APA

Summary Report

VALUATION OF DIRECTLINK INTERCONNECTOR

February 2019

Version 1

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Version Control

Version	Date	Author	Company	Action	Comments
0.1	31/1/19		Energy Edge	Initial Draft	

1 Methodology and Approach

The valuation approach for Directlink has been based on quantifying the cost benefits that accrue to consumers from Directlink in its current state compared to reduced capacity. The economic argument follows that consumers' aggregate cost savings over the long term reflect the financial value of the asset.

To perform the detailed work, an analytical methodology has been applied to quantify the impact on NEM energy market spot prices resulting from a virtual throttling of the capacity of Directlink. Costs to consumers are reflected in pool costs (aggregate demand at regional market prices), which may be savings in some region(s) and higher charges in others, depending on market circumstances at the time.

The technique to estimate the price impact of a reduction in Directlink transmission capacity uses a retrospective analysis of the market appealing to AEMO's published *predispatch price sensitivities*. As market operator, AEMO publishes the dispatch price in real time (using actual demand), but also a *predispatch* price, being a forecast based on projected demand and actual generator bids queued in the system. The forecast extends for around one-day in half-hourly resolution. Above and beyond the predispatch price, AEMO also publishes *predispatch price sensitivities*, which represent a projection for the market spot price under various scenarios that the QLD or NSW demand is 100, 200, 500 MW higher or lower

To illustrate the methodology, we present the following conceptual example. The figure on the left represents an historical half-hour trading interval with published prices and demands. The figure on the right represents the transformed system when we would like to model market outcomes under the scenario that Directlink was throttled to 0 MW capacity.

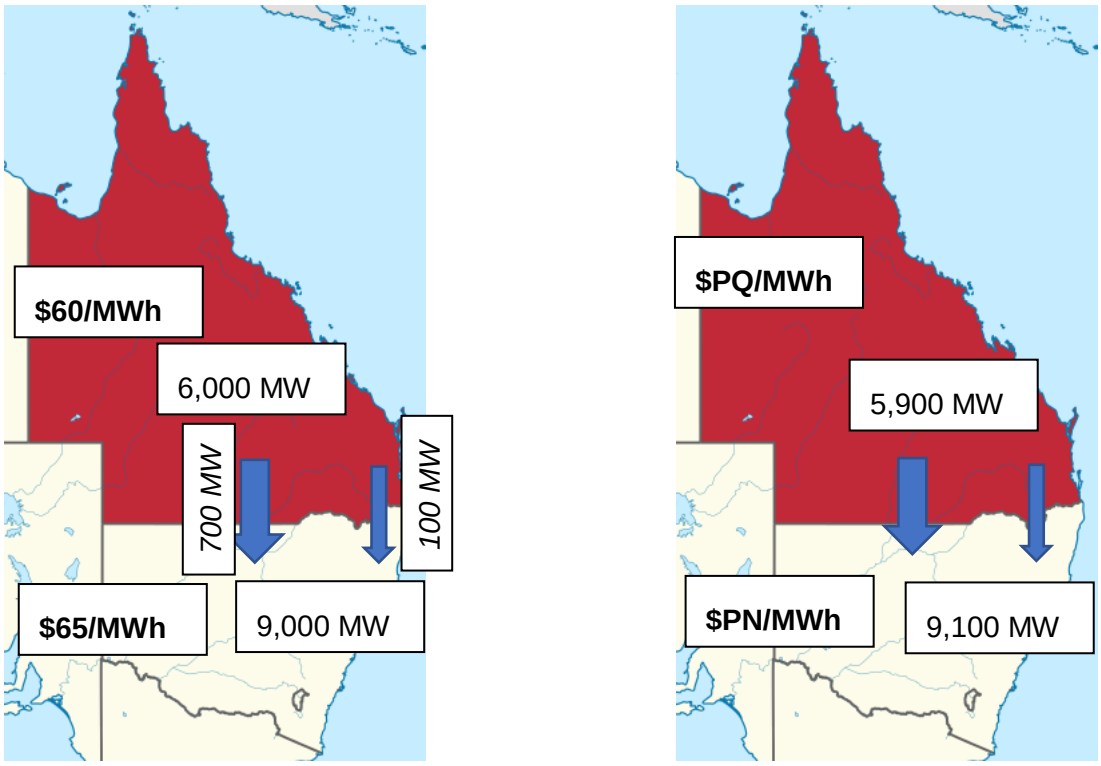

Figure 1: Left historical market outcome, Right scenario where Directlink is throttled to zero capacity

