 495 minutes/customer/year in 2011, 557 minutes/customer/year in year 2012 dan 424 minutes/customer/year in the year 2013. Sabah has achieved in reducing 85% of its SAIDI level in 2013 compared to the level recorded in year 2009.

Initiatives taken to achieve the targeted SAIDI includes the following:

- Ensure the successful implementation and completion of generation, transmission and distribution system improvement projects;
- Improve implementation of effective preventive maintenance regime/vegetation management;
- Improving SESB staff competency;
- Reviewing system stability in Sabah including transmission system and adequate generation margin for operation and maintenance;
- Reviewing of total capacity requirement in East Coast of Sabah;
- Develop Distribution Code for Sabah and Labuan;
- Establish regulatory accounts by business entities: generation, single buyer, system operation, transmission and distribution;
- Establish entities of single buyer, grid system operator and distributor;
- Operationalise of Service Level Agreements (SLAs) for SESB's major power plants namely Tenom Pangi, Kubota and Patau-patau; and
- Monitoring of SESB Key Performance Indicators (KPIs) on quarterly basis.

Figure 2: SAIDI of Sabah 2008 - 2014



PERFORMANCE REVIEW

Generation Capacity And Energy Mix

Following the state's moderate GDP growth rate, electricity generation and sales growth rates for the year 2014 stood at only 4.0% and 2.5% respectively, lowest growth recorded since west and east interconnected in 2005. Peak demand growth of 4.7% was significantly less than projected growth of 5.8%.

In terms of generation capacity, the amount of Dependable Capacity is being used as indicator to gauge the capacity adequacy in the system in place of Installed Capacity. With the full commissioning of three power plants (Table 1), Dependable Capacity connected to the grid stands at 1,497MW by the end of 2014. Out of the 1,497MW dependable capacity, 27% of the capacity is owned by SESB with the balance by Independent Power Producers (IPPs) under power purchase agreements with SESB.

Maximum demand in Sabah as of 31st December 2014 was at 908MW as recorded in May 2014, an increase of 41MW compared to the previous year record of 867MW in September 2013.

Table 1: Three new commissioned plants in 2014

Plant owner	Installed capacity (MW)	Commercial Operation Date (COD)
SPR Energy Sdn. Bhd. (SPR)	100	13th August 2014
Cash Horse Sdn. Bhd.	10	5th November 2014
Kimanis Power Sdn. Bhd. (KPSB)	285	7th November 2014

As of July 2015, Dependable Capacity in Sabah stood at 1,324MW, primarily fuelled by gas 74%, followed by diesel/MFO 17%, hydro 6% and biomass/biogas 3%. Similar trend was also observed in terms of generation mix. From the total generation of 5,420GWh recorded in 2014, gas-based generation had the highest share at 76%, followed by diesel/MFO at 15%, hydro at 6% and biomass at 3%.

Figure 3: Dependable Capacity mix by type of fuel

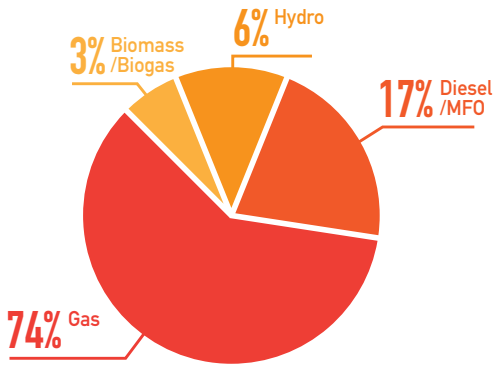


Figure 4: Electricity generation mix by type of fuel

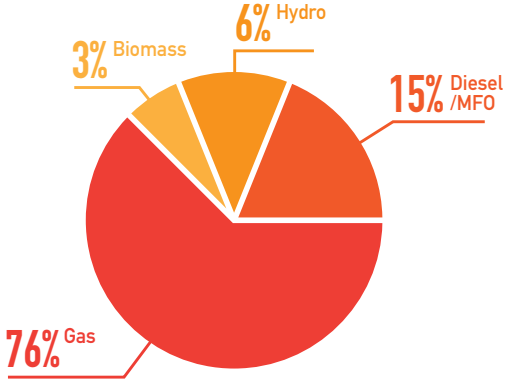
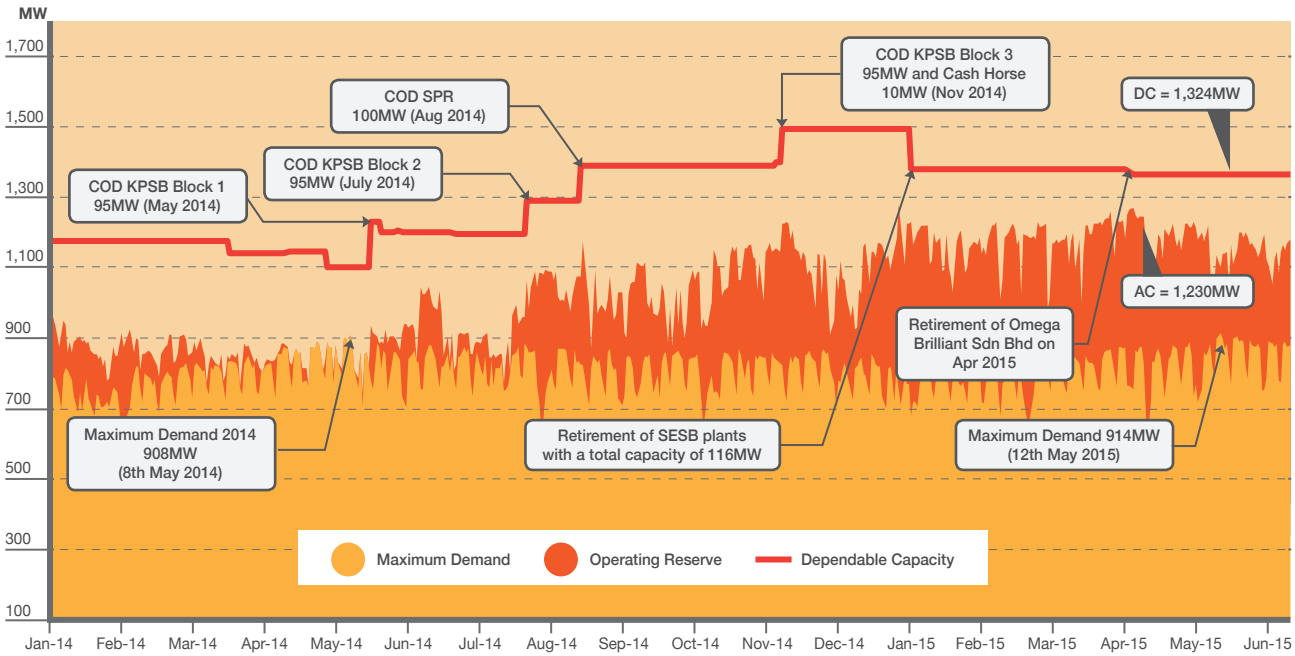
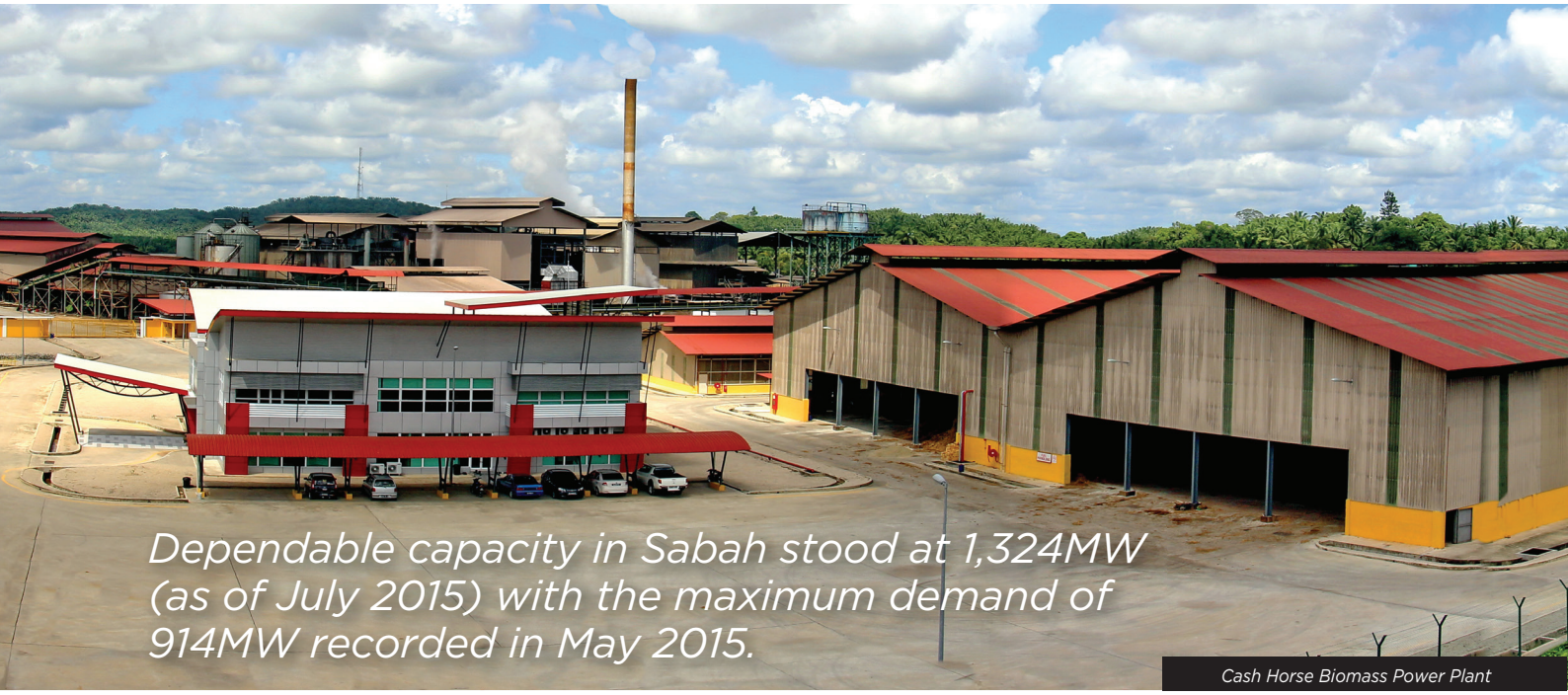


Figure 5: Daily demand and operating reserve





Dependable capacity in Sabah stood at 1,324MW (as of July 2015) with the maximum demand of 914MW recorded in May 2015.

Cash Horse Biomass Power Plant

PERFORMANCE REVIEW

Declaration of system Dependable Capacity will be made by SESB as the System Operator whenever new plant has successfully commissioned to the system or retired from the system. As of July 2015, total Dependable apacity was revised to 1,324MW based on latest tested capacity, plants condition, plants retirement as well as commissioning of new plants with details as follows:

Table 2: Existing power plants in Sabah

No	Plant	Owner	Dependable Capacity (MW)	Fuel	Commissioning Year
1	Tenom Pangi[2]	SESB	69	Hydro	1984
2	Tawau	SESB	30	Diesel	1984
3	Mini Hydro Melangkap	SESB	0.8	Hydro	1990
4	Mini Hydro Sayap	SESB	0.8	Hydro	1991
5	Patau-Patau	SESB	104.5	Gas	1992
6	Melawa	SESB	31.5	Diesel	1992
7	Mini Hydro Merotai	SESB	0.8	Hydro	1992
8	Mini Hydro Bombalai	SESB	0.8	Hydro	1996
9	Labuk Canopy Genset	SESB	8	Diesel	2009
10	Batu Sapi GT[3]	SESB	17.4	Diesel	2013
11	Kubota	SESB	64	Diesel	2013
			Total capacity of SESB plants (MW)		**327.6**
12	ARL Power (ARL)[4]	IPP	22.7	Diesel	1996
13	Serudong Power	IPP	36	MFO	1996
14	Stratavest (Libaran)[5]	IPP	15	MFO	1998
15	Ranhill Powertron (RP1)	IPP	190	Gas	1998
16	TSH Bioenergy	IPP	10	Biomass	2004
17	Sepanggar Bay Power Corp. (SBPC)	IPP	100	Gas	2006
18	Kina Biopower	IPP	10	Biomass	2009
19	Seguntor Bioenergy	IPP	10	Biomass	2009
20	Esajadi Sg. Kedamaian	IPP	2	Hydro	2009
21	Ranhill Powertron II (RP2)[6]	IPP	195.4	Gas	2010
22	Esajadi Sg. Pangapuyan	IPP	4.5	Hydro	2011
23	Teck Guan	IPP	3	Biomass	2011
24	Kimanis Power	IPP	285	Gas	2014
25	SPR Energy	IPP	100	Gas	2014
26	Cash Horse	IPP	10	Biomass	2014
27	TSH Biogas[7]	IPP	2.7	Biogas	2015
			Total capacity of IPP plants (MW)		**996.3**

2. Dependable capacity increased to 25MW after rehab completed on 21st April 2015
3. Based on Tested Annual Available Capacity (TAAC) test on 22nd April 2015
4. Based on Net Capacity Test (NCT) on 5th June 2015
5. Based on Net Capacity Test (NCT) Test on 31st March 2015
6. Additional capacity of 5MW
7. Started commissioning in April 2015

Kimanis Power CCGT Power Plant

SESB's share of total on-grid generation capacity was reduced from 42% in 2013 to 27% in 2014 and further reduced to 25% as of July 2015, with completion of three IPP power plants. The dominant position of IPP in Sabah is expected to continue since SESB precarious financial position has put limit to the company's ability to secure financial for new power generation projects. Nevertheless, there are clauses in the Grid Code that empowers SESB as the System Operator and the Single Buyer in making sure that all parties adhere to the rules and conducts as prescribed. Likewise, IPPs are motivated by performance clauses stipulated in the PPA as their earning is dependent upon the plant's availability, reliability and efficiency.

