

ENERGY ADVISORY COMMITTEE

Electricity Market Review: Return on Investment

The Issue

To review the different approaches in determining the return on investment in the electricity supply industry, and to consider possible options for the post-2008 electricity market in Hong Kong.

Background

2. **Return on investment** is the compensation that providers of capital require or expect, and is the opportunity cost foregone by tying up the capital so invested. In regulated electricity markets, return on investment is subject to regulatory oversight. In liberalised markets, whilst electricity tariff is largely determined by market force, usage charges (and hence the return on investment) for transmission and distribution networks, which remain as natural monopolies, are still under regulatory oversight.

3. In regulated electricity markets, and for the regulated services in liberalised markets, the target return on investment is usually determined by a permitted **rate of return** on the **rate base**. It has a direct bearing on tariff, as the latter is the source of a power company's revenue that generally includes the target return on investment and recovery of operating costs. Given this relationship, oversight of the setting of the rate of return and rate base thus represents a control mechanism to balance between a reasonable price to the consumers and a fair and attractive return to the investors that encourages continuous investments to maintain stable and reliable electricity supply. The control mechanism can be a traditional Rate-of-Return or Cost-of-Service regime that regulates the tariff through determination of an appropriate rate of return on a defined rate base, or a more complex Performance-based Ratemaking (PBR) regime that also includes incentive elements in addition to the rate regulation for power companies to achieve efficiency gains, service and quality improvements. Under the PBR regime, the focus will be shifted from cost monitoring to productivity analysis, and a number of incentive elements including bonus schemes for power companies to meet specific targets, sharing efficiency gains between power companies and consumers, etc. can be applied to the capped price or revenue.

Rate of Return

4. The **rate of return** can be determined by a number of approaches, which include: the General Approach, the Economic Approach and the Cost of Capital Approach. The General Approach recognises the need to provide a real growth on top of inflation to support further investment of the business. The Economic Approach employs the opportunity cost concept and recognises the need to provide a return that can be earned from an alternative investment. The Cost of Capital Approach determines a rate of return by systematically analysing the cost of equity and the cost of debt taking into account the risk-free return, the equity risk premium and the company-specific debt premium. — Details of the three approaches and their pros and cons are provided at Annex.

5. A fixed rate of return determined for use over a protracted period may at times be inappropriate to take account of changes in the economic environment. During a period of rapid inflation, for example, the fixed rate would appear to be inadequate to compensate investors for the capital they provide. On the other hand, during a period of recession, the fixed rate could mean excessive earnings to investors. Therefore, mechanism for review is another key factor in considering the rate of return for regulated power companies.

Rate Base

6. There are two basic approaches to determining the rate base – the Asset Base Approach and the Equity Base Approach.

Asset Base Approach

7. This approach uses the aggregate of **net fixed assets** as the rate base, thus linking the return with the value of the aggregated assets (return on asset or **ROA**). The aggregated asset value can be determined by the original costs of the assets less depreciation, or by the replacement costs of assets less depreciation.

8. It is rather common that working capital¹ is also included in the rate base as the power company may have on hand money, accounts receivable, etc. to meet current obligations. The rate base would then be the **net total asset**, i.e. the aggregate of net fixed assets and working capital.

9. The ROA approach provides an incentive for continued investment in assets as target return on such investments is assured. Given this linkage, regulation of the return on investment using the ROA approach implies that the power companies' capital expenditure on new and replacement assets is also under regulatory oversight to ensure proper investment.

Equity Base Approach

10. Alternatively, shareholders' funds (i.e. equity) can be used as the rate base to determine permitted return (return on equity or **ROE**). The usual arrangement under this approach is that, a sample of companies believed to be of comparable risk vis-a-vis the regulated utility will be selected, and each company's ROE, which is the ratio of book earnings to the book value of equity, will be calculated. The cost of equity for the regulated utility will then be set with reference to the ROE of these comparable-risk companies. However, the situation in Hong Kong is that it may be difficult to find a company of comparable risk or of the same nature and any choice may lead to an estimate regarded as too crude and arbitrary.

