Attachment PWCR03.2P

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Forecasting Advice for the Revised Regulatory Proposal

November 2018

Demand and consumption forecast advice for Power and Water Corporation's revised regulatory proposal (2019-24 distribution determination)

Important notice

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VERSION CONTROL

Version	Release date	Changes
0.1	9/11/2018	Draft for PWC comment
1.0	21/11/2018	November Final

Executive summary

This report contains AEMO's updated forecasts of customer connections in the Northern Territory power systems: Darwin Katherine, Alice Springs, and Tennant Creek, used as input to Power and Water Corporation's (PWC's) regulatory proposal submission to the Australian Energy Regulator (AER) for the 2019-24 period (Regulatory Proposal).

AEMO originally provided PWC with forecasts of customer connections, energy consumption, and maximum demand in September 2017 as a key input to its Regulatory Proposal. The updated forecasts reflect recent historical data, revised population and Gross State Product (GSP) projections from Northern Territory Treasury, and improvements to methodology to better reflect region-specific population projections.

Based on these changes, forecast customer connections have:

- Increased for Darwin Katherine, due to updated model coefficients that are based on an updated history of connection numbers and input drivers (population in the Darwin-Katherine region and GSP).
- Decreased for Alice Springs and Tennant Creek, reflecting negative projected population growth in these power systems.

Energy consumption and maximum demand forecasts have not been updated. The assessment of the impacts of updated driver variables indicates that changes to demand and energy consumption would be immaterial and within historical variability observed at the overall level covering PWC's three regulated power systems.

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1. Connections forecast update

1.1. Background

PWC submitted its regulatory proposal to the AER for the 2019-24 period on 31 January 2018, issuing an updated proposal on 16 March 2018.

Key inputs to the proposal were forecasts of customer connections, energy volumes, and maximum demand which were prepared by AEMO in September 2017. During evaluation of the PWC's submission, the AER and stakeholders made submissions in relation to the forecasts.

In preparation for its response to the AER's Draft Determination, PWC engaged AEMO to update, or provide qualitative assessment of, the customer connection, energy consumption, and maximum demand forecasts contained in its September 2017 report to address stakeholder feedback and incorporate new information.

This document presents this updated assessment and includes:

- An updated forecast of customer connections, reflecting new population and GSP projections.
- A review of the energy consumption and maximum demand forecasts in light of new information.

A summary of stakeholder feedback, and AEMO's response to that feedback, is included in Appendix A1.

1.2. Updated forecast

The forecasts for Darwin-Katherine are summarised in Figure 1, which shows customer numbers are projected to increase overall. This is largely due to increasing population growth and GSP in the Darwin-Katherine region. The updated customer connections forecast is included as Attachment 1 and an overview of the methodology applied is provided in Appendix A2

The customers are grouped into three categories:

- RES – Residential, including prepay.
- C&I – Contestable commercial/Industrial >750 MWh.
- C&G – Non-contestable commercial and government <750 MWh.

Connection numbers for the C&I category are lower than the previous forecast, due to PWC reallocating customers in this category in the 2017-18 year[1] to the RES category. The forecasts reflect this new allocation.

[1] Advice from PWC confirms that in previous years some customers who used <750 MWh were included in the count of customers who used >750 MWh. The reason for this is uncertain, however the 2017-18 data has been cross-checked and verified by PWC to categorise the customers appropriately.

Figure 1 Darwin-Katherine connections actual and forecast (number of connections)