Figure 6: IPP & SESB's share of Dependable Capacity, 2015

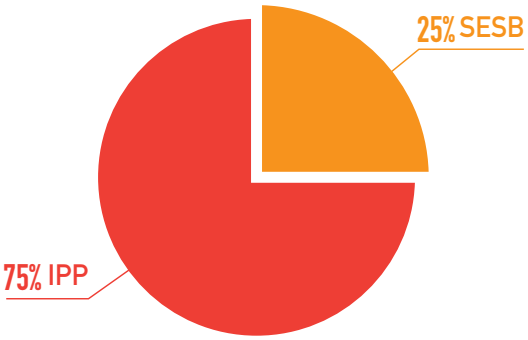


Figure 7: Existing power plants in Sabah, 2015

POWER PLANT PERFORMANCE

Most of IPPs in Sabah, particularly gas-based combined cycle power plants (CCGT) are relatively new and more efficient compared to SESB-owned power plants which mostly consists of ageing diesel-fired plants, which have been in operation for more than 20 years. As expected, thermal efficiencies for IPP power plants were generally better compared to SESB power plants. Similarly, availabilities of power plants operated by SESB measured through equivalent availability factor (EAF) were lower compared to power plants operated by IPPs.

However, comparing the EAF for the IPPs according to plant type reveals large gap performance between CCGT and diesel power plants. While EAF for CCGT plants was more than 90%, diesel plants recorded much lower EAF at an average of 58%. In addition to plants age, technical problems due to operational regime, fuel and parts obsolescence contributed to decaying performance of these plants.

For SESB, lower EAF was recorded with CCGT and diesel plants at 74% and 63% respectively attributed to the age factor and frequent breakdown as well as maintenance activities. Meanwhile, hydroelectric plants fared better at EAF of 87% due to consistent water flow and good technical conditions.

Table 3: Sabah's power plant performance in 2014

Plant Type	Average Thermal Efficiency (%)		Equivalent Availability Factor (%)		Equivalent Unplanned Outage Rate (%)	
	SESB	IPP	SESB	IPP	SESB	IPP
Combined Cycle	22	37	74	91	5	6
Diesel	30	37	63	58	34	51
Hydro	-	-	87	-	2	-

Figure 8: Plants efficiency (%) of Sabah's power plants

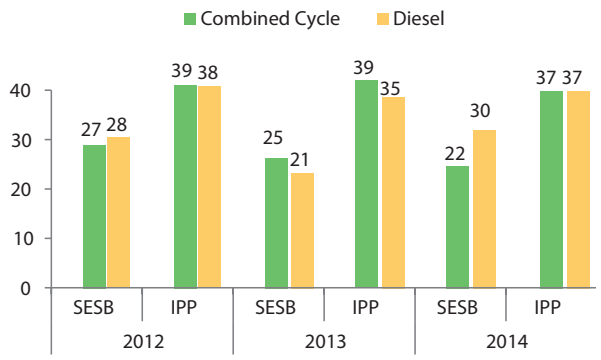


Figure 9: Equivalent unplanned outage rate (%) of Sabah's power plants

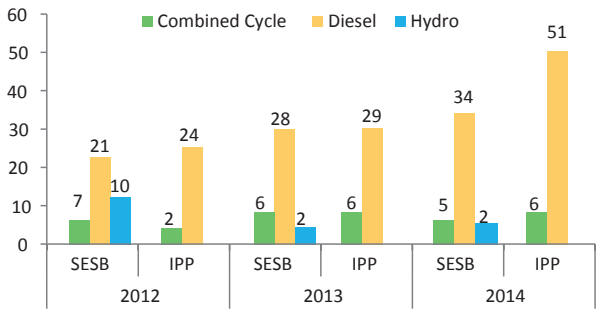


Figure 10: Equivalent availability factor (%) of Sabah's power plants

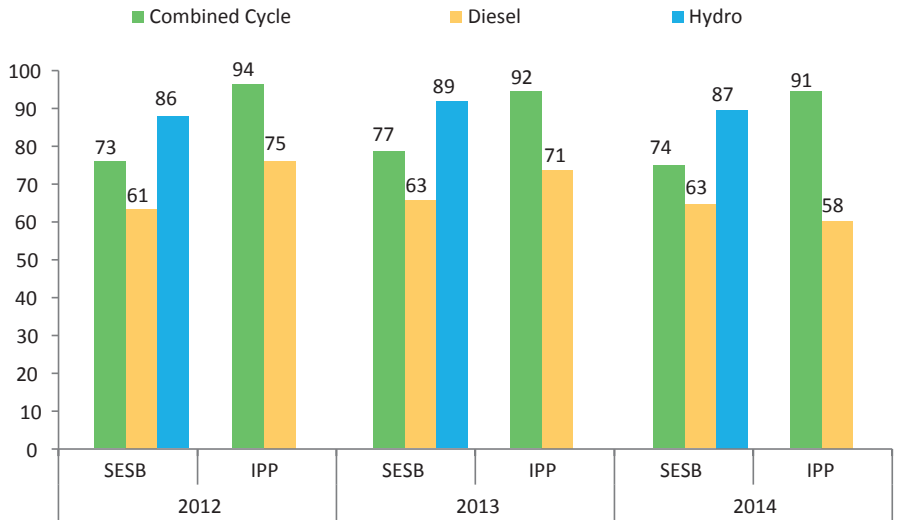
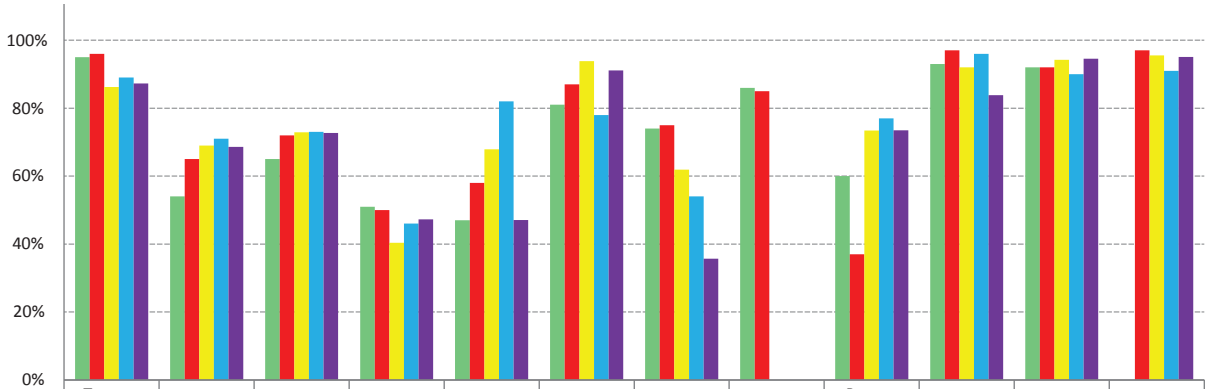


Figure 11: Average annual availability for major power plants in Sabah



	Tenom Pangi	Melawa	Tawau	Sandakan	ARL Power	Serudong	Stratavest	SPC	Patau-patau	SBPC	Ranhill I	Ranhill II
2010	95%	54%	65%	51%	47%	81%	74%	86%	60%	93%	92%	0%
2011	96%	65%	72%	50%	58%	87%	75%	85%	37%	97%	92%	97%
2012	86%	69%	73%	40%	68%	94%	62%	0%	73%	92%	94%	96%
2013	89%	71%	73%	46%	82%	78%	54%	0%	77%	96%	90%	91%
2014	87%	69%	73%	47%	47%	91%	36%	0%	74%	84%	95%	95%

FINANCIAL PERFORMANCE

Financial Performance of SESB

For the Financial Year of 2014, SESB's sales of electricity grew by 14.5% to reach RM 1.57 billion compared to RM 1.37 billion in the previous financial year. Total unit sold amounted to 4,765GWh in FY2014 compared with 4,635GWh in FY2013 (restated).

SESB's operating expenditure increased marginally from RM 1,313.9 million in FY2013 (restated) to RM 1,526.5 million. In FY2014, SESB received substantial diesel and medium fuel subsidies of RM 683 million from the Government, the operating expenditure amount presented being the net total subsidy.

Total profit for FY2014 stood at RM 96.7 million, while total finance costs and foreign exchange losses amounted to RM 184.7 million compared to RM 97.5 million in FY2013 (restated).

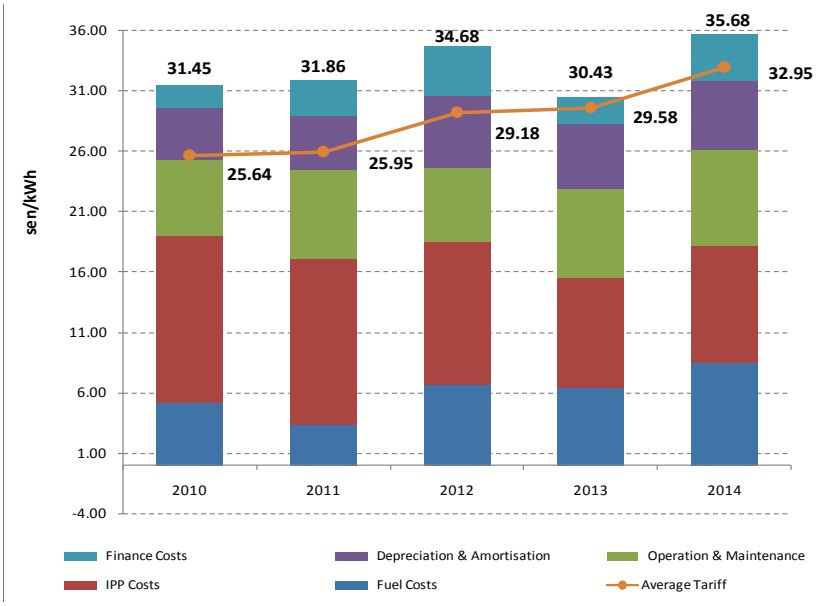
In FY2014, SESB's subsidized operating cost per unit (CPU) was at 35.68 sen/kWh and the average tariff was at 32.95 sen/kWh. Meanwhile, the operating CPU without fuel subsidies was at 50.02 sen/kWh.

Improving SESB Financial Viability Through Tariff Revision

The tariff revision approved by the Government effective 1st January 2014 provided a 16.9% increase of SESB tariff revenue. As of financial year end, the average selling price is 32.95 sen/kWh, compared to 29.58 sen/kWh in FY2013. This increase is timely to meet new IPP costs as two new CCGT IPPs, namely Kimanis Power Sdn. Bhd. and SPR Energy Sdn. Bhd. have come online in August 2014. Profit After Tax of SESB is recorded at RM 96.7 million, showing an improving positive margin.

However, given the major investments needed in improving the electricity network in Sabah, SESB is working very closely with the Federal and State Governments to secure additional funding for power system improvements.

Figure 12: Comparison of SESB's average electricity tariff and subsidised operating cost per unit (sen/kWh)



PERFORMANCE REVIEW

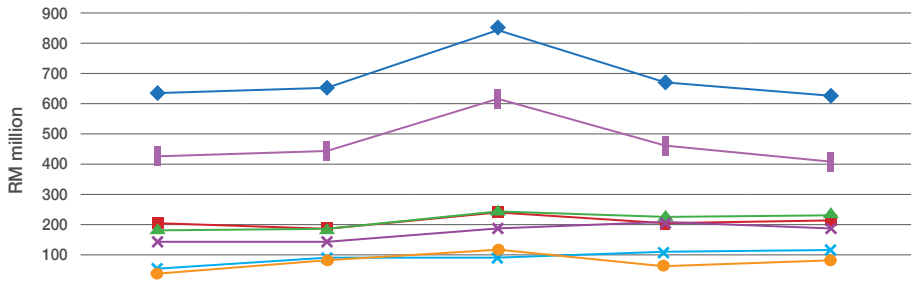
Financial Performance of IPP

Collectively, revenue for the existing operating IPPs in Sabah was at RM 616 million in 2013, reduced from RM 668 million in 2012. Even though there is a decrease in terms of revenue, the net profit has shown a slight increase from RM 82 million in 2012 to RM 98 million in 2013.

Return on Assets (ROA) is an indicator of asset utilisation in order to generate returns. Higher ratios generally indicate better ability in converting investment into profit. For the IPPs in Sabah, their ROA showed an upward trend, where it rose to 3.5% in 2013 from 2.1% in 2009.

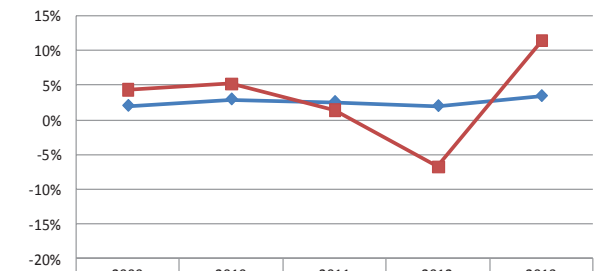
Return on Equity (ROE) on the other hand measures how well a company used business equity to generate profits. A high ROE number directly translates into strong company growth. ROE for IPPs in Sabah is increasing to 11.3% in 2013 from 4.3% in 2009.

