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Legislative Council Panel on Economic Services

Study of Interconnection and Competition in the Electricity Supply Sector in Hong Kong

Introduction

This paper briefs Members on key findings of a consultancy study of Interconnection and Competition in the Electricity Supply Sector in Hong Kong.

Background

2. Recognizing the global and regional trend and that a number of long term issues will need to be addressed in future, Government commissioned a consultancy in 1998 to conduct an independent Study of Interconnection and Competition in the Electricity Supply Sector in Hong Kong as a first step. The main objective was to establish whether additional interconnection between Hong Kong's two electricity supply companies and encouragement of competition in the electricity supply sector would be in the interests of consumers. The consultants were specifically asked to carry out the following tasks in the course of the Study-

Task 1: Assessment of the potential costs, benefits and other implications of increasing interconnection capacity between CLP Power Hong Kong Limited (CLP) and The Hongkong Electric Company, Limited (HEC).

Task 2: Assessment of the potential for competition in the electricity supply sector, evaluation of alternative market structures and identification of the optimal market structure.

3. The results of the Study reflect the independent findings of the consultants. The Final Report submitted by the consultants comprises over 160 pages and is written in English only because of the numerous technical terms involved. We have provided copies to the Legislative Council Secretariat for reference by Members. To facilitate Members' consideration of the matter, a copy of the Executive Summary (available in both Chinese and English) is attached at the **Annex** to this paper. The Final Report and the Executive Summary could also be accessed at the web site of the Economic Services Bureau at-

http://www.info.gov.hk/esb/new/index.htm

Consultants' Findings

Task 1 : Interconnection

4. Key findings are broadly set out below.

(a) There is an existing interconnector with limited capacity between CLP and HEC. Increased interconnection capacity is technically feasible, although there may be some logistical and timing constraints which need to be studied further.

(b) Increasing the capacity of interconnection has certain potential benefits. However, the benefits in Hong Kong compared to those enjoyed by other interconnected systems elsewhere, would be limited because of the similarities in the peak load profiles and generation plant types of the two power companies.

(c) Under the current Scheme of Control Agreements (SCAs), which run to 2008, the Government cannot require the utilities to take steps to construct increased interconnection capacity. Implementation of such a requirement before 2008 would therefore be difficult to arrange without voluntary acceptance by the utilities.

(d) Under the least cost scenario analysed by the consultants, whereby HEC and CLP systems were regarded as one system for the purpose of planning for additional generation capacity, constructing substantial additional CLP-HEC interconnection capacity would enable CLP generation capacity to be used to support the HEC service area. Compared to the base case which entails construction of additional generation capacity within the HEC system in the near term, this option would bring overall economic benefits equivalent to on average a reduction in tariffs of 0.4 cents/kWh in the period up to 2008. The economic benefits however would not be evenly distributed between customers of the two power companies. Compared to the base case, HEC tariffs would decrease whereas CLP tariffs would increase.

(e) There may be a risk that implementing increased interconnection between HEC and CLP, deferring construction of additional generation capacity and implementing joint plant dispatch in the near term - which would deliver economic benefits by reducing costs and hence tariffs under the SCA - may also have the effect of strengthening CLP and weakening HEC from the point of view of future introduction of competition, and may work against longer-term consumer interests. However, increased interconnection capacity will eventually be necessary for competition and technical reasons.

Task 2 : Competition

5. Key findings are broadly set out below.

6. There are several constraints in Hong Kong against the introduction of competition in the electricity supply industry in the short term. The key ones are -

(a) The SCAs, which are structured for regulating individual power utilities, are not compatible with the concept of competition. There will be virtually no scope for competition with the SCAs remaining as they are and with only two players in the market.

(b) The transfer capacity of the existing 132kV interconnectors is rather limited and therefore is not conducive to any meaningful competition between the two power companies. Installation of large capacity interconnectors is a pre-requisite for competition.

(c) Electricity supply from the Southern China network may be a potential source of economic electricity supply and may help bring additional competition to the Hong Kong electricity supply sector in future. However, until the electricity supply industry in the Mainland is restructured, the prospect of having major new entrants into the Hong Kong electricity supply sector will be rather limited.

7. The consultants have identified and assessed four types of possible market structure, namely Vertically Integrated model, Single Wholesale Purchaser model, Multiple Wholesale Purchasers model and Retail Competition model. Hong Kong currently has in place the Vertically Integrated model, whereby power companies undertake all activities, including generation, transmission, distribution and retailing, in distinct service areas. The consultants consider that, while consumer benefits may be realised from increasing the interconnection capacity and operating power pooling arrangements, such changes would not in themselves promote competition under this model. The other models identified envisage, inter alia, separation of the generation business from the transmission, distribution and retailing business, the operation of the transmission network by an independent system operator, procurement of new generation capacity through competitive tender and different degrees of competition at generation, wholesale or retail level or at more than one level.

