VOL. 10, NO. 15, AUGUST 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences


www.arpnjournals.com

SCORE: CHALLENGES & IMPLICATIONS IN SARAWAK'S POWER SUPPLY SCENARIO

Cheng Yong Lau
Faculty of Business, Nilai University, Persiaran Universiti, Putra Nilai, Nilai, Malaysia
E-Mail: cylau@nilai.edu.my

ABSTRACT

This article investigates the on-going issue that is associated with the Sarawak Corridor of Renewable Energy, or SCORE, from the perspective of the five dimensions of mega project success of Sovacool and Cooper (2013) – social (governance), technological (systems), democratic (politics), externalities (economics, ecology) and risk assessment (accountability), and its possible impact on Sarawak's power surplus issue (reserve margin) from having excessive hydropower station construction. Now, the energy efficient mission development may be questionable through the issues raised by the people which are the current and future Sarawak's total installed capacity versus the peak demand for energy. i.e electricity. Sarawak could see the extensive construction of SCORE as an unnecessary option whereby with partial discontinuation of the construction, it can close the gap to match up to the international standard of energy efficiency (EE) by lowering the reserve margin.

Keywords: score, Sarawak, bakun dam, renewable energy, hydroelectricity.

INTRODUCTION

Sarawak is the biggest and richest resources state among the Malaysia's 13 states, with an estimation of oil and gas reserves at 1.2 billion barrels and 40.9 trillion standard cubic feet (s.c.f) respectively. The controversial plan facing Sarawak now is it calls for a network and transmission of 12 hydroelectric dams to be constructed in the Malaysia's biggest rainforests by 2020, and by the year of 2037, an estimated of 51 dams will have been constructed (Moses, 2009). SCORE, in this case, much likely would be seen as a necessity for Sarawak's development by attracting foreign investors; hence the foreign direct investment (FDI) for the state soared up tremendously, achieving US$8.5 billion in the early 2014. Furthermore, SCORE's forecast is that it will attract up to US$200 billion worth of investment in the future (Recoda, 2014). In order to power foreign industries, mega dam's construction in this case seems inevitable. In this paper itself, the author hope to raise discussions about the current criticism faced by the SCORE and its associated projects, as well as to examine the energy demand situation in Malaysia especially electricity. Whether Sarawak will be benefitting from SCORE and fulfilling its dream to serve as effective powerhouse of Southeast Asia and exporting electricity to countries like Brunei, Indonesia, and the Philippines still remains unknown. SCORE, one of the biggest development projects in Sarawak state ever, is expected to generate US$105 billion of investment revenue and through this project it will finalize the construction 20,000 Megawatt (MW) of hydroelectric dams along a 320km corridor crisscrossing 70,000 square kilometers in 2030.

SARAWAK CORRIDOR OF RENEWABLE ENERGY (SCORE)

The controversial project lies in Sarawak which is part of the puzzle for Malaysian central planners and also acts as one of the key development projects for the nation. It is also part of the components of both the Ninth Malaysia Plan (2006-2010) and the Tenth Malaysia Plan (2011-2015). As mentioned earlier, SCORE would have the possibility of obtaining US$105 billion of foreign investment and constructing 20,000MW of hydropower (Sovacool and Bulan, 2012). Next, this project is targeted at 1.6 million of jobs creation under SCORE with its target completion year by 2030 and with SCORE leading the growth, speculators believes that Sarawak could achieve growth of 5-6% by 2015, and possibly outperform the forecasted average national growth (Puthankattil, 2013).
Even though it has the attraction of bringing cash from overseas corporation, the challenges and impacts towards the social, economic, and environmental should not be ignored. For instance, the dam's construction has already created massive wave of criticisms from the local communities. The areas of industrialization, energy security, inclusive development, and spillover effects are largely mentioned in the SCORE mission. The Samalaju industrial park near the coastal township of Bintulu would turn to be the center for heavy industries and it operates within a seaport. Another example will be Mukah, which would be the center for administration and training.

Finally, with Tanjung Manis, it will eventually transform into a food-processing center and a port that permits food, timber and palm oil exports all over the world (Bruno Manser Fonds, 2012). At the moment, investors such as Press Metal Bhd's aluminum smelter was the first energy-intensive industry operating in SCORE which commenced operations in 2013, together with Tokuyama's polycrystalline silicon plant which is also in operation now. The projected upcoming plant will be the OM Materials (Sarawak) Sdn Bhd Ferro alloy smelting plant, followed by Pertama's Ferro alloy smelter (Wong, 2014). Again, the projects, as stressed by "SCORE, will act as the catalyst for growth and development" and that they "will capitalize on the region's abundance of energy resources such as hydropower for the

development of energy-based industries to relatively cheaper-priced electricity".