Figure 13: Profitability of IPPs in Sabah



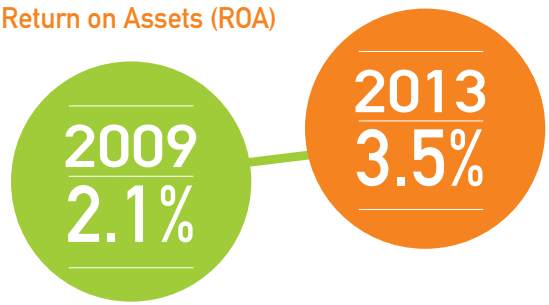
		FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
◆	Revenue	644	648	857	668	616
▮	Cost of sales	432	455	616	468	403
■	Gross Profit	212	193	241	200	213
▲	EBITDA	183	178	250	237	242
×	EBIT	136	138	202	202	199
×	Profit before tax	66	86	87	110	117
●	Profit for the financial year	51	79	127	82	98

Figure 14: ROA & ROE of IPP in Sabah



	2009	2010	2011	2012	2013
ROA	2.1%	3.0%	2.6%	2.0%	3.5%
ROE	4.3%	5.2%	1.4%	-6.7%	11.3%

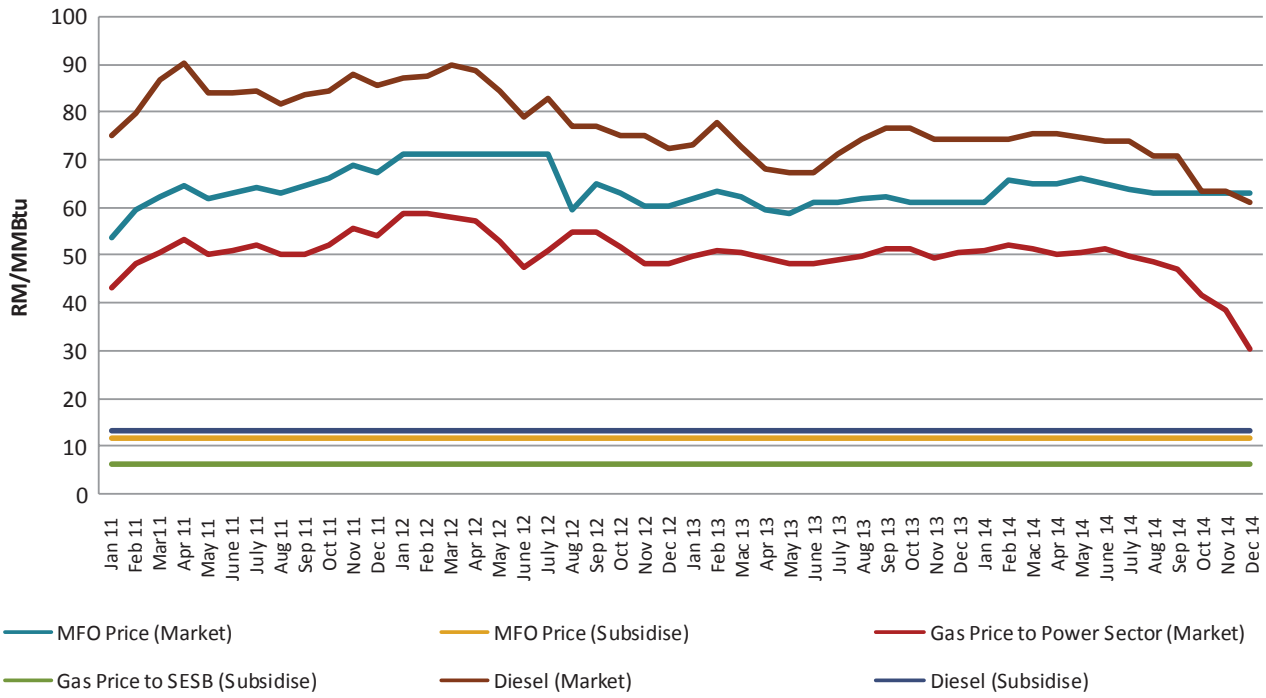
Return on Assets (ROA)



Fuel Price Movement

Electricity generation in Sabah is fuelled mostly by gas (76%), followed by MFO & diesel (15%), hydroelectric (6%) and biomass wastes (3%). The piped gas price for power sector in Sabah is controlled at RM 6.40/mmBtu compared to the price for power sector in Peninsular, which recently increased from RM 13.70/mmBtu to RM 15.20/mmBtu. Based on prevailing market price as published by the Statistic Department, the average gas price in 2014 is RM 46.93/mmBtu as compared to subsidised price at RM 6.40/mmBtu. It represents an indirect subsidy to the customers. The Government will continue to subsidise the MFO price in excess of RM 0.42/litre and diesel price in excess of RM 0.495/litre. Currently the average market price for MFO and diesel in 2014 is RM 2.34/litre and RM 2.54/litre consecutively.

Figure 15: Comparison of various fuel price



DEMAND FORECAST

23

DEMAND FORECAST

Sabah electricity demand is driven by commonly correlated factors namely state income, socio demographic, technical and historical electricity demand trend. Analysis of historical pattern of these factors coupled with assumptions of their future trend forms the basis of aggregated electricity forecast for the state. This forecast includes electricity demand, electricity generation and peak demand of the SESB system in accordance to the utility's financial year.

Figure 16: Process flow of electricity demand forecasting analysis

In principle, the magnitude of future electricity consumption by the SESB customers, referred to as Sabah electricity demand or the SESB's sales, are projected through time series and regression analysis with income and socio demographic as its determinant. The short term forecast of Sabah's electricity demand is derived through time series analysis which involves trending of previous years SESB sales. The medium to longer term forecast, on the other hand, entails regression analysis and requires a set of assumptions on future economy as well as demographic growth.

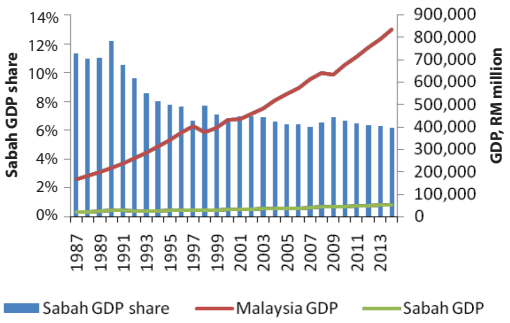
Incorporate transmission and distribution losses into the annual projected demand results in forecast of electricity generation. This forecasted generation value is the amount of electricity required to be generated by the SESB and IPP power plants to fulfil the expected customers demand.

Forecasted system peak demand on the other hand is derived from the earlier determined electricity generation and system load factor. This future increment of peak demand is then translated into the capacity and plant up required by the system and is significantly applied in the Sabah generation development plan.

GROSS DOMESTIC PRODUCTS (GDP) AND POPULATION AS DETERMINANT OF DEMAND FORECAST

The Malaysian economy is expected to remain on a steady growth path of 4.5 to 5.5% for the year 2015 with domestic demand through private sector spending continues to be the main anchor of growth. Sabah, which for the past ten years contributed around 6.2 to 6.4% of the country's Gross Domestic Products (GDP), is expected to remain its percentage share for the year 2015 and hovering around 6% for the next ten years.

Figure 17: Share of Sabah's GDP from total Malaysia GDP (%)



Historical trends show that there is a strong relationship between Sabah's GDP and Malaysia's total GDP. Thus, deriving Sabah GDP forecast took into account the projected Sabah GDP percentage share as well as the current declared year-a-head GDP forecast of Malaysia. However, the interplay between Sabah's GDP and Malaysia's GDP is interestingly less intact during economic crisis in 1999 and 2009.

Figure 18: Historical trend and relationship between total Malaysia and Sabah GDP

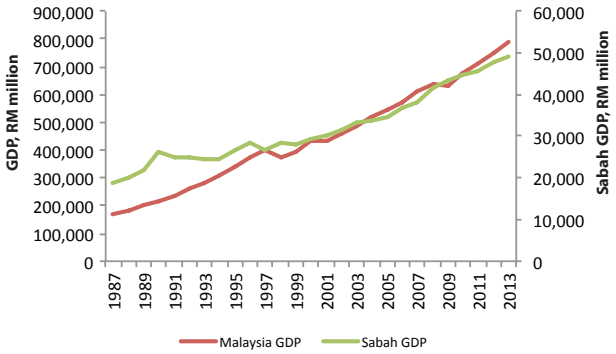
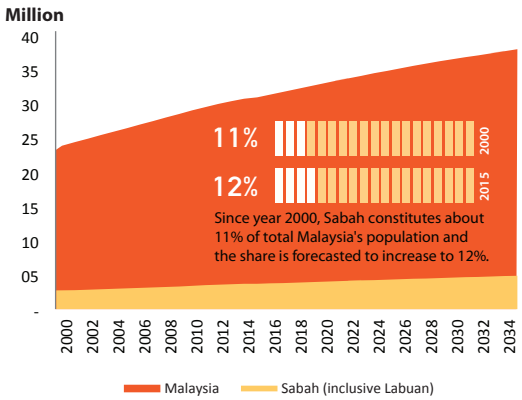
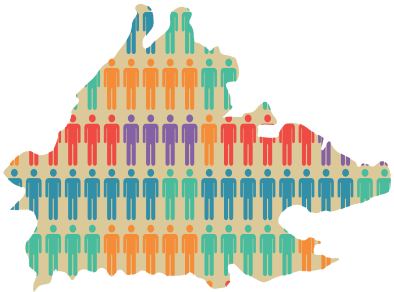


Figure 19: Malaysia and Sabah population

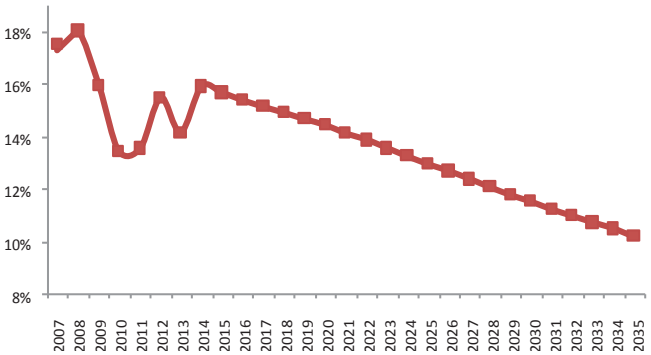


Sabah population is forecasted to grow at 1.6 percent per annum over the short term horizon. At this projected growth, Sabah population is expected to stretch up to 3.6 million in 2015, nearly 12 percent of total Malaysia population.



3.6 million population expected in Sabah in 2015, nearly 12 percent of total Malaysia population.

Figure 20: Actual and future assumed T&D losses (%)



TECHNICAL PARAMETER OF SABAH GRID SYSTEM TO SUPPORT FORECAST ANALYSIS

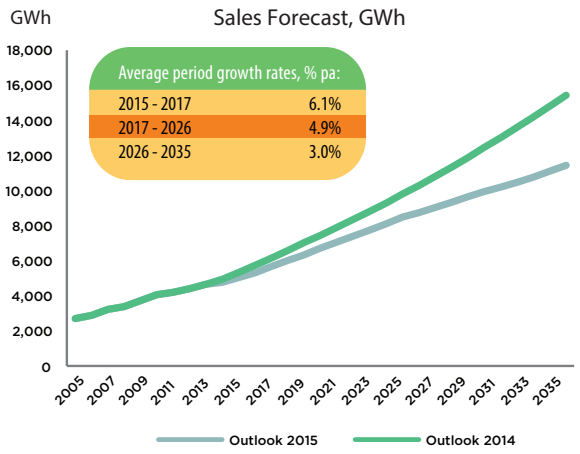
Transmission and distribution losses of SESB electricity supply system stood at 15.9% in 2014. The losses are anticipated to reduce about 1.6% annually for the next five years through implementation of various initiatives planned under the 11th Malaysia Plan to strengthen the state's supply system. In a longer term, the T&D losses are expected to continue to improve and reach 10% by year 2035. In addition, annual load factor for Sabah system is expected to increase to almost 74% within a 20 years horizon from the current load factor of 72%.

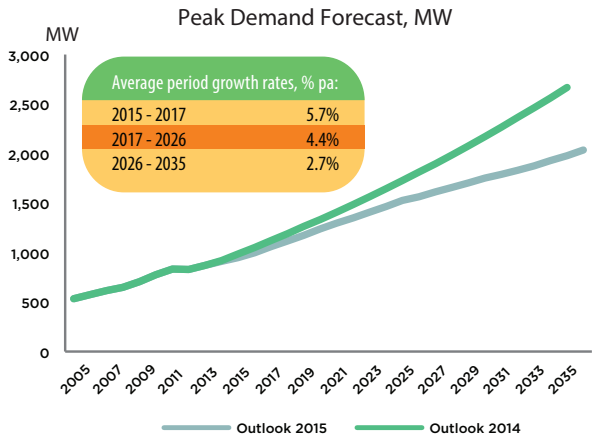
DEMAND FORECAST

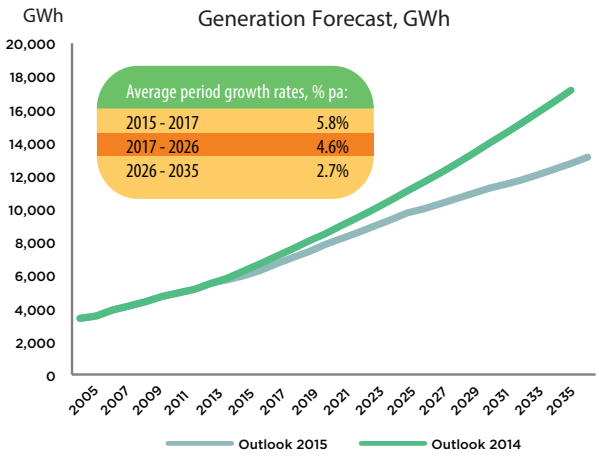
ELECTRICITY DEMAND FORECAST FOR SABAH (2015 – 2035)

Sabah electricity forecast is reviewed on a yearly basis. It is presented to the Committee for the Planning and Implementation of Electricity Supply and Tariff, also known as JPPPET, and applied in the development of generation planting-up plan for Sabah. Comparing the forecast presented in 2014 Outlook, the 2015 forecast is revised downwards in view of lower than expected electricity demand recorded in year 2014 which was at only 2.5%. For year 2015, the demand is forecasted to growth at a rate of 5.6%, compared to 7.8% as previously forecasted.