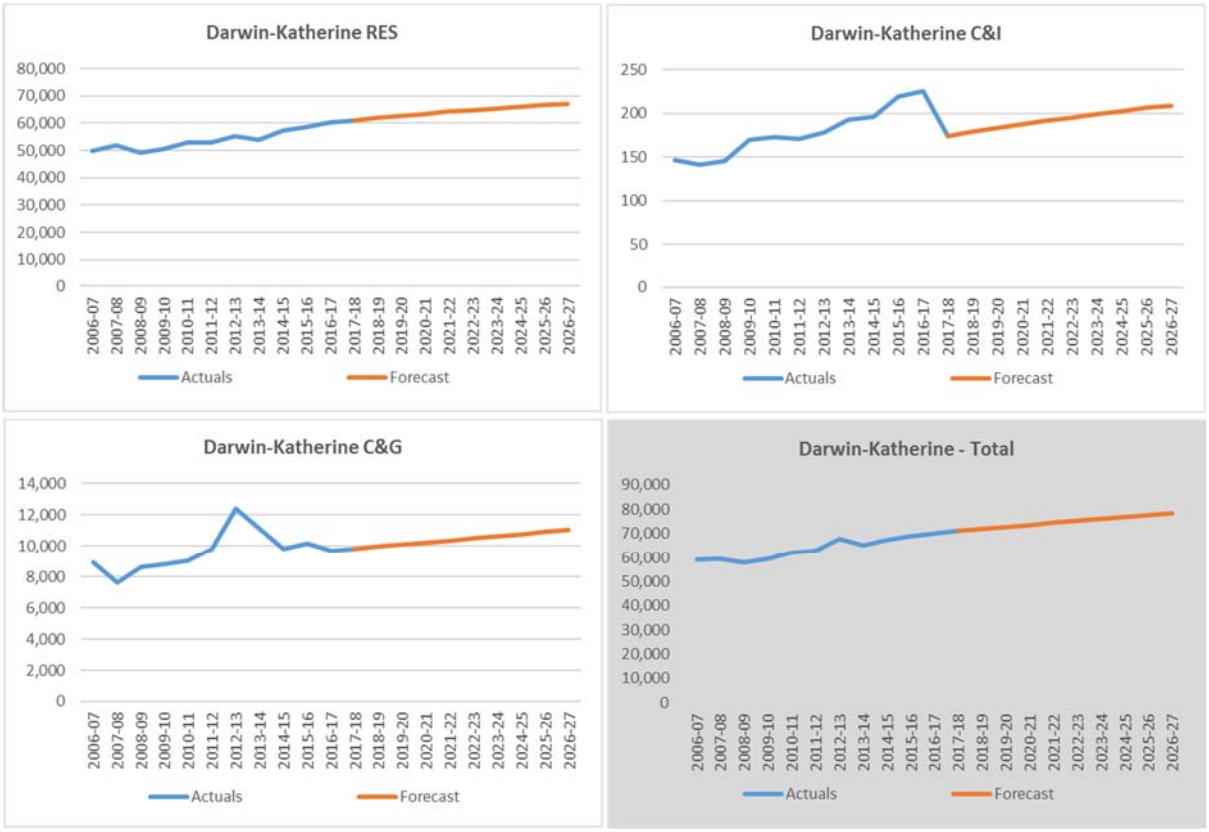


Table 1 Darwin–Katherine connections forecast (number of connections)

Customer type	*2017-18 actual*	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
RES	*61,061*	61,962	62,533	63,210	64,183	64,765	65,353	65,944	66,541	67,142
C&G	*9,823*	9,959	10,095	10,232	10,368	10,504	10,640	10,776	10,913	11,049
C&I	*174*	179	183	187	192	195	199	202	206	209
Total	*71,058*	72,100	72,811	73,629	74,743	75,464	76,192	76,922	77,660	78,400

Charts and forecast customer numbers for Alice Springs and Tennant Creek are included in Attachment 1 (Connections forecast 20181018_V2.4.xlsb).