The goal is to "transform Sarawak into a developed State" and to "significantly improve the socio-economic well-being of the people" (Bruno Manser Fonds, 2012). To date, the total investment for 15 approved projects in SCORE is approximately MYR 24.033 billion and they are expected to create 13,994 jobs. For instance, the forecasted number of manufacturing jobs in Samalaju Industrial Park based on 11 projects approved to date is 11,679. But now there are almost 11,188 construction workers of various nationalities in the park (Sarawak, 2014).

Current & on-going mega dams in the SCORE region

Sarawak has the Batang Ai dam which has already been in operation since early 1980s, as well as the most controversial dam the Bakun dam that has been operating since 2011. Besides that, SCORE also added 2 coal-fired power plants among the 18 mega dams as shown below which can probably generate nearly 9,400MW (Sovacool and Bulan, 2012).

Table-1. Hydropower and coal-fired plants potential in SCORE (Sovacool and Bulan, 2012).

Project	Rated Capacity (MW)	Cost (million RM)	Type	Reservoir Area (hectares)	Catchment Area (hectares)	Date of Commencement of Construction	Construction Time (months)
Batang Ai	108	1,278	Reservoir, Convex Concrete Faced Rock Filled	9,000	120,000	1981	52
Bakun	2,400	15,325	Reservoir, Straight Concrete Face Rock Filled	69,640	1,500,000	1994	132
Murum	944	3,500	Reservoir	24,500	275,000	2008	60
Belaga	230	800	Reservoir	-	-	2014	-
Pelagus	411	1,400	Reservoir	-	-	2015	-
Baram	1,212	5,000	Reservoir	-	-	2015	-
Limbang 1	45	400	Run of River	-	-	2018	-
Limbang 2	200	900	Reservoir	-	-	2018	-
Baleh	1,400	8,000	Reservoir	-	-	2019	-
Balingian	900	3,000	Coal-fired	-	-	2019	-
Merit	600	2,000	Coal-fired	-	-	2022	-
Punan Bah	130	390	Run of River	-	-	After 2022	-
Lawas	105	315	Reservoir	-	-	After 2022	-
Limbang 3	50	150	Reservoir	-	-	After 2022	-
Linau	290	870	Reservoir	-	-	After 2022	-
Tutoh	160	480	Reservoir	-	-	After 2022	-
Belapeh	140	420	Reservoir	-	-	After 2022	-
Ulu Ai	54	162	Reservoir	-	-	After 2022	-
Total	**9,379**	**44,390**					

CONCEPTUAL FRAMEWORK

As highlighted earlier, SCORE is viewed as a necessity for future development but, the SCORE execution process in this case might experience a certain degree of potential failure. In order to determine the sources of failure in this energy mega project, this article adopts the five dimensions of Sovacool and Cooper (2013) to evaluate this case. The five dimensions are namely, (i) Social (Governance), (ii) Technological (Systems), (iii) Democratic (Politics), (iv) Externalities (Economics & Ecology), (v) Risks Assessment (Accountability).

Social (Governance): Megaproject can fail from the social point of view because their size, construction difficulties, and complexity. Also, the involvement of numbers of stakeholders could trigger internal conflicts and fragmentation of the project execution.

Technological (Systems): The technological experts stated that megaproject could slump technologically. The more complicated the project has become, the more technical issue will occur such as delays, and cost overruns. Hence, it will increase the risk of the project execution.

Democratic (Politics): Megaproject could fail because they are secretive and undemocratic. This is because most of the on-going projects executions are likely fail to present its transparency, and it is still remained as 'closed system' without any public declaration.

Externality (Economics & Ecology): From the externality economics theory, the megaproject will fail because they allow firms to mobilize technology to shift externalities from themselves to society as a whole. The bigger the scale of the system, the more opportunity to externalize costs.

Risks Assessment (Accountability): The issue of overestimation from the megaprojects especially the perspectives of resources, benefits, and revenue could trigger execution failure, the reason being too skeptical towards its attraction to investors and the issues on environment is underestimated.

In this case, the author adopts Sovacool and Cooper's conceptual and methological choices and at the same time refer to their work for full explanation of the research design.