Figure 21: Comparison on electricity demand forecast between outlook 2014 and outlook 2015







In the future, an average electricity demand growth of 6.1% per annum is forecasted for the short term period (2015 – 2018) and 5% per annum for the medium term (2019 – 2024). During the same term, electricity generation is projected to grow at an average of 5.8% per annum and 4.7% per annum respectively. Peak demand is also projected to grow strongly at the average of 5.6% per annum and 4.5% per annum for the period 2015 – 2018 and 2019 – 2024 respectively.

Table 4 shows the historical electricity demand, generation and peak demand of the SESB system for financial years of 2006 to 2014 as well as those values forecasted for years 2015 up to 2035.

Table 4: Long term demand forecast 2015 - 2035

	Year	Demand / Sales GWh	Growth %	Generation GWh	Growth %	Peak demand MW	Growth %	MW increase
HISTORICAL	2006	2,875	6.3%	3,549	4.6%	573	7.9%	42
	2007	3,221	12.0%	3,908	10.1%	612	6.8%	39
	2008	3,385	5.1%	4,131	5.7%	647	5.7%	35
	2009	3,713	9.7%	4,412	6.8%	704	8.8%	57
	2010	4,051	9.1%	4,726	7.1%	773	9.8%	69
	2011	4,199	3.7%	4,940	4.5%	830	7.4%	57
	2012	4,401	4.8%	5,147	4.2%	828	-0.2%	-2
	2013	4,650	5.7%	5,506	7.0%	867	4.7%	39
	2014	4,765	2.5%	5,718	4.0%	908	4.7%	41
FORECAST	2015	5,033	5.6%	5,970	4.4%	946	4.2%	38
	2016	5,315	5.6%	6,286	5.3%	995	5.2%	49
	2017	5,669	6.7%	6,685	6.4%	1,057	6.2%	62
	2018	6,006	5.9%	7,063	5.6%	1,115	5.5%	58
	2019	6,344	5.6%	7,440	5.3%	1,173	5.2%	58
	2020	6,726	6.0%	7,867	5.7%	1,238	5.6%	66
	2021	7,063	5.0%	8,231	4.6%	1,294	4.5%	56
	2022	7,397	4.7%	8,590	4.4%	1,348	4.2%	54
	2023	7,745	4.7%	8,963	4.3%	1,405	4.2%	57
	2024	8,105	4.6%	9,347	4.3%	1,463	4.1%	58
	2025	8,480	4.6%	9,747	4.3%	1,524	4.1%	60
	2026	8,739	3.1%	10,009	2.7%	1,564	2.6%	40
	2027	9,033	3.4%	10,311	3.0%	1,610	2.9%	46
	2028	9,340	3.4%	10,626	3.1%	1,658	3.0%	48
	2029	9,641	3.2%	10,933	2.9%	1,704	2.8%	47
	2030	9,952	3.2%	11,250	2.9%	1,753	2.8%	48
	2031	10,188	2.4%	11,481	2.1%	1,787	2.0%	35
	2032	10,459	2.7%	11,752	2.4%	1,828	2.3%	41
	2033	10,768	3.0%	12,064	2.7%	1,876	2.6%	47
	2034	11,099	3.1%	12,400	2.8%	1,926	2.7%	51
	2035	11,437	3.0%	12,742	2.8%	1,978	2.7%	52

GENERATION DEVELOPMENT PLAN

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GENERATION DEVELOPMENT PLAN

REVISED GENERATION DEVELOPMENT PLAN (2015 – 2025)

The Generation Development Plan is revised through a new set of electricity demand forecast, with medium term aim of rejuvenating generation capacity especially in the East Coast. In the revised plan, reserve margin is set to be at minimum level of 20% throughout planning horizon while Loss of Load Expectation (LOLE) is capped at less than 1.5 day/year. In addition to reserve margin and LOLE, the plan aimed at ensuring enough capacity at both ends with existing East-West Interconnection performing crucial link-up function for the whole system.

With these reliability criteria, new additional capacities have been identified. East Coast dependency on energy from the West Coast is expected to reduce, and will eventually strengthened the overall supply system. The revised Generation Development Plan indicates a total new capacity of 388MW at the West Coast and 429MW in the East Coast will be required up till year 2025.

Most of the existing baseload plants including Sepanggar Bay Power Corporation and Kimanis Power are built at the West Coast where the gas receiving terminals – Sabah Gas Terminal (SGT) in Teluk Sepanggar and Sabah Oil and Gas Terminal (SOGT) are located. However, the new baseload plant is planned to be located at the East Coast of Sabah and is expected to be fuelled by Trans-Sabah Gas Pipeline which connects SGT at the west to Palm Oil Industrial Cluster (POIC) Sandakan at the East Coast of Sabah.

The capacity requirement during short term period would be fulfilled by the commissioning of an 8MW upgrading of Tenom Pangi and additional capacity from Renewable Energy (RE) sources such as the 10MW biomass and 10.8MW biogas plants. These plants will help in serving the demand in years as early as 2015 and 2016. It is expected that more generation capacity will be contributed by RE through the implementation of FiT in Sabah.

The planned commissioning of 90MW power plants in Lahad Datu (30MW) and Sandakan (60MW) in year 2017 and 2018 respectively will contribute in meeting the state's short term demand growth, particularly in the East Coast. For the medium term requirement, new CCGT power plant with total capacity of 300MW in Sandakan is expected to come on stream in stages during the years 2019 (200MW) and 2020 (100MW). These plants are meant to cater the medium to long term demand growth for the East Coast and will act as an anchor plant with natural gas sources through the Trans-Sabah Gas Pipeline. In order to diversify the generation fuel mix in Sabah, development of 180MW Upper Padas Hydroelectric Power Project (Upper Padas HEP) is already in the pipeline for commissioning post 2023.

For this time horizon, electricity demand is projected to expand at an average annual rate of 3%. Thus, to prepare Sabah for this growth as well as to reduce the system dependency on gas fuelled generation, the Generation Development Plan has considered other sources of energy. These include the state hydro potential as well as the energy import from Sarawak, Brunei and Indonesia.

Sabah's revised Generation Development Plan which consists of committed and other approved projects for a ten years planning horizon is depicted in Table 5 below:-

For this time horizon, electricity demand is projected to expand at an average annual rate of 3%. Thus, to prepare Sabah for this growth as well as to reduce the system dependency on gas fuelled generation, the Generation Development Plan has considered other sources of energy. These include the state hydro potential as well as the energy import from Sarawak, Brunei and Indonesia.

GENERATION DEVELOPMENT PLAN

Table 5: Revised Generation Development Plan for Sabah

Year	West Coast	East Coast	Installed Capacity (MW)	Reserve Margin (%)	LOLE (day/year)
2015	• Tenom Pangi Upgrade (8MW)	• TSH Biogas (3MW) • QL (2MW)	1,324	40	0.12
2016	• Ranhill Powertron II additional capacity until July 2016 (5MW)	• Melawa GTM Relocation (18MW) • Cahaya Bumijasa (3.8MW) • IOI Bio Energy (10MW) • Our Energy Group (2MW)	1,307	31	0.48
2017	-	• New Lahad Datu (30MW) • New Sandakan (30MW)	1,314	24	1.03
2018	-	• New Sandakan (30MW)	1,374	23	1.30
2019	-	• CCGT (200MW)	1,538	31	0.43
2020	-	• CCGT (100MW)	1,571	71	0.26
2021	• CCGT (100MW)	-	1,661	28	0.14
2022	-	-	1,661	23	0.43
2023	• Upper Padas HEP (180MW)	-	1,841	31	0.05
2024	-	-	1,777	21	0.35
2025	• Sabah Hydro (100MW)	-	1,857	22	0.28
Total	**388MW**	**429MW**			

Most of the diesel plants located at the Sabah's West Coast already retired in 2014, of which the gap was filled with commissioning of Kimanis Power and SPR Energy CCGT plants. For the East Coast, existing diesel-fired / MFO plants are expected to be retired after the commissioning of new 300MW CCGT plant in year 2019 and 2020. The scheduled retirement will involve cumulative capacity reduction of 299.6MW as shown in Table 6 below:

Table 6: Retirement plan up to 2025

Year	Plants	Capacity (MW)
2015	Libaran (45MW) – Based on latest DC declared by SO, SESB in July 2015	45
2016	Melawa (13.5MW), Tawau (13MW), Labuk (8MW)	34.5
2017	ARL (22.7MW)	22.7
2018	-	-
2019	Serudong (36MW)	36
2020	Batu Sapi (17.4MW), Melawa GTM (18MW), Tawau GT2 (17MW), Libaran (15MW)	67.4
2021	TSH (10MW)	10
2022	-	-
2023	-	-
2024	Kubota (64MW)	64
2025	Kinabio (10MW), Seguntor (10MW)	20
	Total Retirement Capacity (MW)	**299.6**

GENERATION DEVELOPMENT PLAN

NEW COMMITTED GENERATION PROJECTS

Renewable energy is making a very significant stride in Sabah as more projects are being committed for commissioning in 2015/2016 period. In view of complexities of project implementation and to ensure enough capacity made available in the system, some of the following projects were not considered in the revised Generation Development Plan. Nevertheless, these projects still remain as components in the overall power generation planning.

The cumulative additional committed renewable capacity amount to 283.9MW with hydro contributes the most at 215.5MW followed by geothermal 30MW, biomass 27.6MW and biogas 10.8MW. Upon successful completion of these projects, renewable capacity will increase from 127MW in 2015 to 398MW in 2025.

Apart from committed new generation projects in Table 7, rejuvenation of generation continue with the development of 90MW new dual-fired plant followed by 300MW CCGT power plant for commissioning in 2017, 2018 and 2019 at the back of impending retirement of diesel and MFO power plants during that period.

Table 7: List of committed renewable energy projects

No	Project	Location	Fuel	SCOD	Capacity (MW)
1	TSH Bio Gas	Tawau	Biogas	Apr 2015	3
2	QL	Tawau	Biogas	Nov 2015	2
3	Mistral Engineering	Sandakan	Biogas	Nov 2015	3.8
4	Tenom Pangi Upgrade	Tenom Pangi	Hydro	Dec 2015	8
5	Cahaya Bumijasa	Tawau	Biogas	Jan 2016	3.8
6	IOI Bio Energy	Sandakan	Biomass	Apr 2016	10
7	Our Energy Group	Telupid	Biogas	July 2016	2
8	SD Resources	Lahad Datu	Biomass	Aug 2016	7.6
9	Bell Tech	Lahad Datu	Biomass	Nov 2016	10
10	One River	Kota Marudu	Hydro	Dec 2016	27.5
11	Tawau Green Energy	Tawau	Geothermal	Dec 2017	30
12	Upper Padas HEP	Tenom	Hydro	2023	180
				Total Capacity (MW)	**287.7**

Upper Padas Hydroelectric Power Project

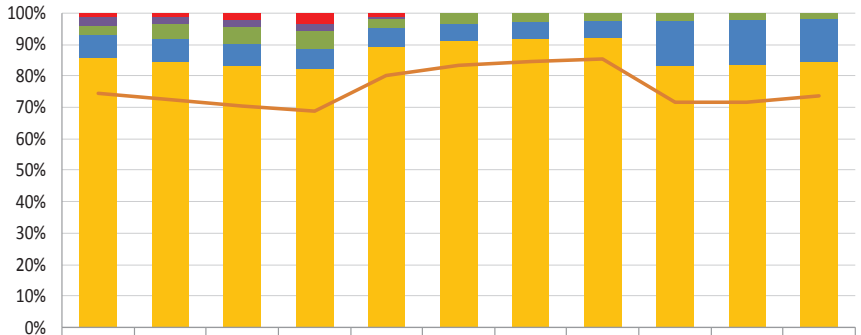
The idea of developing Upper Padas Hydroelectric Power Project (Upper Padas HEP) was long mooted as the government seeks a more balanced approach to the fuel mix quandary faced by lack of realistic alternative to gas. Upper Padas HEP, planned as storage-type dam with installed capacity of 180MW, is expected to act as an intermediate and peaking plant for the system. In addition, the presence of large water-storage capacity can assist in flood control in Tenom and Beaufort due to overflow of Sungai Padas.

Study on Upper Padas HEP is now at the engineering stage by SESB. Subject to appointment of project developer and EPC contractor, Upper Padas HEP can be commissioned as early as 2024.

FUTURE GENERATION MIX

Future generation fuel mix for Sabah which is derived from the revised plan is as described in Figure 22 :

Figure 22: Generation fuel mix projection



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Diesel	1%	1%	2%	3%	1%	0%	0%	0%	0%	0%	0%
MFO	3%	2%	3%	3%	0%	0%	0%	0%	0%	0%	0%
Other RE	3%	5%	5%	5%	3%	3%	3%	2%	2%	2%	2%
Hydro	7%	7%	7%	6%	6%	6%	6%	5%	14%	14%	14%
Gas	86%	85%	83%	82%	89%	91%	92%	92%	83%	83%	85%
HHI	0.74	0.72	0.70	0.69	0.80	0.83	0.85	0.86	0.72	0.72	0.73

Current dependency of gas in the generation mix is expected to continue throughout the ten (10) years planning horizon even after expected operationalisation of 180MW Upper Padas HEP beginning 2024 However, during gas supply curtailment, diesel as the back-up fuel for all CCGTs will be use. In this regards, it is important for all plant operators to maintain adequate diesel supply in addition to regular fuel changeover exercise. For prolonged outages, fuel supply system adequacy needs to be assessed from time to time by all relevant stakeholders including off-taker and major fuel suppliers.

Nevertheless, together with output from Upper Padas HEP, hydro contribution in overall generation mix is projected to increase from 7% in 2015 to 14% in 2025. Indeed, the role of hydroelectric is very crucial from supply security perspective throughout the planning horizon with limited options available at present.

Approximately one-tenth of current generation mix is from renewable energy (RE). This considerably high generation mix took into consideration the new definition of RE which includes large hydro as RE. The 32th ASEAN Ministers on Energy Meeting (AMEM) held on 23rd September 2014 in Vientiane Lao PDR has agreed to the new definition of renewable energy which includes all on-grid and off-grid hydro-based capacity and excludes traditional biomass. Thus, based on this new definition, large hydro generation is considered as renewable energy sources under the generation mix.