11. Using equity as the rate base has the disadvantage of not providing incentives for efficiency in financing, i.e. the regulated power companies may rely too heavily on equity financing and may not make use of cheaper sources of finance when the interest rate is low, hence leading to higher tariff. In regulated electricity markets, the ROE approach is not as commonly adopted as the ROA approach.

Overseas Practices

12. In the United States, the United Kingdom and Australia, the electricity supply industry was once dominated by vertically integrated power companies under regulated rates and services. Most of the electricity markets in these countries are now liberalised with competition introduced to the generation and the purchasing (wholesale or retail) sectors. The power grid,

¹ Working capital means current assets less current liabilities. Current assets include accounts receivable and cash at bank; whereas current liabilities mainly refer to accounts payable and bank borrowings.

i.e. transmission and distribution networks, remains regulated owing to its natural monopoly nature.

13. Most of the regulators in the United States adopt the Rate of Return (ROR) regime to regulate charges, which comprise all costs of service plus an appropriate return. The Cost of Capital Approach is usually applied to determine the rate of return, whereas the Asset Base Approach is commonly adopted to set the rate base although some regulators choose to apply the ROE Approach where it is deemed more appropriate. There is no fixed review period for setting the rate of return. Power companies or the regulator can initiate a review if the actual returns vary significantly from the permitted returns.

14. Regulators in the United Kingdom and Australia adopt the PBR regime whereby power companies are permitted to secure a share of the gains (profits) resulting from improvements in operating efficiency and improved productivity. To meet this objective, the regulator sets an initial price or revenue target (Price Cap or Revenue Cap) in a manner similar to that under rate of return regulatory regime. This target is normally derived using the Cost of Capital Approach to determine the rate of return, and the Asset Base Approach to determine the rate base. A package of incentives is then proposed to permit a power company to lower its costs relative to the baseline costs, in which case the savings realized are shared between the customers and the shareholders. Implementation of this approach hinges on quality control requirements that would avoid cost savings at the expense of system reliability and service quality.

Hong Kong Situation

15. The two power companies in Hong Kong are regulated via the Scheme of Control Agreements (SCAs). Return on investment permitted under the SCAs is essentially an ROA approach where fixed rates of return are applied to the average net fixed assets (ANFA). At present, a fixed rate of 13.5% is applied to ANFA and an additional 1.5% for that part of ANFA which is acquired by using shareholders' funds.

16. In the last interim review conducted in 1997/98, the SCAs were amended to provide a mechanism to discourage excess investment by not counting part of the cost of additional equipment that is deemed to be excessive in the average net fixed assets for the calculation of the permitted return.

Comparison with Overseas Markets

(I) Rate of Return

17. Hong Kong has a unique traditional electricity market: Power companies in Hong Kong are vertically integrated, investor-owned and they do not face any competition. On the other hand, compared to other liberalised overseas electricity markets, they are under less regulatory control.

18. Similar arrangements like Hong Kong's electricity market could not be found in the major overseas markets studied. There are only some power companies in certain states of the USA that are vertically integrated, investor-owned and that are still not facing retail competition.

19. Therefore, an accurate comparison of the rate of return of the power companies in Hong Kong with the power companies elsewhere on a like-with-like basis cannot be drawn.

(II) Relationship between Supply Reliability, Return on Investment and Tariff

20. Reliability targets that form the basis of the planning criteria have a direct bearing on the capital investment requirements. These targets are either established by the power companies, the regulator or jointly by both parties. Generally speaking, more investments on the power system infrastructure are required in order to achieve a higher reliability target.

21. Under a regulated environment, the investors would be allowed to earn a regulated return on their investments made in accordance with the regulatory regime adopted. In a Rate of Return regime, the target return will be directly proportional to the amount of capital investment expressed in terms of asset or equity. In the PBR type of regime, the target returns are also set based on the projected amount of capital investment though the actual returns varies depending on the performance of the power companies concerned. The target return would ultimately be reflected by the tariff and hence there is a linkage between reliability target, the amount of investment, target return and eventually the tariff.

22. Whilst the amount of investment is primarily driven by the reliability target, actual investments could be affected by the permitted rate of

return. If the rate of return is low, the power company may be reluctant to invest as it may find that return on investment is unattractive, compared to investing in other businesses. Additionally, investors may encounter difficulties or need to pay higher interests in financing infrastructure projects to meet the supply reliability target. On the other hand, if the permitted rate of return is high, the power company may find it very attractive to increase its investments to the extent of going beyond the minimally required level. It is therefore extremely important to have suitable regulatory and monitoring mechanisms to ensure that the amount of investment is appropriate.