If the Directlink interconnector is reduced to zero capacity, then generators in NSW will need to supply an additional 100 MW of power to supply the native demand. Similarly, in QLD generators will be able to back off 100 MW. By shifting perspective, we can transform the market to the one on the right where the NSW native demand is increased to 9,100 MW (the extra supply may come from local NSW generators or across QNI or even from NSW) and QLD native demand falls to 5,900 MW.

By appealing to published predispatch sensitivities, we can retrospectively determine the new price for QLD **PQ** based on the actual price of $60/MWh when Directlink was at capacity. Similarly for NSW.

In the case that Directlink is partially throttled (rather than capacity set to zero), the demands are only adjusted where warranted. For the example above, when we consider the effect of Directlink has maximum capacity throttled to 60 MW or 120 MW, then the demand scenario would be as shown below.

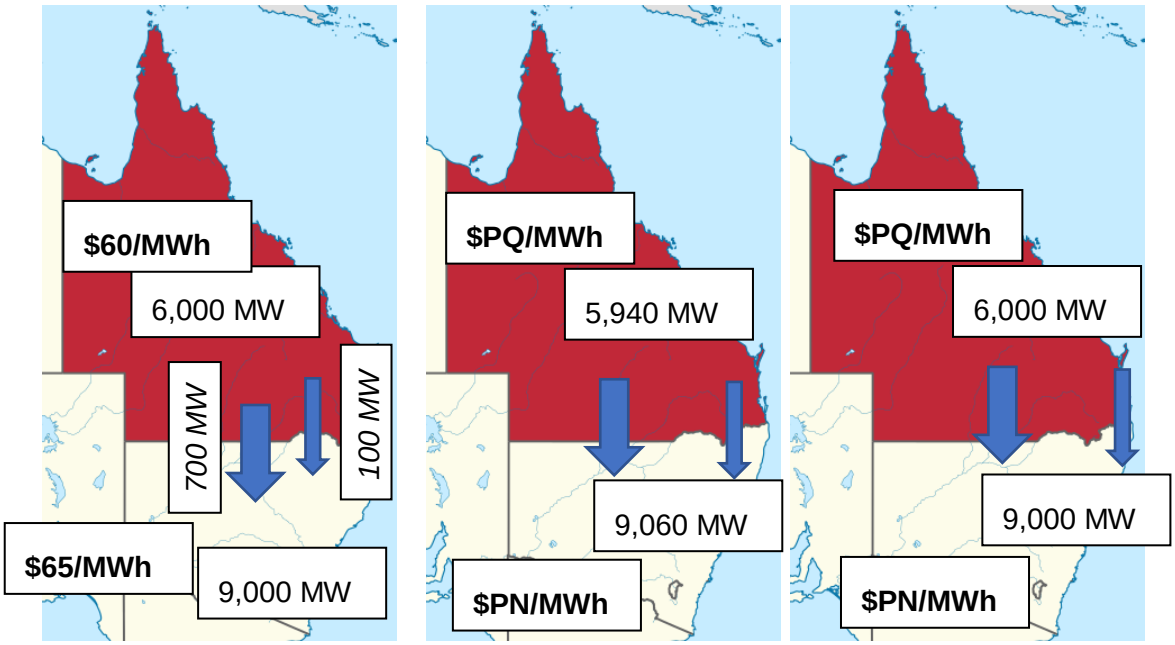

Figure 2: Left historical market outcome, Mid scenario where Directlink is throttled to 60 MW Right scenario where Directlink is throttled to 120 MW capacity

In the case that actual flow was only 100 MW and we consider the scenario of reducing Directlink capacity to 120 MW, then there are no changes needed to be made, and the actual price would be unaffected: see the scenario at the right of figure 2.

These analyses are conducted for each halfhourly trading inverval across the three-year period January 2016 – December 2018.