1.3. Comparison to the 2017 forecast

The revised customer connections forecasts are based on updates to actual customer numbers[2] and projections of GSP and population[3]. The total connection numbers relative to the 2017 forecast are charted in Figure 2. The comparison shows that:

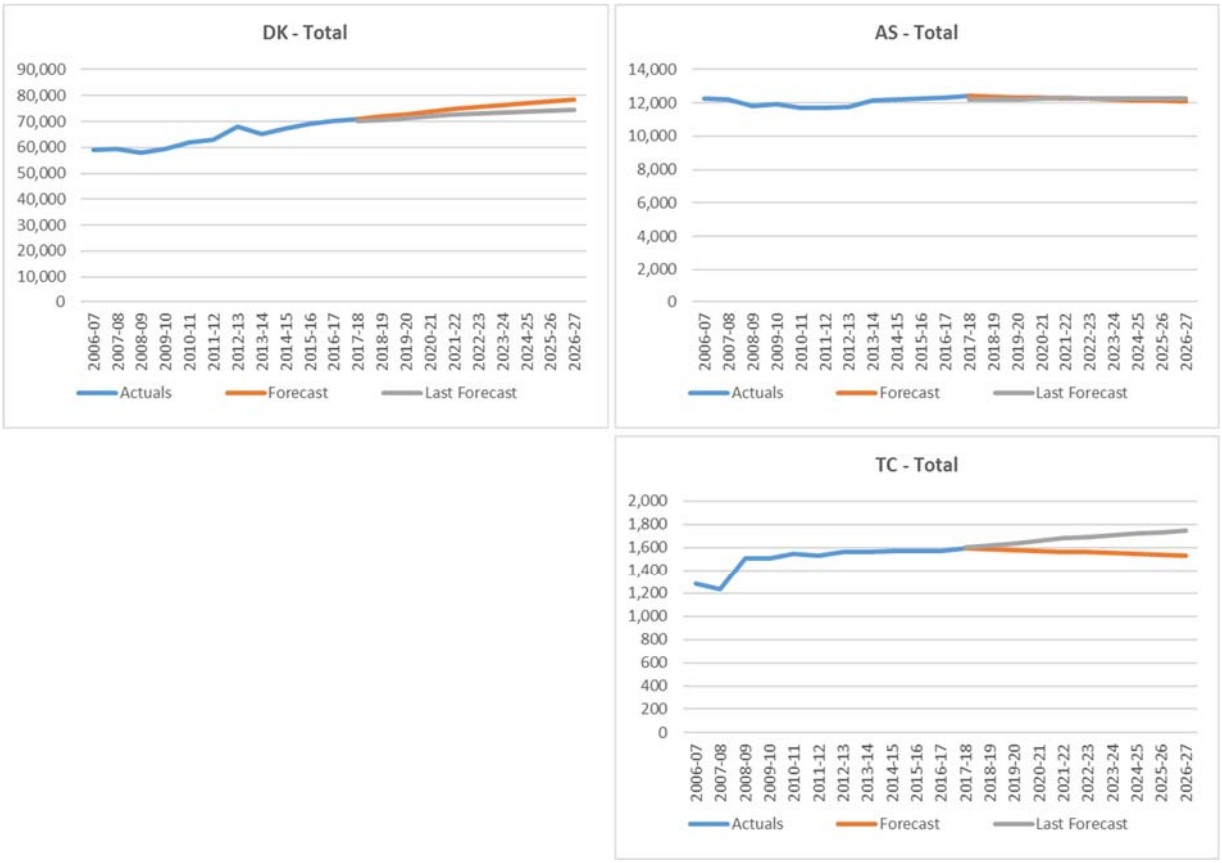
- Darwin-Katherine connection numbers have been revised upwards, reflecting revisions to the connections model.

[2] Provided by PWC.

[3] NT Treasury 2018-19 Economy Book, available at https://budget.nt.gov.au/__data/assets/pdf_file/0013/501016/2018-19-Economy-book.pdf.

- Numbers for Alice Springs and Tennant Creek are lower than the 2017 forecast by the year 2023-24, reflecting the revised (declining) population projections, in particular in Tennant Creek.

Figure 2 Comparison to the 2017 connections forecast (last forecast)



Charts comparing the forecasts at individual customer categories are included in Attachment 1. The 2017 forecasts for 2017-18 are compared to actual 2017-18 numbers in Table 2. C&I customer numbers were over-forecast, as they did not reflect the reallocation of customers in this category.