23. In a liberalised market, it is rather common that a planning agent be assigned the responsibility of forecasting resource adequacy based on established reliability targets². It is generally expected that investors will respond to these forecast market signals and make investment decisions according to the perceived risks, projected energy pricing of the market, estimated return on investments, etc. Under such a mechanism, there are possibly more uncertainties on the adequacy of investments to ensure supply reliability as compared to a regulated market. Moreover, the relationship between the amount of investment and electricity tariff (and hence target return) will be loose as the latter is primarily market driven.

24. Based on the above, coupled with the fact that the generation mix (conventional thermal, hydro & pumped storage and nuclear etc) will affect the generation cost and thus tariff to a large extent, it is therefore impractical to make an accurate comparison of the return on investment/tariff against supply reliability in different places on a like-with-like basis.

Options for Hong Kong

25. The following options on return on investment may be considered for – (I) the entire supply chain if the electricity market in Hong Kong were to remain fully regulated, or (II) the regulated sectors of the supply chain if the electricity market in Hong Kong were to be liberalised with competition introduced to the generation and/or purchase sectors.

² These targets are usually set by a standard development authority or the market operator with consensus by the majority of the market participants.

(I) Regulated Market

26. The government and/or regulator needs to ensure that the regulated utilities are able to finance their operations and any required investment, so that they can continue to provide reliable electricity supply now and in the future. Consequently, their shareholders are able to earn a reasonable return that provides the incentive for continuous investments.

27. The regulated assets or shareholders' fund or equity can be used as a rate base on which to calculate the permitted return as discussed in paragraphs 6 to 11 above. Whilst the ROA rate base approach is a more commonly adopted option, either approach would seem appropriate for Hong Kong.

28. Regarding the determination of the rate of return, different approaches such as General, Economic and Cost of Capital as discussed in paragraphs 4 to 5 above and in Annex could be adopted. Among them, the Cost of Capital Approach is a more scientific approach. Using this approach, the rate of return can be more objectively determined and more easily demonstrated if increased transparency is to be promoted. Benchmarking with overseas markets' regulated rates of return would help to establish an appropriate range of rates of return for Hong Kong, which may be modified to suit local situation such as economic and social characteristics.

29. Consideration may be given to introducing incentive elements to the ROR regime to encourage improvements in operating efficiency and service performance. Essentially, this may be regarded as a PBR regime. Overseas experience has shown that the PBR regime, e.g. the CPI-X regime, has been applied primarily to the regulated services of liberalised electricity markets and other public utility businesses, but is much less commonly applied to the integrated service under traditional electricity market. Whilst in principle the PBR regime can be adopted to regulate returns and hence tariff charged by vertically integrated power companies, a number of economic, reliability and financial risk issues need to be carefully addressed. Additionally, owing to the increased monitoring requirement there will be increased administrative burden and governance costs. Regardless of the regulatory regime to be adopted, a review period that is short enough to allow for changes to reflect economic performance but long enough to encourage adequate investment should be considered.

(II) Liberalised Market

30. The objective of liberalised market is to allow market forces to determine the tariff based largely on a supply/demand mechanism. The rate of return on investments made in the competitive sectors becomes part and partial of the tariff, which is market determined and not regulated.

31. Even with competition introduced, the power grid, being a natural monopoly, will most likely remain to be regulated and hence suitable regulatory regime would continue to apply to this sector. Return on investments on the power grid may be regulated using the options indicated in paragraphs 26 to 29 above. These options may also apply to other regulated sectors such as the purchase sector if this part of the market is not yet liberalised.

Advice Sought

32. Members are invited to offer views on the issues and possible approaches to setting the return on investment for the post-2008 period having regard to the situation in Hong Kong, bearing in mind that the two power companies in Hong Kong are investor-owned.

