

## The EC - ASEAN Business Facilitator

### National Energy Policy Review

Singapore



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# National Energy Policy Review

## Singapore

### Prepared by EC-ASEAN COGEN Programme (COGEN 3)

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## COGEN 3

Proven, Clean & Efficient Biomass, Coal, Gas Cogeneration

The objective of COGEN 3 is to promote the use of proven, clean and efficient cogeneration using biomass, coal or gas as fuel. This is achieved through partnership between ASEAN industries and European equipment suppliers.

The programme is co-ordinated in ASEAN by the Asian Institute of Technology (AIT), Bangkok, Thailand and in Europe by Carl Bro International, Sweden. COGEN 3 started its operation in January 2002 and will continue until December 2004.

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## **List of Abbreviations**

bbl/d	barrel per day.
Bcf	Billion Cubic Feet.
ENV	Ministry of Environment
EMA	Energy Market Authority of Singapore
FP	Forecasted Potential
GDP	Gross Domestic Product.
GWh	Giga Watt Hour.
IPP	Independent Power Producer.
Ktoe	kilo Ton of Oil Equivalent
MW	Mega Watt.
MMBTU	Million British thermal units
PES	Public Electricity Supplier.
SIBOR	Singapore Interbank Offered Rate
MMscf	million standard cubic feet
MRT	Mass Rapid Transit
SGP	Singapore Green Plan
TP	Total Potential

## **Executive Summary**

Singapore has embarked itself on a path towards promoting energy efficiency measures and has set up an agency under the Ministry of National Development to promote energy efficiency. Cogeneration is part of these energy efficiency policies and also finds itself mentioned in the guidelines and policy framework of the Singapore Green Plan 2012 (SGP 2012). The Inter-Agency Committee on Energy Efficiency (IACEE) was formed in 1997 with the objective of reviewing current energy usage and project future demand and supply, benchmarking of Singapore's energy consumption efficiency against other cities in the world and to establish energy related policies on energy demand and supply.

Aiming to promote energy efficiency, a National Energy Efficiency Committee was set up in 2001. The function of this committee is to spearhead programmes to encourage more efficient use of energy in industries, homes, commercial buildings and vehicles. Energy conservation features are being incorporated into new building and architecture designs including district cooling.

One of the major efforts undertaken by the Government of Singapore towards efficient energy management and remain competitive, has been the restructuring of the electricity and gas market. In order to reduce the carbon emission from power plants, Singapore is also gradually heading towards the use of combine cycle power plants that runs on natural gas rather than the conventional oil-fired power generation plant. The new plant would not emit sulphur dioxide and only emit negligible amount of particulate. The trends have also reached smaller power plants that generated electricity according to the needs of the company like ExxonMobil and SembCorp Cogeneration Pte Ltd (SembCorp Cogen).

About 19% and 3.5% of the total installed capacity of electricity generation are represented by the combined cycle plants (including Gas turbine plants) and Ministry of Environment's incinerator power plants. In line with this, Semb Corp Power is the dominant player in Singapore's cogeneration market. It owns and operates the first and largest IPP in Singapore with an installed capacity of 815 MW.

The Energy Market Authority Act, The Gas Act and The Electricity Act were enacted to enforce the liberalisation of the gas and the electricity market.

- The Energy Market Authority Act comprising of 5 parts was promulgated and enacted in year 2001 to address the issues related to promotion of fair and efficient market conduct and effective competition to eliminate any monopoly situation.
- The Gas act has been acted to create a competitive market framework for the gas industry, to make provisions for the safety, technical and economic regulation for transportation and retail of gas, and for other relating matters. This act comprises of seven parts.
- Comprising of eleven parts, the Electricity Act came into existence in 2001 to create a competitive market framework for the electricity industry including economic regulation of the generation, transmission, supply and use of electricity and for other related matters.

Singapore with its over capacity in electricity and energy reforms in place, is not a promising market for cogeneration projects. Solid waste management and to some extent newer power plants are expected to be potential cogeneration customers.

## **1. Introduction**

Singapore is one of the more highly industrialised and urbanised economies in the Southeast Asia region. Singapore being a small country with no natural resources has been developed under consistent and strict regulatory framework.

Singapore energy needs have grown in tandem with economic growth over the years. With the liberalisation of the energy market in electricity and gas sector and the formation of the Energy Market Authority (EMA) on 1 April 2001, there is a clear focus on energy conservation and efficient use.

As of September 2001, Singapore has a total electricity generation capacity of 7.29 GW, and the major generating companies are Senoko Power Ltd, Power Seraya Ltd, Tuas Power Ltd and SembCorp Cogen Pte Ltd. The direct use of diesel, petrol and liquid petroleum also contributes to the national energy consumption considerably. With the emphasis on cheaper and reliable fuel supply and environmental protection, use of natural gas is expected to play a major role in the energy market in due time.

Cogeneration is only indirectly supported in the Singapore Green Plan 2012 (SGP 2012) including Singapore's commitment to Sustainable Development and the National Energy Efficiency Committee is set up in 2001 promoting energy efficiency. The absorption of Independent Power Producers (IPP) to the national grid is being reviewed and the legislations are being formulated.

Apart from the legislation restrictions, the cost of investment for cogeneration is also discouraging the investors. Incentive programs and policies should be brought forward which would encourage the investors.

Inevitably and more securely, the energy sector of the country also tied with the strict regulatory framework, which could lead to discouraging newer technologies absorbed immediately to the existing energy industry. Therefore, although technologies used in cogeneration systems have proved to be energy efficient and leads for sustainable development, absorption of this technology to the countries' energy industry is considered to take some time.

