



**REVIEW OF THE LONG RUN MARGINAL COST PARAMETERS FOR
SETTING THE VESTING CONTRACT PRICE FOR 2017 AND 2018**

CONSULTATION PAPER

Closing date for submissions of comments and feedback: 6 Jul 2016

15 JUN 2016

ENERGY MARKET AUTHORITY
991G Alexandra Road
#01-29 Singapore 238164
www.ema.gov.sg

Disclaimer:

The information contained in this document is subject to change and shall not be treated as constituting any advice to any person. It does not in any way bind the Energy Market Authority (“EMA”) to grant any approval or official permission for any matter, including but not limited to the grant of any exemption nor to the terms of any exemption. EMA reserves the right to change its policies and/or to amend any information contained in this document without prior notice. Persons who may be in doubt about how the information in this document may affect them or their commercial activities are advised to seek independent legal advice or any other professional advice as they may deem appropriate. EMA shall not be responsible or liable for any consequences (financial or otherwise) or any damage or loss suffered, directly or indirectly, by any person resulting or arising from the use of or reliance on any information contained in this document.

REVIEW OF THE LONG RUN MARGINAL COST PARAMETERS FOR SETTING THE VESTING CONTRACT PRICE FOR 2017 AND 2018

CONSULTATION PAPER

1. INTRODUCTION

1.1. The Energy Market Authority (“EMA”) implemented vesting contracts on 1 Jan 2004. The objective of the vesting regime is to mitigate the exercise of market power by the generation companies (“gencos”) to promote efficiency and competition in the electricity market. The vesting contracts mandate a specified amount of electricity (viz. the vesting contract level) to be hedged at a specified price (viz. the vesting contract price). This removes the incentives for gencos to withhold their generation capacity to sustain inefficient spot prices in the wholesale electricity market.

1.2. The vesting contract price is set based on the long run marginal cost (“LRMC”) of the most efficient generation technology that accounts for at least 25% of the system demand in Singapore. The most efficient technology at present is the F-class combined cycle gas turbine (“CCGT”). EMA reviews and determines the vesting contract price parameters biennially or when necessary in accordance with the published *EMA’s Procedures for Calculating the Components of the Vesting Contracts* (“Procedures”). EMA also conducts a mid-term review of the capital cost parameters.¹

1.3. EMA has appointed Parson Brinckerhoff Pte Ltd (“PB”) and KPMG Services Pte Ltd (“KPMG”) (“Consultants”) to conduct a review of the LRMC parameters for setting the vesting contract price for 2017 and 2018. A summary of the Consultants’ assessment of the **financial** and **technical** parameters are set out in **Appendix 1** and **Appendix 2** respectively.

2. COMMENTS AND FEEDBACK

2.1. EMA invites comments and feedback on the Consultants’ draft reports.

2.2. Please submit all written feedback to Mr Eugene Lim (eugene_lim@ema.gov.sg) and Mr Lim Yew Hua (lim_yew_hua@ema.gov.sg).

2.3. All comments and feedback should reach EMA no later than **5pm on 6 Jul 2016** in the format as shown in **Appendix 3**. You are requested to include a soft-copy of your comments in both **PDF and Microsoft Word** format in your submission.

¹ The capital cost parameters refer to item 7 (Capital cost of the plant) and item 8 (Land, infrastructure and development cost of the plant) under Section 2.3 of the Procedures.

2.4. EMA will acknowledge receipt of all submissions via email. Please contact Mr Eugene Lim (DID: 6376 7760) or Mr Lim Yew Hua (DID: 6376 7475) if you do not receive an acknowledgement of your submission within two business days.

2.5. Please note that anonymous submissions will not be considered. EMA reserves the right to make public all or parts of any written submissions made in response to this Consultation Paper and to disclose the identity of the respondent. Any part of the submission, which is considered by respondents to be confidential, should be clearly marked and placed as an annex. EMA will take this into account regarding disclosure of the information submitted.

