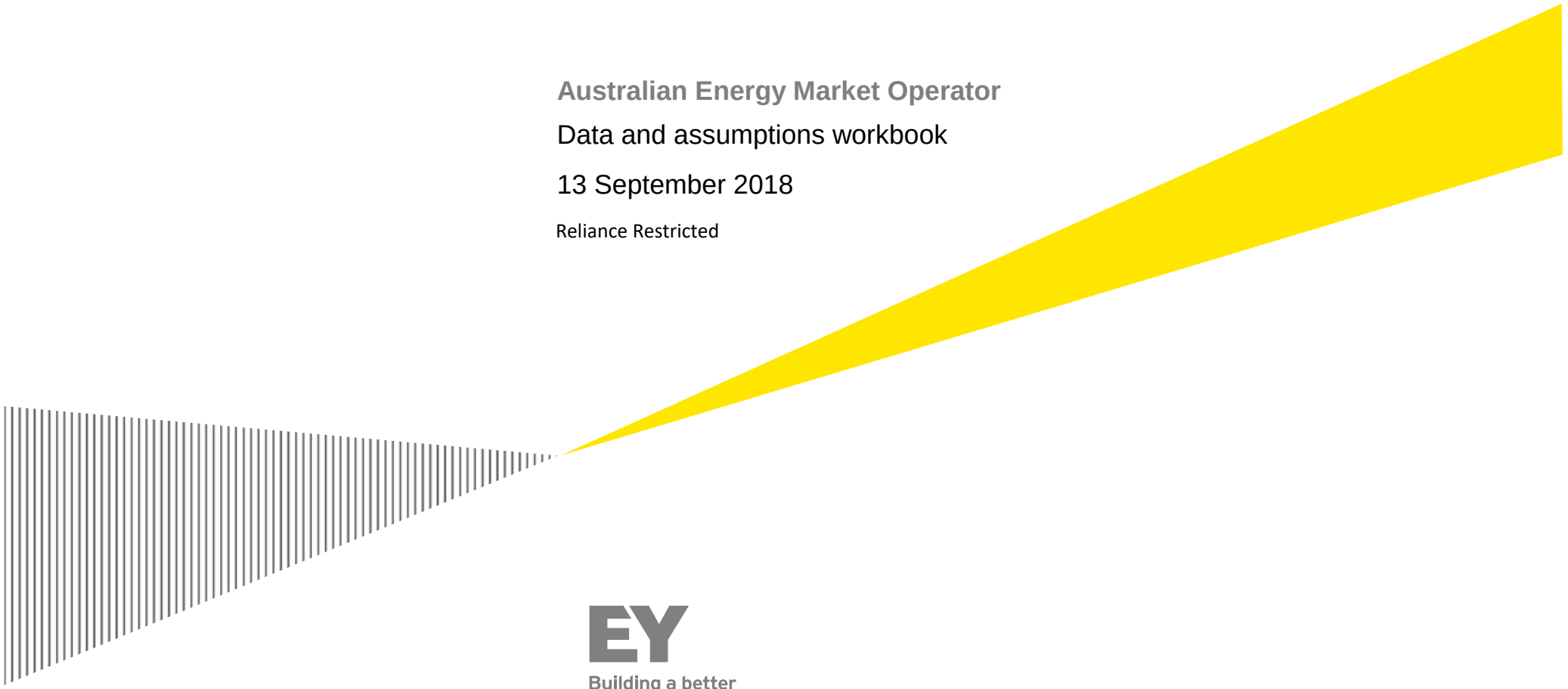
Australian Energy Market Operator

Data and assumptions workbook

13 September 2018

Reliance Restricted



Building a better working world

Ernst & Young ("we" or "EY") has been engaged by the Australian Energy Market Operator ("you", "AEMO" or the "Client") to provide electricity market modelling services to assist AEMO in calculating a number of market parameters in accordance with the Western Australian Wholesale Electricity Market Rules (the "Services"), in accordance with our Assignment commencing 1 August 2018, under the Master Services Consultancy Agreement entered into by AEMO and EY commencing 5 December 2016.

The enclosed report (the "Report") provides an overview of the simulation model and the generic data inputs and assumptions to be used in delivering the Services. The simulation model will form the basis for the outputs produced and either have been, or will be, agreed with AEMO, following the end of a public consultation process and after due consideration of submissions received.

The Report should be read in its entirety including the applicable scope of the work and any limitations. A reference to the Report includes any part of the Report. The report has been constructed based on information current as of 12 September 2018 (being the date of completion of this Report), and which has been provided by the Client, other stakeholders or is available publicly. Since this date, material events may have occurred that are not reflected in the report.
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Australian Energy Market Operator

Purpose

This assumption book illustrates the quantitative assumptions that will be used by EY for the scenarios for electricity market simulations.
The worksheets in this book highlight the assumptions
Associated sources for each data set are outlined in each worksheet along with the real dollar value of any costs.

How to navigate this assumptions book

The Scenarios tab in this workbook contains a list of the key drivers selected for the modelling
The subsequent tabs contain the detailed data behind those selections, with other input data used in the model.