In Singapore, the existing power plants are running with higher amount of reserve capacities, and this is a must for a nation like Singapore where the whole economy is energy incentive. But when there is higher reserve capacity, investment on the new energy efficient power plants are hard to come by making cogeneration option less attractive.

## 2. General Overview of the Energy Sector

Singapore, a highly developed and successful free-market economy, enjoys a remarkably open and corruption-free environment, stable prices, and one of the highest per capita GDPs in the world. Singapore is in the process of restructuring and privatising its electric power sector, which will see the transformation of a monopoly into a competitive market.

**Table 1.1: Economic Figures – compared to other ASEAN countries**

Countries	Purchasing power parity (PPP) \$	Real GDP Growth %		Per Capita PPP \$	GDP per Sector		
		2003	2004		Agriculture %	Industry %	Services %
Cambodia	18 billion	5.0	5.5	1500	50	15	35
Indonesia	663 billion	3.5	4.0	3100	17	41	42
Malaysia	210 billion	4.2	5.1	9300	12	40	48
Philippines	356 billion	4.0	4.5	4200	15	31	54
<b>Singapore</b>	<b>105 billion</b>	<b>2.2</b>	<b>4.2</b>	<b>24000</b>	<b>Negl</b>	<b>33</b>	<b>67</b>
Thailand	429 billion	5.2	5.5	6900	11	40	49
Vietnam	168 billion	6.9	7.1	2100	25	35	40

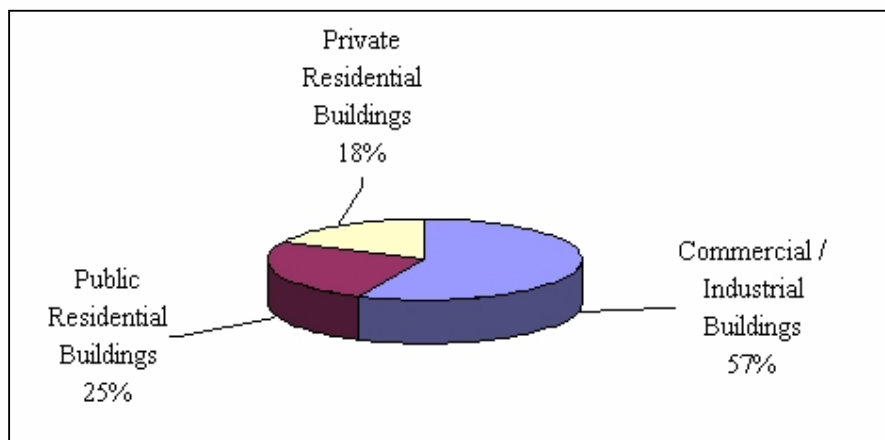
Source: Asian Development Bank and World Bank Yearly Report for Year 2002

In the midst of power sector deregulation, Singapore's energy industry is poised for competition among the established grid companies and with future licensed independent power producers. A generator producing more than 1 MW of Electricity Generation Capacity needs to obtain a license from Electricity Market Authority of Singapore.

The maximum electricity demand in Singapore is projected to increase at 5.7% per annum over the next 5 to 10 years. From a pool of 10 power generation facilities in Singapore, the total power produced is 8,495 MW. The fuels used are fuel oils, natural gas from Indonesia and Malaysia, diesel and also urban waste. Singapore is one of the major petroleum refining centres of Asia, with total crude oil refining capacity of nearly 1.3 million barrels per day (bbl/d). According to the Singaporean Statistical Information Services, the refinery business in Singapore comprised over 12% of its manufacturing sector in 2000.

### 2.1. Energy Statistics and Data

Energy consumption in Singapore can be attributed to three main sectors, namely industries, residential and commercial buildings and transport. Each of them is responsible for roughly one third of the total energy consumed in Singapore.



**Figure 2.1: Electricity Consumption within Building Sector**

**Table 2.1: Electricity Generation, Sales and Consumption- Year 1996 - 2001**

Year	1996	1997	1998	1999	2000	2001
<b>Electricity</b>						
Generation / (GWh)	23,458.4	26,118.1	28,283.2	29,520.1	31,665.0	33,088.5
Sales / (GWh)	21,906.1	24,627.8	26,072.9	27,082.5	29,173.3	29,653.4
Domestic / (GWh)	4,162.9	4,736.9	5,328.4	5,344.1	5,726.3	5,984.6
Manufacturing / (GWh)	9,659.1	10,946.5	11,117.1	11,655.6	12,009.6	11,821.6
Other Industries / (GWh)	8,084.0	8,944.5	9,627.4	10,082.8	11,437.5	11,847.3

Source: Statistics, EMA

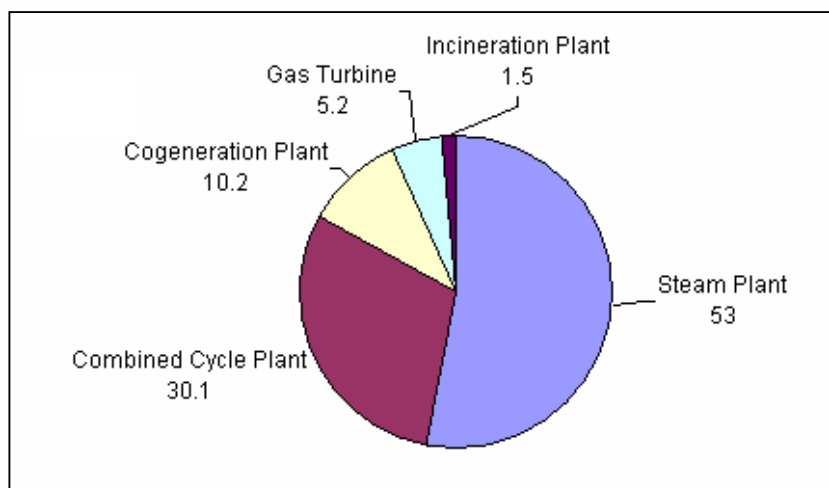
The contribution of natural gas in electricity generation is approximately 40% of total installed capacity. Approximately 2,600 MW of installed capacity is fuelled by natural gas with approximately 470 MW of installed capacity is dual fired, one of the fuel being natural gas.