8. The consultants' main finding in relation to the development of a more competitive market structure in Hong Kong is that no major reforms of the existing market structure are advisable until 2009 at the earliest since there is no real potential for introducing competition at the generation level before then. After that date, it would be possible to introduce competition between generation companies and at the wholesale levels (particularly if the electricity sector in Southern China has developed sufficiently to support participation by power producers located in that area) and eventually at the retail level.

9. The consultants consider that the introduction of competition will require some reorganisation of the present structure of the industry. Generation and transmission activities may have to be separated. Regulation in a form different to the SCAs would be needed for transmission, distribution and retailing activities. Different models could be introduced taking into account, inter alia, developments and industry structure in the Mainland. However, the consultants consider that the Single Wholesale Purchaser model, under which competition is introduced between sellers of electricity at the generation level, offers a common starting point for the different alternative paths.

Preliminary Views of the Energy Advisory Committee

10. The consultants' report and findings were put before the Energy Advisory Committee[1]. Its preliminary views are set out below-

(a) the Study is an important first step by Government in charting the future development of the electricity supply market in Hong Kong. The consultants have stated their views on how such development should proceed and the issues and constraints that will need to be addressed along the way. It is clear however that substantial additional work is needed to define in more detail the institutional and

[1] The Energy Advisory Committee advises the Government on energy policy matters. Its membership is drawn from fields relevant to energy supply, energy efficiency and conservation, environmental protection and consumer interests.

regulatory framework required to support the development of future market structure envisaged by the consultants and the transition path and time-frame. Although the existing SCAs will not expire until 2008, the Committee considers it highly desirable for the Government to map out the way forward early in order to enable interested parties to prepare for any changes that may be introduced.

(b) reliability of electricity supply is vital to Hong Kong's interests, and that due consideration must be given to the maintenance of reliable electricity supply when considering any major changes to the present transmission system and regulatory and market structure.

(c) whilst interconnection does not by itself bring about competition, it would facilitate competition particularly where there are multiple suppliers. The realization of the potential benefits of competition would however hinge on the establishment of a suitable transmission grid and supporting market and regulatory structure whereby competition in the supply of electricity can be introduced to Hong Kong with participation of multiple suppliers, including CLP, HEC and, in due course, electricity suppliers based in Southern China. The Committee believes that this should be the long-term objective.

(d) the environmental impacts of various long and short term options, including those arising from the different types of fuel used for electricity generation under different options, would need to be evaluated and taken into account when considering the way forward.

(e) the economic benefits[2] identified under the least cost scenario whereby joint planning by CLP and HEC as one

[2] The consultants have estimated that the economic benefits of the least cost scenario would translate on average across the two electricity companies into tariffs 0.4 cents/kWh less than those under the base case in the period up to 2008.

system involving increased interconnection are relatively small compared to the present tariffs[3] or the potential long-term benefits that may be brought about by increased competition under the scenario described in (c) above. It is important to consider the Study in context to ensure that discussion on the long-term development of increased interconnection and competition would not be disproportionately overshadowed by the pursuit of relatively small short-term benefits.

Way Forward

11. The consultants have made it clear that this is an initial feasibility study and have recommended further detailed studies in a number of areas. The Energy Advisory Committee has also pointed out that substantial additional work is needed to define in more detail the institutional and regulatory framework required to support the future market structure envisaged by the consultants and the transition path and time-frame. The Government will carefully examine the findings of the Study and conduct the necessary detailed studies with a view to mapping out a way forward that is in the best interest of Hong Kong.

12. Meanwhile, any views from Members and other interested parties are welcome.

Economic Services Bureau
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[3] According to the 1998 Annual Reports of CLP and HEC, the average net tariffs of CLP and HEC for the year 1998 were 89.48 cents/kWh (before a special rebate of 1.82 cents/kWh) and 90.30 cents/kWh respectively.

EXECUTIVE SUMMARY

1 OVERVIEW

1.1 Environmental Resources Management (ERM) was commissioned by the Government of the Hong Kong Special Administrative Region to undertake a study entitled: *Interconnection and Competition in the Hong Kong Electricity Supply Sector* (hereafter referred to as "this Study").

1.2 Hong Kong's electricity needs are served by two separate electricity utilities, each with vertically integrated generation-transmission-distribution-retailing operations: HEC and CLP(1), which have been serving Hong Kong since 1890 and 1901 respectively. The two Hong Kong utilities are connected by an interconnection which is now relatively small compared with the current size of the two systems. CLP is connected to Southern China by an interconnection of much larger capacity. The HEC-CLP interconnection has allowed for some economic benefits to be realised to date, but its usefulness may be limited to some extent by the risk of low frequency oscillations that has developed as the interconnected systems have grown.