* * *

Consultants' Assessment of the Financial Parameters

1. Weighted Average Cost of Capital (“WACC”)

- 1.1 The following formula based on the Capital Asset Pricing Model (“CAPM”) is used to determine the post-tax nominal WACC for a new generation entrant in Singapore:

$$WACC = [g \times (r_f + DP) (1-t)] + \{ (1-g) [r_f + \beta_{equity}(r_m - r_f)] \}$$

where:	r_f	is the risk-free rate
	DP	is the debt premium
	r_m	is the market rate of return
	$(r_m - r_f)$	is the market risk premium (“MRP”)
	β_{equity}	is the measure of the sensitivity of the company's returns to market returns
	g	is the level of gearing, i.e. total debt as a proportion of total debt and equity
	t	is the corporate tax rate

2. Base Month

- 2.1. For the purpose of this initial consultation, **March 2016** is used as the Base Month. The Base Month will be updated to **May 2016** for subsequent reports including EMA's final determination to be made by end Sep 2016.

3. Comparator Companies

3.1. The **gearing** and **equity beta** are determined by taking reference from publicly available information in respect of comparator companies. In selecting the comparator companies, the following screening criteria are applied to ensure that the comparator companies are as relevant as possible for a theoretical new generation entrant in Singapore, in particular its merchant power market structure and power generation sources:

- a. Availability of information. Only companies which are publicly listed are selected so that financial information is transparent and adheres to international standard reporting requirements. Selected companies are also required to have at least 5 years of historical information to derive averages over a longer time frame.
- b. Financial health. Comparator companies should not have adverse financial health in the past 5 years, such as bankruptcy, insolvency, significant acquisitions and/or restructuring.
- c. Business location. Comparator companies should operate mainly in countries with similar credit ratings as Singapore².
- d. Revenue source. Comparator companies should derive more than or equal to 50% of their respective total revenue from electricity generation and sales in merchant markets.
- e. Generation portfolio. Thermal generation plants are exposed to different commodity and operational risks as compared to other types of power plants. As the majority of Singapore's power generation is generated from natural gas, more than or equal to 50% of each comparator company's generation portfolio should be from thermal generation.

3.2. Based on the above criteria, the following five comparator companies are selected: (i) Calpine Corporation; (ii) Capital Power Corporation; (iii) NRG Energy; (iv) SSE plc; and (v) Drax Group plc. Refer to **Annex A** for the profile of each comparator company selected.

4. Risk Free Rate, r_f

4.1 The risk free rate is calculated by averaging the yields of a Singapore Government Security ("SGS") over a period of 3 months. A 30-year SGS with a

² Singapore's sovereign credit rating is AAA by the three rating agencies of S&P, Fitch and Moody's.

remaining maturity period that most closely matches the economic life of the relevant asset is used.

4.2 Based on the average daily closing yields for the three-month period Jan 2016 to Mar 2016 in respect of the 30-year SGS (Issue code: NA12100N) issued on 2 Apr 2012 and maturing on 1 Apr 2042 (remaining maturity of 26 years), the risk free rate is 2.73% (refer to **Annex B** for detailed computation).

5. Debt Premium, *DP*, and Cost of Debt

5.1 The debt premium is 2.57% based on the average yield to maturity of investment grade rated “Baa” bonds in Moody’s Bond Indices for the utility sector less the average yield of US government 30-year bond for the period Jan 2016 to Mar 2016 (refer to **Annex C** for detailed computation). Accordingly, the pre-tax cost of debt is 5.30% (i.e. debt premium of 2.57% plus risk-free rate of 2.73%).

6. Gearing, *g*

6.1 The gearing is 0.48 based on the median of the average gearing of the comparator companies.

7. Tax Rate, *t*

7.1 The tax rate is 17%, which is the corporate tax rate in Singapore.

8. Equity Beta, β_{equity}

8.1 Taking into account the comparator companies’ R-squared weighted unlevered beta of 0.51 and the above gearing (0.48) and tax rate (17%), the equity beta is 0.90 (refer to **Annex D** for detailed computation).

9. Market Risk Premium (“MRP”), $(r_m - r_f)$

9.1 There are various empirical approaches for estimating MRP. Both historical and forward-looking MRPs for Singapore and comparable overseas jurisdictions are used to estimate MRP. The median of the estimated MRPs is 6.24% (refer to **Annex E** for details).