## 2.2. The Electricity Supply Industry

A pool of 10 power generation facilities in Singapore covers the electricity demand of the country. The total installed capacity is 8,495 MW. The fuels used are fuel oils, natural gas from Indonesia and Malaysia, diesel and also urban waste. The combined efficiency of these facilities is approximately 40.38%.

There are four major Generation Companies in Singapore, namely Senoko Power Ltd., Power Seraya Ltd., Tuas Power Ltd. and SembCorp Cogen which is the latest entry to the market and the commercial operation started in July 2001. Senoko Power Ltd. owns Senoko Power Station and Pasir Panjang Power stations, of which the latest upgrade uses cogeneration technology for power generation using natural gas as the fuel. Power Seraya Ltd. owns Pulau Seraya Power Station and Jurong Power Station, of which the upgrade is a cogeneration plant having production capacity of 700 MW.

Combined Cycle plants (including Gas turbine plants) and Ministry of Environment's incinerator power plants represent about 19% and 3.5% of total generating capacity respectively. The total units generated for 2000 is about 31,000 GWh and the average installed plant factor is about 52%.



**Figure 2.2: Installed Generation Capacity by Plant Type as of March 2003(in %)**

As of Mar 2003, total installed generation capacity of system was 8,919 MW. It is sufficient to meet the minimum reserve margin and the maximum demand of 5,029 MW in first quarter of 2003. The maximum demand in the first quarter of 2003 was 2.9% higher than the maximum demand for the same period in 2002.

**Table 2.2: Power Generators in Singapore, 2002**

Company	Installed Capacity (MW)	Authorised Capacity (MW)	Permitted Expansion (MW)
Power Seraya	3,030	3,100	NA
Senoko Power	2,610	3,300	720
Tuas Power	1,935	2,670	735
SembCorp Cogen	785	900	115
Island Power Company	0	800	800
Singapore Syngas Pte. Ltd.	0	20	20
Exxon Mobil Asia Pacific Pte. Ltd.	0	180	180
Keppel Merlimau Cogen	0	470	470
Elba Eastern (Pte) Ltd.	0	50	50
National Environment Agency	135	250	115
<b>TOTAL</b>	<b>8,495</b>	<b>11,740</b>	<b>3,205</b>

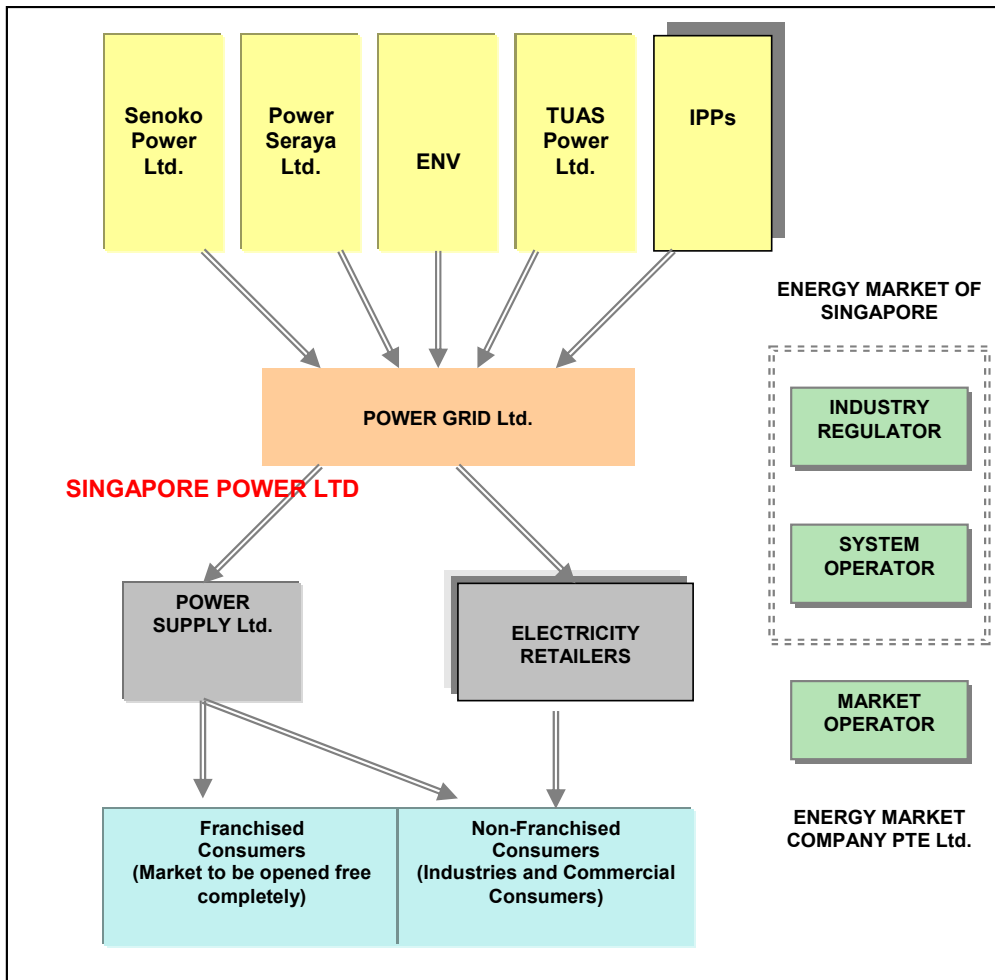


Figure 2.3: Existing Electricity Industry Structure.