To provide some additional insight into how we apply the predispatch sensitivities to arrive at revised spot prices, we refer to the figure below. Based on the arguments above, the problem has been transformed into trying to establish the market spot prices based on a shift in regional demand of ”X” MW in QLD and “-X” MW in NSW.

For each halfhourly trading interval, predispatch sensitivity tables in the AEMO Infoserver database give sensitivities like the following:

ΔQLD Demand	--500 MW	-200 MW	-100 MW	0 MW	100 MW	200 MW	500 MW
RRP QLD	$90	$100	$105	$108	$125	$140	$305

Figure 3: Predispatch price sensitivities

Naively, we could simply consult the table above, and to calculate the resultant spot price for a reduction in QLD demand of 60 MW, we would interpolate between the $105 and $108 prices to arrive at $106.20.

However, predispatch is not always reflective of the actual spot prices that eventuate in dispatch (because actual demands and market conditions vary a little from the forecast). To rectify that forecast error, we determine the location on the predispatch sensitivity curve where the actual price eventuated. In the current example, if the actual spot price eventuated at $125/MWh, the we re-centre the sensitivity. Consequently, the impact of a 60 MW reduction is based on interpolating between the $108 and $125 prices to arrive at $114.80. We can now confidently say that a reduction of 60 MW flow in Directlink would yield a change in the QLD price from $125 to $114.80/MWh. An analogous approach is applied to determine the quantum of price increase in NSW.

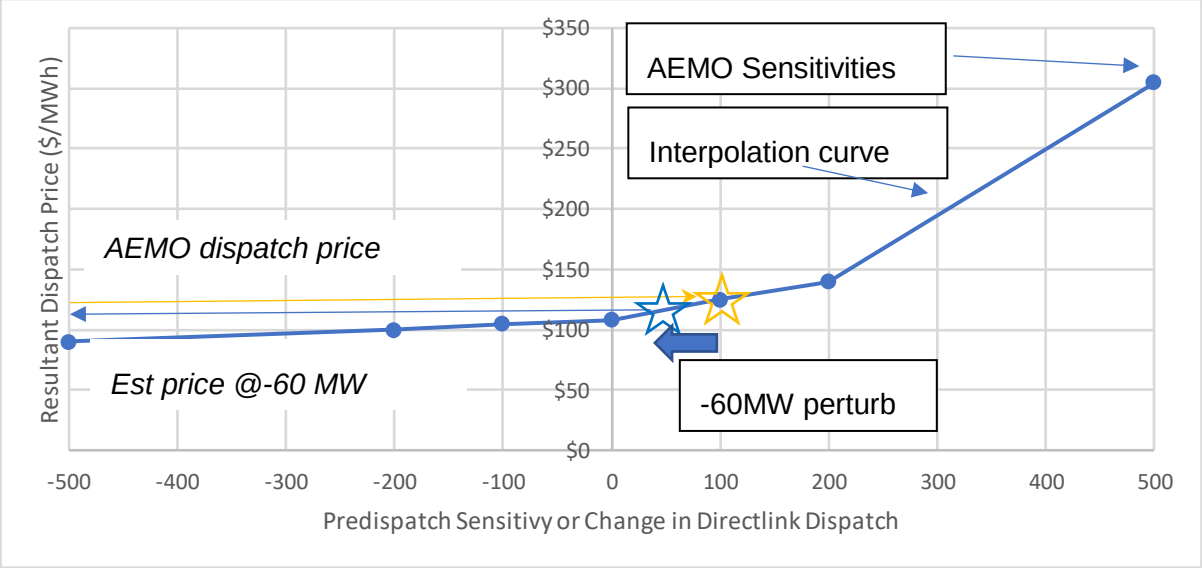

Figure 4 - Sample Sensitivity Curve with recentred zero and impact of 60 MW reduced demand

2 Results

2.1 Summary

The methodology has been applied across 2016, 2017 and 2018. The results have been summarized in 11 tables. The first table assumes that the Directlink capacity has been reduced to 0 (MW), thereafter the capacity of Directlink, is reduced by increments of 20MW. The last table reduces the capacity by 200MW in order to capture those days the Directlink flowed more than 180MW.

