# Executive summary

## 1 TNB's tariff and rebalancing proposal

### 1.1 Key highlights of TNB's 2004 tariff and rebalancing proposal

Tariffs in Peninsular Malaysia have been frozen since 1997 at an average selling price of 23.5 sen/kWh. Although the costs including those related to fuel and power purchase have gone up substantially, in real terms (adjusted for inflation) TNB's tariff has fallen by almost 40 per cent. Also, while power tariffs in other countries viz. Thailand, Korea, Singapore have gone up during the same period, tariffs in Malaysia have remained unrevised, which has resulted in existing power tariffs in Malaysia becoming very low as compared to the countries in Asia Pacific region.

One of the key driving factors for the proposed tariff hike by TNB is the deteriorating financial ratios owing to the current rate of return (approx 4 per cent) earned being very low compared to its weighted average cost of capital (WACC), which is 8.52%. The key features of TNB's tariff proposal are summarized below:

- A tariff hike of 4.7 sen/kWh (with gas price remaining at RM 6.4 / mmbtu) along with the provision of an automatic pass through of fuel cost variations, in order to meet return on rate base equivalent to WACC of 8.5%.
- Limiting the applicability of the domestic tariff 'lifeline' band from 200 kWh to 100 kWh per month. The 0-100 kWh per month domestic consumption slab would have no tariff increase.
- Enhancement of TES (Thermal energy storage) – DSM (Demand side management) tariff by
  - Increasing discount during off-peak hours from 1 sen/kWh to 2 sen/kWh
  - Increasing seven years to lifetime of the plant
  - Introducing TES storage for lifetime of the plant
- Introduction of Low Voltage Peak and Off Peak tariff option for large Low Voltage customers for all categories provided they pay for metering costs.
- Reinstatement of re-connection fees to serve as deterrent measure for late payment
- Replacement of Special Industry Tariffs with inversely declining discount scheme.
- Revert back to 15 days payment period for settlement of electricity bill instead of the current 30 days.
- Automatic pass-through of uncontrollable costs and risks mainly fuel cost.

TNB has maintained that its proposed tariff would not have any adverse significant effect on domestic consumers as electricity forms very small component of household expenditure. Even lowering the 'lifeline' consumption to 100 kWh would not have any adverse effect, as there would be close to 1.27 million domestic consumers who would still benefit from this provision. In case of industrial sector, it claims that it would have some effect on energy intensive industries while marginally affecting the others. TNB has proposed tariffs considering category-wise cost of supply model. It has attempted to re-balance tariffs in line with the cost estimates arrived at through this modelling, thereby proposing tariffs that are cost reflective.

## 1.2 Technical and operational performance

**System losses:** The overall transmission and distribution losses are around 12.7% (FY2004).

**Reliability and Quality:** System reliability measured in terms of SAIDI (System Average Interruption Duration Index)[1] has improved significantly from 747.5 minutes in FY97 to 156.24 minutes in FY2004.

**High reserve margin:** At present TNB is operating at a reserve margin of 40 per cent, which is resulting into an annual operating cost of RM 600 million.

**Generation and power purchase:** The tariff proposal indicates an increasing level of investment being made by TNB for generation projects (up to the year 2004). The total of RM 15.8 billion has been invested in new plants since 1997. It is however stated that the capacity growth since 1994[2], has mainly been met by IPPs, so much so that IPPs contribute about 48% to the total generation capacity mix (FY 2003). The unit cost of generation from IPPs is 14.8 sen/kWh as against the 8.6 sen/kWh of TNB's own generation. This has enabled the IPPs to earn return to the tune of 12-13 per cent while TNB has not been able to earn more than 5 per cent.

## 1.3 Electricity demand

The electricity demand in Peninsular Malaysia has been increasing rapidly with increasing energy intensity i.e. the proportion of consumption to GDP. The trend in energy intensity shows a decline from 0.3 to 0.28 over the period 1990-1995 before increasing to 0.4 during the period 1995 to 1999. It has been viewed that rising energy intensity indicates inefficient usage of electricity, which is partially triggered due to under pricing of the service.

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1 The total outage time the average customer is without service
2 Inception of IPPs

As regards the consumption mix in Peninsular Malaysia, over 50% of the total consumption is on account of industrial usage followed by commercial and domestic usage. The yearly projections carried out by TNB for the period 2003 to 2015 result into a compounded annual growth rate (CAGR) of about 7.7 per cent.

## 1.4 Financial performance

TNB has maintained that its current rate of return on assets (4.3% in FY 2003) is far lower as compared to its WACC of 8.52 per cent indicating lower profitability. While computing WACC, it has assumed a capital structure of 65:35 as Debt Equity ratio with cost of debt pegged at 6.55 per cent and cost of equity at 12.91 per cent3. A snapshot of profit and loss statement of TNB over the last ten years is given in Table 1.1.