Social: The project could possible fail under various participation from other parties such as the Federal Government of Malaysia, State Government of Sarawak, Oversea Hydroelectric Companies and most importantly the Civil Society. This is because it faces fierce challenges and strong opposition from the civil society groups, such as the Environmental Protection Society of Malaysia (EPSM), the Consumer Association of Penang, and also the major NGOs like Worldwide Fund for Nature (previously the World Wildlife Fund for Nature), Conservation International, and the International Rivers Network. These organization planned blockades, wrote letters, and orchestrated protests across seven countries (including the United States and United Kingdom) (Sovacool and Cooper, 2013)

Technological: The underestimation of annual river flows, peak flows, the disregard of evidence of construction delays, and cost overruns have been some of the major fatal blows for SCORE so far. Also, SCORE is lacking in supporting infrastructure for dam's excavation and construction. Without basic infrastructure like highways to carry raw materials or extensive reliable electricity networks, it cost too much for Sarawak to build everything from scratch. Hence, the infrastructure and logistics issues that have haunted SCORE are immense. Meanwhile, each dam site is unique; all the suggested dams are located in rural areas far away from urban areas hence the construction and excavation challenges will likely occur (Sovacool and Cooper, 2013).

Democratic: The SCORE project inanugaration process always operated in 'closed system' where there is no open tender or competitive bidding session, so the project until today still remains secretive and undemocratic. As the first contract was awarded to Ekran Berhad under no bidding situation, the company later said they were no longer interested in this project after they logged the entire catchment area and made their profit. The government had no choice but to bail them out and look for another new company to take charge and eventually it 'dumped' it to Sime Darby. Furthermore, Sarawak Natural Resources and Environment Board manages the environmental impact assessment (EIAs) study and the EIA study commissioned for Bakun was not publicly announced. Next, it was reported that even the Sarawak police has been accused of 'sanctioning violence' against those that have tried to object to SCORE. (Sovacool and Cooper, 2013).

Externality: The controversial and delayed project – the Bakun dam – in this case with its enormous construction cost of 15,325 million (MYR), initially boasts of the world's longest (650km) undersea cable from Tanjung Parih to Tanjung Tenggara to transmit electricity to Peninsular Malaysia. The controversial submarine cable will be delivering another extra 2,000MW from Sarawak into Peninsular by 2021 (Kia Soong, 2009), (The Borneo Post, 2011). Although the submarine cable project was shelved, today there were reports saying that the government and companies still compensated for this underwater cable projects which is now forecast to have arrived at a hefty cost of MYR 21 billion (Kia Soong, 2009). See Figure-1 for submarine cable. Besides that, the total building costs for the dams as listed in Table-1 will be at MYR 44,390 million which is questionable on its economic cost and wastage.

The Bakun dam itself covers an area of 1.5 million hectares of catchment area and the reservoir area is approximately 70,000 hectares, which is the size of the Singapore nation. This act certainly will demolish 50 million cubic meters of biomass home, and put the survival of endangered species on the edge, affecting the lives of 6 rare fish species, 32 protected bird species, 6 protected mammals, and over 1,600 protected plants such as eagles, woodpeckers and herons, to name a few. (Sovacool and Bulan, 2012). The Murum dam with a reservoir area of 24,500 hectares and catchment area of 275,000 hectares will displace 1,000 people and release 3.84 million tons of carbon into the environment which can also threaten the survival and lives of over 300 types of endangered species, The primary source of methane and carbon emission decomposition comes from the rotting of vegetation as well as greenhouse gases released through diffusion as water is degassed through the turbines and spillway. (Sovacool and Bulan, 2012).

Risks assessment: The local communities, mainly Dayak such as the Kenyah, Kayan and Penan, among others are already being affected badly by the Sarawak's dam construction. They rely on hunting and food gathering to survive. Their relationship to the land builds up the core of their belief systems, traditions and culture (Bruno Manser Fonds, 2012). The Bakun dam itself has already displaced nearly 10,000 indigenous with a resettlement cost surpassing $248 million. A further 1,000 people are due to be displaced by the Murum dam as the dam construction was due for completion in 2014 (Moses, 2009). See Table-3 for details. Over-optimism is also causing major issue for SCORE as there is expectation that a lot of investors will invest into it. As of today, Rio Tinto has already pulled out from the SCORE investment and certainly there will be electricity surplus issue (Sarawak Report, 2012).

Figure-1. Undersea cable (Kia Soong, 2009).