### 2.3. Electricity and Fuel Tariff / Prices.

Table 2.3: Electricity Tariff in Singapore

Type of User/Seller	Tariff
<b>Low Tension</b>	
Residential	16.01 cents/kWh
Non Residential	16.01 cents/kWh
<b>High Tension</b>	
Peak period	12.44 cents/kWh
Off-peak period	07.66 cents/kWh
Contracted capacity charge	S\$ 9.01 / kW/month
Un contracted capacity charge	S\$ 13.51 / kW/month
Reactive Power charge	00.72 cents/kArh
<b>Extra High Tension</b>	
Peak period	11.62 cents/kWh
Off-peak period	07.21 cents/kWh
Contracted capacity charge	S\$06.97/kW/month
Un contracted capacity charge	S\$10.45/kW/month
Reactive Power charge	00.47 cents/kWh

Source: EMA-Singapore

The natural gas price for industrial usage in Singapore is US\$3.50 to 4.20 per MMBTU.

#### **2.4. Key Players in the Cogeneration Market**

SembCorp Power is the dominant player in Singapore's cogeneration market. It owns and operates SembCorp Cogen, the first privately developed independent power producer and largest cogeneration plant in Singapore. SembCorp Cogen is a 70/30 joint venture between SembCorp Utilities and Belgium's Tractebel. The 815-megawatt combined cycle co-generation plant produces both steam and electricity with an optimum output capacity of 650 megawatts of electricity and 550 tonnes of steam per hour. The plant comprises two gas turbines with dual fuel capacity and one condensing steam generator with extraction for the supply of steam.

### 3. Energy Sector Legislation Framework

The Government of Singapore has felt the need for the energy market to remain competitive which has resulted in the liberalisation of the gas and electricity market. In order to ensure that the liberalisation of the market is done in an orderly manner, legislations have been drawn up to protect the interest of all parties in the industry. These include the Energy Market Authority Act, The Gas Act and The Electricity Act which are discussed in detail in the following sections.

#### 3.1. The Energy Market Authority of Singapore Act

This Act was promulgated to establish and incorporate the Energy Market Authority of Singapore. It was incorporated in April 2001 comprising of five parts. The complete version of the Act could be found in Chapter 92B of Singapore Statutes.

Energy Market Authority Act part III section 6 list out the functions of the Authority, which include:

1. To create a market framework in respect of the supply of gas and electricity which promotes and maintains fair and efficient market conduct and effective competition or, in the absence of a competitive market, which prevents the misuse of monopoly or market power
2. To secure that all reasonable demands for the supply of electricity are satisfied
3. To promote the development of the electricity and gas industries
4. To protect the interests of consumers in respect of the quality of electricity supply, gas supply and district cooling services provided
5. To protect the interests of the public in respect of the supply and use of electricity and gas and the provision of district cooling services
6. To promote the efficient use of energy utilities
7. To exercise licensing and regulatory functions in respect of electricity, gas and district cooling systems and services, including the establishment of standards and codes relating to any matter in connection
8. To advise the Government on national needs, policies and strategies relating to energy utilities, and on matters appertaining to the Authority generally
9. To exercise any other functions and duties conferred on the Authority by or under any other written laws.

#### 3.2. The Gas Act

The Gas Act is drawn up to create a competitive market framework for the gas industry, to make provision for the safety, technical and economic regulation for transportation and retail of gas, and for other relating matters. There has been no date confirmed for the enforcement of the act as yet. The Act comprises of seven parts and the complete version of the act is listed under chapter 116A of Singapore's statutes.

In Part II of the Gas Act (Section 3 to 4), the obligations of the authority, who is given the right to administer the act, is laid out. Below are some of the functions and duties of the Authority as provided by the Gas Act:

1. To protect the interest of consumers with regard to-
  - a. The prices and other terms for the supply of gas
  - b. The reliability, availability and continuity of the supply of gas
  - c. The quality of gas supply services provided.
2. To protect the public from danger arising from production, processing, storage, conveyance, shipping, supply or use of gas.

3. To secure that gas licensees, whose prices are controlled by the Authority, are able to provide an efficient service and maintain financial viability.
4. To promote the efficient use of gas by consumers
5. To promote competition in the supply of natural gas
6. To perform the functions of economic, technical and safety regulator for the gas industry in Singapore
7. To advise the Government on all matters relating to the production, processing, storage, conveyance, shipping, supply or use of gas
8. To do such other things as are required under this Act and to take such steps as are necessary or expedient for the effective discharge of its functions and duties under this Act.

The Act also states that the Authority shall apply principles and methodologies to gas licensees who conduct a similar activity within a particular sector of the gas industry in a non-discriminatory manner and the Authority must act in reasonable manner in all circumstances.

Part III (Section 6 to 13) of the act related to licensing of activities relating to gas. In relation to prohibition on unauthorised activities relating to gas, it is stated that no person shall:

1. Convey gas
  - a. Through a gas pipeline or gas pipeline network to any premises; or
  - b. To a gas pipeline or pipeline network of a gas transporter.
2. Retail gas which has been so conveyed for use in any premises; or
3. Carry on such other activity relating to gas.

unless he is authorised to do so by a gas transporter's license or gas retailer's license. However, a person do not require a license to convey, in any premises or part thereof in which that person has an interest, gas supplied for use in the premises; or to sell, for use in any premises or part thereof in which that person has an interest, gas retailed for use in the premises by a gas retailer.

In section 7 (5), it is stated that the gas transporter's licence should not be granted to:

1. A person holding a gas retailer's licence
2. Any other person, if the grant of such licence may, in the opinion of the Authority, give rise to a conflict of interest in the discharge of any duty imposed on such person under this Act, the Electricity Act (Cap. 89A) or any licence issued to him under this section.