**Table 1.1:** Profit and loss statement of TNB    (all figures in RM million)

|  | 1990 | 1992 | 1995 | 1998 | 2001 | 2003 |
|---|---|---|---|---|---|---|
| Revenue | 3279 | 4276 | 6855 | 11536 | 13940 | 15496 |
| IPP payments | 0 | 0 | -1009 | -3841 | -4123 | -5223 |
| Other operating expenditure | -1591 | -2309 | -3203 | -4332 | -5468 | -5068 |
| HC Depreciation | -463 | -502 | -895 | -1413 | -1891 | -2235 |
| Operating surplus | 1225 | 1465 | 1748 | 1950 | 2458 | 2970 |
| Non operating income | 62 | 157 | 84 | 186 | 561 | 291 |
| FX gains (losses) | -124 | 61 | 213 | -3503 | 846 | -41 |
| Profit before interest & tax | 1163 | 1683 | 2045 | -1367 | 3865 | 3220 |
| Interest | -317 | -401 | -518 | -1624 | -1546 | -1579 |
| Less IDC capitalised | 4 | 122 | 109 | 373 | 424 | 354 |
| Tax | -230 | -264 | -383 | -241 | 9 | -601 |
| Dividends | -54 | -132 | -258 | -112 | -223 | -228 |
| Retained earnings | 566 | 1008 | 995 | -2971 | 2529 | 1166 |
|  |  |  |  |  |  |  |
| Financial ratios |  |  |  |  |  |  |
| Cash Interest cover | 5.32 | 4.91 | 5.10 | 2.07 | 2.81 | 3.30 |
| Interest coverage ratio | 3.67 | 4.20 | 3.95 | -0.84 | 2.50 | 2.04 |

Table 1.2 shows a snapshot of the various financial ratios (existing as well as projected) depicting TNB's performance under various scenarios:

**Table 1.2:** TNB's performance under various scenarios

| Financial year | Rate of return (%) | Debt service coverage | Self-financing ratio (%) | Gearing (%) | Income after Tax (RM million) |
|---|---|---|---|---|---|
| | | Scenario-1: Gas price @ RM 6.40 / mmbtu and no tariff increase | | | |
| FY 2003 | 5.50 | 1.85 | 58.30 | 183.50 | 1420.20 |
| FY 2006 | 3.80 | 1.13 | -7.80 | 172.60 | 1103.50 |

[3] Cost of equity considered as per Bloomberg Financial Review on TNB (September 2004).

| | | | | | |
|---|---|---|---|---|---|
| FY 2009 | 3.90 | 2.00 | 26.90 | 167.30 | 1456.70 |

<table>
<tr><td colspan="6" align="center">Scenario-2: Gas price @ RM 7.68 / mmbtu and no tariff increase</td></tr>
<tr><td>FY 2003</td><td>5.50</td><td>1.85</td><td>58.30</td><td>183.50</td><td>1420.20</td></tr>
<tr><td>FY 2006</td><td>2.60</td><td>0.97</td><td>-25.3</td><td>193.20</td><td>524.00</td></tr>
<tr><td>FY 2009</td><td>2.70</td><td>1.62</td><td>12.60</td><td>219.40</td><td>699.60</td></tr>
<tr><td colspan="6" align="center">Scenario-3: Gas price @ RM 6.40 / mmbtu and 4.7 sen/kWh tariff increase (return of 8.5%)</td></tr>
<tr><td>FY 2003</td><td>5.50</td><td>1.85</td><td>58.30</td><td>183.50</td><td>1420.20</td></tr>
<tr><td>FY 2004</td><td>4.30</td><td>1.51</td><td>31.00</td><td>213.00</td><td>557.90</td></tr>
<tr><td>FY 2005</td><td>9.60</td><td>3.49</td><td>103.00</td><td>169.20</td><td>4353.10</td></tr>
<tr><td>FY 2006</td><td>8.60</td><td>1.99</td><td>81.40</td><td>116.40</td><td>4054.30</td></tr>
<tr><td>FY 2007</td><td>8.60</td><td>1.74</td><td>73.90</td><td>89.40</td><td>4708.10</td></tr>
<tr><td>FY 2008</td><td>8.10</td><td>3.35</td><td>110.00</td><td>74.20</td><td>5118.20</td></tr>
<tr><td>FY 2009</td><td>7.90</td><td>4.03</td><td>89.20</td><td>61.00</td><td>5706.80</td></tr>
<tr><td colspan="6" align="center">Scenario-4: Gas price @ RM 7.68 / mmbtu and 5.64 sen/kWh tariff increase (return of 8.5%)</td></tr>
<tr><td>FY 2003</td><td>5.50</td><td>1.85</td><td>58.30</td><td>183.50</td><td>1420.20</td></tr>
<tr><td>FY 2006</td><td>8.50</td><td>1.99</td><td>81.00</td><td>116.50</td><td>4041.80</td></tr>
<tr><td>FY 2009</td><td>8.00</td><td>4.05</td><td>90.00</td><td>60.70</td><td>5774.60</td></tr>
</table>

# 2   Consultant's approach to tariff determination

## 2.1   Regulatory approach

The consultant has adopted Rate-of-Return (RoR) approach (also referred to as cost-plus regulation) for the purpose of evaluating the tariff proposal submitted by TNB. The main rationale for this approach is that the utility (electric supply company) is able to collect from its customers all its prudently incurred expenses plus a commercial return on its prudent investment.