Date	Version	Notes
13/09/2018	1	Data and assumptions workbook

Simulation Parameters

Study start:	2019-20	* Determination of Margin Value is for the 2019-20 year.
Study end:	2021-22	* Determination of Cost_LR is for the 2019-20, 2020-21, 2021-22 year.
Number of years:	3	
Reference years:	Two reference years	
PoE for peak demand	50% POE	

Reporting dollars: **real June 2018 AUD**

Key driver	Sheet	Options	Base assumptions
New renewable generation	SWIS renewable planting list	1. Suggested initial expansion plan provided in SWIS renewable planting list based on advanced generator connections and information available in the public domain regarding capacity credit accreditation process. 2. Alternative plan, which could be requested by the Client. [Note: Additional renewable projects are planted throughout the study in response to market conditions]	SWIS renewable planting list based on advanced generator connections and information available in the public domain regarding capacity credit accreditation process.
Thermal generation retirements	Generator retirements	1. Synergy 380 MW base retirement schedule, with retirements of plant based on end of life asset retirements age, described below. 2. Synergy 380 MW base retirement schedule, with additional Client specified retirements.	Synergy 380 MW base retirement schedule.
Energy	Energy Forecasts Peak Demand Forecasts	2018 AEMO Electricity Statement of Opportunities (ESOO) 1. Strong Economic Growth 2. Neutral Economic Growth 3. Weak Economic Growth	2018 AEMO ESOO - Neutral Growth Scenario Note: 50% POE values for peak demand are used
Rooftop PV	Rooftop PV	2018 AEMO ESOO 1. Strong Economic Growth 2. Neutral Economic Growth 3. Weak Economic Growth	2018 AEMO ESOO - Neutral Growth Scenario
Behind-the-meter storage uptake	Battery storage forecasts	2018 AEMO ESOO 1. Strong Economic Growth 2. Neutral Economic Growth 3. Weak Economic Growth	2018 AEMO ESOO - Neutral Growth Scenario
Electric vehicles	Electric vehicles	2018 AEMO ESOO 1. Strong Economic Growth 2. Neutral Economic Growth 3. Weak Economic Growth	2018 AEMO ESOO - Neutral Growth Scenario
Fuel Prices	Fuel prices	1. AEMO 2017 GSOO - High scenario 2. AEMO 2017 GSOO - Base scenario 3. AEMO 2017 GSOO - Low scenario	2017 AEMO GSOO - Base scenario
Industrial load demand	N/A	1. Same as the selected 2018 AEMO ESOO electricity demand and energy scenario 2. Client specified industrial load changes	2018 AEMO ESOO - Neutral Growth Scenario
Demand response	N/A	1. DSM capacity to be modelled as per AEMO ESOO 2018 with 57 MW in 2018-19 and 66 MW from 2019-20 onwards for the duration of the study period. This demand response is modelled explicitly in the simulation responding to high prices as a last resort. 2. User specified assumption around uptake of DSM.	DSM capacity to be modelled as per AEMO ESOO 2018 with 57 MW in 2018-19 and 66 MW from 2019-20 onwards for the duration of the study period
New entrant renewable bidding	N/A	1. Renewable projects to be bid at $0/MWh. 2. New entrant renewable projects to bid at -$40/MWh for the study period	New entrant renewable projects to bid at -$40/MWh for the study period
GIA implementation	N/A	1. Fully constrained access is implemented in 2022 2. Partially constrained access is implemented in 2022 3. Continuation of current access framework and GIA implementation.	N/A - Note that GIA constraint equations are not modelled Note also that constrained access does not impact the study period
Generator marginal loss factors	MLFs	1. Static MLF's for future years based on 2018-19 MLF's calculated based on the Muja reference node. 2. Revised MLF values based on the Southern Terminal reference node.	MLF's for all future years based on 2018-19 MLF's calculated based on the Muja reference node.
Ramp rates by facility	Facility ramp rates	1. As provided in public market data from AEMO dashboard. 2. User specified ramp rates	Facility ramp rates provided as provided from AEMO dashboard
Planned maintenance periods	Planned maintenance	1. Planned maintenance as per MTPASA records 2. Maintenance allocated such that the availabilty adjusted peak demand is minimised throughout the year.	Planned maintenance as per MTPASA provided data

Facility Level Assumptions																			
Sources: Various, please refer to Assumptions Report. All costs are Real June 2018.																			
Units	*GJ/MWh sent out*	*GJ/MWh sent out*	*GJ/MWh sent out*	*GJ/MWh sent out*	*% of as-generated output*	*$/MWh sent out*	*$ / MW (nameplate*	*Hours*	*Hours*	*Hours*	*$ / MW as gen*	*$ / MW as gen*	*$ / MW as gen*	*$ / MW*	*$/GJ*	*$/GJ*	*N/A*	*MW/min*	*MW/min*
Unit ID	**Avg. HR at min gen**	**Avg. HR at 0.33 * [max gen - min gen]**	**Avg. HR at 0.66 * [max gen - min gen]**	**Avg. HR at max gen**	**Auxiliary factor**	**Variable operating and maintenance costs (VOM)**	**Fixed operating and maintenance costs (FOM)**	**Time elapsed after which a start is considered a cold start**	**Time elapsed after which a start is considered a warm start**	**Time elapsed after which a start is considered a hot start**	**Unit startup cost (from cold)**	**Unit startup cost (from warm)**	**Unit startup cost (from hot)**	**Unit shutdown cost**	**Fuel price**	**Transport charge**	**MLF**	**Ramp Rates Up**	**Ramp Rates Down**
ALCOA_WGP																			
ALINTA_PNJ_U1																			
ALINTA_PNJ_U2																			
ALINTA_WGP_GT																			
ALINTA_WGP_U2																			
BW1_BLUEWATERS_G2																			
BW2_BLUEWATERS_G1																			
COCKBURN_CCG1																			
COLLIE_G1																			
KEMERTON_GT11																			
KEMERTON_GT12																			
KWINANA_GT2																			
KWINANA_GT3																			
MUJA_G5																			
MUJA_G6																			
MUJA_G7																			
MUJA_G8																			
NAMKKN_MERR_SG1																			
NEWGEN_KWINANA_CCG1																			
NEWGEN_NEERABUP_GT1																			
PERTHENERGY_KWINANA_GT1																			
PINJAR_GT1																			
PINJAR_GT10																			
PINJAR_GT11																			
PINJAR_GT2																			
PINJAR_GT3																			
PINJAR_GT4																			
PINJAR_GT5																			
PINJAR_GT7																			
PINJAR_GT9																			
PPP_KCP_EG1																			
PRK_AG																			
STHRNCRS_EG																			
TESLA_GERALDTON_G1																			
TESLA_KEMERTON_G1																			
TESLA_NORTHAM_G1																			
TESLA_PICTON_G1																			
TIWEST_COG1																			