1.3 The **objective** of this Study, as stated in the Terms of Reference, is to:

establish whether additional interconnection between Hong Kong's two electricity supply companies and encouragement of competition in the electricity sector would be in the interests of consumers. The Consultants [are] required to provide independent findings and recommendations sufficient to enable the Government to formulate a substantive response to public concern on these issues.

1.4 The Terms of Reference ask for answers to two main questions, under two tasks.

- **interconnection:** *assessment of the potential costs, benefits and other implications of increasing interconnection capacity between CLP and HEC;*

- **competition:** *assessment of the potential for competition in the electricity supply sector, evaluation of alternative market structures and identification of the optimal market structure.*

1.5 This is an initial feasibility Study: it does not include detailed, full-scope engineering analysis nor in-depth planning and design. However, the Study included a substantial portion of quantitative analysis — based on the development of several alternative resource planning scenarios — in order to provide an indication of the potential costs and benefits of increased HEC-CLP interconnection capacity.

(1) CLP has arrangements with several separate companies for the provision of electricity generation. For the purposes of the Scheme of Control Agreement and for this Study, they may be considered to operate as an integrated whole.

1.6 The **methodology and approach** adopted to answer the **interconnection** question, was to:

- assess technically possible alternative resource options for future generation and transmission that would meet Hong Kong's projected electricity demand, with a level of reliability greater than or equal to the level presently specified in the planning criteria;

- apply standard economic analysis techniques to assess the incremental costs of each set of options, such that comparison of each of the alternative additional interconnection options with the base case (namely, no additional interconnection) reveals the economic benefit of each option;

- apply the Scheme of Control accounting framework to the incremental costs of each option in a financial analysis to determine the incremental effect of each option on utility revenues (= customer bills), and hence customer tariffs; and

- assess any other technical and qualitative considerations for the various interconnection options, which are not directly related to the economic analysis.

1.7 The **methodology and approach** adopted to answer the **competition** question, was to:

- delineate alternative electricity sector market structures;

- evaluate qualitatively each of the market structures and their variations with respect to their applicability to Hong Kong against a specified set of criteria on system operation, procurement cost and the degree of regulatory oversight required; noting key characteristics of the electricity supply industry in other places that are comparable to Hong Kong and possible constraints on electricity sector competition locally; and

- assess alternative transition paths from the present structure to alternative structures and the timing constraints on the introduction of each particular market structure.

1.8 These two questions — on interconnection and competition — are interrelated. Inter-area transmission capacity is important to electricity competition, since it determines the upper limit for the nett transfer of electricity that can be bought and sold between the areas at any given time.

1.9 In addition, the two main questions are inevitably related to the following areas, consideration of which is not specifically included in the Terms of Reference, but which were considered within the "**other implications**" referred to in the first task:

- regulation of utility investment, operations, profits and tariffs under the present Scheme of Control Agreements between Government and each of the two utilities; and

- the present stage of the generation and transmission development investment cycle for each utility, and the consequent incremental costs for

subsequent generation siting, transmission connection and fuel supply costs for each utility.

1.10 Each of these considerations are very significant — they are at least as important, and arguably more important than the two direct questions on interconnection and competition addressed in this Study. They therefore need to be considered in conjunction with interconnection and competition in the overall decision-making process. However, these are higher level considerations — they set the context within which the technical and economic analysis of interconnection and the qualitative analysis of alternatives for competition are conducted. Therefore the Study necessarily considered them separately from the direct analysis of interconnection and competition.

1.11 The **Scheme of Control Agreements**, which were first agreed between CLP and Government in 1964 and between HEC and Government in 1979 were designed for the regulation of an individual, stand-alone, vertically integrated electricity utility. These are considered contractual agreements between Government and each utility. The current fifteen year agreements are due for a second five-year interim review in 2003 and are due to expire in 2008.

1.12 The stated intention of the agreements is to provide a stable framework to encourage investment while ensuring that customers receive a reliable and efficient supply of electricity at a reasonable price. The rate-of-return on fixed assets form of regulation is the means provided to achieve this end.

1.13 Under the agreements, the electricity companies recognise their continuing obligation to contribute to the development of Hong Kong by providing sufficient facilities to meet the present and future demand for electricity. In addition, the Government has to be assured that service to consumers is adequate to meet demand, reliable, efficient and of high quality, and is provided at the lowest cost which is reasonable in the light of financial and other considerations.

1.14 Under the **regulatory system**, the utilities propose future investments as part of a financial plan submitted to Government, which has the role of examining those plans to determine whether the inclusion of the proposed fixed assets in the fixed asset base may be approved.

1.15 There is nothing explicitly included in the regulatory framework to provide for joint consideration of least cost investments between the companies. There is no formal provision in the process which would allow Government actively to suggest or propose particular investments. However, this Study represents examination by Government of a particular type of investment option (increased interconnection). Furthermore, the two utilities have a co-operative Interconnection Agreement for the existing interconnection, which was originally developed with input from Government.