Table-2. Native communities displaced by the Bakun hydroelectric project (Sovacool and Cooper, 2013).

Ethnic Group	Longhouses	Families	Population
Kenyah	4	1,024	4,708
Kayan	8	881	3,781
Lahanan	1	138	535
Ukit	1	74	104
Penan	1	24	104
Total	**15**	**2,141**	**9,232**

Malaysia's electricity usage, production & generation outlook

Malaysia uses a lot of energy. According to the World Bank, each Malaysian used 2,693kg of oil in 2008. In comparison, each Indonesian used only 870kg, Filipino 455kg and Chinese 1,598kg within the same year. As for electricity usage, on average every individual Malaysian used 3,667kWh (kilowatt hours) in 2008 (Choong, 2011). In the last 11 years, the total electricity generation increased about 72% and the Malaysia government predicts that electricity demand will continue to grow 3.1% on average every year through 2020.

Meanwhile the cost of power from coal is approximately 30% cheaper than gas in Southeast Asia, Also natural gas will increasingly have to be sourced from higher cost imports. (Zhu, 2013). The Malaysia's electricity generation and the share of production from the year of 2010 at 41% went up to nearly 50% in 2030. For hydropower, from the peak year in 2010 with a share of 9.4% declined to 6% in 2030. In this case, coal will still continue to be the fuel of choice on economic grounds for Malaysia rather than hydro in the coming years.

Table-3. Production Outlook (Tan *et al*., 2013).

Fuel by Type	Electricity Production (GWh)			Share of Electricity Production (%)		
	2005	2010	2030	2005	2010	2030
Coal	23,134	49,675	154,686	26.5	41.6	49.0
Oil	2,489	2855	3,107	2.9	2.4	1.0
Natural Gas	55,899	55,700	139,025	64.0	46.6	44.0
Hydro	5,784	11,245	18,166	6.6	9.4	6.0
Total	87,306	119,475	314,984	100.0	100.0	100.0

Malaysia's current and forecast electricity demand & total installed capacity outlook

Total installed generation capacity in 2012 was approximately 29.1 gigawatts (GW) which is equivalent to 29,100MW, and this means that the nation can power up to this number without suffering from electricity shortage (EIA, 2013) and the peak demand for 2012 was forecast at 15,826MW. From Table-4 which shows the forecast data for year 2015, 2020, 2025 and 2030, it shows interesting figures where the predicted peak demand would be only at 24,770MW in 2030. In short, the capacity that Malaysia installed in 2012 had fulfilled the potential to power the demand in 2030 (EIA, 2013).

Besides that, the power supply from SCORE in Sarawak to Peninsular underwater cable and the additional proposal on Sumatra – Peninsular Malaysia cable suggested that Malaysia will import another 600MW from Sumatra, Indonesia (TNB, 2009). Tenaga Nasional Bhd (TNB) is expected to take up the full cost of constructing the underwater cable across the Straits of Malacca for about MYR 1.2 billion. (Oxford Business Group, 2012)

In this condition, Malaysia will be having the coal or fuel to power the hefty installed capacity in 2012 (29,100MW) to meet the peak electricity demand in 2030.

Table-4. Growth & Peak Demand Outlook (Energy Commission, 2013).

Year	Sales GWh	Growth %	Generation GWh	Growth %	Peak Demand MW	Growth %
2015	108,167	3.7	118,420	3.3	17,671	3.2
2020	129,482	3.8	140,613	3.6	20,847	3.5
2025	141,188	2.1	155,462	2.0	22,900	1.8
2030	157,980	1.7	169,250	1.6	24,770	1.4

International standard for reserve margin and reserve margin in Malaysia

The definition of reserve margin as quoted by (EIA, 2012) is explained in term of reserve margin (capacity minus demand) divided by capacity, where the 'capacity' would be the expected maximum available supply and 'demand' is the expected peak demand.

(1)

$$\text{Reserve Margin \%} = \frac{\text{(Capacity - Demand)}}{\text{Capacity}} \times 100\%$$

According to (TNB, 2014), the usual case for international standard on reserve margin for certain country will be only at the level of 5-10%. But for Malaysia's reserve margin as calculated based on the previous part information, the calculation for 2012 would be the capacity (29,100MW) less demand (15,826MW) and divided by capacity (29,100MW). The result will be with 13,274MW as reserves margin (at about 45.6%) (Energy Commission, 2013). This is 35.6% higher than that of the international energy efficiency level reserve margin of 10%.