[Confidential]

Assumed renewable connections					
List based on updated information provided through available market data and information					
Assumed capacity factors based on historical data for existing projects. For new entrants, capacity factors are indicative and are assumed.					
Other renewables in excess of LRET may be built based on market outcomes.					
Commissioning date	**Project**	**Capacity (MW)**	**Load area**	**Technology**	**Target capacity factor (%)**
Existing	ALINTA_WWF	89.1	North Country	Wind turbine	42%
Existing	ALBANY_WF1	21.6	Albany	Wind turbine	31%
Existing	EDWFMAN_WF1	79.2	North Country	Wind turbine	35%
Existing	INVESTEC_COLLGAR_WF1	206	East Country	Wind turbine	37%
Existing	GRASMERE_WF1	13.8	Albany	Wind turbine	33%
Existing	GREENOUGH_RIVER_PV1	10	North Country	Fixed Plate PV	25%
Existing	MWF_MUMBIDA_WF1	55	North Country	Wind turbine	39%
1/10/2018	Emu Downs Solar Farm	20	North Country	Single axis tracking PV	29%
1/10/2018	Northam Solar Project	10	East Country	Single axis tracking PV	27%
1/10/2018	Byford Solar/Westgen Solar Farm	30	Kwinana	Single axis tracking PV	29%
1/10/2019	Merredin Solar Farm	120	East Country	Single axis tracking PV	28%
1/01/2020	Badgingarra Wind Farm	130	North Country	Wind turbine	44%

Announced and suggested capacity developments

Based on public announcements further retirements may be implemented based on simulation outcomes.

Age-based retirements based on current asset age as per market data

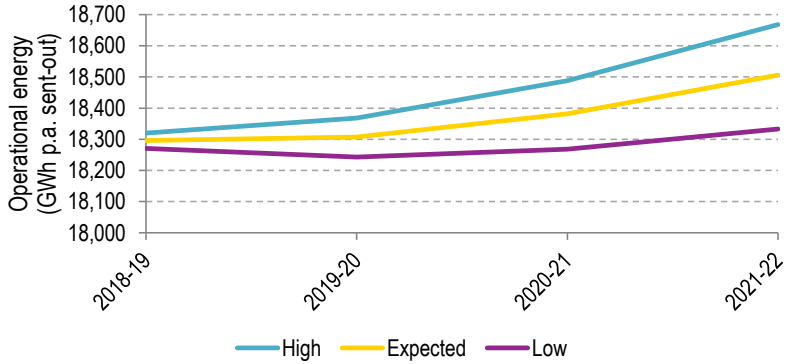
Station	Capacity (MW)	Tech	Retirement date	Comments
KWINANA_GT1	20.8	OCGT	30-Sep-18	https://www.synergy.net.au/About-us/News-and-announcements/Media-releases/Synergy-to-Reduce-Generation-Capacity-by-380-MW
MUJA_G1 (Muja A)	55	Black Coal	30-Apr-18	
MUJA_G2 (Muja A)	55	Black Coal	30-Apr-18	
MUJA_G3 (Muja B)	55	Black Coal	30-Apr-18	
MUJA_G4 (Muja B)	55	Black Coal	30-Apr-18	
MUNGARRA_GT1	37.2	OCGT	30-Sep-18	
MUNGARRA_GT2	37.2	OCGT	30-Sep-18	
MUNGARRA_GT3	38.2	OCGT	30-Sep-18	
WEST_KALGOORLIE_GT2	38.2	Distillate	30-Sep-18	
WEST_KALGOORLIE_GT3	24	Distillate	30-Sep-18	

Operational energy forecasts for the WEM

Sources: *2018 ESOO for the WEM. https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities*

Targets shown are 'Operational, sent-out'

	AEMO forecast			
;Operational energy (GWh p.a. sent-out)	**2018-19**	**2019-20**	**2020-21**	**2021-22**
High	18,320	18,368	18,488	18,668
Expected	18,296	18,307	18,382	18,506
Low	18,271	18,243	18,268	18,333