1.16 The utility profit level (or return) allowed under the Scheme of Control Agreements is a function of the fixed assets of each individual utility. It is possible that investment options that are least-cost for HEC-CLP overall can

involve asymmetric incremental asset additions between HEC and CLP. This situation would translate under the present Scheme of Control Agreements to a difference of investment incentive between the two utilities, or even an incentive for one and a disincentive for the other. Such asymmetric asset additions would also translate under the present Scheme of Control Agreements to asymmetric tariff impacts for consumers.

1.17 The incentive for each individual utility to maximise its own fixed assets is an inherent feature of regulatory systems of the type characterised by the Scheme of Control Agreements. It must therefore be observed at the outset that the present Scheme of Control Agreements do not fit naturally with the full pursuit of economic synergy between utility systems that may potentially be available from interconnection, because minimising the assets required to meet the electricity demand at the desired level of reliability is inherent in pursuing such synergy. The results of the Study summarised below make this clear.

2 INTERCONNECTION

General Considerations

2.1 Interconnection of the electricity networks of two neighbouring areas can provide a number of advantages, which may be realised as economic benefits depending on the way that the interconnected systems are planned and operated. Examples of the **potential sources of economic benefits** include:

- sharing reserve plant capacity to reduce the total amount that needs to be carried on the whole system;
- increasing the total interconnected load to allow the spinning reserve requirement (the spare capacity instantaneously available on the system) to be reduced;
- increasing the overall generation and transmission reliability by increasing the number of supply sources and supply paths for serving load;
- reducing the size of the peak load relative to the energy consumption, where peaks in separate areas occur at different times; and
- enabling greater operational flexibility on the system as a whole than is possible when operating the plants in the two areas separately, thereby allowing the generation fuel mix and/or the operating points of individual plants to be further optimised.

2.2 The existing HEC-CLP interconnection in Hong Kong has enabled some of these potential benefits to be realised to some extent. Some of these potential benefits are limited in Hong Kong: the peak loads in each area occur in the same season and at approximately the same time, the diversity of generation fuels and plant types is somewhat limited and contractual fuel and electricity purchase commitments to a large extent constrain the degree of flexibility in optimising outputs from the various generation plants.

2.3 However, further benefits may be available from increasing the HEC-CLP interconnection capacity. Increasing HEC-CLP interconnection capacity is considered technically feasible, although there are a number of technical and institutional constraints, which have implications for the level of certainty in meeting projected demand with sufficient reliability. These are further discussed below.

2.4 The potential additional benefits from increased interconnection were estimated by selecting a set of cases for increased interconnection and then developing these into broad generation/transmission planning scenarios by modelling the generation resources required in each scenario and quantifying the discounted present value of the investment stream in each scenario.

2.5 This quantitative analysis has an emphasis on the near-term time frame up to 2008, because reasonably detailed data is available on resource options and projected peak demands and energy consumption. While the quantitative analysis was extended into the medium- and long-term time frames, the issues then become broader as the possibilities for the introduction of competition open up and the question of the optimal long-term electricity market structure becomes more significant. These medium- and long-term issues are considered in the competition section.

Results of Analysis

2.6 The results of the quantitative **economic analysis** show that potential exists for overall economic benefits from substantially increased interconnection and joint generation expansion planning. These economic benefits to the Hong Kong economy overall up to 2008 are estimated to have a present value of some $347 million, using a real discount rate of 4% per annum. This is 5% of the present value incremental cost of relevant generation/transmission capital expenditure in the no increased interconnection scenario. It is noted that the assumptions underlying this estimate are both technically and economically conservative in a number of respects, and very unlikely to overestimate the potential economic benefits. Over the period up to 2018, it is estimated that the benefits would increase to $562 million and to $896 million up to 2028.

2.7 The economic benefits would translate on average across the two electricity companies into tariffs 0.40¢ /kWh less than those under the base case in the period up to 2008. However, the quantitative **financial and tariff analysis** shows that the tariff adjustments associated with the increased interconnection scenarios under the present Scheme of Control Agreements, given the present stage of generation development in each of the two utilities, would distribute the overall economic benefits asymmetrically between the two utilities and therefore also between customers of the two utilities in the near-term. In the period up to 2008 — the remaining period of the current Scheme of Control Agreements — HEC tariffs would *decrease* by 2.21¢ /kWh and CLP tariffs would *increase* by 0.35¢ /kWh, using a simple average of the in-year tariff effects across all customer types for illustrative purposes.

2.8 The *overall* economic benefits translate under the existing Scheme of Control Agreements to a commercial advantage for one utility (CLP) and a commercial disadvantage for the other utility (HEC). This finding has a corollary in the tariff impact results, where increased interconnection and joint generation expansion planning would result in customers in one utility (CLP) experiencing tariffs slightly higher than they would otherwise be and customers in the other utility (HEC) experiencing tariffs somewhat lower than they would otherwise be.