Likewise, under section 7 (6) it stated that the gas retailer's license should not be granted to:

1. A person holding a gas transporter's licence,
2. Any other person, if the grant of such licence may, in the opinion of the Authority, give rise to a conflict of interest in the discharge of any duty imposed on such person under this Act, the Electricity Act (Cap. 89A) or any licence issued to him under this section.

As such, it ensures that the gas transporter would not be involved in retail or supply of gas.

Conditions for obtaining the gas transporter's licence is as laid out in section 9 (3) of the Gas Act. It stated that the gas transporter's licence may include conditions that:

1. Requires the gas transporters to enter into an agreement with any person for-
  - a. The conveyance of gas through a gas pipeline or gas pipeline network of the gas transporters
  - b. Such other purposes as may be specified in the gas transporters' licence, on such terms as may be approved by the Authority.
2. Identifying specified agreements or classes of agreements which the gas transporters may only enter into on such terms as may be approved by the Authority
3. Pertaining to the transmission and distribution of gas
4. Requiring the gas transporters to have in place procedures to be followed in the event of a public emergency and requiring it to maintain a national gas emergency service for the gas supply system

5. Requiring the gas transporters to interconnect one or more gas pipelines or gas pipeline networks or to convert a gas pipeline network to allow for the conveyance of natural gas through that gas pipeline network
6. Pertaining to the prices to be charged by the gas transporters for use of the gas transporter's gas pipeline or gas pipeline network and the methods by which such charges are determined
7. Requiring the gas transporters to establish and maintain arrangements with respect to the provision of special services for meeting the needs of consumers who are chronically sick, disabled or elderly or as appear to the Authority to be requisite or expedient having regard to those duties.

Likewise, conditions for the gas retailer's licence are specified in section 9 (4), that the gas retailer's licence may include conditions:

1. Requiring the gas retailer to secure such rights for the conveyance of gas through a gas transporter's gas pipeline or gas pipeline network as are necessary for the purposes of complying with those obligations owed by it to consumers connected to such gas pipeline or gas pipeline network
2. Requiring the gas retailer to establish and maintain arrangements with respect to the provision of special services for meeting the needs of consumers who are chronically sick, disabled or elderly or as appear to the Authority to be requisite or expedient having regard to those duties
3. Requiring the gas retailer to act as a retailer of last resort in the event of the failure or default of another gas retailer
4. Pertaining to converting a gas pipeline network to allow for the conveyance of natural gas through a gas pipeline network
5. Pertaining to the prices to be charged by the gas retailer for the retailing of gas and the methods by which such charges are determined.

Part IV (Section 15 to 20) of the Gas Act gives the Authority the power to modify the conditions of the gas licence but could be done only if the Authority is satisfied that modification is a requisite or expedient having regard to the functions and duties of the Authority. The Authority also has the power to suspend or revoke the licence.

The duties and the responsibilities of a gas transporter are stated in Part V of the Gas Act. As extracted from the complete act, the duties of the gas transporter include:

1. To develop and maintain a safe, efficient, reliable and economical gas pipeline or gas pipeline network for the conveyance of gas
2. To connect to that gas pipeline or gas pipeline network, and convey gas by means of that gas pipeline or gas pipeline network to, any premises when requested and found economical to do so.
3. To carry on its licensed gas business at all times in such a manner so as not to prevent, restrict or otherwise hinder the development of competition in any gas market in Singapore
4. To avoid undue preference or undue discrimination, in the terms on which it undertakes the conveyance of gas by any gas pipeline or gas pipeline network owned and operated by him or in the connection of premises to such a gas pipeline or gas pipeline network.

As for the duties and responsibilities of a gas retailer, it is stated in Part VI (Section 21 to 36) of the Gas Act. Briefly summarised, the duties of the gas retailer include:

1. To develop and maintain a safe, efficient, reliable and economical service for the retailing of gas
2. To carry on its licensed gas business at all times in such manner so as not to prevent, restrict or otherwise hinder the development of competition in any gas market in Singapore.

Relating to competition in the gas industry, Part IX of the Gas Act stated against any agreements or means to prevent, restrict, distort competition. Agreements, decisions or concerted practice that:

1. Directly or indirectly fix purchase or selling prices or any other trading conditions of gas in Singapore

2. Limit or control production, markets, technical development or investment in the gas industry in Singapore
3. Share markets or sources of supply of gas in Singapore
4. Apply dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage
5. Make the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts
6. Provide for the acquisition, directly or indirectly, of shares in or the assets of a gas licensee.

are prohibited. This applies only if the agreement, decision or practice is, or is intended to be, implemented in Singapore. Also, any conduct on the part of one or more persons which amounts to the abuse of a dominant position in any gas market in Singapore is prohibited if it may affect trade within Singapore. These conducts include:

1. Directly or indirectly imposing unfair purchase or selling prices or other unfair trading conditions of gas in Singapore
2. Limiting production, markets or technical developments in the gas industry in Singapore to the prejudice of consumers
3. Applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage
4. Making the conclusion of contracts subject to acceptance by the other parties of supplementary obligations, which, by their nature or according to commercial usage, have no connection with the subject of the contracts.

The Authority may conduct an investigation when they suspect that any of the above has been infringed.

### **3.3. The Electricity Act**

The Electricity Act is drawn up to create a competitive market framework for the electricity industry, to make provision for the safety, technical and economic regulation of the generation, transmission, supply and use of electricity, and for other matters. The Act was put into operation first on 1st April 2001. Comprising of eleven parts, the complete Electricity Act can be found under Chapter 89A of the Singapore statutes.