10. Summary

10.1 Table 1 summarises the financial parameters.

Table 1: Financial Parameters

WACC Parameters	2017-2018 #	Current (2015-2016)
Risk-free rate, r_f	2.73%	3.08%
Debt Premium, DP	2.57%	2.42%
Gearing, g	0.48	0.50
Equity Beta, β_{equity}	0.90	1.00
Market Risk Premium, MRP	6.24%	6.00
Corporate Tax Rate, t	17%	17%
Return on Equity	8.35%	9.08%
Cost of Debt	5.30%	5.50%
Post-Tax Nominal WACC (%)	6.45%	6.82%

Assuming Base Month of Mar 2016.

* * *

Consultants' Assessment of the Technical Parameters

1. Base Month

1.1 For the purpose of this initial consultation, **March 2016** is used as the Base Month. The Base Month will be updated to **May 2016** for subsequent reports including EMA's final determination to be made by end Sep 2016.

2. Generating Technology

2.1. Currently, the most efficient technology that accounts for at least 25% of the system demand in Singapore is the **F-class CCGT**.

3. Capacity per generating unit

3.1 A new entrant is assumed to install two units of CCGTs. Taking into account the effects of degradation (due to fouling, erosion and material losses in the turbine section), local air temperature and conditions, and allowance for gas compression, the achievable effective plant capacity in Singapore for an F-class CCGT is **407.9 MW**.

4. Heat Rate

4.1. The CCGT higher heating value ("HHV") heat rate is **7,072.1 Btu/kWh**, after taking into account the effects of degradation, local air temperature and conditions, part load factor, start-up gas usage, and adjustments for gas compression.

5. Exchange Rate

5.1. The SGD/USD and SGD/EUR exchange rates, averaged over the three-month period from Jan 2016 to Mar 2016 (i.e. assuming Base Month of March 2016), are **1.4018** and **1.5475** respectively.

6. Build Duration

6.1. The build duration is **30 months**.

7. Economic Lifetime

7.1. The economic lifetime of the CCGT is **25 years**, equal to its technical life.

8. Plant Load Factor

8.1. The plant load factor is **60.2%**, based on the actual performance of existing efficient F-class CCGTs in operation (viz. Senoko Energy's CCP 3 to 7, YTL PowerSeraya's CCP 1 to 4, Tuas Power Generation's CCP 1 to 5, Keppel's CCP 3 and 4, Sembcorp's CCP 3, PacificLight Power's CCP 1 and 2 and Tuaspring BLK1³) over the period Apr 2015 to Mar 2016. This has been checked to be achievable for 2017 and 2018. Station load has been subtracted to determine the plant load factor.

9. Investment Cost

9.1. Capital cost. The capital cost includes the cost of purchasing the plant and all associated equipment, including the cost of delivery of the plant in a state suitable for installation in Singapore. The total capital cost for one CCGT unit is **\$507.7m**, comprising:

- | | |
|---|--------------------------------|
| a. Turnkey Engineering, Procurement and Construction ("EPC") cost: ⁴ | \$500.4m
(about US\$357.0m) |
| b. Discounted through-life capital cost: | \$7.3m |

9.2. Land and site preparation cost. The total land and site preparation cost for one CCGT unit is **\$18.8m**, comprising:

- | | |
|--|---------|
| a. Land lease cost and water front fees: | \$17.7m |
| b. Land preparation cost: | \$1.1m |

9.3. Connection cost. The total connection cost for one CCGT unit is **\$46.1m**, comprising:

³ Tuaspring BLK1 is included in the computation of the plant load factor for the period 1 Mar 16 to 31 Mar 16.

⁴ The EPC costs include the cost for specialised equipment, mechanical and electrical engineering, gas compressors, jetty and fuel tanks.

- | | |
|---|----------------|
| a. Electrical connection cost including standard connection charge payable, switchgear GIS and underground cable: | <i>\$39.0m</i> |
| b. Gas connection cost: | <i>\$7.1m</i> |

9.4. Miscellaneous costs. The total miscellaneous cost for one CCGT unit is **\$92.9m**, comprising:

- | | |
|--|-----------------|
| a. Owner's costs after financial close including engineering, initial spares, start-up costs and construction related insurance: | <i>\$60.1 m</i> |
| b. Owner's costs prior to financial closure including permits, licences, fees, legal and financial services, engineering and in-house costs: | <i>\$32.8m</i> |