2.9 The quantitative **technical analysis** shows that such substantially increased interconnection would also benefit HEC by improving the dynamic stability of the system.

Implications of the Results

2.10 The potential economic benefits from increased interconnection would be due partly to the general synergy available from interconnecting electricity systems, whereby the economies of larger systems can be captured. But a large portion of the potential benefits would be due to the existence of low incremental cost generation expansion options at CLP. Increased interconnection capacity would mean that additional capacity can be provided most economically by CLP adding committed units to existing buildings and new units to existing land without the need to expand transmission capacity.

2.11 Such a scenario would require higher investment in (generation) assets in CLP and lower investment in (generation, transmission and associated) assets in HEC than would otherwise be the case. Therefore, capturing the economic benefits of increased interconnection strictly within the existing Scheme of Control arrangements — without making any adjustments to the accounting of costs and revenues *between* the two utilities — would improve the business position of CLP at the expense of HEC, the permitted return being proportional to fixed assets under the present Scheme of Control Agreements.

2.12 The overall system-wide economic benefits would flow through to overall consumer benefits. However — in a corollary of the previous point — if the existing Scheme of Control arrangements were followed completely and no adjustments were made to the accounting of costs and revenues *between* the two utilities, then these consumer benefits would not be evenly spread. CLP customers would experience a tariff slightly higher than they would otherwise have paid and HEC customers would experience a tariff somewhat lower than they would otherwise have paid.

Near-Term Constraints on and Risks of Increased Interconnection

2.13 The most **critical decision-point** for electricity system planning in Hong Kong is currently that associated with the expected need for additional capacity around 2004 to meet projected peak load growth in the HEC system with the necessary reserve plant to ensure the specified reliability level. At the time of

writing, the 2004 summer peak is some five years in the future. However, the lead times for constructing the resources to meet this projected load is such that the decision must be made by late 1999 or early 2000.

2.14 Broadly, there are **two alternatives** for meeting this projected load growth:

- the construction of additional generation capacity within the HEC system; or
- construction of substantial additional HEC-CLP interconnection capacity to allow the generation reliability criteria to be met with existing available CLP generation capacity.(2)

The first alternative has been formally proposed by HEC, consistent with the procedures under the Scheme of Control Agreements whereby each utility plans their own capacity to meet their customers' projected electricity demand. The second alternative would capture potential overall economic benefits by making maximum use of two already committed units at Black Point power station as well as substantial additional land and transmission capacity already available at that site. It would also be commercially beneficial for CLP by providing additional load which would bring forward the as-needed installation date for (already committed) combined cycle units 7 and 8 at Black Point.(3)

2.15 For the first alternative, the **necessary process** in respect of site selection and environmental impact assessment has already been completed. The steps that remain are regulatory approval in accordance with the Scheme of Control Agreement, tendering, detailed design and construction. For the second alternative, all of the steps prior to final approval of the timing of installation of generation units have been undertaken on the generation side. However, on the transmission side none of the steps beyond the initial conceptual outline of increased interconnection as described in this report have been undertaken.(4)

2.16 Therefore, both of the alternatives to meet the projected capacity requirements of the HEC system in 2004 would require substantial **lead time**. The construction of additional interconnection capacity would require lead time

(2) Under such a scenario, in the years immediately following 2004, the CLP plant would be used primarily as reserve generation capacity with energy transfers not necessary (although the opporturuty for using energy transfers to reduce system-wide fuel and operating costs may also be increased somewhat). However, in later years under this generation expansion scenario, some energy transfers to HEC would be required, at least during times of HEC peak load.

(3) CLP has contracts to purchase these two generation units, which were originally scheduled for installation in 2000 and 2001. All of the civil works and transmission connections for these units are already in place. Based on agreement with Government, the two units have been deferred by three years each to 2003 and 2004, with the possibility of further deferral to 2005 and 2006. The timing of the installation of these units in each interconnection case in the Study analysis was determined by the planning criteria and economic considerations from an overall system point of view, not by contractual considerations. However, it should be noted that CLP's agreement with Government under the Scheme of Control Agreement — on which they based their contracts with suppliers — is legally binding and any attempt to alter these agreements would have compensation implications.

(4) The necessary steps would include: the detailed specification of cross-harbour sub-marine cable routes, landing points, land routes and associated sub-station facilities, official approval for these infrastructure plans and engineering design as well as tendering and construction.

for planning, approval, design and construction. As this is a proposed option arising from this Study, none of these steps beyond the conceptual outline have been initiated. The construction of additional generation capacity would require time for site formation, submarine cable laying, submarine gas pipe construction, civil works and electrical and mechanical generation plant installation. The decision as to which option should be adopted to meet the 2004 demand requires consideration in a number of areas, in particular engineering constraints and project timing. These considerations are beyond the scope of this feasibility Study.