Under this approach, the Aggregate Revenue Requirement (ARR) of the utility is calculated as the sum of return on rate base, operating expenses, depreciation and tax paid by the utility. This is indicated in the formula given below: -

ARR = (RB x WACC) + OE + DE + T

Where,
ARR is the aggregate revenue requirement
RB is the rate base of the utility
WACC is the post-tax weighted average cost of capital
OE is the operating expenses incurred by the utility
DE is the depreciation expense
T is the tax paid by the utility

The revenue from existing tariffs (at sales level of ensuing year) is then subtracted from the ARR obtained above to arrive at the revenue gap. The revenue gap is the measure of tariff increase required for the ensuing year. This is indicated in the formula given below: -

RG = ARR – RT (sales of ensuing year @ existing tariff)

Where,
RG is the revenue gap
RT is the revenue at existing tariffs

## 2.2 Aggregate Revenue Requirement

The approach adopted by the consultant to estimate various components of the ARR is discussed below.

### 2.2.1 Demand forecasting

The consultant has reviewed the methodology followed by TNB for forecasting the demand. It has been observed from the past data on forecasts that the accuracy of the methodology followed by TNB is in accordance with the international norms i.e. +/- 1 to 3% deviation for 1 to 3 years ahead. The main reason for the same being that TNB takes into account the effect of micro variables on the electricity demand for various consumer categories. Besides, the methodology adopted by TNB is verified by external agencies viz. the ADB, the World Bank from time to time. Given the high accuracy witnessed with respect to their past forecasts, the consultant has considered the TNB's proposed level of demand for estimating the energy requirement for FY 2006. Thus, the aggregate demand for FY 2006 as considered by the consultant is 81501 MU i.e. a growth rate of 8.89% over the previous year.

### 2.2.2 System losses

The total system losses as reported by TNB are 12.7% for FY 2004-05[4]. As the level of transmission and distribution losses depends on a number of factors, it is difficult to benchmark then with those prevailing in other countries. Notwithstanding, as per international experts, for overall system, 9 to 10% losses are considered suitable and 15 to 16% the maximum allowable[5]. For distribution part, 4 to 4.5% is considered satisfactory and 10% the maximum allowable. The consultant has considered a reduction of 0.5% for FY 2004-05 and FY 2005-06. Accordingly, the system losses for FY 2005-06 works out to be 11.7% (= 12.7%– 0.5%– 0.5%).

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[4] Based on the actual data for FY 04
[5] Source: Management stories on power distribution system losses; EDF

### 2.2.3 Energy requirement

Energy requirement for FY 2005-06 has been considered taking into account the demand forecast and the loss level estimated above. The same works out to be 92300 MU.

### 2.2.4 TNB's generation & quantum of power purchase

TNB maintains a high reserve margin of about 40%, thus at any given point of time there is a surplus power in the system. Scheduling of generating units to minimize the cost therefore becomes important.

The consultant has analysed plant-wise generation (along with the fuel used) for various TNB plants from FY 2001-02 to FY 2004-05. Significant variation has been observed in the plant load factor (utilization level) of each station from one year to another. Thus, for the purpose of estimating the plant wise availability for FY 2006, use of past trends in plant load factor would not have been appropriate.

A review of data for the past four years reveals that TNB's own generation forms approximately 53-54% of the total energy requirement in Peninsular Malaysia. The same trend has been assumed for FY 2005-06 as well. Accordingly, the TNB generation and quantum of power purchase works out to be 49104 MU and 43196 MU respectively for FY 2005-06.

### 2.2.5 Fuel cost

Fuel cost with regards to TNB's own generation for FY 2005-06 has been estimated considering the following: -

- Auxiliary consumption of TNB's plants
- Calorific values of the fuels used by TNB's plants
- Station heat rates, as provided by the Energy Commission and TNB
- Fuel prices considered at the level of those prevailing in FY 2005 (coal price of RM 195/metric tonne (approximately US$ 52) and gas price fixed at RM 6.4 mmbtu).

Based on the above parameters, the per unit cost of fuel for TNB works out to be 6.68 sen/kWh with aggregate amount of fuel cost estimated at RM 3278.42 million. As against this estimate, the proposed figure of TNB stands at RM 4070.80 million.

### 2.2.6 Power purchase cost

For the purpose of estimating the power purchase cost, the consultant has reviewed the existing PPAs that TNB has signed with various IPPs. The per unit cost for FY 2005 as per these PPAs works out to be 15.33 sen/kWh. The same has been assumed for determination of power purchase cost for FY 2006. Accordingly, the total cost on this account works out to be RM

6623.28 million. The proposed figure by TNB against this estimate is RM 6456.80 million.