10. Non-fuel Operating Costs

10.1. Fixed annual running cost. The fixed annual running cost includes the operating and overhead costs that are incurred to have the plant available for supplying energy and reserves. This cost does not vary with the level of energy output. The fixed annual running cost for one CCGT unit is **\$19.7m per annum**, comprising:

- | | |
|--|---------------|
| a. Manpower and allowance for head office services: | <i>\$4.3m</i> |
| b. Emergency fuel usage: | <i>\$0.4m</i> |
| c. Fixed maintenance and other fixed operations including start-up impact on turbine maintenance, and distillate usage on turbine maintenance: | <i>\$9.7m</i> |
| d. Working Capital: ⁵ | <i>\$1.9m</i> |
| e. Insurance, property tax and EMA licence fee (fixed component): | <i>\$3.4m</i> |

⁵ The working capital costs include the costs of holding emergency fuel inventories, which is based on EMA's requirement on Gencos to maintain a 30-day backup fuel stockpile onsite for their exclusive right of use, and an additional 30-day backup fuel stockpile offsite for their first right of use.

10.2. Variable Non-Fuel Costs. The variable non-fuel costs include costs, other than fuel cost, that vary with the level of energy output. The variable non-fuel cost for one unit of CCGT is **\$7.45/MWh**, comprising:

- | | |
|--|-------------------|
| a. Long Term Service Agreement (“LTSA”) for maintenance of gas and steam turbines: | <i>\$6.01/MWh</i> |
| b. EMC, PSO and EMA licence fees (variable component): | <i>\$0.71/MWh</i> |
| c. Consumables (chemicals and town water): | <i>\$0.73/MWh</i> |

10.3. Fuel Cost. Assuming the weighted average gas price of \$8.47/GJ for setting the Q2 2016 vesting price, the fuel cost component is **\$63.23/MWh**.

11. Summary

11.1. Table 2 and Table 3 respectively summarises the technical parameters, and the corresponding indicative vesting contract price for 2017-2018.

Table 2: Technical Parameters

Technical Parameters	2017-2018	Current (2015-2016)	
		Biennial review	Mid-term review for 2016
Capacity per Generating Unit (MW)	407.9	386.7	-
HHV Heat Rate (Btu/kWh)	7,072.1	7,103.8	-
Build Duration (months)	30	30	-
Economic Lifetime (years)	25	24	-
Plant load factor (%)	60.2	64.4	-
Capital Cost (S\$ million) <ul style="list-style-type: none"> • Turnkey EPC cost • Discounted through-life capital cost 	507.7	455.7	490.4
Land, infrastructure and development Cost (S\$ million) <ul style="list-style-type: none"> • Land and site preparation cost • Connection cost • Miscellaneous cost 	157.7	151.3	155.4
Fixed Annual Running Cost (S\$ million/year)	19.7	23.8	-
Variable Non-fuel Cost (S\$/MWh)	7.45	6.56	-

Table 3: Indicative Vesting Contract Price for 2017-2018

	2017-18	Current (2015-2018)	
		Biennial review	Mid-term review for 2016
Vesting Contract Price (S\$/MWh)	110.06	109.76	111.86
Capital Cost Component (S\$/MWh)	30.23	28.76	30.60
Non-fuel Operating Cost Component (S\$/MWh)	16.60	17.49	17.75
Fuel Component (S\$/MWh)*	63.23	63.51	

* Based on the weighted average gas price of S\$8.47/GJ for setting Q2 2016 vesting price.

* * *

FORMAT FOR SUBMISSION OF COMMENTS AND FEEDBACK

REVIEW OF LRMC PARAMETERS FOR SETTING THE VESTING CONTRACT PRICE FOR 2017 AND 2018

S/No.	Please indicate in each cell in this column, the section/paragraph in the Consultation Paper/Consultant's Report to which your comment/feedback refers	Comments and Feedback
1		
2		
3		
4		

Comments/Feedback submitted by

Name :
Designation :
Company :
Email :
Contact No. :

Profile of Comparator Companies Selected

(Source: Capital IQ, Company Websites, Company Annual Reports)

Calpine Corp. (NYSE:CPN)

Calpine Corporation, a wholesale power generation company, owns and operates natural gas-fired and geothermal power plants in North America. It operates natural gas-fired combustion turbines and renewable geothermal conventional steam turbines.