2.17 Furthermore, the increased interconnection alternative would require decisions and agreement by all parties involved for **adjustment or modification of the Scheme of Control Agreements and the Interconnector Agreement** before the project could be taken forward. In addition, pursuing the potential economic benefits identified under the large interconnection scenario would at the very least require a number of quite significant changes to the Interconnection Agreement between HEC and CLP. Increased use of interconnection to realise potential economic benefits as described in this Study does not fall within the scope of the Scheme of Control Agreements as they have been applied to date in Hong Kong. It is therefore likely that a number of significant changes to the Scheme of Control Agreements would be required to facilitate such increased use of interconnection. Such changes would almost certainly need to be more substantial in a qualitative and a quantitative sense than those embodied in the Supplemental Agreements that emerged from the 1998 interim review of the Scheme of Control Agreements.(5)

2.18 Therefore, **capturing the set of potential economic benefits** from increased interconnection — as analysed in the scenarios in this Study — would be contingent on being able to complete all of the planning and approval steps. These steps would include obtaining the necessary approvals from the relevant Government authorities and allowing time for construction of a second, larger capacity HEC-CLP interconnector before the deadline of the summer 2004 peak load. However, even if HEC-CLP interconnection capacity is not increased prior to 2004, such that the generation scenario is not implemented as analysed, a number of benefits from interconnection would still be available once the interconnection capacity is increased; including increased supply reliability, reduction of the risk of low-frequency oscillations and facilitation of the future introduction of competition.

Key Conclusions on Interconnection

2.19 It is considered technically feasible to increase **interconnection capacity** between HEC and CLP. Benefits in Hong Kong are limited by the similarities of peak time and generation plant types between the two systems, but overall economic benefits from increased interconnection could be realised by jointly planning generation expansion to share reserve plant capacity. Additional

(5) These supplemental agreements were signed by the parties on 6 May 1999.

potential benefits from optimising plant operation between the two systems are considered to be small.

2.20 Under the existing Scheme of Control Agreements, the **overall economic benefits** from increased interconnection would be distributed unevenly between the two electricity companies and their customers, since the investment in generation and transmission assets would be distributed asymmetrically. In general, it is observed that there is a clear disjunction between realising potential economic benefits from the combined utility systems and the financial incentives arising from both the form of regulation under the existing Scheme of Control framework, and its separate application to individual utilities. In the near-term, a scenario that seeks to realise the maximum overall potential economic benefits would further exacerbate this effect, because it would require more fixed assets to be added to one company than the other.

2.21 To be certain of meeting the projected 2004 HEC summer peak load with the required level of reliability, the **adjustments or modifications to the Scheme of Control Agreements and the Interconnection Agreement** necessary for the additional interconnection option would need to be completed by the end of 1999 or early 2000. While this may be theoretically possible, it seems very unlikely that it could be accomplished in practice. The ability of the system to meet the 2004 HEC peak load with the desired level of reliability would be contingent on resolution of these complexities within a very short time-frame. The critical decision-point is set by the longer of the two lead times to provide either increased interconnection or additional generation capacity within HEC to meet the 2004 peak load. When this point is reached, a decision will need to be made one way or the other to ensure reliability of supply is not compromised.

3 COMPETITION

3.1 The Study considered the **present situation** in Hong Kong, characterised by:

- two separate, vertically integrated, Government-regulated, privately-owned electricity companies — HEC and CLP — which have been and are at present the only electricity suppliers in their respective regions;
- a small interconnection between HEC and CLP;
- a large interconnection between CLP and Southern China; and
- import of some of Hong Kong's electricity requirements from generation plant in Southern China.

3.2 It is considered that it would be necessary to increase the HEC-CLP interconnection capacity to facilitate the suitable operation of **future electricity sector competition** in Hong Kong.

3.3 To examine the potential for the introduction of competition, the Study considered three broad possible **alternatives to the present market structure** of two separate, vertically integrated suppliers. These alternatives were:

- the introduction of competition between sellers at the generation level, with competitive procurement of new generation capacity managed by an independent third party (such as a Government regulator) and the establishment of an Independent System Operator to manage the day-to-day dispatch of electricity from power plants; referred to as the Single Wholesale Purchaser market structure;

- the addition of large buyers as direct participants in the competitive market, including both the energy retailing part of companies in the electricity supply business as well as large electricity consumers; referred to as Multiple Wholesale Purchasers (also known as wholesale competition in some countries); and

- the creation of a retail market to allow all electricity consumers to choose their supplier — whether the retail arm of a traditional utility or a company that simply buys on the wholesale market and sells on the retail market; referred to as full Wholesale and Retail Competition.