The Authority charged with the general administration of the Act is the Energy Market Authority of Singapore established under the Energy Market of Singapore Act (Chapter 92B). The functions and duties of the Authority as stated by the Electricity Act include:

1. To protect the interest of the consumers with regards to
  - a. The prices charged and other terms for the supply of electricity
  - b. The reliability, availability and continuity of supply electricity
  - c. The quality of electricity services provided.
2. To promote
  - a. The efficient use of electricity by consumers
  - b. Economic efficiency and maintenance of such efficiency in the electricity industry.
3. To perform the functions of economic and technical regulator for the electricity industry, including the exercise of licensing and regulatory functions in respect of the generation, transmission, import, export, trading and retail of electricity, the provision of market support services, the operation of any wholesale electricity market and the establishment of standards of performance and codes of practice relating to any matter in connection.
4. To secure that electricity licensees whose prices are controlled by the Authority are able to provide an efficient service and maintain financial viability

5. To ensure security of supply of electricity to consumers and to arrange for the secure operation of the transmission system in accordance with the market rules or other codes of practice
6. To protect the public from dangers arising from the generation, transmission, supply or use of electricity
7. To create an economic regulatory framework in respect of the generation, transmission, import, export, trading and retail of electricity, the provision of market support services and the operation of any wholesale electricity market which
  - a. Promotes and safeguards competition and fair and efficient market conduct or, in the absence of a competitive market, prevents the misuse of monopoly or market power
  - b. Provides non-discriminatory access to any wholesale electricity market and to transmission services and market support services
8. To advise the Government on all matters relating to the generation, transmission, trading, retail and use of electricity, the provision of market support services and the operation of any wholesale electricity market.

It is also stated that when performing its function and exercising its power the Authority is required to

1. Use its reasonable endeavours to apply principles and methodologies to licensees who conduct similar activities within a particular sector of the electricity industry in a non-discriminatory manner
2. Act in a reasonable manner in all circumstances.

Part III (Section 6 to 27) of the Electricity Act relates to matters regarding issue of license for activities relating to electricity. Under section 9, it clearly states the different licenses that the Authority is given the rights to issue. These includes licenses for any person to generate electricity, transmit electricity, retail electricity, import or export electricity, provide any market support services, trade in any wholesale electricity market or operate any wholesale electricity market. It is also stated that transmission licensee or market support services licensee shall not be granted an electricity license to carry out any activity other than the transmission of electricity or the provision of market support services respectively. No electricity licensee who is authorised by his license to operate any wholesale electricity market shall be granted an electricity license to carry out any activity other than the operation of that market.

Conditions of the electricity licenses include:

1. Requiring the electricity licensee:
  - a. To enter into any agreement or arrangement on specified terms or on terms of a specified type relating to its trading or operation or for the connection to or use of any electric line or plant owned or operated by the electricity licensee or the other party to the agreement or arrangement
  - b. To observe, with such modification or exemption as may be approved by the Authority, specified codes of practice and the market rules
  - c. To prepare for approval by the Authority guidelines regarding the procedures the licensee must follow in the event of any public emergency.
2. Controlling or fixing prices to be charged for the services provided by a transmission licensee, a market support services licensee or an electricity licensee authorised to operate any wholesale electricity market including
  - a. The fixing of prices or the rate of increase or decrease in prices
  - b. The fixing of a maximum price or maximum rate of increase or minimum rate of decrease in the maximum price
  - c. The fixing of an average price or an average rate of increase or decrease in the average price
  - d. The setting of pricing policies or principles

- e. The setting of prices with reference to a general price index, the cost of production, a rate of return on assets employed or any specified factor
- f. The setting of prices with reference to the quantity, location, period or other specified factors relevant to the activities authorised by the licence.

Section 20 states a list of duties of the electricity licensees. As an electricity transmission licensee, it would be their duty to

1. To develop and maintain a reliable, efficient, coordinated and economical transmission system in accordance with such applicable codes of practice and other standards of performance as may be issued or approved by the Authority
2. To facilitate competition in the generation and sale of electricity by making its transmission system available to persons authorised to generate, trade or retail electricity or to provide market support services on terms which neither prevent nor restrict such competition
3. To provide non-discriminatory access to its transmission system for the supply and use of electricity in accordance with this Act, its transmission licence and the market rules.

As for the electricity retail licensee, it is their duty to develop and maintain a reliable, efficient, coordinated and economical electricity retail business in accordance with such applicable codes of practice and other standards of performance as may be issued or approved by the Authority.

Lastly, for the market support services licensees, it would be their duty to

1. To develop and maintain a reliable, efficient, coordinated and economical system for the provision of market support services in accordance with such applicable codes of practice and other standards of performance as may be issued or approved by the Authority
2. To facilitate competition in the retail of electricity by providing market support services to consumers and retail electricity licensees on terms which neither prevent nor restrict such competition
3. To provide non-discriminatory access to its market support services in order to facilitate retail competition in accordance with this Act, its market support services licence and the market rules.

A Market Company is recognised as the company which holds an electricity license authorising it to operate any wholesale electricity market. Part VI Section 43 of the Electricity Act lists the functions of the Market Company as below:

1. To operate and administer any wholesale electricity market specified in its licence
2. To schedule generating units, loads and the transmission system
3. To facilitate the planning and augmentation of the transmission system
4. To provide information and other services to facilitate decisions for investment and the use of resources in the electricity industry
5. To exercise and perform any other powers and duties assigned to the Market Company under this Act, its licence, the market rules and any code of practice.

Part VII (Section 50 to 63) of the Electricity Act prohibits any agreements, decisions or concerted practices by persons which have as their object or effect the prevention, restriction or distortion of competition in any wholesale electricity market or the retail electricity market in Singapore. The conditions for prohibition are similar to that found in the Gas Act above.