The company sells power, steam, capacity, renewable energy credits, and ancillary services to utilities, independent electric system operators, industrial and agricultural companies, retail power providers, municipalities and other governmental entities, and power marketers, as well as retail commercial, industrial, and residential customers.

Capital Power Corporation. (TSX:CPX)

Capital Power Corporation acquires, develops, operates, and optimizes power generation facilities in Canada and the United States. The company generates electricity from various energy sources, such as natural gas, landfill gas, coal, wind, solid fuels, and solar.

As of February 18, 2016, it owned approximately 3,200 megawatts of power generation capacity at 18 facilities; 371 megawatts of capacity through a power purchase agreement; and 530 megawatts of owned generation capacity under the advanced stages of development. Capital Power Corporation was founded in 1891 and is headquartered in Edmonton, Canada.

NRG Energy, Inc. (NYSE:NRG)

NRG Energy, Inc., or NRG, is an integrated competitive power company, which produces, sells and delivers energy and energy products and services in major competitive power markets in the U.S. while positioning itself as a leader in the way residential, industrial and commercial consumers think about and use energy products and services.

NRG has one of the nation's largest and most diverse competitive generation portfolios balanced with the nation's largest competitive retail energy business.

NRG owns and operates approximately 50,000 MW of generation; engages in the trading of wholesale energy, capacity and related products; transacts in and trades fuel and transportation services; and directly sells energy, services, and innovative, sustainable products and services to retail customers under the names "NRG", "Reliant" and other retail brand names owned by NRG. NRG was incorporated as a Delaware corporation on May 29, 1992.

SSE plc. (LSE:SSE)

SSE plc generates, transmits, distributes, and supplies electricity in the United Kingdom and Ireland. The company also produces, stores, distributes, and supplies natural gas, as well as is involved in energy portfolio management activities. It generates electricity from gas, oil, coal, water, and wind.

The company operates in three segments: Networks, Retail, and Wholesale. Its electricity networks transmit and distribute electricity to approximately 3.7 million businesses, offices, and homes through approximately 130,000 kilometres of overhead lines and underground cables; and gas networks distribute gas to approximately 5.7 million homes, offices, and businesses through 75,000 kilometres of gas mains. The company also supplies electricity and gas to approximately 9 million households and businesses under the SSE, Scottish Hydro, Southern Electric, SWALEC, Atlantic, and SSE Airtricity brands.

It owns or has an ownership interest in approximately 11,733 megawatts of generation capacity.

Drax Group plc. (LSE:DRX)

Drax Group plc, together with its subsidiaries, engages in the generation and supply of electricity in the United Kingdom. It operates through three segments: Generation, Biomass Supply, and Retail.

The company owns and operates Drax Power Station that produces electricity from biomass located in Selby, North Yorkshire. It sells its electricity to the wholesale market and business customers. In addition, the company manufactures and supplies compressed wood pellets for commercial and domestic customers for heating. Drax Group plc was incorporated in 2005 and is based in Selby, the United Kingdom.

Average Yield on Singapore Government Securities: 30-Year Bond
 (Source: <https://secure.sgs.gov.sg/fdanet/BenchmarkPricesAndYields.aspx>)

Yield on Singapore Government 30-Year Security "NA12100N" Issued in 2012 and Maturing 2042			
4/1/2016	2.97	18/2/2016	2.70
5/1/2016	2.93	19/2/2016	2.63
6/1/2016	2.91	22/2/2016	2.65
7/1/2016	2.83	23/2/2016	2.68
8/1/2016	2.91	24/2/2016	2.68
11/1/2016	2.94	25/2/2016	2.80
12/1/2016	2.96	26/2/2016	2.82
13/1/2016	2.91	29/2/2016	2.82
14/1/2016	2.86	1/3/2016	2.78
15/1/2016	2.82	2/3/2016	2.81
18/1/2016	2.86	3/3/2016	2.79
19/1/2016	2.84	4/3/2016	2.75
20/1/2016	2.82	7/3/2016	2.73
21/1/2016	2.80	8/3/2016	2.68
22/1/2016	2.81	9/3/2016	2.63
25/1/2016	2.83	10/3/2016	2.65
26/1/2016	2.78	11/3/2016	2.68
27/1/2016	2.80	14/3/2016	2.75
28/1/2016	2.84	15/3/2016	2.78
29/1/2016	2.75	16/3/2016	2.74
1/2/2016	2.72	17/3/2016	2.61
2/2/2016	2.73	18/3/2016	2.59
3/2/2016	2.71	21/3/2016	2.61
4/2/2016	2.73	22/3/2016	2.60
5/2/2016	2.71	23/3/2016	2.61
10/2/2016	2.62	24/3/2016	2.55
11/2/2016	2.52	28/3/2016	2.55
12/2/2016	2.61	29/3/2016	2.51
15/2/2016	2.73	30/3/2016	2.42
16/2/2016	2.76	31/3/2016	2.42
17/2/2016	2.75	Average	2.73