Each table states the Original Price, or the actual price, for each quarter in Queensland and New South Wales. The methodology is applied for every half hour in each quarter, which either increases or decreases the price based on AEMO price sensitivities published on the actual day. This results in the Adjusted price for QLD and NSW. The Underlying Value ($M) is assessed based on the adjusted price and actual demand for each half hour period. The Directlink Benefit ($M), is the difference between the Original Price and Adjusted Price multiplied by the demand.

Table 1, reduces the Directlink capacity to zero, effectively removing it from the Queensland and NSW markets. Across the last three calendar years the Directlink

Benefit has equated to $1.192 billion; if Directlink was removed the wholesale energy prices in NSW and QLD would be been $1.192 billion worse off. Except for Quarter 1 2017, the Directlink Benefit has been positive during each period. During Quarter 1 2017, Queensland experienced numerous high price events (largely due to generator rebidding), when Directlink was supplying northern New South Wales. The benefits of Directlink supporting this northern NSW (system stability and security), has not been valued in this paper. The four positive outliers across this three-year period were Quarter 2 2016, Quarter 4 2016, Quarter 2 2018 and Quarter 3 2018 when the Directlink Benefit equated to a 15-30% wholesale price reduction. Across these periods spot prices were significantly more sensitive to supply/demand imbalances due to a tight reserve owing to high levels of generator outages.

In Table 2 the Directlink capacity is reduced by 60MW to 120MW. The Directlink Benefit is reduced dramatically to $233 million. Table 3, reduces the Directlink capacity by 120MW to 60MW further reducing the Directlink Benefit to $37.14 million.

The results show that a significant proportion of value that Directlink provides, is when its capacity is above 120MW. A sharp kink arises in all sensitivity curves (see figure 4) and when Directlink is able to inject larger volumes of power it has disproportionately larger impacts on smoothing spot prices. Consequently significant value in Directlink is attributable to it's ability to suppress large spot price excursions, and this is only achievable for the asset when it has transmission capacities exceeding 120 MW.

2.2 Numerical Results

Time Bucket	Start Date	End Date	Orig. Price ($/MWh)		Adj. Price ($/MWh)		Underlying Value ($M)		Directlink Benefit ($M)		
			QLD1	NSW1	QLD1	NSW1	QLD1	NSW1	QLD1	NSW1	Total
Q01-2016	1/01/2016	31/03/2016	80.95	43.11	79.01	46.53	1275.70	805.70	-29.61	85.10	55.49
Q02-2016	1/04/2016	30/06/2016	73.99	76.06	65.71	87.73	1021.71	1375.06	-116.44	223.41	106.97
Q03-2016	1/07/2016	30/09/2016	51.83	53.25	47.93	57.76	709.37	1018.62	-54.62	90.39	35.76
Q04-2016	1/10/2016	31/12/2016	62.91	63.23	59.86	83.08	896.54	1108.07	-42.09	403.73	361.64
Q01-2017	1/01/2017	31/03/2017	173.98	116.17	125.02	148.03	2906.82	2437.59	-894.46	842.30	-52.16
Q02-2017	1/04/2017	30/06/2017	85.89	93.68	81.01	98.16	1113.76	1626.07	-61.32	76.75	15.43
Q03-2017	1/07/2017	30/09/2017	79.99	93.81	74.94	98.03	1050.58	1722.71	-64.74	81.44	16.70
Q04-2017	1/10/2017	31/12/2017	71.83	79.36	67.61	83.30	990.62	1350.27	-55.29	71.99	16.70
Q01-2018	1/01/2018	31/03/2018	70.05	71.79	68.32	73.91	1031.36	1280.62	-22.06	39.37	17.31
Q02-2018	1/04/2018	30/06/2018	69.78	84.46	63.54	109.74	949.65	1538.01	-87.75	537.41	449.65
Q03-2018	1/07/2018	30/09/2018	77.55	87.27	72.84	95.56	1043.38	1636.67	-65.51	173.94	108.44
Q04-2018	1/10/2018	31/12/2018	82.11	85.98	78.28	92.51	1160.61	1459.58	-56.29	116.37	60.09
Total Period									-1550.18	2742.19	1192.01

Table 1 Directlink capacity reduced to zero.