After one year of implementation, FiT mechanism proved to be well received in Sabah. RE share towards the total generation mix surges to up to 5% during the short to medium term window, significantly contributed by successful commissioning of new biomass and biogas plants. While output is expected to be consistent, RE share in the generation mix will be reduce as the output will be overly dependent on the palm oil wastes source from surrounding areas. Share of gas-based generation will pick up after commencing operation of the East Coast CCGT plants in 2019. While the share is getting smaller, RE generation is one of the key components to the fuel diversification effort in the system. Efforts then must be intensify to ensure security and sustainability of feedstock.

GENERATION DEVELOPMENT PLAN

Tenom Pangi Hydroelectric Power Plant

MFO plant contributes about 4% of the overall mix during the early planning horizon but phases out in stages starting in the year 2016. Meanwhile, diesel generation contributes around 1% to 2% upon commissioning of the new 90MW diesel plant. However, the share will be markedly drops towards the end of the planning horizon after gas is made available in the East Coast through the Trans-Sabah Gas Pipeline. The 60MW capacity in Sandakan will be then operated on gas while the 30MW capacity in Lahad Datu will continue to operate on diesel.

Upon expiry of existing plants, MFO will cease from the generation mix as most of the output will be drawn from gas, hydro and renewables. Diesel however, due to supply accessibility, will continue to perform complementary role in the main grid Sabah and main fuel for rural, off-grid application. The reality, however, is that among the pre-requisites of a secure, robust electricity supply system is the ability for power generation component to react to sudden fuel supply constraint.

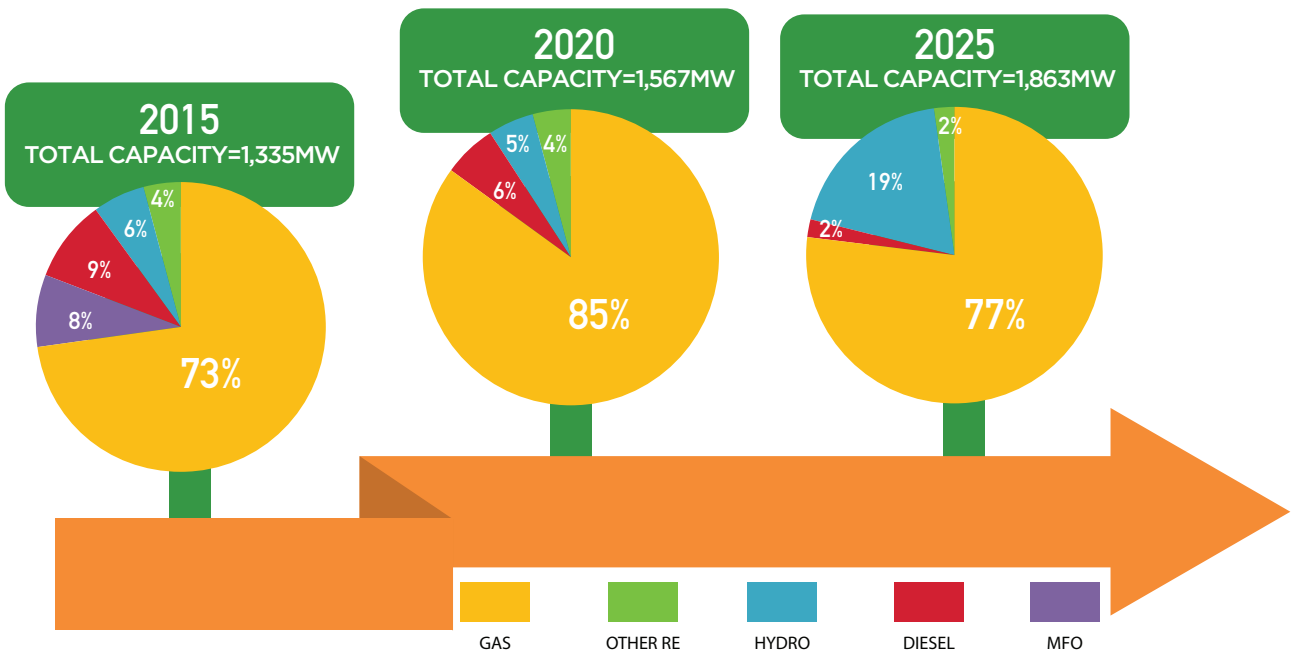
Moving forward, other energy options such as coal-fired generation, indigneous hydro potential and power transfer via interconnection with Sarawak are also important and can be considered to be part of a longer term development. At the same time, possible interconnection with neighbouring countries such as Brunei, Indonesia and Philippines are currently being explored and these cross border interconnection potential is deliberated further in the next chapter.

GENERATION CAPACITY PROJECTION

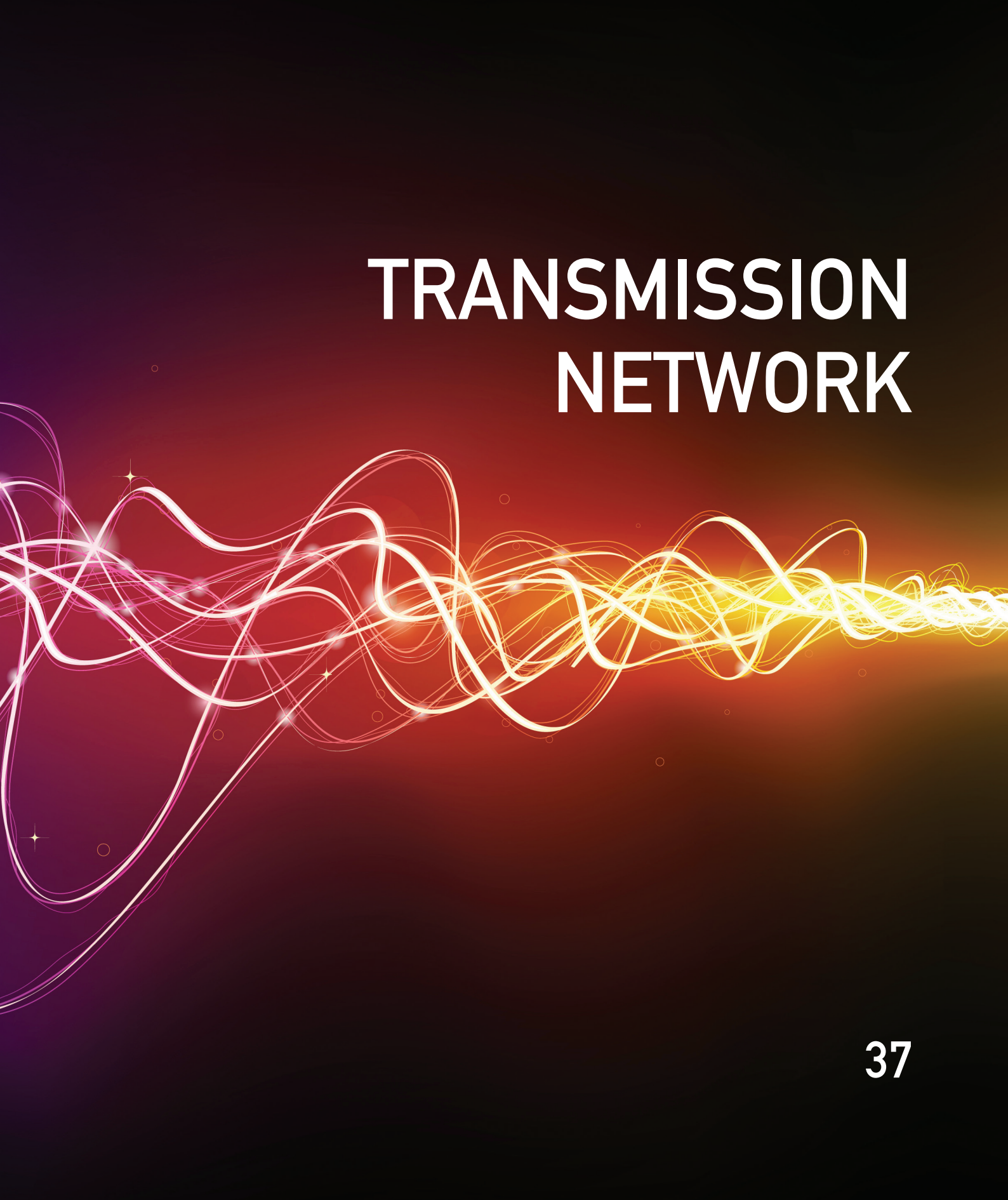
The system is projected to experience growth of between 4.5% to - 6% in the next 10 year period. Demand will be catered through a combination of new and existing generation capacity. As mentioned in the previous chapter, key generation components during this period will be the new 390MW diesel/gas plants in Lahad Datu and POIC Sandakan and 180MW Upper Padas HEP. In addition, development of renewable energy under the FiT scheme will be intensified with the increase of surcharge on electricity bill from 1.0% to 1.6%. It is expected that capacity from biomass and biogas will almost double from 33MW in 2013 to 64MW by the end of 2016.

Generation capacity will increase by more than 500MW to 1,863MW by 2025 from 1,335MW in 2015. By 2020, it is expected that MFO-based capacity will be retired from the grid system after full commissioning of the new CCGT in POIC Sandakan. As for the hydroelectric potential, development of new plants will be crucial in order to reduce dependency to gas. In that respect, Upper Padas HEP can be the catalyst to downstream potential development in Padas basin. With longer lead time compared to thermal projects, hydroelectric potential will be develop in stages, thus ensuring proper resources management in terms of financing, manpower and technology know-how.

Figure 23: Generation capacity mix projection



TRANSMISSION NETWORK



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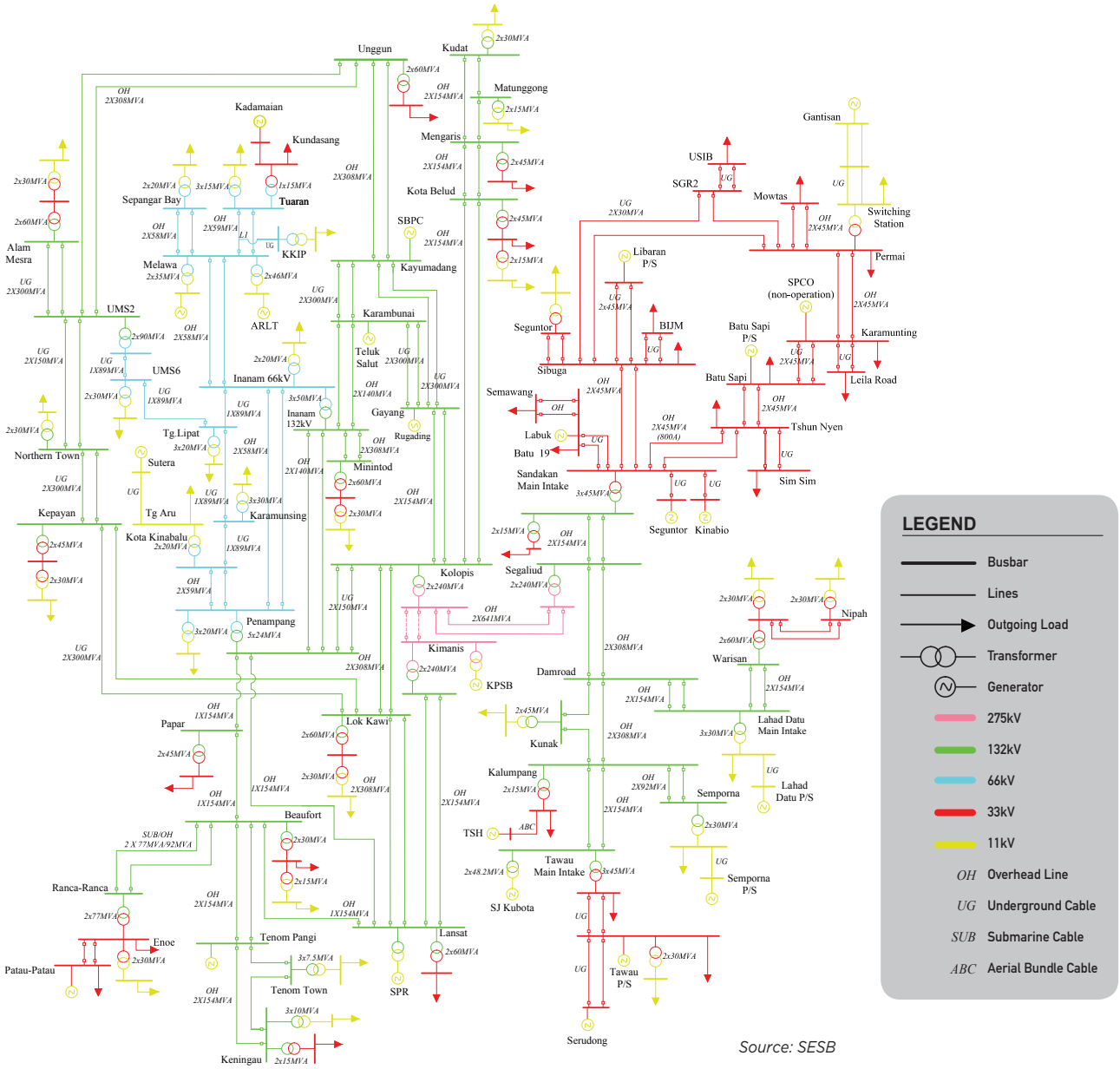
TRANSMISSION NETWORK

SABAH NETWORK

West Coast and East Coast have been fully connected since 28th July 2007. As of first half of the year 2015, the highest recorded maximum demand stood at 914MW on 12th May 2015 whilst the demand is being supported by 1,324MW of dependable generation capacity distributed in the Sabah Grid. Currently, there are about 493 circuit-km of 275kV lines, 1,829 circuit-km of 132kV lines, and 118 circuit-km of 66kV transmission networks connecting all major townships in Sabah. Single line diagram for the existing network is shown as follows:-