### **3.4. Programs Promoting Cogeneration and Renewable Energy Utilisation**

The Singapore Green Plan 2012 (SGP 2012) is an affirmation of Singapore's commitment to Sustainable Development, thus facing the challenge of sustaining quality environment while maintaining economic progress. The SGP 2012 is not the first of its kind in Singapore. The Green Plan in 1992 concentrated strengthening the performance in being Clean and Green. This

promotes the nation to be more environmentally conscious through resource conservation and clean technologies to protect the environment. The SGP 2012 aims to go beyond Clean and Green, with emphasis on the sustainability of the Singapore Development Progress. The nation is cultured to be more civic minded, learning to protect the environment as a personal responsibility. In addition, there is focus of greater innovation and collaboration with strategic partners in SGP 2012.

Relating SGP 2012 to supply and consumption of energy in Singapore, the concern is focused on ensuring clean air and reducing harmful substance found in commonly used forms of energy. Currently, with the strict enforcement of laws and regulation, Singapore is able to boast ambient air comparable to the best in the world as per the SGP 2012 publications. However, this situation would not last as the increase standard of living resulted in increase in air pollutants like cars, factories, homes and even personal gadgets. Therefore, the SGP 2012 is targeted at the upstream section to promote greater energy efficiency, cleaner fuel sources and cleaner technology.

The main contributors to air pollution are the power plants, crude oil refineries, heating and motor vehicle emission. Therefore, maintaining clean air would require focus on three particular areas: reducing energy consumption, pursuing cleaner energy and recovering energy. The approach adopted combines emission curtailment, constant monitoring of air quality, consumer education and active encouragement of clean technology. The aim is to maintain the Pollutant Standards Index to be within the 'good' range at least 85% of the time and within 'moderate' range for the remaining 15% of the time.

In order to promote energy efficiency, a National Energy Efficiency Committee was set up in 2001. The function of this committee is to spearhead programmes to encourage more efficient use of energy in industries, homes, commercial buildings and vehicles. Energy conservation features are being incorporated into new building and architecture designs. Energy efficiency benchmarks will be established for buildings like offices, hotel and public housings. If possible, fiscal incentive would be introduced to motivate the private sector towards greater energy efficiency. A labelling scheme will be introduced to help consumers make informed choices on energy efficient electrical appliances. To reduce fuel consumption, public transport would be enhanced further as an attractive alternative to private transportation. The mass rapid transit (MRT) route would undergo further extension to cover a larger part of Singapore. In order to reduce the carbon emission from power plants, Singapore is also gradually heading towards the use of combine cycle power plants that runs on natural gas rather than the conventional oil-fired power generation plant. The new plant would not emit sulphur dioxide and only emit negligible amount of particulate. The trends have also reached smaller power plants that generated electricity according to the needs of the company like ExxonMobil and SembCorp Cogeneration Pte Ltd (SembCorp Cogen).

To pursue cleaner energy, Singapore phased out leaded petrol in 1998. For diesel power vehicles, the permissible sulphur content in diesel is cut from 0.5% to 0.3% in 1996 and later further reduced to 0.05% in 1999. These are just some examples to show Singapore's progress towards more stringent emission standards. In January 2001, Singapore adopted the more stringent Euro II standards for both petrol and diesel driven vehicles. The search for cleaner burning fuel leads to plan to replace fuel oil with natural gas in power generation. The one of the targets in SGP is for 60% of Singapore's electricity needs to be met by natural gas in 2012. As for replacement of diesel powered vehicles to natural gas powered, trials are underway using public buses and taxis. If successful, the use of natural gas would be extended to other types of vehicles.

As for the plan to recycle energy, Singapore is embarking on an exciting project that aims to recover waste heat from the petrochemical plants on Jurong Island to power a centralised cooling system for the Jurong Industrial Estate. The project will probably take off in 2008 when it is assessed to be more economically viable. Once operational, the system could cut down 50 % from the Jurong Industrial Estate's operating bill for cooling. Current estimates are that Jurong Island now produces enough waste heat to power some 200,000 households, if only it could be harnessed. Capturing that heat and channelling it to good use would reduce the amount of carbon emitted into the atmosphere by 60,000 tonnes a year.

## **4. Conclusions**

## **5. Links and Other Sources of Information**

1. Electricity Market Authority of Singapore [www.ema.gov.sg](http://www.ema.gov.sg)
2. <http://www.ema.gov.sg/FILES/2003Q1.pdf>
3. World Energy Council Research and Publications.
4. Asian Development Bank Publications
5. UNDP Publications
6. ASEAN Centre for Energy
7. Presseae - [www.aseanenergy.org/presseae/](http://www.aseanenergy.org/presseae/)
8. [www.bp.com](http://www.bp.com) – World Energy statistics Database
9. World Bank Yearly Economic Output Publications.

## ANNEXES

### Annex 1: National Income

Year	Gross National Product (GNP) \$ M	Per Capita GNP \$	Gross National Saving \$ M	Gross Capital Formation \$ M	Gross Domestic Products \$M	Gross Fixed Capital Formation \$M
1991	75,325.6	24,021	34,181.6	25,750.7	71,183.4	24,469.2
1996	130,129.7	35,454	65,307.1	47,581.5	110,730	45,542.4
1997	149,450.4	39,394	81,045.5	54,137.2	120,191	49,937.8
1998	145,872.7	37,193	78,807.7	45,827.5	120,081	46,914.4
1999	143,507.2	36,323	72,672.1	44,659.7	128,405	45,056.1
2000	160,913.4	40,051	77,961.3	50,514.6	141,572	47,892.4
2001	154,644.5	37,433	69,292.3	37,248.5	138,683	45,675.9
Percentage of change over previous year						
1991	10.3	7.2	13.9	5.8	7.1	13.4
1996	72	3	5.4	16.4	7.7	23.1
1997	14.8	11.1	24.1	13.8	8.5	9.7
1998	-2.4	-5.6	-2.8	-15.3	-0.1	-6.1
1999	-1.6	-2.3	-7.8	-2.3	6.9	-4
2000	12.1	10.3	7.3	13.1	10.3	6.3
2001	-3.9	-6.5	-11.1	-26.3	-2	-4.6