### 2.2.7  Operational expenses

The operational expenses consist of the (i) staff costs, (ii) repair and maintenance (R&M) costs and (iii) administration and general (A&G) expenses.

As a first step, the audited values of staff costs, R&M and A&G expenses for the utility's operation in Peninsular Malaysia for FY 2004 were ascertained reviewing the accounts of TNB, SESB and LPL. For the purpose of estimation of the staff cost for FY 2006, CAGR of 5.6% over the last few years has been applied to the actual staff cost of FY 2004 for both FY 2005 and FY 2006. For estimating A&G expenses for FY 2006, an inflationary increase of 3.29% has been provided for FY 2005 and FY 2006.

In case of R&M expenses, it was observed that it forms about 1.11% of the gross fixed assets for FY 2004. The same percentage has therefore been used for estimating the R&M expense for FY 2006 given the gross fixed assets estimated for FY 2006.

Based on the above computations, the total operating expenses work out to be RM 3829.18 million as against RM 3856.4 million proposed by TNB. The table 2.1 below summarizes the total operating expenses for FY 2006.

**Table 2.1:** Total operating expenses for FY 2006

| Item | RM million |
|------|-----------|
| Staff costs | 1485.46 |
| Repair and maintenance expenses | 829.60 |
| Administration and general expenses | 1514.12 |
| **Total operating expenditure (RM million)** | **3829.18** |

### 2.2.8  Depreciation

The consultant has followed a straight line depreciation method for charging annual depreciation. Depreciation has been provided on all categories of assets excluding the cost of land. The weighted average depreciation rate has been calculated based on the acquisition costs of the assets and the depreciation rates (taking into account the useful life of various assets). The consultant has considered the historical cost of assets for calculation of depreciation while not considering the re-valuation of assets (in case of land) as part of the total asset base. This has been discussed in detail as part of the rate base. Table 2.2 shows the computation of the overall average depreciation rate for FY 2003-04.

**Table 2.2** Depreciation rate for Peninsular Malaysia

| Description | Unit | Group | SESB | LPL | Peninsular Malaysia |
|---|---|---|---|---|---|
| Depreciation charged during 2003-04 | RM million | 2611.00 | 83.25 | 66.03 | 2461.71 |
| Gross Fixed Assets (as at 01 Sep. 2003) | RM million | 61088.10 | 1469.64 | 1406.34 | 58212.10 |
| Depreciation Rate | % | | | | 4.23% |

A review of past trends reveal that the average depreciation rate does not vary much on year-to-year basis; hence depreciation rate for FY 2005-06 has been considered equivalent to 4.23%.

### 2.2.9 Weighted average cost of capital

As mentioned earlier, TNB has proposed a post-tax WACC of 8.5% to be allowed as return on rate-base. The break-up of the proposed WACC is mentioned as follows:

WACC = (65%*6.55%) * (1-0.06) + (35%*12.91%)

Where,
65% is the percentage of debt financing in the capital structure
6.55% is the effective cost of debt
6% is the rate of tax assumed by TNB
35% is the percentage of equity financing in the capital structure
12.91% is the cost of equity (Bloomberg's Financial Review)

### Consultant's approach to WACC

*Cost of debt*
A review of the existing debt profile of TNB covering the amount outstanding against and the interest rate being charged for each loan has been carried out by the consultant. The loans taken by Sabah Electricity Sdn. Berhad (SESB) and Liberty Power Limited (LPL) have not been considered, as these subsidiaries of TNB do not form part of its operations in Peninsular Malaysia. As part of this review, a currency-wise weighted average cost of each loan has been calculated. In the next step, a weighted average cost of the total debt raised by TNB has been estimated, which works out to be 5.41% as on July 31, 2005. As regards cost of debt for FY 2006, this has been arrived at in consultation with TNB and has been estimated at 5.7% for FY06.

*Cost of equity*
There are various approaches for estimation of cost of equity such as dividend growth model, capital asset pricing model, price earning ratio etc. However, capital asset pricing model (CAPM) is the most widely used approach for estimating the cost of equity by financial experts as well as the regulatory agencies. The consultant too has followed this approach for estimating the cost of equity of TNB. The CAPM formula for cost of equity is as follows:

Re = Rf + ß (Rm-Rf)
Where:
Re is the required return on equity
Rf is the risk free return
Rm-Rfis the market risk premium – the return on market index less the risk free return
ß is the equity beta for the company estimating the movement in stock price of the company w.r.t. the market index

The risk free return has been estimated taking into account the yield on Malaysian Government Securities (MGS). The term of MGS considered for calculation of risk free return is 10 year conforming the long-term nature of investments in the industry, and also because short-term rates are more volatile than long term rates. Further, simple average of the closing yield on 10-year MGS for the last 6 months has been considered for calculation of the risk free return. The risk free return so estimated is 4.243%.