3.4 The qualitative **analysis of competitive market options for Hong Kong** found that it would be possible to introduce some competitive pressures in the medium-term and more extensive forms of competitive electricity markets after that. In fact several practical electricity sector competitive market development options are available to Government, involving transition between the three alternative structures described above.

3.5 Under the **Single Wholesale Purchaser** model, competitive tendering for new generation would be possible. Given the present load forecast and already committed units in one utility, generation introduced on such a basis would not be practical until after 2008, although the lead time for tender assessment and construction would require the process to begin several years before the generation capacity was required. The limited form of competition provided under this market structure could be left in place indefinitely or used as an intermediate stage in the development of more extensive electricity sector competition.

3.6 The **Multiple Wholesale Purchasers** market structure requires more than two competing generators to work. The Consultants conclude that practical opportunities do not exist *within Hong Kong* to introduce sufficient additional generation competitors for the effective operation of wholesale electricity competition. Therefore, the implementation of this market structure is contingent upon working with the electricity industry authorities in Southern China to implement a Hong Kong-Southern China competitive wholesale electricity market. Implementation of such a system is certainly not considered possible until after 2008, by which time the current Scheme of Control Agreements will have expired.

3.7 Full **Wholesale and Retail Competition** clearly entails wholesale competition (as under Multiple Wholesale Purchasers). It is possible, but not advisable to implement both wholesale and retail competition simultaneously. Therefore, implementation of full Wholesale and Retail Competition requires that

wholesale competition under Multiple Wholesale Purchasers be established first.

Key Conclusions on Competition

3.8 The various alternative competitive market structures offer policy-makers a reasonable **degree of flexibility**. Given the existing electricity industry structure in Hong Kong and the experience with the introduction of competition around the world, it is clearly advisable to implement electricity sector competition in stages, rather than moving to complete wholesale and retail competition all at once.

3.9 Government would need to monitor the **implementation of competition** carefully — particularly in the early years — and make any necessary adjustments to the market rules to ensure that the intended competitive pressures are functioning as intended. Those parts of the market that are not subject to genuine competitive pressures would need to remain under some form of regulation to protect the interests of consumers.

3.10 Experience elsewhere shows that wholesale competition is a pre-requisite for retail competition, but the reverse does not apply. It is therefore advisable to begin the implementation of competition at the wholesale end of the market, rather than the retail end. If a long-term policy of moving towards competition is chosen, then a number of **paths from one market structure to another** are possible. The Single Wholesale Purchaser market structure offers a common starting point in the most feasible of these alternative paths. This market structure could be implemented relatively smoothly after the expiry of the Scheme of Control Agreements in 2009, assuming that the necessary detailed planning work is undertaken in the intervening years.

4 SOUTHERN CHINA ELECTRICITY SECTOR

4.1 The **electricity sector in Southern China** is large — with over five times the installed capacity of Hong Kong — is already strongly interconnected with Hong Kong, is developing rapidly and is currently in the process of restructuring under the general process of the separation of government and enterprises occurring in mainland China.

4.2 Electricity generators in Southern China may provide a **future opportunity to establish a wholesale market** with a sufficient number of entities to ensure genuine competition. In addition, the capacity availability of the hydro-electric generation resources in Southern China follow the seasonal load characteristics of Hong Kong, so the potential may exist for economic benefits to be realised in a competitive wholesale market whereby there is a nett flow of electricity to Hong Kong in the summer and to Southern China in the winter.

Key Conclusions on Co-ordination with Southern China

4.3 The eventual inclusion in a future competitive Hong Kong electricity market of electricity generation companies in Southern China is considered necessary for the **establishment of genuine wholesale competition**, due to the practical limitations for sufficient competing entities to be located within Hong Kong. Such inclusion is likely to be possible in the future. It would first require a number of commercial, legal, technical and environmental issues to be agreed between the relevant parties.

4.4 Although Hong Kong is part of China, it has a separate legal and commercial system and its electricity system is at a more advanced stage of development. Nevertheless, the appropriate co-operative **relationships between Hong Kong and Southern China** should be established in the short term. A broad review (but with more detail than was possible in this feasibility Study) of the technical, commercial legal and regulatory requirements for a Hong Kong-Southern China competitive wholesale electricity market should be undertaken. The general situation should be monitored and reviewed periodically.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 To identify the likely magnitude of *overall* economic and technical **potential benefits** from increased interconnection capacity and increased use of that capacity, the Study analysed electricity system planning scenarios under which the two electricity companies would use increased interconnection capacity to share reserve generation capacity by jointly planning system expansion. A scenario with increased interconnection capacity represents a technically possible way that projected electricity loads could be served with lower overall investment in generation and transmission assets than the base scenario, which involves no increase in interconnection capacity (and in which increase in the use of the existing interconnection capacity is not possible). Under the scenario that is most economically attractive, the increasing the interconnection capacity would defer the need for generation expansion in one area and result in an asymmetric distribution of new investment between the two areas.