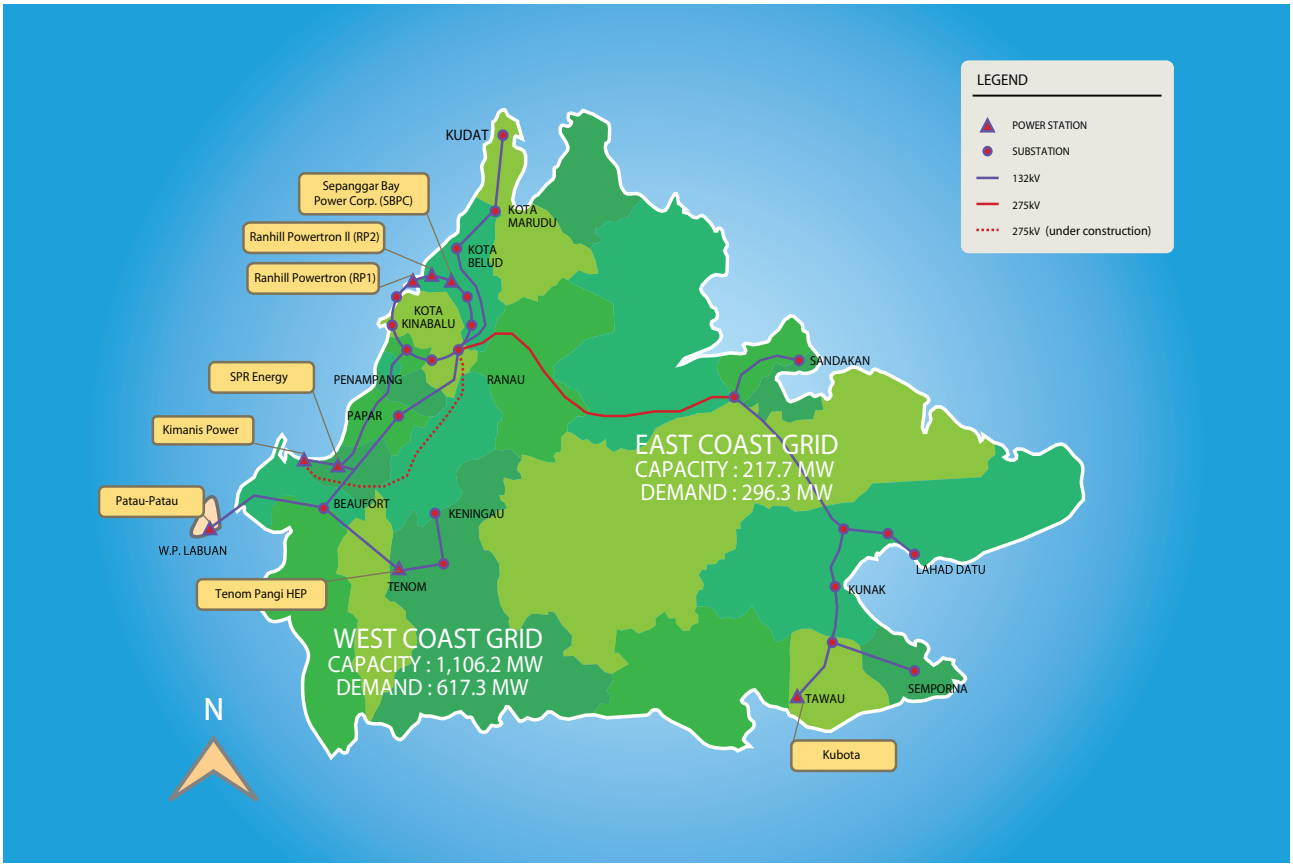
Figure 24: SESB transmission network



Source: SESB

Sabah transmission system is divided into West Coast Grid (WCG) and East Coast Grid (ECG) where the bulk of generation capacity and demand is in the WCG due to its economic activities and gas resource availability.

Figure 25: Current transmission system in Sabah



TRANSMISSION DEVELOPMENT PLAN

The 10-year transmission development plan was based on electricity demand forecast by TNB-SESB Planning Working Group (TSPWG). Among others, the TSPWG was also tasked to appraise the transmission development projects. The works that have been carried out includes identification of transmission system requirements associated with load growth and security of the system. Resulting from the study, preliminary work such as acquisition of future substation land and survey for new transmission route will then carried out by SESB.

The 10-year plan was established by merging the existing transmission system modeled in base year with latest inputs that includes new load forecast, generation development plan, plants retirement, ongoing/committed transmission projects, and identified load-related substation projects. The planning criterion of (N-1) is adhered to at all times to ensure that the transmission development plan is in compliance with the License Condition, Sabah and Labuan Grid Code and Transmission System Reliability Standards. Compliance with the performance criteria and limits as stipulated in the Grid Code also require system reinforcement projects to resolve the fault level issue in the identified areas.

TRANSMISSION NETWORK

There are 11 ongoing transmission projects currently being carried out by SESB, which is based on the findings by TSPWG are necessary to cater for load growth and system security. The projects are financed through grant or soft loan from the government. For implementation of the proposed new projects which will be in stages, project reassessment will be conducted prior to execution.

Upgrading works particularly on the 66kV network will alleviate the possibility of high fault level in the event of fault occurrence. Interim operational measure such as introduction of off-point(s) is already implemented and should reduce the amount of fault level, hence reducing the risk of equipment failure though at the expense of reliability and security of the network.

Securing access for new transmission and distribution lines remains a huge challenge to SESB. Delays in project implementation, more often than not, were attributed to the delay in getting the wayleave or access to the site. Consequently, the planned lines were not able to be completed on time and put more constraints to the System Operator, which then had to resort to the less than optimal operational regime.

Figure 26: Transmission projects associated with system development

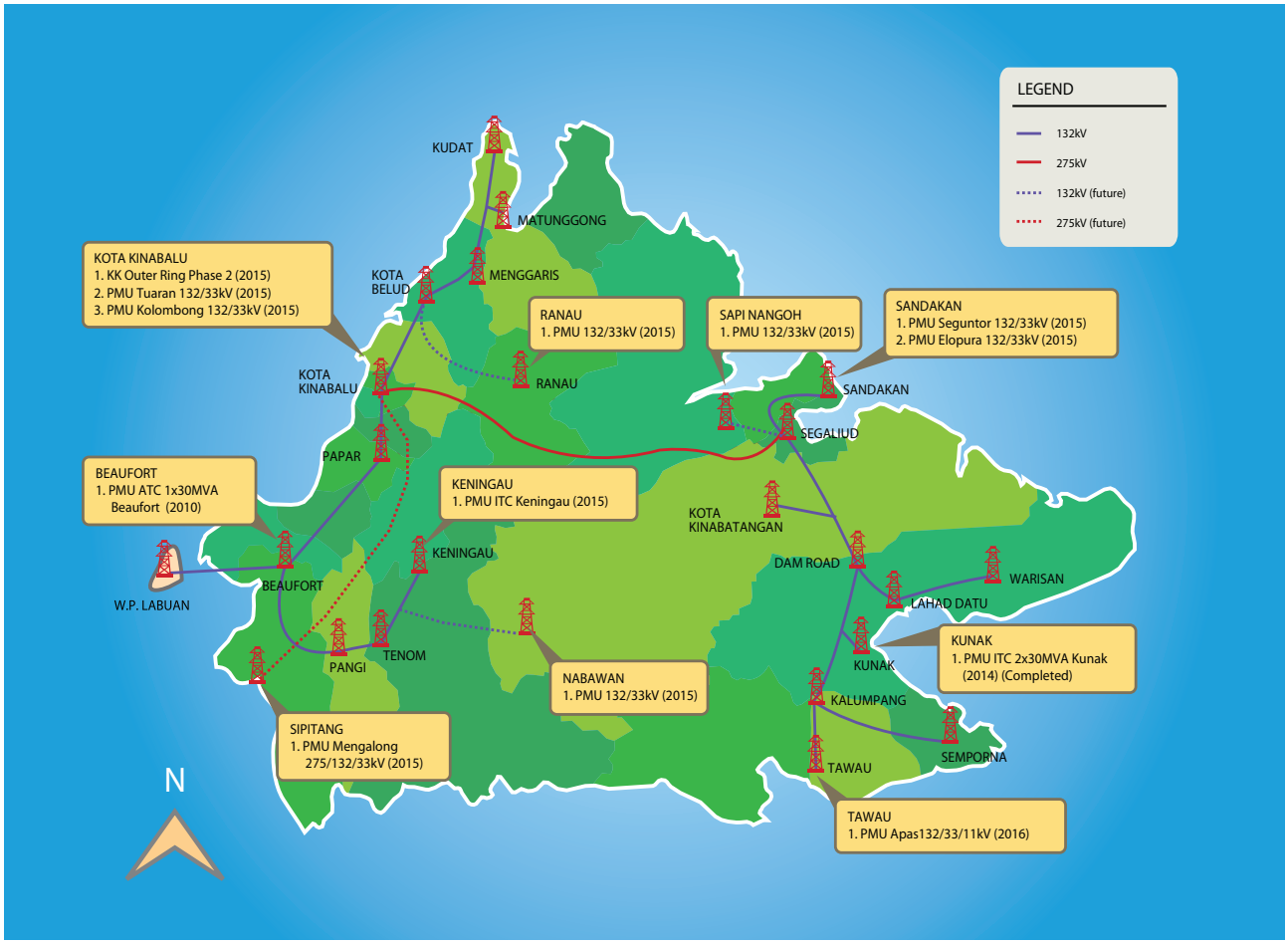
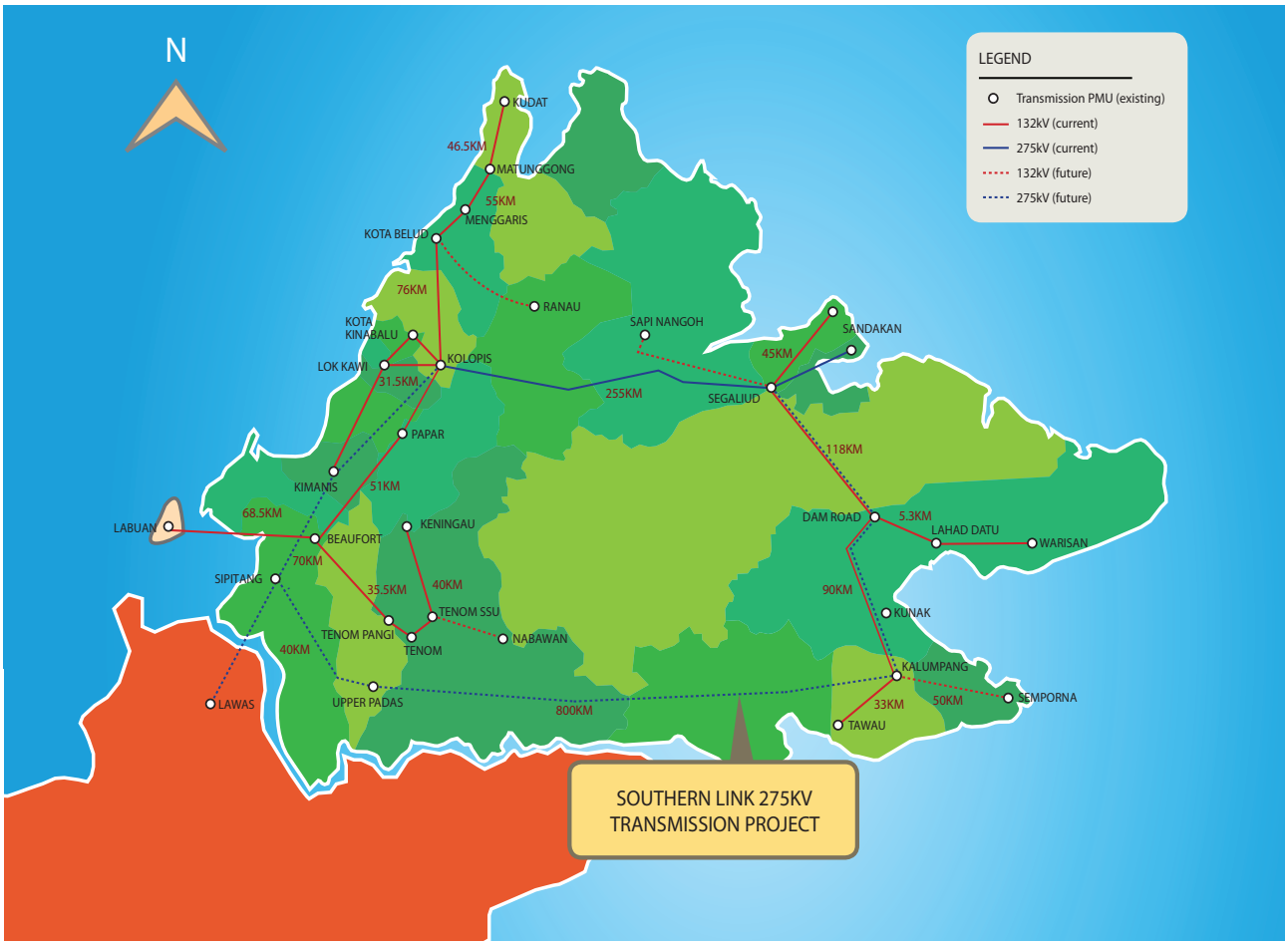


Figure 27: Future transmission system in Sabah



GOVERNMENT INITIATIVES

GOVERNMENT INITIATIVES

GOVERNANCE OF SABAH ELECTRICITY SUPPLY INDUSTRY

With the addition of generation capacity from several new power plants in the West and East Coast of Sabah, existing dependable capacity increased to 1,324MW. The peak load is expected to reach 946MW in year 2015, an indication of relatively comfortable reserve margin though still vulnerable to disturbance in the event of large units multiple tripping.