Time Bucket	Start Date	End Date	Orig. Price ($/MWh)		Adj. Price ($/MWh)		Underlying Value ($M)		Directlink Benefit ($M)		
			QLD1	NSW1	QLD1	NSW1	QLD1	NSW1	QLD1	NSW1	Total
Q01-2016	1/01/2016	31/03/2016	80.95	43.11	80.81	44.07	1275.70	805.70	-2.04	25.56	23.52
Q02-2016	1/04/2016	30/06/2016	73.99	76.06	71.58	79.17	1021.71	1375.06	-34.25	62.53	28.28
Q03-2016	1/07/2016	30/09/2016	51.83	53.25	50.65	54.58	709.37	1018.62	-16.46	26.75	10.29
Q04-2016	1/10/2016	31/12/2016	62.91	63.23	61.64	70.13	896.54	1108.07	-18.33	143.14	124.80
Q01-2017	1/01/2017	31/03/2017	173.98	116.17	143.54	126.32	2906.82	2437.59	-565.79	273.93	-291.86
Q02-2017	1/04/2017	30/06/2017	85.89	93.68	84.31	95.05	1113.76	1626.07	-18.96	22.55	3.59
Q03-2017	1/07/2017	30/09/2017	79.99	93.81	78.39	95.04	1050.58	1722.71	-20.36	23.71	3.35
Q04-2017	1/10/2017	31/12/2017	71.83	79.36	69.87	81.16	990.62	1350.27	-25.43	33.25	7.82
Q01-2018	1/01/2018	31/03/2018	70.05	71.79	69.48	72.42	1031.36	1280.62	-7.38	11.87	4.49
Q02-2018	1/04/2018	30/06/2018	69.78	84.46	66.63	98.20	949.65	1538.01	-45.66	295.18	249.52
Q03-2018	1/07/2018	30/09/2018	77.55	87.27	76.04	90.34	1043.38	1636.67	-20.93	66.21	45.27
Q04-2018	1/10/2018	31/12/2018	82.11	85.98	81.28	87.97	1160.61	1459.58	-12.37	36.05	23.68
Total Period									-787.97	1020.73	232.76

Table 2 Directlink capacity reduced to 120MW.

Time Bucket	Start Date	End Date	Orig. Price ($/MWh)		Adj. Price ($/MWh)		Underlying Value ($M)		Directlink Benefit ($M)		
			QLD1	NSW1	QLD1	NSW1	QLD1	NSW1	QLD1	NSW1	Total
Q01-2016	1/01/2016	31/03/2016	80.95	43.11	80.95	43.11	1275.70	805.70	0.00	0.00	0.00
Q02-2016	1/04/2016	30/06/2016	73.99	76.06	73.79	76.27	1021.71	1375.06	-2.74	4.10	1.35
Q03-2016	1/07/2016	30/09/2016	51.83	53.25	51.82	53.27	709.37	1018.62	-0.18	0.30	0.12
Q04-2016	1/10/2016	31/12/2016	62.91	63.23	62.90	63.24	896.54	1108.07	-0.14	0.13	0.00
Q01-2017	1/01/2017	31/03/2017	173.98	116.17	172.22	116.38	2906.82	2437.59	-34.74	6.13	-28.61
Q02-2017	1/04/2017	30/06/2017	85.89	93.68	85.73	93.74	1113.76	1626.07	-1.79	0.92	-0.87
Q03-2017	1/07/2017	30/09/2017	79.99	93.81	79.73	93.95	1050.58	1722.71	-3.05	2.74	-0.31
Q04-2017	1/10/2017	31/12/2017	71.83	79.36	71.60	79.63	990.62	1350.27	-2.87	5.08	2.21
Q01-2018	1/01/2018	31/03/2018	70.05	71.79	70.01	71.83	1031.36	1280.62	-0.47	0.81	0.35
Q02-2018	1/04/2018	30/06/2018	69.78	84.46	69.42	87.08	949.65	1538.01	-5.20	56.29	51.10
Q03-2018	1/07/2018	30/09/2018	77.55	87.27	77.43	87.68	1043.38	1636.67	-1.59	9.18	7.59
Q04-2018	1/10/2018	31/12/2018	82.11	85.98	82.08	86.24	1160.61	1459.58	-0.46	4.68	4.22
Total Period									-53.22	90.36	37.14

Table 3 Directlink capacity reduced to 60MW.

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