Average Yield on US Gov't 30-Year Bond & Moody's Bond Indices for Utilities
 (Source: Bloomberg)

Date	30 year T-Bill	Baa	Date	30 year T-Bill	Baa
04-Jan-16	2.98	5.56	18-Feb-16	2.62	5.30
05-Jan-16	3.01	5.59	19-Feb-16	2.61	5.26
06-Jan-16	2.94	5.52	22-Feb-16	2.62	5.27
07-Jan-16	2.92	5.52	23-Feb-16	2.60	5.25
08-Jan-16	2.91	5.52	24-Feb-16	2.61	5.23
11-Jan-16	2.96	5.54	25-Feb-16	2.58	5.20
12-Jan-16	2.89	5.48	26-Feb-16	2.63	5.25
13-Jan-16	2.85	5.43	29-Feb-16	2.61	5.23
14-Jan-16	2.90	5.53	01-Mar-16	2.70	5.32
15-Jan-16	2.81	5.45	02-Mar-16	2.69	5.30
19-Jan-16	2.82	5.44	03-Mar-16	2.65	5.26
20-Jan-16	2.77	5.40	04-Mar-16	2.70	5.28
21-Jan-16	2.79	5.47	07-Mar-16	2.71	5.26
22-Jan-16	2.83	5.51	08-Mar-16	2.63	5.18
25-Jan-16	2.80	5.48	09-Mar-16	2.68	5.24
26-Jan-16	2.79	5.48	10-Mar-16	2.70	5.20
27-Jan-16	2.80	5.48	11-Mar-16	2.75	5.22
28-Jan-16	2.79	5.49	14-Mar-16	2.74	5.19
29-Jan-16	2.75	5.40	15-Mar-16	2.73	5.17
01-Feb-16	2.77	5.44	16-Mar-16	2.73	5.17
02-Feb-16	2.67	5.33	17-Mar-16	2.69	5.12
03-Feb-16	2.70	5.36	18-Mar-16	2.68	5.05
04-Feb-16	2.70	5.37	21-Mar-16	2.72	5.07
05-Feb-16	2.68	5.34	22-Mar-16	2.72	5.05
08-Feb-16	2.56	5.22	23-Mar-16	2.65	4.96
09-Feb-16	2.55	5.22	24-Mar-16	2.67	4.98
10-Feb-16	2.53	5.21	28-Mar-16	2.66	4.95
11-Feb-16	2.50	5.18	29-Mar-16	2.60	4.91
12-Feb-16	2.60	5.26	30-Mar-16	2.65	4.94
16-Feb-16	2.64	5.29	31-Mar-16	2.61	4.89
17-Feb-16	2.68	5.36			

	30 year T-Bill	Baa
Average	2.72	5.29

Debt Premium = 5.29 - 2.72 = 2.57%

Beta

Comparator company	5-year average D/E	5-year levered beta	Tax rate	Unlevered beta	R²
Calpine Corporation (NYSE:CPN)	1.47	0.95	40.0%	0.51	0.24
Capital Power Corporation (TSX:CPX)	0.93	0.75	26.5%	0.44	0.17
NRG Energy, Inc. (NYSE:NRG)	2.73	1.04	40.0%	0.39	0.20
SSE plc (LSE:SSE)	0.47	0.70	20.0%	0.51	0.24
Drax Group plc. (LSE:DRX)	0.15	0.89	20.0%	0.80	0.12

R² weighted average un-levered beta:	0.51
Singapore corporate tax rate:	17%
D/E ratio:	0.93
Re-levered beta:	0.90