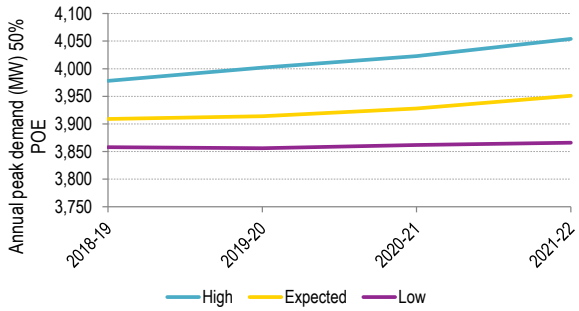
Operational peak demand forecasts for the WEM

Sources: *Based on information presented in the 2018 ESOO for the WEM. https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities*

Targets shown are 'Operational, sent-out'

AEMO forecast

;Annual peak demand (MW) 50% POE	2018-19	2019-20	2020-21	2021-22
High	3,978	4,002	4,023	4,054
Expected	3,909	3,914	3,928	3,951
Low	3,858	3,856	3,862	3,866



Rooftop PV forecasts for the WEM

Sources: *EY calculations based on information presented in the 2018 ESOO for the WEM. https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities*

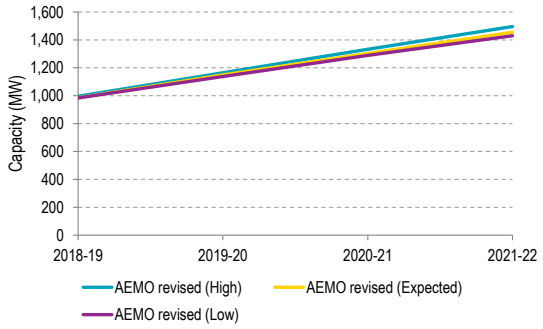
AEMO revised (High) High rooftop PV uptake
AEMO revised (Expected) Expected rooftop PV uptake
AEMO revised (Low) Low rooftop PV uptake

AEMO forecast

Capacity (MW)	2018-19	2019-20	2020-21	2021-22
High	996	1,164	1,333	1,496
Expected	985	1,149	1,303	1,455
Low	984	1,138	1,289	1,430

Energy (GWh p.a. sent-out)	2018-19	2019-20	2020-21	2021-22
High	1,379	1,611	1,845	2,071
Expected	1,363	1,590	1,803	2,014
Low	1,362	1,575	1,784	1,979

Rooftop solar PV capacity factor	15.80%



Behind-the-meter (domestic) storage uptake forecasts for the WEM

Sources: *Source: Calculations based on information presented in the 2018 ESOO for the WEM. https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities*
MW capacity figures are sourced from AEMO - all other assumptions presented on this sheet are assumptions
Large-scale storage could be installed in addition to the below forecast, if profitable.

Aggregated battery performance assumptions

Total daily energy charge discount factor	0.7	To allow for some batteries to not be fully charged on any given day.
Coincident charge/discharge discount factor	0.25	To allow for some batteries to not be discharged or charged with perfect coincidence to impact on maximum and minimum demand (in line with AEMO's contribution to peak assumptions)

Assumed battery size (hours) 2

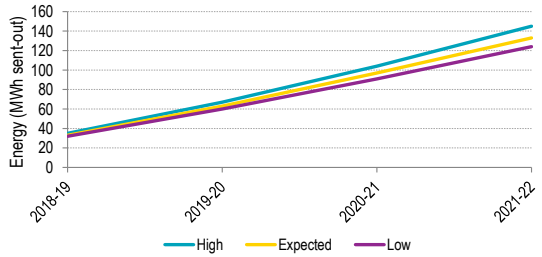
;Capacity (MW)

AEMO forecast

	2018-19	2019-20	2020-21	2021-22
High	17.5	33.5	52	72.5
Expected	16.5	31.5	48.5	66.5
Low	16	30	45.5	62

;Energy (MWh sent-out)

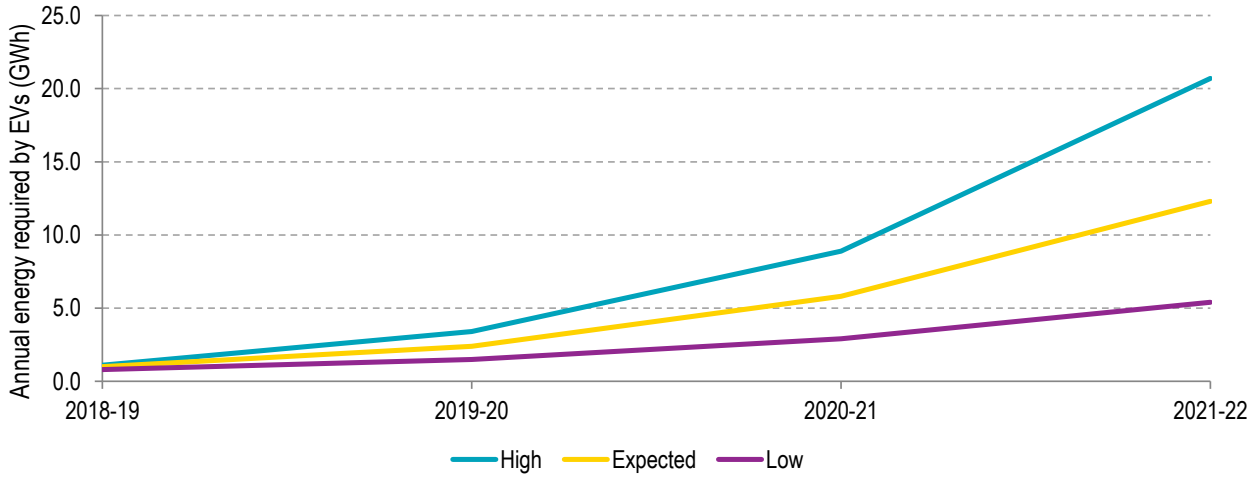
	2018-19	2019-20	2020-21	2021-22
High	35	67	104	145
Expected	33	63	97	133
Low	32	60	91	124