Approaches to Determine the Rate of Return

(A) *General Approach*

Under this approach, the rate of return can be equated with the rate that is required to offset the effect of inflation and to provide a real growth for furthering the investment. When there is inflation, an investor will expect his investment to generate a return, which will at least preserve the real value of his capital. He will also look for a certain amount of real growth of his capital to be able to cope with business expansions or improvement. In this regard, every investor has his own desired rate of real growth, depending on the prevailing investment climate and the degree of risk he is prepared to take.

2. Though simple to understand, this approach however lacks objectivity and does not reflect the special characteristics of individual utilities.

(B) *Economic Approach*

3. This approach suggests that the rate of return should be equated with the return which the capital could earn from a similar investment. The rates of return of comparable utilities can be used as yardsticks for comparison.

4. This approach is again simple to understand and easy to apply. However, setting returns based on the performance of another business, which may not be totally the same in nature, can be criticized as too crude and arbitrary.

(C) *Cost of Capital Approach*

5. The level of return that is required by the market suppliers of capital in order to attract their funds to finance the assets of a company is called the Cost of Capital. Capital intensive companies usually raise capital through both debt and equity. The return required by the market for each of these two elements is likely to be different. The Cost of Capital approach suggests that the rate of return should be equated with the Weighted Average Cost of Capital (WACC), i.e. the weighted average of the costs of equity and debt. If the rate of return is lower than the WACC, shareholders will receive a return lower than that required by the market and the company will not be able to attract new funding. The WACC method is quite scientific. However, it can be argued that the rate of return is pre-fixed through negotiation or mutual agreement and

it is this rate of return that determines the cost of capital and not vice versa.

6. The formula of WACC and the methods of estimation of its components, namely, cost of equity and cost of debt are provided in Appendix.

(A) Formula of Weighted Average Cost of Capital (WACC)

The WACC (after tax) is defined as:

$$\text{WACC} = g \times (1 - T) \times r_d + (1 - g) \times r_e$$

where,

g	=	gearing = debt/ (debt + equity)
r_d	=	the cost of debt
r_e	=	the cost of equity; and
T	=	corporate tax rate

The cost of equity is an after-tax measure and the cost of debt is a before-tax measure. The formula for the WACC assumes that companies can tax-deduct interest payments at the corporate tax rate.

(B) Estimation of Cost of Equity

There are several methods to estimate the cost of equity. The most common method used by regulators in Australia and the United Kingdom is Capital Asset Pricing Model (CAPM). There is also a tendency for the regulators in the United States to use CAPM to estimate the cost of equity.

Capital Asset Pricing Model (CAPM)

The CAPM model defines the required returns on the equity of a company in the following way:

$$r_e = r_f + (r_m - r_f)$$

where,

r_e	=	the cost of equity
r_f	=	the risk-free rate of return
r_m	=	the rate of return for the market
$r_m - r_f$	=	equity risk premium, which is a proxy for expectations taken from historical experience, i.e. the excess returns investors

would have received from investing in the market over the historical risk free rates; and
= an index of the degree of movement of the company's return in response to a change in the market return

The CAPM links together non-diversifiable risk³ and return for assets. The non-diversifiable risk (i.e. risk premium) for any particular investment depends on the sensitivity of its return to movements in the market as a whole. This sensitivity is measured by the investment's beta factor (β). An investment with a beta of 1.0 has average market risk, while that with a beta of less than 1.0 has below-average market risk.

The CAPM relies primarily on historical data to calculate the risk premium (backward looking) and the choice of any particular historical period for use in providing the required input may appear to be arbitrary.

(C) Estimation of Cost of Debt

The cost of debt can be estimated by the following formula:

$$r_d = r_f + k$$

where,

r_d = the cost of debt
 r_f = the risk-free rate of return; and
 k = company-specific debt premium

The company-specific debt premium is driven by the credit ratings assigned by specialist credit rating agencies based on financial characteristics such as market capitalization, earnings volatility and business risks specific to the company.

³ The economic risk associated with an investment can be divided into two components: (i) non-diversifiable risk which reflects the volatility of the returns from an investment in response to changes in the state of the economy and the financial markets as a whole, e.g. inflation, war, international incidents and political events and (ii) diversifiable risk from events which uniquely affect the returns from a particular investment e.g. strikes, lawsuits and regulatory actions. Diversifiable risks can be eliminated by holding a well diversified portfolio of investments.