Gearing

Comparator company	Average total debt (SGD millions)					
	Filing currency	2011	2012	2013	2014	2015
Calpine Corporation (NYSE:CPN)	USD	13,405	13,606	14,598	16,240	16,108
Capital Power Corporation (TSX:CPX)	CAD	1,957	1,995	1,788	1,726	1,612
NRG Energy, Inc. (NYSE:NRG)	USD	12,968	20,595	22,094	28,423	25,997
SSE plc (LSE:SSE)	GBP	12,991	11,962	13,804	13,402	13,889
Drax Group plc. (LSE:DRX)	GBP	16	405	665	657	670

Comparator company	Average market value of equity (SGD millions)					
	Filing currency	2011	2012	2013	2014	2015
Calpine Corporation (NYSE:CPN)	USD	10,413	11,642	11,128	11,778	7,278
Capital Power Corporation (TSX:CPX)	CAD	1,753	1,817	2,385	2,228	1,796
NRG Energy, Inc. (NYSE:NRG)	USD	4,485	10,624	13,017	11,673	5,528
SSE plc (LSE:SSE)	GBP	25,238	26,832	29,893	30,150	28,921
Drax Group plc. (LSE:DRX)	GBP	3,990	4,623	6,462	3,002	2,141

Comparator company	Gearing ratios					5-year average gearing ratio
	2011	2012	2013	2014	2015	
Calpine Corporation (NYSE:CPN)	0.563	0.539	0.567	0.580	0.689	0.595
Capital Power Corporation (TSX:CPX)	0.528	0.523	0.429	0.437	0.473	0.481
NRG Energy, Inc. (NYSE:NRG)	0.743	0.660	0.629	0.709	0.825	0.732
SSE plc (LSE:SSE)	0.340	0.308	0.316	0.308	0.324	0.319
Drax Group plc. (LSE:DRX)	0.004	0.080	0.093	0.180	0.238	0.127

Median gearing ratio:	0.481
------------------------------	--------------

Market Risk Premium (MRP)**Summary of Approaches**

MRP Approach	MRP Estimate
Historical market risk premium ⁶	5.57%
Implied market risk premium ⁷	6.24%
Local benchmark ⁸	5.00%
Overseas benchmarks	6.32%
Dividend Growth Model ⁹	6.68%
Median:	6.24%

Historical Market Risk Premium

Country	Arithmetic Mean	Geometric Mean
Australia	6.60%	5.00%
New Zealand	5.50%	4.00%
United Kingdom	5.00%	3.60%
United States	6.40%	4.30%
Median:	5.95%	4.15%
Weighting factor:	0.79	0.21
Weighted average historical market risk premium¹⁰:	5.57%	

⁶ Source: Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2016 Edition, Damodaran, 2016

⁷ Implied market risk premium is based on Aswath Damodaran, <http://pages.stern.nyu/~adamodar/>

⁸ 2015 company annual reports. The estimated MRP for the Local benchmark is based on the median MRP of Keppel Corporation (5.0%), SembCorp Industries (5.0%), CapitaLand Limited (5.78%) and SMRT Corporation (5.0%) and ST Engineering (5.0%).

⁹ Source: Bloomberg

¹⁰ The Historical Premium Approach used to calculate the MRP can be based on Geometric Mean (“GM”) or Arithmetic Mean (“AM”). Both GM and AM can be weighted for a more representative market risk premium - refer to study by Daniel C. Indro and Wayne Y. Lee (Biases in Arithmetic and Geometric Averages as Estimates of Long-Run Expected Returns and Risk Premia, Financial Management 26(4) p81- 90)

Overseas Benchmarks

Country	MRP
Australia ¹¹	6.90%
New Zealand ¹²	6.32%
United Kingdom ¹³	5.30%
Median:	6.32%

¹¹ Sources: Rate of Return Factsheet, October 2015, Australia Energy Regulator and Review of the method for estimating the Weighted Average Cost of Capital for the Regulated Railway Networks – Final Decision, September 2015, Economic Regulation Authority

¹² Source: Cost of capital determination for information disclosure year 2017 for electricity distribution services and specified airport services (March year-end), April 2016, Commerce Commission New Zealand

¹³ Source: Cost of Capital – Annual Update Report: 2015-16, March 2016, UK Regulators Network