Electric vehicle uptake

Source: 2018 ESOO for the WEM. https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities

	AEMO forecast			
; Annual energy required by EVs (GWh)	**2018-19**	**2019-20**	**2020-21**	**2021-22**
High	1.1	3.4	8.9	20.7
Expected	1.0	2.4	5.8	12.3
Low	0.8	1.5	2.9	5.4



Gas fuel costs for new contracts

Sources: **EY calculation of financial year prices based on CPI and AEMO GSOO Dec 2017:**

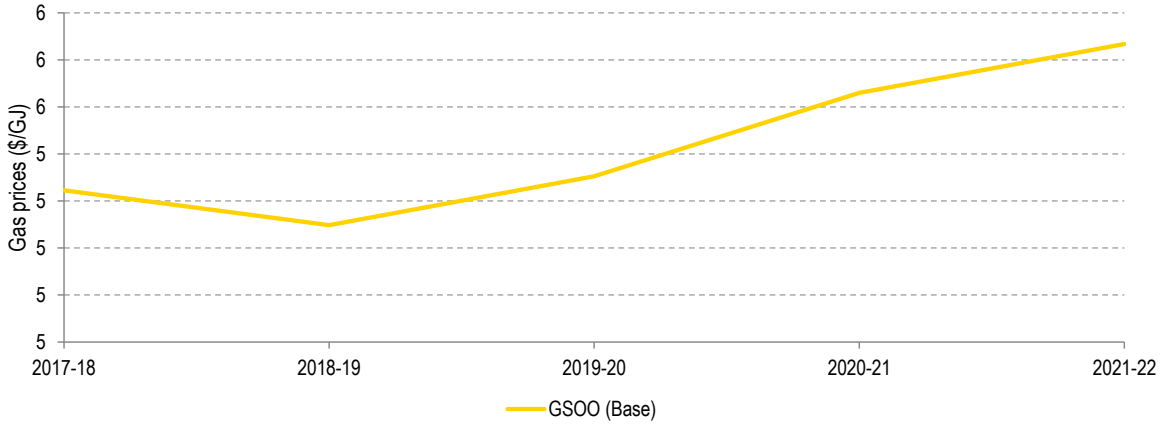
Gas Statement of Opportunities - December 2017, AEMO. https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/WA_GSOO/2017/2017-WA-GSOO.pdf

Real June 2017 dollars

CPI Q2 2015	107.5
CPI Q2 2016	108.6
CPI Q2 2017	110.7
CPI Q4 2017	112.1

;Gas prices ($/GJ)

	2017-18	2018-19	2019-20	2020-21	2021-22
GSOO (High)	6.80	7.29	8.19	8.91	9.43
GSOO (Base)	5.32	5.25	5.35	5.53	5.63
GSOO (Low)	5.28	4.62	3.95	3.95	3.95



Existing generator params			
Source: Various, as listed			*BASED ON NEM GENERATORS
	2018 AEMO ISP	2015-16 IMO Margins Review	2018 AEMO ISP
Station ID	**FOM ($/MW nameplate, June 2018 dollars)**	**VOM ($/MWh sent-out, June 2014 dollars)**	**Auxiliary factor (%)**
ALCOA_WGP	*[Confidential]*		
ALINTA_PNJ_U1			
ALINTA_PNJ_U2			
ALINTA_WGP_GT			
ALINTA_WGP_U2			
BW1_BLUEWATERS_G2			
BW2_BLUEWATERS_G1			
COCKBURN_CCG1			
COLLIE_G1			
TESLA_PICTON_G1			
KEMERTON_GT11			
KEMERTON_GT12			
KWINANA_GT2			
KWINANA_GT3			
PPP_KCP_EG1			
PERTHENERGY_KWINANA_GT1			
MUJA_G5			
MUJA_G6			
MUJA_G7			
MUJA_G8			
NAMKKN_MERR_SG1			
NEWGEN_KWINANA_CCG1			
NEWGEN_NEERABUP_GT1			
PRK_AG			
PINJAR_GT2			
PINJAR_GT4			
PINJAR_GT7			
PINJAR_GT1			

PINJAR_GT3	
PINJAR_GT5	
PINJAR_GT10	
PINJAR_GT9	
PINJAR_GT11	
STHRNCRS_EG	
TESLA_GERALDTON_G1	
TESLA_KEMERTON_G1	
TESLA_NORTHAM_G1	
TIWEST_COG1	

Fuel costs for new and existing generators including delivery

Sources:

EY calculations based on AEMO GSOO Dec 2017: *Gas Statement of Opportunities - December 2017, AEMO. https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/WA_GSOO/2017/2017-WA-GSOO.pdf*

EY calculations based on Jacobs IMO assumptions: *Jacobs for IMO, 2018/19 Margin Peak and Margin Off-peak Review, Final assumptions report - PUBLIC, 23 September 2017. https://www.erawa.com.au/cproot/18657/2/20180131_AEMO%2019%20Margin%20Peak%20Review%20V2_markup.PDF*

Jacobs for IMO, 2016/17 Margin Peak and Margin Off-peak Review. Assumptions report - PUBLIC, 18 September 2015. https://www.aemo.com.au/media/docs/default-source/rules/other-wem-consultation-docs/assumptions-report--v1-3-public-cleanf6a0.pdf?sfvrsn=0

Assumptions:

Coal and liquid fuel prices kept constant (and as such alternative maximum market price also kept constant)

All prices on this sheet in real June 2017 dollars

Margin Peak off-peak Review (IMO) fuel prices ($/GJ) by technology type.