Government recognizes that there is a need to increase the quality of power industry in Sabah and to ensure a more reliable electricity supply is delivered as electricity industry is the major catalyst for Sabah's development and industrialisation activities especially in the East Coast area. The Government is also aware of the electricity supply system in Sabah and Labuan which requires further improvement due to the limited robustness of the existing transmission and distribution network. This issue coupled with occurrence of theft of electricity contributes to the incidence of frequent power disruptions in Sabah.

In view of this situation and in line with the Government's efforts to ensure and improve the efficiency of the electricity supply industry in Sabah, the Ministry of Energy, Green technology and Water together with the MyPOWER Corporations has conducted a study on the 'Strategy Development and Implementation Plan for Sabah Electricity Supply Industry' (SESI). This study covers improvement strategies of Sabah electricity supply system including initiatives to improve the quality of services by Sabah Electricity Sdn. Bhd. (SESB), as the utility and the sole holder of the license of electricity supply in Sabah and Labuan. In addition, the Government through Suruhanjaya Tenaga is monitoring the situation of electricity supply and has drawn up a development plan of the electricity supply industry in Sabah.

SESI covers improvement strategies of Sabah electricity supply system including initiatives to improve the quality of services by Sabah Electricity Sdn. Bhd. (SESB), as the utility and the sole holder of the license of electricity supply in Sabah and Labuan.

SPR Energy CCGT Power Plant

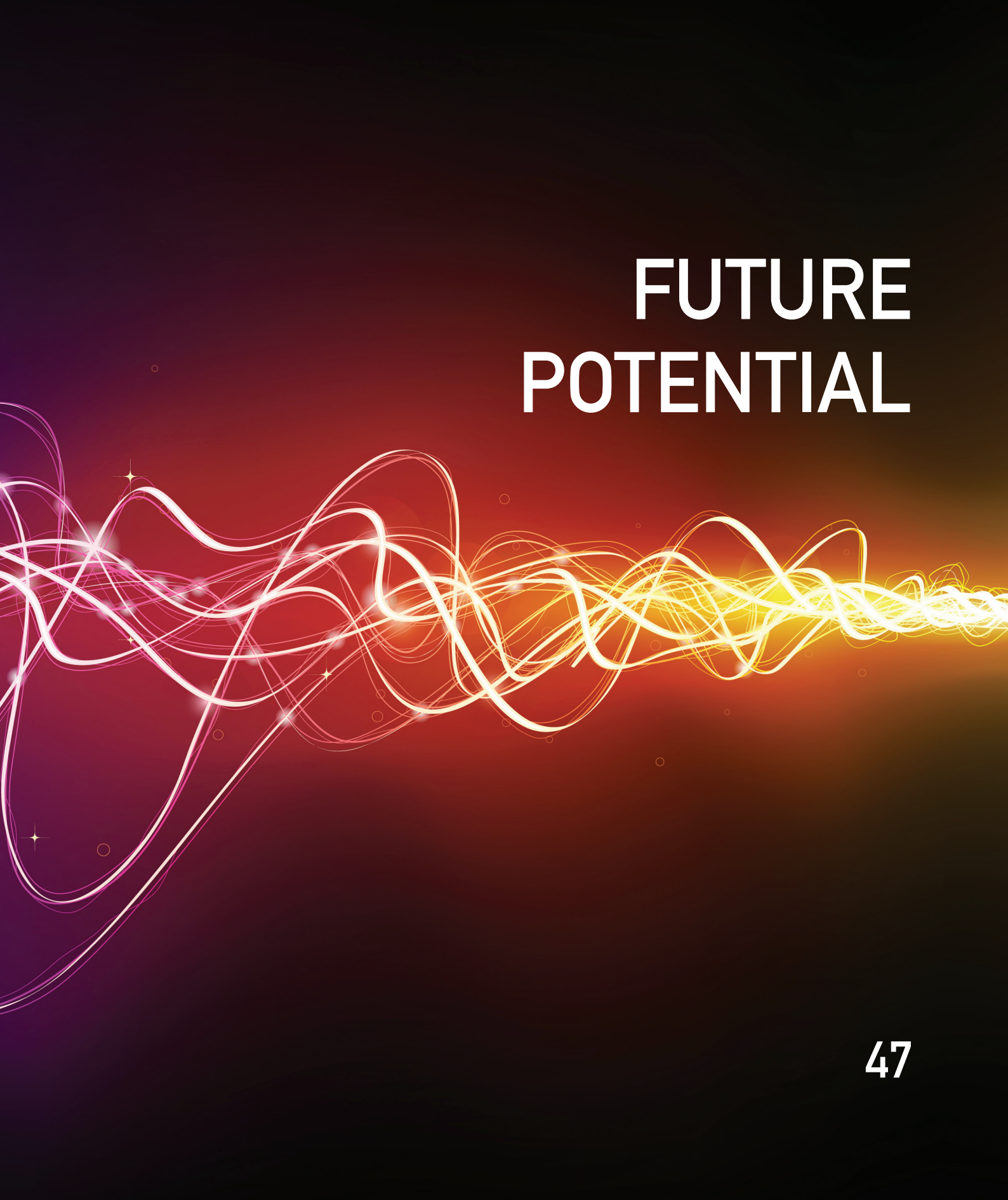
Among the initiatives that have been identified to improve the governance in the electricity supply industry of Sabah, is as follows: -

Table 8: Initiatives to enhance governance in Sabah electricity supply industry

No	Initiatives
1	Establishment of Grid System Operator (GSO), Grid Owner (GO) and Single Buyer (SB) within SESB
2	SESB Counter Review of new Sabah & Labuan Grid Code
3	Operationalise of Service Level Agreements (SLAs) for SESB's Major power plants (Tenom Pangi, Kubota and Patau-Patau)
4	Establishment of Divisional Accounting for each division in SESB
5	Establishment of Sabah Grid System Reliability Standard (SGSRS)
6	Setting of SESB KPIs and monitoring performance on quarterly basis
7	Development of Distribution Code for Sabah and Labuan

In the meantime, the Ministry, Suruhanjaya Tenaga and SESB have also identified several mitigations for short-term, medium and long term to overcome the weakness of the electricity supply system in Sabah and Labuan within the next 5 years period (2015 to 2020). In addition, the Government has also established a Special Project Team for Sabah known as SAPADU which will implement and regulate the electricity supply projects in Sabah and Labuan.

FUTURE POTENTIAL



FUTURE POTENTIAL

Federal Government through the Ministry of Energy, Green Technology and Water since year 2009 has allocated grants amounting to RM 795 million and more than RM 2,656 million of soft loan to SESB in order to implement various generation, transmission and distribution projects. Under the 11th Malaysia Plan, the Government has allocated another of RM2.295 billion to strengthen Sabah electricity supply system within the next 5 years (2015 – 2020). The Government also established a dedicated project team namely SAPADU to undertake and monitor project implementation identified under this new allocation.

Apart from all initiatives and assistance which have been planned by government together with the utility company, there are also a few options that can be adopted and studied further to improve the electricity supply industry in Sabah.

SABAH HYDRO POTENTIAL DEVELOPMENT

Harnessing the state's remaining hydroelectric potentials remains one of most viable options for Sabah so as to get continuous sustainable supply of energy at affordable prices. For the 10-year revised Generation Development Plan, two large hydroelectric plants have been identified as possible candidates. The 180MW Upper Padas HEP is targeted for commissioning in the year 2024.

SESB is currently undertaking a study on Sabah Hydro Potential Development to assess further hydro potential and identified sites for its hydro mapping. Based on the latest development, 8 out of 12 sites identified earlier have been proposed for feasibility study under the 11th Malaysia Plan.

Table 9: List of Sabah hydro potential

No	Site	River	Capacity	Feasibility Study Period
1	LW.06	Liwagu	57	2015 – 2017
2	PD.01	Padas	114	2015 – 2017
3	WC.05	Tuaran	41	2016 – 2018
4	PD.08	Padas	120	2016 – 2018
5	PD.14	Padas	59	2016 – 2018
6	PD.03	Padas	48	2016 – 2018
7	LW.05	Liwagu	45	2017 – 2019
8	PD.09	Padas	67	2017 – 2019
		Total Capacity (MW)	**551**	

Figure 28: Future hydropower in Sabah

FUTURE POTENTIAL

PROSPECT FOR INTER/INTRA STATE INTERCONNECTION

The potential of electricity supply through interconnections with Sarawak and neighbouring countries is explored to further optimize Sabah grid system. Initial steps have been undertaken by SESB with various parties so as to consult the needs and barriers of having the electricity interconnections. These interconnections are also parts of the ASEAN Power Grid (APG). For Malaysia, it will be guided by guidelines on cross border interconnection established by the Ministry of Energy, Green Technology and Water. Some of the guidelines highlighted are as follows:

Table 10: Guidelines for cross border electricity exchange and trading policy framework

No	Guidelines
1	Ability to fulfill and supply forecasted peak demand
2	Ability to fulfill and supply forecasted electricity demand
3	Ability to fulfill and maintain system requirement and reliability
4	Transaction to be conducted in accordance to market based pricing
5	Ability to fulfill comfortable reserve margin requirement
6	Consideration towards Government target to reduce carbon emission
7	Besides emergency conditions, Utility have to prove that the energy import is less expensive than cost of electricity production in the country

Sabah-Sarawak-Brunei Interconnection

The proposed establishment of a fully integrated 275kV backbone system in Sabah enables further enhancement of the system grid reliability and provide flexibility for cross border interconnection. Part of the 275kV system includes PMU Mengalong, Sipitang (275/132/33kV) at the West Coast and PMU Kalumpang, Tawau (275/132/33 kV) at the East coast of Sabah. By having these upgrading systems, more interconnection projects under the ASEAN Power Grid (APG) namely; Sabah-Sarawak-Brunei Interconnection and Kalimantan Interconnection could be implemented and materialised.

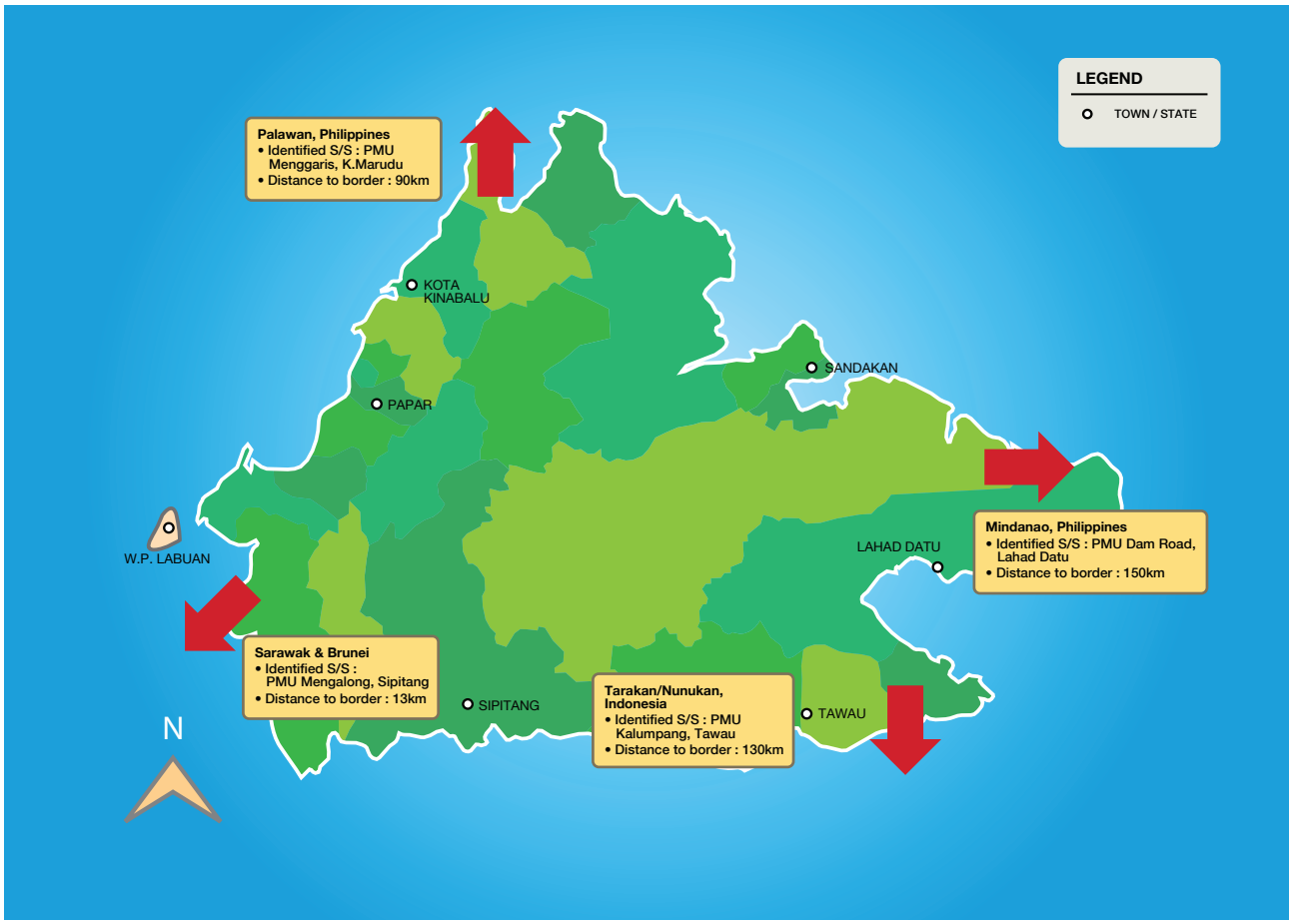
The ASEAN Interconnection Master Plan Study (AIMS) has earlier recommended an interconnection project connecting Sarawak-Sabah-Brunei systems with a maximum capacity of 300MW to be commissioned by the year 2019. The project has been assessed in detail recently under the Trans-Borneo Power Grid Interconnection Implementation Study funded by EC-ASEAN Energy Facility.