The full potential power capacity of SCORE and Sarawak's initial power demand with power surplus issue

With SCORE alone, it will have the full potential of generating about 20,000MW of power by 2030. (Sovacool and Bulan, 2012). Meanwhile, Sarawak's initial demand is forecast to go up to 1,450MW by 2020 and 1,950MW by 2025 (Wong, 2014). As in 2014, the current total installed capacity so far in Sarawak would be 2,010MW. By 2030, the power demand for Sarawak will increase from 1,950MW in 2025 to 2,000MW, and with an additional 6,000MW of power required from the customers in SCORE region alone, that would probably make up approximately a total of 8,000MW of power for the entire Sarawak in 2030 (Lim, 2014).

So, from the above data and by using calculation for reserve margin for Sarawak in 2030, it will be capacity (20,000MW) less demand (8,000MW) divided by capacity (20,000MW), Sarawak will have 12,000MW as reserve margin which is at the astonishing level of 60%. Table-1 shows that there are 18 dams that will power up to 9,379MW of power, which is sufficient to handle the demand in 2030. With these 18 dams, the international standard for reserve margin - capacity (9,379MW) less demand (8,000MW) divided by capacity (9,379MW) - stands at 14.7% rather than 60%.

DISCUSSION & FUTURE RESEARCH

From the SCORE exploitation towards Sarawak, whether Sarawak will still be in the position of eco, renewable energy, and energy efficient state in the future due to the dam's exploitation towards the environment, especially with the release of greenhouse gas emissions from rotting vegetation submerged underwater, remains unanswered together with the enormous reserve margin issue. In addition, the issue on whether the Sarawak – Peninsular Malaysia cable is in line with the entire electricity outlook will still remain questionable.

Furthermore, will Sarawak be still able to realize the energy efficient dream when most of its excessive hydropower stations are located in the state under the unfortunate situation whereby hydropower will not be the biggest power contributor, and creating unnecessary massive reserve? Furthermore, the previous part analysis has mentioned the power surplus issue and this could raise a complicated message to the public - Does Sarawak really need an enormous amount of power supply?

CONCLUSIONS

The SCORE was discussed within the context of the five dimensions of energy megaproject success as postulated by Sovacool and Cooper (2013) and its impact on Sarawak's power surplus issue (reserve margin). From the social dimension, the SCORE has triggered the awareness of the civil society which might create a massive barrier for its future construction. As for the technological dimension, the project was also involved in cost overrun issue such as the Bakun Dam issue, and difficulties from the aspects of logistics and infrastructure in Sarawak whereby it could delay the construction progress.

In addition, with evaluation from the democratic perspective, transparency still remained as one of the major concerns where the project inauguration was carried out secretly without any open tender or bidding, and also the EIA results were not declared publicly. Furthermore, from the externalities aspect, the underwater cable construction fee could be seen as one of the wastages where the government is still funding it, not forgetting the disastrous environmental damages in the SCORE region where flora and fauna around the area were destroyed. Lastly, from the perspective of risk assessment dimension, the SCORE is expected to affect the local communities within the region in terms of dislocation, relocation and resettlement which involved high social and compensation costs to Sarawak.

Furthermore, the priority for Malaysia so far has been to refocus into securing for more raw materials like natural gas and coal in order to match with the future power generation and domestic demand since hydropower is not a major source of power in the future for Malaysia and Sarawak, as we can see in Table-3.

Hence, the SCORE project has to contend with these issues associated with the five dimensions of megaproject success and future energy efficiency adjustment strategy in order to avoid a large volume of power surplus issue. The author is of the view that with the current development in Sarawak and in the light of the issues discussed above, the SCORE should probably discontinue part of the mega dam's construction in order to achieve the 14.7% reserve margin by focusing only the 18 dams construction as listed in Table-1 which can reduce the reserve margin gap closer to that of the international standard of 5-10% rather than a 60% reserve margin. This is to ensure the smooth process of transformation plan for Sarawak to become a better, safer, and more efficient renewable energy powerhouse in the future.

ACKNOWLEDGEMENTS

The author is using this opportunity to express his gratitude to Nilai University for the financial support given throughout this research. The author would also like to express warm thanks to Mr Ang Wen Loong for his guidance and invaluable constructive criticism and advice given during the research.

REFERENCES

[1] Bruno Manser Fonds. 2012. Sold down the river: How Sarawak dam plans compromise the future of Malaysia's indigenous peoples. http://www.stop-corruption-dams.org/resources/Sold_down_the_river_BMF_dams_report.pdf. Accessed 14 May 2014.