5.2 However, for reasons associated with the historical development of the Hong Kong electricity supply sector, there are considerable **institutional barriers** to the realisation of such benefits, which may be summarised as follows.

5.3 Under the present Scheme of Control regulation, the potential economic benefits from increased interconnection would translate to **consumer benefits** — bills and tariffs would be lower than would otherwise be the case — *when averaged across HEC and CLP as a whole*.

5.4 However, under the two existing separate Scheme of Control Agreements, the **distribution of overall economic benefits** would be such that HEC customers would experience a lower tariff and CLP customers would experience a

slightly higher tariff than would otherwise be the case. The corollary of this outcome is that CLP would experience higher return and HEC a lower return than would otherwise be the case because of the asymmetric distribution of new assets between the two companies.

5.5 These institutional barriers arise due to the nature of the **Scheme of Control Agreements** that were originally developed under quite different conditions in the 1960s. The current agreements are due for review in 2003 and due to expire in 2008.

5.6 The potential economic benefits calculated are the result, in part, of applying standard incremental economic analysis to the **relative stages of generation capacity development** between the two Hong Kong utilities. Nevertheless, the report has identified that increased interconnection capacity in general is likely to deliver other types of benefits to Hong Kong.

5.7 The **broader set of potential benefits** include:

- resolution of low frequency inter-area oscillation problems;
- the opportunity to obtain a general increase in overall generation and transmission reliability that generally comes from strengthened interconnection between adjacent systems; and
- opening up the possibility for introduction of electricity sector competition with participants in both Hong Kong and Southern China in the long-to medium-term.

Those benefits would be available from the time that increased interconnection capacity was installed, and would not be as closely related to the generation expansion schedule as are the potential economic benefits.

5.8 The Consultants concluded that increasing the HEC-CLP **interconnection capacity** would be a necessary pre-condition for the introduction of generation-level competition in future.

5.9 Furthermore, the Consultants observed that two suppliers in a market will tend not to compete with one another. Therefore for the **successful functioning of future electricity sector competition** at any level, more competing generation companies would be required. The Hong Kong electricity system is relatively small and there are very few individual power stations. Generation competition within Hong Kong itself is therefore not likely to be practical within the foreseeable future.

5.10 The most promising opportunity for **introducing a sufficient number of competing generators** would be to introduce competition between generators in Hong Kong and those in Southern China. The electricity sector in Southern China is not currently in a position to participate in such a market. However, it is in the early phase of restructuring that could make such strategy possible in the medium- to long-term (post-2008). There are many detailed commercial, legal, technical and environmental aspects of such an approach which would need to be agreed between the relevant parties in Hong Kong and China.

5.11 Therefore, the Consultants' **major recommendation** is that Government immediately develop a long-term strategy for the Hong Kong electricity sector, that:

- describes the long-term goal for the industry structure;
- describes the transition path and planned time-line to move from the current structure to the long-term industry structure; and
- specifies the relationship between the time-line and external developments, over which Hong Kong does not have direct control — in particular in the Southern China electricity sector.

5.12 Such an **industry strategy** would:

- maintain a stable environment with an appropriate level of certainty for electricity consumers, utilities and investors;
- enable the industry to continue to plan development and allow for a smooth transition path from the current arrangements to the future structure; and
- ensure that Hong Kong's electricity needs are met at reasonable cost with the desired level of reliability.

5.13 In the **near-term**, an **assessment** needs to be made as to:

- the extent of adjustments or changes that would be required for the Scheme of Control Agreements to distribute the economic benefits of increased interconnection fairly between CLP and HEC consumers and to avoid providing a commercial advantage to one utility and a commercial disadvantage to the other utility;
- whether or not it is feasible for Government to reach consensus with both utilities on such adjustments or changes to the Scheme of Control Agreements within the time available before a decision is made on the resource plan to meet the projected HEC summer peak load in mid-2004;
- whether it is feasible to conduct a full-scope study of system stability under greater reliance on increased interconnection, obtain the relevant statutory approvals and design and construct a large increase in HEC-CLP interconnection capacity within the available time frame before summer 2004.

5.14 Government will need to decide on the best options for the **development of electricity supply sector resource planning** in Hong Kong for the short- medium- and long-term, based on the results of this assessment and taking into account all available information. The key decisions for the short-term involve the selection of a resource option to provide sufficient capacity to meet reliably the projected demand in the HEC supply area in 2004. If the overall, long-term goal for the industry structure outlined in the electricity sector strategy is to move towards the introduction of competition, then in the medium-term the initial steps to introducing a competitive market will need to be planned in more detail and discussions initiated between the relevant industry and Government parties in Hong Kong and Southern China.