As regards market return, composite Index of the Kuala Lumpur Stock Exchange has been chosen as the indicator. The methodology adopted is Systematic Investment Plan (SIP) approach applied on the historical data of the composite index. The investment period considered under this approach is three years. Table 2.3 below shows the market return as computed by the consultant.

**Table 2.3:** Return on KLSE Composite Index

| Year | Closing date | Composite Index | Investment amount | No. of units purchased at the prevailing index | Cash flows |
|------|------|------|------|------|------|
| 1 | 01/10/2002 | 644.99 | 1000 | 1.55 | -1000 |
| 2 | 01/10/2003 | 737.64 | 1000 | 1.36 | -1000 |
| 3 | 01/10/2004 | 853.93 | 1000 | 1.17 | -1000 |
| Total number of units (1.55+1.36+1.17) | | | | 4.08 | - |
| 4 | 30/09/2005 | 927.54 | - | - | - |
| Total value of the units at the end of investment period (4.08*927.54) | | | | | 3782 |
| Internal Rate of Return / Return on market index | | | | | 12.03% |

Considering return on composite index of 12.03% and risk free return of 4.243%, the market risk premium estimated is 7.8%.

For estimating the equity beta, the monthly return on TNB's stock has been regressed on the monthly return on composite index. The slope of the regression line fitted through this data represents the equity beta, which thereby has been estimated at 1.189.

Using 4.243% as risk free return, 7.8% as market-risk premium and equity beta of 1.189, the cost of equity works out to be 13.51%. The break up of the calculation is as follows:

Cost of Equity =  4.243% + (1.189*7.79%)
              =  13.51%

Using the CAPM approach, the cost of equity estimated by TNB is 16.17%.

### *WACC*

Using the debt: equity ratio of 66:34, corporate rate of tax of 28%, the cost of debt and the cost of equity as determined above; the post tax WACC of TNB has been arrived at 7.314%. The calculation is shown as below:

Post-tax WACC    = {66% x 5.71% (1-28%)} + {(1-66%) x 13.51%}
                 = 7.314%

The consultant has attempted to compare the WACC, as estimated above, with the ones derived by financial analysts such as Morgan Stanley, Goldman Sachs, Bloomberg etc. The key difference is the debt: equity ratio assumed by these analysts, which is resulting into higher estimates. The comparison is shown as below:

**Table 2.4:** Estimation of TNB's WACC by financial analysts

| Parameter | Morgan Stanley | Goldman Sachs | Bloomberg | TNB | TERI |
|---|---|---|---|---|---|
| Analysis horizon | 2006-12 | 2006-12 | - | 2005-09 | Existing |
| Gearing | 50.00% | 50.00% | 42.80% | 65% | 65.90% |
| Return on market portfolio | 14.50% | 11.30% | 12.30% | | 12.03% |
| Risk free rate | 6.00% | 5.00% | 3.70% | | 4.24% |
| TNB beta | 1 | 1 | 1.03 | | 1.189 |
| Cost of equity | 14.50% | 11.30% | 12.53% | 12.91% | 13.51% |
| Pre-tax cost of debt | 6.40% | 5.30% | 3.75% | 6.55% | 5.71% |
| Effective tax | 28.00% | 28.00% | 31.70% | 6% | 28% |
| Post tax cost of debt | 4.60% | 5.20% | | 6.16% | 4.11% |
| Post tax nominal WACC | 9.60% | 8.30% | 8.18% | 8.52% | 7.31% |

## 2.2.10  Rate base

There is no uniform approach for estimating the rate base on which WACC has to be applied to determine the return, which forms an integral component of the revenue requirement. For the purpose of determining the ratebase, the consultant has followed the historical cost standard, which involves valuation of assets at their original purchase price. This approach has been used extensively by regulatory agencies around the world. The consultant's approach vis-à-vis the one followed by TNB differed primarily on account of re-valuation of land and the amount of consumer deposits & contributions not been considered as part of the rate base. It is viewed that these as costs have not been incurred by TNB, it is not entitled to earn return on the same. The approach avoids double accounting, ensuring that consumers do not pay for capital works and then for assets again through tariff charged to them. For the purpose of estimating the rate base for FY 2006, the consultant has applied a rolled

forward approach wherein it has established the rate-base for FY 2004 taking into account the audited financial statements, which has then been rolled over considering net additions in the asset base and annual depreciation for FY 2005 and FY 2006. Table 2.5 illustrates the various components and their estimates considered by the consultant for arriving at the rate base of TNB for FY 2006.