At utility level, Head of Agreement (HOA) for the feasibility study of Sabah-Sarawak Interconnection has been signed in 2013 between SESB and SEB. A more optimise solution requires interconnection with Brunei system as the infrastructure development can then be better allocated and utilised. Initial findings of the study indicated that Interconnection can be conducted in 2 phases. For Phase 1, interconnection can be done through 33kV lines connecting PMU Megalong to Lawas in which two-ways power transfer is envisaged due to different peak periods. For Phase 2, interconnection at transmission level (132kV or 275kV) is required to enable higher power transfer.

Sabah-North Kalimantan Interconnection

The discussion on Sabah-North Kalimantan Interconnection started during the years 2011 - 2012, leading to signing of Non-Disclosure Agreement (NDA) for feasibility study purposes. To facilitate the interconnection study, a Memorandum of Understanding (MoU) between SESB and PLN of Indonesia was signed in 2014 with the objective to explore the feasibility of Sabah-North Kalimantan interconnection. Subsequently, discussion centred around the interconnection options - either on economic exchange, economic exchange with minimum off take or on energy purchase.

Figure 29: Potential of Sabah Interconnection between neighboring countries



Sabah-Philippines (Mindanao and/or Palawan) Interconnection

The interconnection of Sabah-Philippines through Palawan was identified under the AIMS II with the earliest scheduled commercial date of operation by the year 2020. The Brunei-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) meeting in Davao, Philippines between senior officials from the Philippines, Malaysia and Indonesia agreed on commencing a pre-feasibility assessment of further integration of power systems among the three countries.

Pre-feasibility assessment of the Borneo-Mindanao power interconnection (ADB TA-8040 REG: Master plan on ASEAN Connectivity Implementation) was conducted by Asian Development Bank in 2014. Subsequent to the preliminary study, a more detailed power system interconnection study is required so that most feasible options can then be drawn for further consideration.

FUTURE POTENTIAL

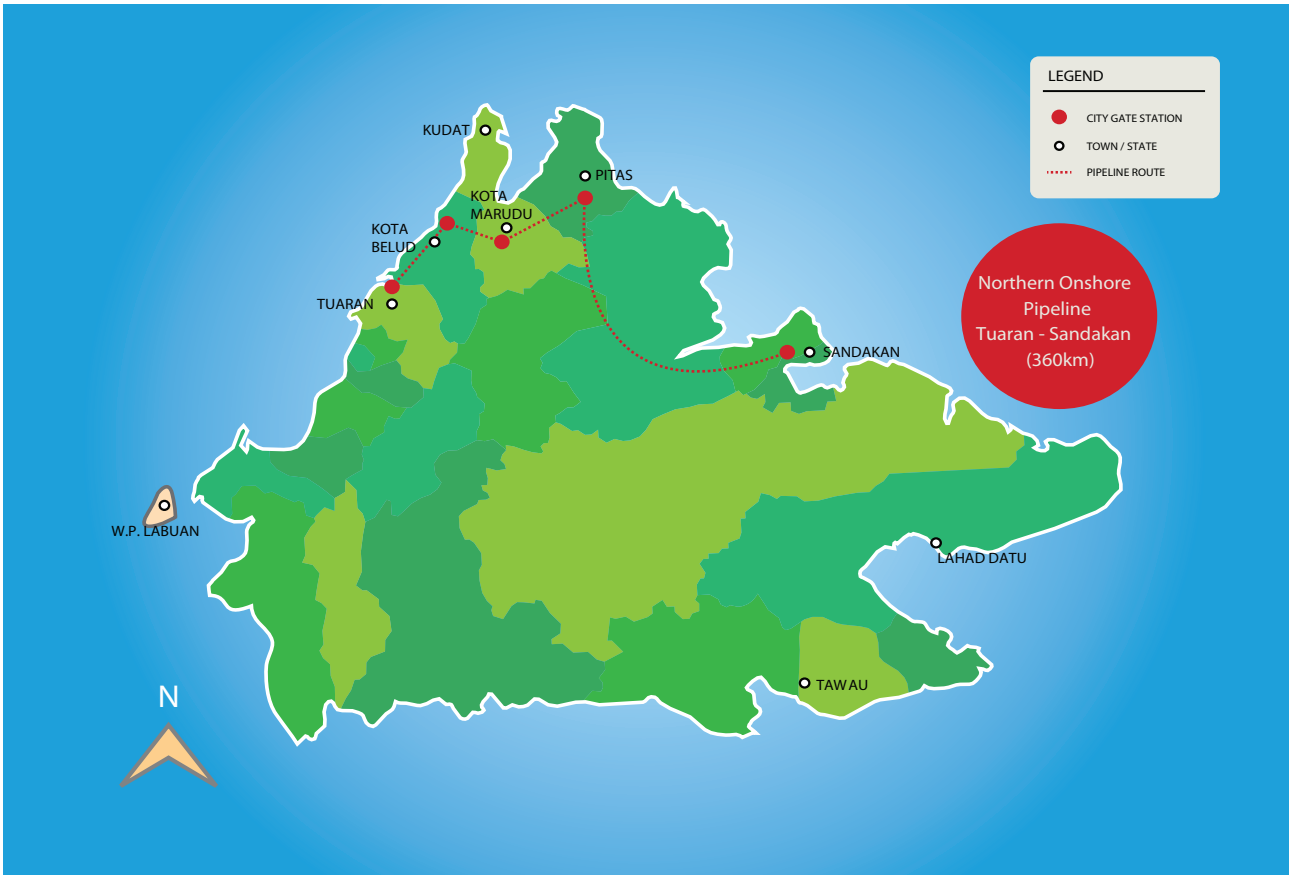
TRANS-SABAH GAS PIPELINE

The LNG regasification terminal (RGT) in Lahad Datu was initially planned as replacement to the cancelled coal-fired power plant project. However, due to security concern and relatively higher gas price that remains beyond the level that can be afforded by the system, the RGT project was then deemed to be not viable.

In place of the RGT, a new gas pipeline known as the Trans-Sabah Gas Pipeline is now being planned to be developed in order to transport natural gas from Kota Kinabalu to Sandakan. Prerequisite to development of CCGT plants, implementation of the gas pipeline project will also allow other industrial consumers along the pipeline vicinity an opportunity to utilise gas unlike before.

Details of the proposal are unknown, however the project is now being seriously considered at policy-decision level. Subject to approval, pipeline alignment and land acquisition exercises are expected to be conducted with close cooperation by state agencies.

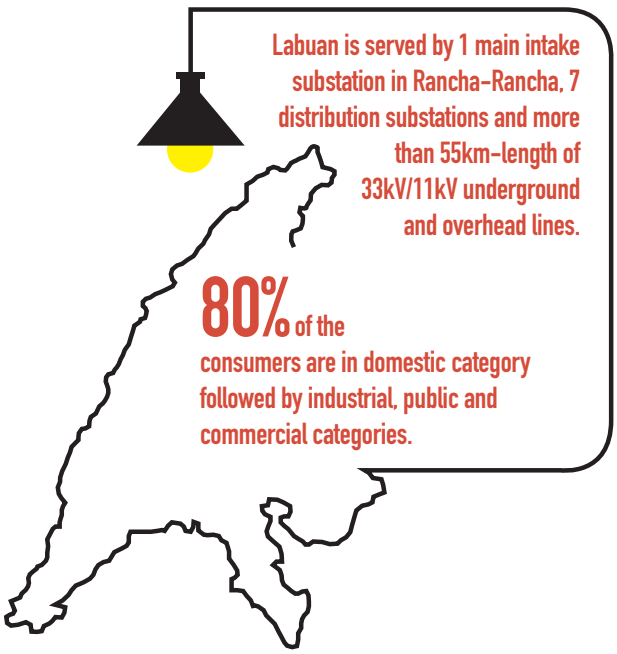
Figure 30: Trans-Sabah Gas Pipeline



LABUAN DEVELOPMENT PLAN

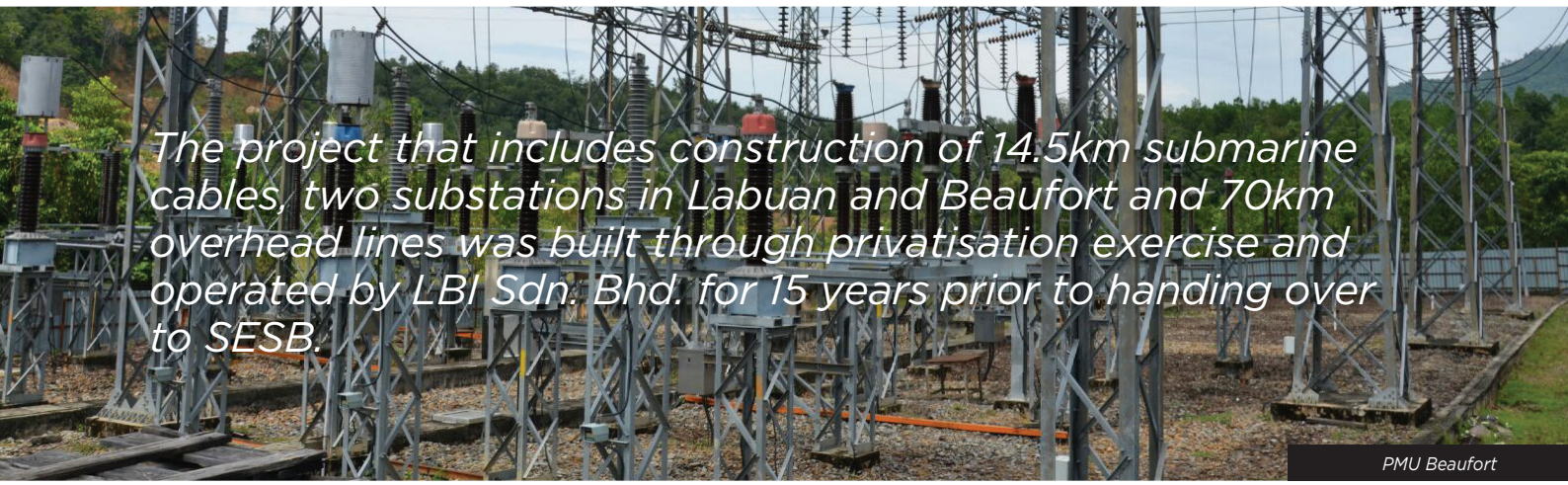
Labuan is connected to the mainland grid through Labuan-Beaufort Interconnection (LBI) 132kV submarine cables since 1990. The project that includes construction of 14.5km submarine cables, two substations in Labuan and Beaufort and 70km overhead lines was built through privatisation exercise and operated by LBI Sdn. Bhd. for 15 years prior to handing over to SESB. Throughout 25 years of operation, the LBI has proved to be one of the important elements in the Sabah power system as cost-effective electricity generated from SJ Patau-Patau is supplied to consumers through the installation.

SJ Patau-Patau has been in operation since 1983 with initial capacity of 73MW, consists of two gas turbines and one steam turbine. In 1995, additional gas turbine of 31MW was installed to bring the total capacity to 104MW. Considering the age of the plant, it is timely that life assessment study to be carried out to determine the plant remaining economic life before any decision to upgrade or redevelop being made.



In terms of distribution network, Labuan is served by 1 main intake substation in Rancha-Rancha, 7 distribution substations and more than 55km-length of 33kV/11kV underground and overhead lines. Currently, close to 80% of the consumers are in domestic category followed by industrial, public and commercial categories. With peak demand in excess of 55MW compared to total capacity of 290MVA, the distribution network is expected to be able to serve consumers in the short to medium term.

As the international business and financial centre, Labuan requires reliable supply of electricity at all time. In this respect, SESB has commenced the study to improve Labuan supply system that is schedule to complete by the end of the year.



PMU Beaufort

CLOSURE

Adequate and reliable generation capacity, robust transmission and distribution network and operational sustainability are some of the hallmarks of a performing electricity supply system, which the elements are still not found in the case of Sabah electricity supply industry. Total system collapse in January 2014 has called for a thorough review that triggered action plans set to be accomplished during the 10th and 11th Malaysia planning period. With proper execution of new infrastructure development or system upgrades, identified critical weaknesses will be corrected that will result in improved performance of overall system.

One must also look beyond the infrastructure aspect as improvement in operation and maintenance culture needs to be speeded up in order to bring the best out of the investment. Introduction of various initiatives such as IBR, ring-fencing of Single Buyer and Grid System Operator as well as SLAs for SESB-owned power plants are being carried out to institutionalise operational discipline and accountability within the organisation.

SESB as the utility, while assisted by significant government grant and fuel subsidies, is also saddled with huge debts that limits the ability to finance new projects. In this respect, establishment of SAPADU will ensure that all the projects are to be implemented as planned. RM 2.295 billion has been allocated to strengthen Sabah electricity supply system within the next 5 years under the 11th Malaysia Plan.

The development of new diesel/gas capacity of 390MW in the East Coast area and 180MW Upper Padas HEP project in the West Coast will address the medium and long term requirement of the system. In addition, study will be carried out to determine the feasibility of remaining hydro potential. While gas continues to dominate the landscape, development of renewable energy for power in the form of hydroelectric, palm oil wastes, geothermal and solar is essential for security of supply.

Interconnection with neighbouring systems must be further explored to capitalise on each member advantages. As such, regional cooperation framework or arrangement that will mutually benefits all participants must be pursued.

In general, the “work-in-progress” status of the electricity supply industry in Sabah requires concerted efforts from all the relevant agencies. SAPADU in particular will help to further improve deliverable of projects that are critical to the system reliability. It is our hope that significant development and improvement of overall system performance can then be reported in the next edition to provide milestones to this long journey of bringing the Sabah electricity supply industry up to the stakeholders’ expectation.

NOTE

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