[2] Choong M.Y. 2011. Conserve energy and reduce costs. http://www.thestar.com.my/story/?file=%2F2011%2F9%2F20%2Flifefocus%2F9075953&sec=lifefocus. Accessed 5 March 2014.

[3] EIA. 2013. Country analysis brief overview – Malaysia. http://www.eia.gov/countries/country-data.cfm?fips=MY#elec. Accessed 23 April 2014.

[4] Energy Commission. 2013. Peninsular Malaysia electricity supply industry outlook 2013. http://www.st.gov.my/index.php/component/k2/item/561-peninsular-malaysia-electricity-supply-industry-outlook-2013.html. Accessed 25 August 2014.

[5] Kia Soong K. 2009. Bakun dam to be much worse than PKFZ scandal. http://www.malaysiakini.com/news/113340. Accessed 14 June 2014.

[6] Lim A. 2014. Sarawak's Power Play. The Borneo Post. http://www.theborneopost.com/2014/02/23/sarawaks-power-play/. Accessed 15 April 2015.

[7] Moses K. 2009. Power, profit, and pollution: dams and the uncertain future of Sarawak. http://news.mongabay.com/2009/0903-moses_sarawak_dams.html. Accessed 9 January 2015.

[8] Oxford Business Group. 2012. Power hungry: Efforts to attract more private investment into the electricity sector. The Report Malaysia 2012. http://www.oxfordbusinessgroup.com/analysis/power-hungry-efforts-attract-more-private-investment-electricity-sector. Accessed 30 March 2015.

[9] Puthankattil V. 2013. SCORE for Sarawak: Towards a developed state echelon. http://www.theborneopost.com/2013/06/30/checking-the-score-board/. Accessed 30 September 2014.

[10] Recoda. 2014. FDI tops US$8.5 billion. http://www.recoda.com.my/news-events/newsletter-article/fdi- tops-us8-5-billion/. Accessed 20 May 2014.

[11] Sarawak A. 2014. Transforming Sarawak through SCORE. http://www.newsarawaktribune.com/opinion/58/Transforming-Sarawak-through-SCORE/. Accessed 10 October 2014.

[12] Sarawak Report. 2012. Backing out of Bakun – Rio Tinto pulls out!. http://www.sarawakreport.org/2012/03/backing-out-of-bakun-rio-tinto-pulls-out/. Accessed 10 August 2014.

[13] Sovacool B.K. and Bulan L.C. 2012. Energy security and hydropower development in Malaysia: The drivers and challenges facing the Sarawak Corridor of Renewable Energy (SCORE). Renewable Energy, 40(1), pp. 113–129. doi:10.1016/j.renene.2011.09.032

[14] Sovacool B.K., Cooper C.J. 2013. The Governance of Energy Megaprojects: Politics, Hubris, and Energy Security. London: Edward Elgar. pp. 137-171.

[15] Tan C.S., Maragatham K. and Leong Y.P. 2013. Electricity energy outlook in Malaysia. IOP Conf. Series: Earth and Environmental Science, Vol. 16, 012126. Doi:10.1088/1755-1315/16/1/012126.

[16] The Borneo Post. (2011). TNB mulls sourcing electricity fromS'wak. http://www.theborneopost.com/2011/07/17/tnb-mulls-sourcing-electricity-from-s%E2%80%99wak/. Accessed 25 July 2014.

[17] TNB. 2009. Electrical power interconnection project between Sumatera, Indonesia and Peninsular Malaysia, http://www.tnb.com.my/highlights/2009/10/electrical-power-interconnection-project-between-sumatera-indonesia-and-peninsular-malaysia.html. Accessed 18 March 2014.

[18] TNB. 2014. Healhty reserve margin ensures power supply security. Focus Malaysia. http://www.tnb.com.my/newsclips/2014/01/healthy-reserve-margin-ensures-power-supply-security.html. Accessed 15 April 2015.

[19] Wong J. 2014. Sarawak Energy needs to raise generating capacity to 7,000 MW. http://www.thestar.com.my/Business/Business-News/2014/05/12/SEB-needs-to-raise-generating-capacity-to-7000-MW/. Accessed 27 December 2014.

[20] Zhu W. 2013. Coal to surpass gas in Southeast Asia power boom. http://www.bloomberg.com/news/2013-10-02/coal-to-surpass-gas-in-southeast-asia-power-use-boom-iea-says.html. Accessed 17 November 2014.