**Table 2.5:** Rate Base-TNB's operations for Peninsular Malaysia

| S.No. | Parameter | Unit | FY 2005 | FY 2006 |
|---|---|---|---|---|
| 1 | Net Fixed Assets | RM million | 49217.8 | 50122.3 |
| 2 | Coal mining rights* | RM million | 312.2 | 312.2 |
| 3 | Associates* | RM million | 132.1 | 132.1 |
| 4 | Investments* | RM million | 100.5 | 100.5 |
|  | Net Fixed Assets incl. Coal mining rights, Associates and Investments | RM million | 49762.6 | 50667.1 |
| 5 | Capital Works-in-Progress | RM million | 2160.8 | 2988.4 |
| 6 | Working Capital | RM million | 4068.6 | 3879.8 |
| 7 | Consumer Deposit | RM million | -1798.4 | -1954.4 |
| 8 | Consumer capital contributions | RM million | -2228 | -2306 |
|  | Rate Base | RM million | **51965.6** | **53274.9** |

*Assumed to be constant for the year 2005 and 2006

## 2.2.11  Return on ratebase

Considering WACC of 7.314% and rate base of RM 53274.9 million, the return on rate base estimated for FY 2006 is RM 3896.27 million. This has been appropriately accounted for as part of the revenue requirement of TNB for FY 2006.

## 2.2.12  Interest on consumer deposits

As the total amount of consumer deposits has been deducted from the rate base, the interest liability on this account has been separately accounted for in the ARR. An average of the effective rates of interest being paid out by TNB in the past few years has been taken in order to estimate the cost on this account. The average rate of interest has been estimated at 4.73%, which has been considered to estimate the cost arising on this account during FY 2006.

## 2.2.13  Cost of tax

The tax liability proposed by TNB under the scenario of 8.5% return on rate base for the FY 2006 has been adjusted on pro rata basis for 7.314% return that is established by the consultant. Accordingly, the cost of tax estimated for FY 2006 is RM 498.70 million against the RM 579.6 million proposed by TNB.

### 2.2.14  Aggregate revenue requirement (ARR)

Taking into account the estimates arrived at against the various components in the foregoing description, the aggregate revenue requirement of TNB during the FY 2006 has been estimated at RM 21380.78 million. The break up of the estimate is given in Table 2.6.

**Table 2.6:** Break up of ARR (Proposed Vs Consultant's estimate)

| Item | RM million | |
|------|------------|---|
| | Proposed by TNB @ 8.5% RoRb and gas price @ RM 6.4 / mmbtu | Estimated by consultant @ 7.31% RoRb and gas price @ RM 6.4/mmbut |
| | RM million | RM million |
| Power purchase | 6456.80 | 6623.28 |
| Fuel cost (TNB generation) | 4070.80 | 3278.24 |
| Operating expenses | 3856.4 | 3829.18 |
| Depreciation | 2711.4 | 3166.40 |
| Post tax return on rate base | 5954.5 | 3896.27 |
| Interest on customer deposits | 0 | 88.72 |
| Tax | 579.6 | 498.70 |
| **ARR** | **23629.5** | **21380.78** |

### 2.2.15  Non-tariff income

The non-tariff income has been estimated in the same manner as the tax liability. The calculation is presented in Table 2.7.

**Table 2.7:** Non tariff Income for TNB operations for Peninsular Malaysia

| | | FY 2006 | |
|---|---|---------|---|
| | | TNB | Consultant |
| WACC | % | 8.50% | 7.314% |
| **Non Tariff Income** | **RM million** | **399.6** | **343.82** |

### 2.2.16  Net ARR

The Net ARR after deducting non-tariff income from the ARR is RM 21036.96 million. The break up of the estimate is shown in Table 2.8.

**Table 2.8:** Net ARR of TNB for FY 06

| | Proposed by TNB @ 8.5% RoRb and gas price @ RM 6.4 / mmbtu | Estimated by consultant @ 7.31% RoRb and gas price @ RM 6.4/mmbut |
|---|---|---|
| | RM million | RM million |
| ARR | 23629.5 | 21380.78 |
| Non tariff income | 399.6 | 343.82 |
| **Net ARR** | **23229.9** | **21036.96** |

## *2.3  Tariff hike*

### 2.3.1  Revenue at existing tariff

The revenue at existing tariffs has been arrived at by using the current levels of tariffs on the sales level estimated for the ensuing year (FY 2006), which works out to be RM 19220.51 million. This has been compared with the Net ARR to estimate the revenue gap during FY 2006.

### 2.3.2  Revenue gap and tariff increase

Revenue gap gives the quantum of tariff increase that is required to meet the Net ARR of the utility. For TNB, it has been estimated as follows: -

Revenue gap = ARR of TNB (for FY 2006) – Revenue at existing tariffs (at sales of FY 2006)

The consultant has estimated a revenue gap of RM 1816.45 million assuming 7.314% of return on rate base and gas price of RM 6.4/mmbtu. Against this, the revenue gap estimated by TNB is RM 4008.89 million assuming 8.5% return on rate base with gas price assumed at the same level.