## Annex 2. Wholesale petroleum prices set by oil refineries in Singapore

In US cents per US gallon (1 US barrel = 42 gallons)							
		BP	CALTEX	ESSO	MOBIL	SHELL	SPC
	Effective Date	20 Jun 02	30 May 02	13 Jun 02	13 Jun 02	14 Jun 02	1 Nov 02
1	LPG	110.00	110.00	110.00	110.00	110.00	115.00
2	NAPHTHA	0.00	0.00	64.00	64.00	64.00	70.00
3	GASOLINE						
	- 98 Unleaded	84.00	91.00	83.00	83.00	84.00	76.00
	- 98 0.15 g/l lead	0.00	0.00	80.00	80.00	81.50	0.00
	- 97 unleaded	80.00	83.00	79.00	79.0	80.00	72.00
	- 97 0.15	0.00	0.00	0.00	82.00	80.00	0.00
	- 95 Unleaded	77.50	83.00	0.00	79.50	80.00	69.50
	- 95 0.15	0.00	0.00	0.00	79.50	78.00	0.00
	- 92 Unleaded	76.00	79.00	75.00	78.00	76.00	68.00
	- 92 0.15	0.00	0.00	75.00	78.00	76.00	0.00
4	JET A-1	68.00	69.00	68.00	68.00	68.00	72.00
5	KEROSENE						
	- Dual purpose	0.00	0.00	69.00	69.00	0.00	73.00
	- Premium	70.00	0.00	0.00	0.00	0.00	0.00
	- Regular	0.00	0.00	0.00	0.00	0.00	0.00
6	GASOIL						
	- 0.3% Sulphur (New)	71.00	0.00	71.00	71.00	71.00	71.00
	- 0.50%	70.00	73.00	70.00	70.00	71.00	72.00
	- 1.00%	0.00	0.00	69.50	69.50	69.50	71.50
In US Dollars per barrel							
7	DIESEL						
	- Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	- Marine	0.00	0.00	29.50	29.00	29.50	28.50
8	FUEL OIL						
	- Light	0.00	0.00	0.00	26.90	0.00	0.00
	- Medium	25.00	24.00	25.00	25.00	25.50	23.00
	- Heavy	0.00	0.00	0.00	0.00	0.00	0.00

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**Annex 3. Singapore National Grid**

No	Plant Name	Type of Power Plant	Type of Fuel	No. of Unit	Capacity (MW/unit)	Total Capacity (MW)	Total Licensed Capacity /(MW)
1	Senoko Power Ltd <b>Senoko Power Station consists of</b>  Pasir Panjang Power station consists of	Steam Turbines [3]	Fuel Oil / Natural Gas	5	250	1,250	3,300
		CCP (each consists of 2 units of 131MW GT+ 2 units of HRSG+1unit of 163 MW ST) [3]	Natural Gas / Diesel ( Back up)	2	425	850	
		CCP(1 units of 120 MW ST has already being converted to 372MW CCP and 2 are being converted to CCP) [3]	Natural Gas / Diesel( Back up)	3	372	1,116	
		Open cycle Gas Turbines [4]	Diesel	2	105	210	
	<b>Current operating capacity [4]</b>						<b>2,610</b>
2	PowerSeraya Ltd. Owns Pulau Saraya Power station and Jurong Power Station <b>Pulau Saraya Power Station consists of [5]</b>	Steam Turbines	Fuel Oil (Bunker C Oil)	9	250	2,250	3,100
		Open cycle Gas turbine	Diesel	2	20	40	
		CCP (will be commissioned soon)	Natural Gas / Diesel( Back up)	2	370	740	
	<b>Current operating capacity</b>						<b>2,290</b>
	<b>Jurong Power Station consists of</b>	Open cycle Gas turbine	Diesel	2	105	210	

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No	Plant Name	Type of Power Plant	Type of Fuel	No. of Unit	Capacity (MW/unit)	Total Capacity (MW)	Total Licensed Capacity/ (MW)
3	Tuas Power Ltd -Owns <b>Tuas Power Station</b> [6],	Stage I Steam Turbine	Fuel Oil	2	600	1,200	2,670
	Stage II blk 1 & 2	CCP ( 1 unit of GT+1 unit of ST+HRSG)	Natural Gas / Diesel( Back up)	2	367.5	735	
	Stage III blk 3 & 4	CCP ( 1 unit of GT+1 unit of ST+HRSG)- will be operated by 2006	Natural Gas / Diesel( Back up)	2	367.5	735	
	<b>Current operating capacity</b>					<b>1,935</b>	
4	SembCorp Cogen Pte Ltd <sup>1</sup>	CCP ( 2 units of GT+ 2 units of HRSG + 1 unit of ST)	Natural Gas	1	815	815	900
		<b>Current operating capacity</b>					
5	Island Power Company Pte Ltd					800	800
6	Singapore Syngas Pte Ltd					20	20
7	ExxonMobil Asia Pacific Pte Ltd					180	180
8	Keppel Merlimau Cogen Pte Ltd - Owns CCP at Jurong Island					470	470
9	Ellba Eastern (Pte) Ltd					50	50
10	National Environment Agency- Owns incinerator plants					135	250
		<b>Current operating capacity</b>					