	2016-17	2018-19
Black Coal	2.61	2.60
Cogeneration	2.93	2.88
Synergy contract gas	3.45	
New gas	6.89	5.91
Distillate	18.48	16.23

Margin Peak off-peak Review (IMO) distillate transport costs ($/GJ) by zone.

	2016-17	2018-19
Goldfields	1.50	1.38
Perth	0.35	0.35
East Country	**1.50**	**1.38**
North Country	1	1

Select GSOO gas price trajectory: GSOO (Base) 2

	$/GJ					
	2016-17		**2017**	**2018**	**2019**	**2020**	**2021**
Average gas spot price reported in the Jacobs report for 2016-17:		GSOO (Base)	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**

		$/GJ	**Fuel price uplift assigned to each generator in each forecast year, relative to 2016-17.**				
Facility code	**Fuel type**	**Starting price (2016-17)**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
ALCOA_WGP	Cogeneration						
ALINTA_PNJ_U1	Cogeneration						
ALINTA_PNJ_U2	Cogeneration						
ALINTA_WGP_GT	New Gas						
ALINTA_WGP_U2	New Gas						
BW1_BLUEWATERS_G2	Black Coal						
BW2_BLUEWATERS_G1	Black Coal						
COCKBURN_CCG1	New Gas						
COLLIE_G1	Black Coal						
KEMERTON_GT11	New Gas						
KEMERTON_GT12	New Gas						
KWINANA_GT1	New Gas						
KWINANA_GT2	New Gas						
KWINANA_GT3	New Gas						
MUJA_G1	Black Coal						
MUJA_G2	Black Coal						
MUJA_G3	Black Coal						
MUJA_G4	Black Coal						
MUJA_G5	Black Coal						
MUJA_G6	Black Coal						
MUJA_G7	Black Coal						
MUJA_G8	Black Coal						
MUNGARRA_GT1	New Gas						
MUNGARRA_GT2	New Gas						
MUNGARRA_GT3	New Gas						
NAMKKN_MERR_SG1	Distillate						
NEWGEN_KWINANA_CCG1	New Gas						
NEWGEN_NEERABUP_GT1	New Gas						
PERTHENERGY_KWINANA_GT1	New Gas						
PINJAR_GT1	New Gas						
PINJAR_GT10	New Gas						
PINJAR_GT11	New Gas						
PINJAR_GT2	New Gas						
PINJAR_GT3	New Gas						
PINJAR_GT4	New Gas						
PINJAR_GT5	New Gas						
PINJAR_GT7	New Gas						
PINJAR_GT9	New Gas						
PPP_KCP_EG1	Cogeneration						
PRK_AG	New Gas						
STHRNCRS_EG	New Gas						
TESLA_GERALDTON_G1	Distillate						
TESLA_KEMERTON_G1	Distillate						
TESLA_NORTHAM_G1	Distillate						
TESLA_PICTON_G1	Distillate						
TIWEST_COG1	Cogeneration						
WEST_KALGOORLIE_GT2	Distillate						
WEST_KALGOORLIE_GT3	Distillate						
New generators (or post fuel contract)							
New gas generator (Muja region)	New Gas						

0.00

Transport cost ($/GJ)	Zone (If using diesel)	Starting price (2016-17)	2017-18	2018-19
ALCOA_WGP				
ALINTA_PNJ_U1				
ALINTA_PNJ_U2				
ALINTA_WGP_GT				
ALINTA_WGP_U2				
BW1_BLUEWATERS_G2				
BW2_BLUEWATERS_G1				
COCKBURN_CCG1				
COLLIE_G1				
KEMERTON_GT11				
KEMERTON_GT12				
KWINANA_GT1				
KWINANA_GT2				
KWINANA_GT3				
MUJA_G1				
MUJA_G2				
MUJA_G3				
MUJA_G4				
MUJA_G5				
MUJA_G6				
MUJA_G7				
MUJA_G8				
MUNGARRA_GT1				
MUNGARRA_GT2				
MUNGARRA_GT3				
NAMKKN_MERR_SG1	East Country			
NEWGEN_KWINANA_CCG1				
NEWGEN_NEERABUP_GT1				
PERTHENERGY_KWINANA_GT1				
PINJAR_GT1				
PINJAR_GT10				
PINJAR_GT11				
PINJAR_GT2				
PINJAR_GT3				
PINJAR_GT4				
PINJAR_GT5				
PINJAR_GT7				
PINJAR_GT9				
PPP_KCP_EG1				
PRK_AG	Goldfields			
STHRNCRS_EG	Goldfields			
TESLA_GERALDTON_G1	North Country			
TESLA_KEMERTON_G1	East Country			
TESLA_NORTHAM_G1	East Country			
TESLA_PICTON_G1	Perth			
TIWEST_COG1				
WEST_KALGOORLIE_GT2	Goldfields			
WEST_KALGOORLIE_GT3	Goldfields			
New gas generator (Muja region)				