The average tariff increase required to cover the revenue gap of RM 1816.45 million, as estimated by the consultant, is 9.45%. Against this, the tariff increase proposed by TNB is 20.8%.
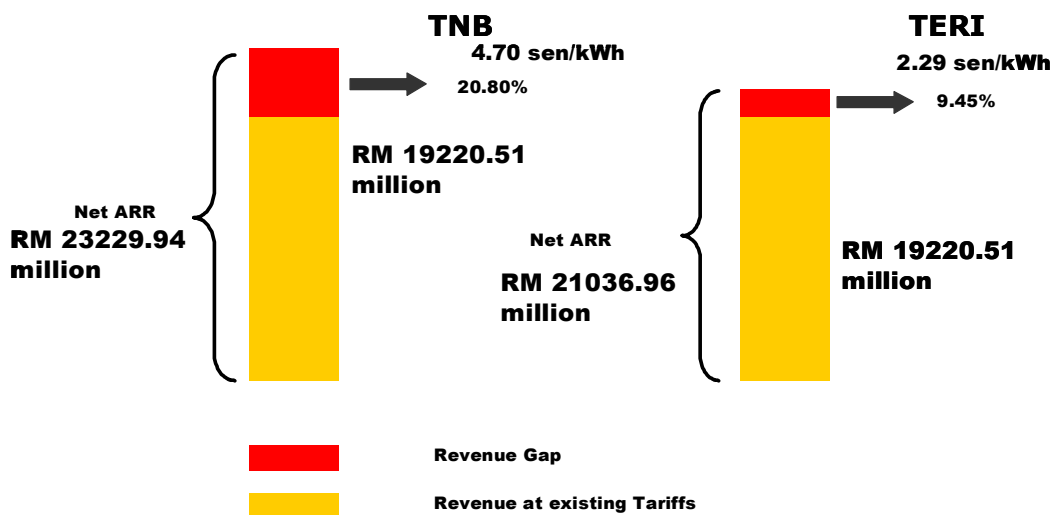


**Base Case Tariff Hike Scenario**

## *2.4 Tariff hike scenarios*

Given below are the different tariff hike scenario's depicting the tariff hike under various conditions

### 2.4.1 Scenario-I

This scenario corresponds to the following: -

(a) Weighted Average Cost of Capital (WACC) as derived by the Consultant equivalent to 7.31%;
(b) Cost of debt as derived by the Consultant equivalent to 5.70%;

The tariff increase required for bridging the revenue gap corresponding to different gas prices is summarized below:

**Table 2.9:** Tariff hike at different gas prices and RoRb@7.31%

| Description | Units | TNB @8.52 | Consultant (TERI) @7.31% RoRb | | | | |
|---|---|---|---|---|---|---|---|
| Gas price | RM / mmbtu | 6.4 | 6.4 | 7.4 | 8.4 | 9.4 | 10.4 |
| % Increase/(decrease) required | % | 20.86% | 9.45% | 10.57% | 11.69% | 12.81% | 13.93% |
| **Average tariff** | **sen/kWh** | **28.50** | **25.81** | **26.08** | **26.34** | **26.60** | **26.87** |
| **Hike** | **sen/kWh** | **4.70** | **2.29** | **2.55** | **2.82** | **3.08** | **3.34** |

### 2.4.2 Scenario-II

This scenario corresponds to WACC of 7.45%, which is arrived by assuming the cost of debt at 6%[6].

**Table 2.10:** Tariff hike at different gas prices and RoRb@7.45%

| Description | Units | TNB @8.52 | Consultant (TERI) @7.45% RoRb | | | | |
|---|---|---|---|---|---|---|---|
| Gas price | RM / mmbtu | 6.4 | 6.4 | 7.4 | 8.4 | 9.4 | 10.4 |
| % Increase/(decrease) required | % | 20.86% | 9.85% | 10.97% | 12.09% | 13.22% | 14.34% |
| **Average tariff** | **sen/kWh** | **28.50** | **25.91** | **26.17** | **26.44** | **26.70** | **26.96** |
| **Hike** | **sen/kWh** | **4.70** | **2.38** | **2.65** | **2.91** | **3.17** | **3.44** |

### 2.4.3 Scenario-III

This scenario corresponds to WACC of 7.71%, which is arrived by assuming the cost of debt at 6.55% (as per TNB proposal).

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[6] During the discussion with the Ministry of Energy, Water and Communication and TNB on December 19, 2005 it was requested that alternative tariff hike scenarios by changing the cost of debt to 6% should also be provided along with this report.

**Table 2.11:** Tariff hike at different gas prices and RoRb@7.71%

| Description | Units | TNB @8.52 | Consultant (TERI) @7.71% RoRb | | | | |
|---|---|---|---|---|---|---|---|
| Gas price | RM / mmbtu | 6.4 | 6.4 | 7.4 | 8.4 | 9.4 | 10.4 |
| % Increase/(decrease) required | % | 20.86% | 10.60% | 11.73% | 12.85% | 13.97% | 15.09% |
| **Average tariff** | **sen/kWh** | **28.50** | **26.08** | **26.35** | **26.61** | **26.88** | **27.14** |
| **Hike** | **sen/kWh** | **4.70** | **2.56** | **2.82** | **3.09** | **3.35** | **3.62** |

## 2.5   Conclusions

It is clear from Table 2.9 above that the increase required in the current average selling price of TNB to cover its cost of operation and of capital is approximately 9.45%. This is subject to the prevailing fuel price levels including the gas price, which has been considered @ RM6.4/mmbtu and weighted average cost of capital of 7.31 per cent.

The Consultant recommends the following:

(i) Keeping in view the volatility in fuel prices, and fuel and power purchase expenses forming close to 46% of the entire costs of the utility, the consultant proposes a two tier tariff structure for Peninsular Malaysia wherein the consumers shall be charged base tariffs as per the increase estimated above, and a fuel and power purchase cost adjustment, as and when there is an appreciable increase in the fuel prices.

(ii) Appropriate mechanism can be built in the regulatory system wherein the proposed fuel and power purchase cost adjustment by the utility can be passed through periodically after a due check of prudence by the regulating authority. The periodicity of this adjustment can be arrived at after due consultation with all the stakeholders.

(iii) Review of other operating costs including staff, repair and maintenance etc; and more importantly cost of capital including the debt equity structure of the utility to be carried out every three years so as to allow the necessary adjustments in tariff in line with the changes witnessed in these parameters.

(iv) Assessment of baseline T&D losses through an independent agency with appropriate bifurcation of technical and non-technical losses in future.

(v) Ministry to consider bringing down the currently high reserve margin inline with the international practices.

(vi) TNB to initiate renovation and modernization of its plants

## 2.6   Recommendation for tariff design

For designing the tariff structure, the Consultant recommends the followings:

**(i) Incentivise consumers for efficient usage of electricity**

From the review of proposed tariff schedule, it is observed that TNB offers incentives/penalty for efficient consumption, particularly to industrial consumers. Given the fact that industry forms more than half of the total consumption in Peninsular Malaysia, there is a compelling case for continuation of incentives/penalty for maintaining a healthy power factor. An efficiently design incentive/penalty structure could result in reduction of technical losses and thereby savings in energy.  This feature therefore should continue in the revised tariff structure as well.

**(ii) Introduce Reactive Energy charge (kVArh)**

The reactive energy consumption not only contributes to the losses in the transmission and distribution (T&D) lines but has other detrimental side effects also. It is responsible or blocking a significant portion of the generation, transmission and distribution capacities. It is also responsible for much wider voltage fluctuations that are harmful and frequently damage the electrical and electronics appliances.

We suggest that reactive energy charge based tariff should be introduced in the industrial category to begin with. During the initial period of 2 years, the new tariff can be introduced as an optional tariff system that would co-exist with the current tariff structures. During this period, it is ideal to restrict the application of the new tariff to the following two sub-categories (a) old connections, which need meter replacement, and (b) new connections in LV/HV and industrial category. The sites, which are identified for the new total energy tariff, be fitted with apparent energy meters. After the initial 2 years period, the apparent energy tariff can be made mandatory in high consumption LT categories such as LT industrial and commercial loads.

**(iii) Time of Use (ToU) tariffs**

TNB has extended ToU tariff as an alternative tariff option to LV residential (A1) and commercial (B1) consumers along with the normal tariff structure. LV residential and commercial accounts for nearly 39 per cent of total sales.  If cost of ToU metering is detrimental in its wide spread adoption particularly by LV consumers, the same can be provided through separate energy meters for certain applications such as electric storage water heaters during night time off-peak hours. The exact format of the TOU periods should be determined based on the analysis of how specific tariff and customer groups contribute to network peaks at particular times.

**(iv) Rebate for high load factor consumption**

Energy drawl closer to their contract demand improves the system load factor, thereby, reducing the technical losses in the system as well. This is particularly important for industrial consumers with high contract

demand. We suggest offering rebate to for consumption at high load factor by industrial consumers.

### (v) Rebate to energy intensive industries

This is a very innovative change proposed by the TNB as the incentives to a particular industry will decrease as return earned by those industries increase. It is therefore suggested the measure proposed by TNB should be adopted while deciding tariff structures for the next year.

### (vi) Encourage renewable energy based generation

Renewable energy is an environmentally benign source of producing power, and therefore, should be encourage in future. Therefore, proper analysis should be undertaken to identify the potential of renewable energy from various sources, its costing, and its inclusion into the existing generation mix.

## 3 Tariff structures, methodologies and revision process: International comparison

This section of the Consultant's report presents an in-depth comparison and analysis of various countries in the Asia Pacific Region in terms of their approach/methodology for tariff determination, process being followed in tariff setting, nature of regulation followed, existing tariff structures including innovative features promoting energy conservation, average consumer category-wise selling price, fuel mix etc. The countries selected for this study include Philippines, Hong Kong, Singapore, Thailand, Indonesia, Korea and Japan. Geographical proximity and foreign investment are considered as the two important criteria while selecting the countries for comparison.

The country-wise case studies have been used as inputs for tariff structuring, and innovative concepts being used for promoting energy conservation etc. while designing the consumer category-wise tariffs for Peninsular Malaysia currently under review by the Energy Commission.