Generator outage rate data

EY calculation based on IMO Planning Criterion Review. https://www.erawa.com.au/cproot/15250/2/Market%20Reform%20Presentation%20-%20Review%20of%20Planning%20Criterion.pdf

Fuel type	Full forced outage rate (%)						Planned outage rate (%)					
	2007	2008	2009	2010	2011	Avg	2007	2008	2009	2010	2011	Avg
Coal	1.4	2.1	1	2.1	2	**1.72**	8.9	8.3	8.3	12	11.9	**9.88**
Gas	4	6.5	0.8	1	2.8	**3.02**	4.4	6.5	7.9	10.1	10.3	**7.84**
Gas/Liquid	0.2	0.6	1.9	1.3	1.3	**1.06**	3.1	3.5	6.9	8.6	4	**5.22**

* Other technologies not reported against, outage rates provided in the 'new entrant worksheet'

New entrant technology parameters (*Applied to existing units where unit-specific data not available)

Source: 2016 NTNDP. http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan/NTNDP-database

Source: 2017 ESOO for the WEM. https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities

Source: 2017 NEM ESOO. https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities

Source: IMO Planning Criterion Review. https://www.erawa.com.au/cproot/15250/2/Market%20Reform%20Presentation%20-%20Review%20of%20Planning%20Criterion.pdf

Source: Electricity and Gas Market Benefits and Costs of an Energy Efficiency Obligation Scheme. https://industry.gov.au/Energy/EnergyEfficiency/Documents/energy-efficiency/electricity-gas-market-benefits-costs-energy-efficiency-obligation-scheme.pdf

Costs in real June 2016 AUD

Sources:	2016 NTNDP	2016 NTNDP	2016 NTNDP	2016 NTNDP	2016 NTNDP	IMO Planning Criterion Review	2017 NEM ESOO	IMO Planning Criterion Review	2017 NEM ESOO	2017 NEM ESOO	Electricity and Gas Market Benefit Report
NTNDP technology	**Auxiliaries (%)**	**FOM ($/MW)**	**VOM ($/MWh sent-out)**	**Economic life (years)**	**Emissions captured (%)**	**Full forced outage rate (%)**	**Mean time to repair - full (hours)**	**Partial forced outage rate (%)**	**Partial derating (%)**	**Mean time to repair - partial (hours)**	**Maintenance outage rate (days per year)**
Black Coal - SC	7%	42073	3	30	0%	**1.72%**	55.03	**9.88%**	26.17%	26.62	3
Black Coal - SC - w CCS	21%	43359	10	30	90%	**1.72%**	55.03	**9.88%**	26.17%	26.62	3
CCGT / Cogeneration	3%	10000	7	30	0%	**3.02%**	14.05	**7.84%**	29.88%	71.64	2
CCGT - w CCS	12%	30941	12	30	80%	**3.02%**	14.05	**7.84%**	29.88%	71.64	2
OCGT - gas fuel	1%	4000	10	30	0%	**3.02%**	33.55	**7.84%**	31.89%	10.75	1
OCGT - liquid fuel	1%	4000	10	30	0%	**1.06%**	33.55	**5.22%**	31.89%	10.75	1
Solar PV - Fixed	0%	25000	0	25	0%	Included in modelled half-hourly availability profile.					
Solar PV - SAT	1%	30000	0	25	0%						
Solar PV - DAT	0%	40000	0	25	0%						
CST central receiver - 6h storage	0%	65000	4	30	0%						
Wind	1%	45000	0	25	0%						
Large-scale storage (4 hours)	0%	0	0	15	0%	No data - assume 0%					

Generator marginal loss factors assumed in the forward-looking modelling

Source: *https://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Data/Loss-factors*

Loss factors are based on Muja as the regional reference node

Code	Unit Id	Loss factor	Starting from	MLF/DLF
WALB	ALBANY_WF1	1.0384	1-Jul-18	TLF * DLF
WWGP	ALCOA_WGP	0.9701	1-Jul-18	TLF
TAPL	ALINTA_PNJ_U1	0.9747	1-Jul-18	TLF
TAPL	ALINTA_PNJ_U2	0.9747	1-Jul-18	TLF
TLWA	ALINTA_WGP_GT	1.0135	1-Jul-18	TLF
TLWA	ALINTA_WGP_U2	1.0135	1-Jul-18	TLF
WWWF	ALINTA_WWF	0.9475	1-Jul-18	TLF
TBLB	BW1_BLUEWATERS_G2	1.0004	1-Jul-18	TLF
TBLB	BW2_BLUEWATERS_G1	1.0004	1-Jul-18	TLF
WCCT	COCKBURN_CCG1	1.0351	1-Jul-18	TLF
WCPS	COLLIE_G1	0.9974	1-Jul-18	TLF
WEMD	EDWFMAN_WF1	1.027	1-Jul-18	TLF
WALB	GRASMERE_WF1	1.0384	1-Jul-18	TLF * DLF
TMGS	GREENOUGH_RIVER_PV1	1.0031	1-Jul-18	TLF
WCGW	INVESTEC_COLLGAR_WF1	1.006	1-Jul-18	TLF
WKEM	KEMERTON_GT11	1.0108	1-Jul-18	TLF
WKEM	KEMERTON_GT12	1.0108	1-Jul-18	TLF
WKPS	KWINANA_GT1	1.0301	1-Jul-18	TLF
WKPS	KWINANA_GT2	1.0301	1-Jul-18	TLF
WKPS	KWINANA_GT3	1.0301	1-Jul-18	TLF
WMPS	MUJA_G1	1	1-Jul-18	TLF
WMPS	MUJA_G2	1	1-Jul-18	TLF
WMPS	MUJA_G3	1	1-Jul-18	TLF
WMPS	MUJA_G4	1	1-Jul-18	TLF
WMPS	MUJA_G5	1	1-Jul-18	TLF
WMPS	MUJA_G6	1	1-Jul-18	TLF
WMPS	MUJA_G7	1	1-Jul-18	TLF
WMPS	MUJA_G8	1	1-Jul-18	TLF
WMGA	MUNGARRA_GT1	0.9957	1-Jul-18	TLF
WMGA	MUNGARRA_GT2	0.9957	1-Jul-18	TLF

WMGA	MUNGARRA_GT3	0.9957	1-Jul-18	TLF
TMBA	MWF_MUMBIDA_WF1	0.9573	1-Jul-18	TLF
TMDP	NAMKKN_MERR_SG1	0.9997	1-Jul-18	TLF
WNGK	NEWGEN_KWINANA_CCG1	1.0247	1-Jul-18	TLF
WGNN	NEWGEN_NEERABUP_GT1	1.0372	1-Jul-18	TLF
WKND	PERTHENERGY_KWINANA_GT1	1.0323	1-Jul-18	TLF
WPJR	PINJAR_GT1	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT10	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT11	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT2	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT3	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT4	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT5	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT7	1.0322	1-Jul-18	TLF
WPJR	PINJAR_GT9	1.0322	1-Jul-18	TLF
TMSK	PPP_KCP_EG1	1.0343	1-Jul-18	TLF
WPKS	PRK_AG	1.1686	1-Jul-18	TLF
TBLS	STHRNCRS_EG	1.1679	1-Jul-18	TLF
QTCG	TESLA_GERALDTON_G1	0.9922	1-Jul-18	DLF
QTES	TESLA_KEMERTON_G1	0.9982	1-Jul-18	DLF
QTCN	TESLA_NORTHAM_G1	0.9943	1-Jul-18	DLF
QTES	TESLA_PICTON_G1	0.9982	1-Jul-18	DLF
WKMK	TIWEST_COG1	1.032	1-Jul-18	TLF
TWKG	WEST_KALGOORLIE_GT2	1.1172	1-Jul-18	TLF
TWKG	WEST_KALGOORLIE_GT3	1.1172	1-Jul-18	TLF

Facility ramp rates							
Source: AEMO facility data, market data webpage, http://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Data-dashboard#generation-facilities, and facility balancing submissions							
Facility Code	**Ramp Rate DOWN (MW/min)**	**Ramp Rate UP (MW/min)**					
ALCOA_WGP	3	3					
ALINTA_PNJ_U1	9.4	9.4					
ALINTA_PNJ_U2	9.4	9.4					
ALINTA_WGP_GT	8	8					
ALINTA_WGP_U2	8	8					
BW1_BLUEWATERS_G2	2	2					
BW2_BLUEWATERS_G1	2	2					
COCKBURN_CCG1	12	12					
COLLIE_G1	4	4					
KEMERTON_GT11	15	15					
KEMERTON_GT12	15	15					
KWINANA_GT2	30	30					
KWINANA_GT3	30	30					
MUJA_G5	4	4					
MUJA_G6	4	4					
MUJA_G7	4	4					
MUJA_G8	4	4					
NAMKKN_MERR_SG1	6	6					
NEWGEN_KWINANA_CCG1	6	6					
NEWGEN_NEERABUP_GT1	11	11					
PERTHENERGY_KWINANA_GT1	6	6					
PINJAR_GT1	8	8					
PINJAR_GT10	10	10					
PINJAR_GT11	10	10					
PINJAR_GT2	8	8					
PINJAR_GT3	8	8					
PINJAR_GT4	8	8					
PINJAR_GT5	8	8					
PINJAR_GT7	8	8					
PINJAR_GT9	10	10					
PPP_KCP_EG1	1	1					
PRK_AG	3	3					
STHRNCRS_EG	3	3					
TESLA_GERALDTON_G1	2	2					
TESLA_KEMERTON_G1	2	2					
TESLA_NORTHAM_G1	2	2					
TESLA_PICTON_G1	2	2					
TIWEST_COG1	3	3					
ALBANY_WF1	86	0					

ALINTA_WWF	89	0					
EDWFMAN_WF1	2	0					
GRASMERE_WF1	10	0					
GREENOUGH_RIVER_PV1	2	0					
MWF_MUMBIDA_WF1	8	0					
INVESTEC_COLLGAR_WF1	33	0					

Planned maintenance									
Source: AEMO, MTPASA (Accessed on 23 August 2018)									
							2018-19	**2019-20**	**2020-21**
Unit_ID	**Start**	**Finish**	**FY**	**Hours**		**Unit_ID**	**Total Hours**	**Total Hours**	**Total Hours**
[Confidential]									