Table 2 2017-18 Actual compared to the 2017 connections forecast (last forecast)

Customer type	Last forecast (2017)	2017-18 actual	Difference relative to actual
RES	59,678	61,061	-2%
C&G	10,233	9,823	4%
C&I	224	174	29%
Total	71,058	71,058	0%

1.4. Updates to input drivers and methodology.

Updates to the customer connections forecast were made to reflect:

- An additional year of connection numbers for 2017-18, provided by PWC.

- Updated GSP and population data and projections in line with the most recent Northern Territory Treasury budget paper[4].
- Updated model relationships (connections versus population and GSP), which lead to improved coefficients for population.
- Incorporation of region-specific population growths for Alice Springs and Tennant Creek (Barkly) instead of using growth for NT overall, to reflect regional differences in growth rates.

The methodology used for the connections forecast update is included in Appendix A2. Updates to the methodology take into account stakeholder feedback that region-specific population growth should be reflected in the connections forecast.

Population projections

Population projections from the Northern Territory Treasury have changed since last released 2017. A new estimate of 2017-18 population is available and the long-term growth rates have been updated by Northern Territory Treasury. Table 3 presents a summary of the projections as applied to the energy forecasts.

Table 3 Population projections

Network	Units	Old value	New value
Darwin-Katherine (derived from population-weighted Darwin and Katherine growth rates)	% year-on-year change (5-year average)	2.0	1.8
Alice Springs (Alice Springs growth rate adopted)		-0.1	-0.8
Tennant Creek (Barkly growth rate adopted)		0.9	-1.1

1.5. Gross State Product (GSP) projections

The changes in Northern Territory Treasury[5] GSP projections from 2017 and 2018 are presented in Table 4.

Table 4 GSP projections, comparison of NT Treasury projections from 2017 and 2018.

Projection	2016-17	2017-18	2018-19	2019-20f	2020-21	2021-22
NT Treasury 2017	1.0 (estimate)	1.0	5.1	2.0	2.1	Not projected
NT Treasury 2018	3.9 (actual)	2.6 (estimate)	2.1	-0.4	2.6	2.8

AEMO applied a 1.0% GSP growth rate after the end of the Northern Territory Treasury projections for both the 2017 forecast and this update, which remains conservative.

[4] NT Treasury 2018-19 Economy Book, available at https://budget.nt.gov.au/__data/assets/pdf_file/0013/501016/2018-19-Economy-book.pdf.

[5] ibid.

2. Energy volume and maximum demand forecasts

2.1. Review conclusions

AEMO analysis indicates the changes in inputs (primarily population and GSP) would not materially impact AEMO's September 2017 projections of energy or demand at the PWC level. Population is the most dominant driver of energy consumption and maximum demand in AEMO's Northern Territory forecast models.

The change in population projection plays the greatest role in the Tennant Creek forecast, however, this is also the smallest network, therefore the forecast impact of 7.2% decrease in annual energy is 0.12% of total demand for the three networks.

Updating GSP is estimated to have a minor impact, judged not material, on the Darwin-Katherine network, due to the relatively low impact it has in the consumption model. It is not used as a driver of energy in Alice Springs or Tennant Creek.

Recent installed solar photovoltaic (PV) capacity (residential and commercial rooftop) suggests actual installed capacity is ahead of the forecast by about six months. Nevertheless, this is estimated to have a small impact on energy (roughly 5 GWh per annum) and demand (roughly 2 MW, less than 1% in Darwin-Katherine). No new information obtained by AEMO warrants a change to the long-term rooftop PV forecast.

2.2. Overview of assessment

The assessment focused on impacts to annual energy as its key driver – population growth – drives both energy consumption and maximum demand. Nonetheless, the impacts on maximum demand have also been considered where deemed relevant.

2.3. Annual energy in 2017-18

Actual consumption data for 2017-18, collated since the forecasts were made in 2017, indicate the 2017-18 forecast sits within the natural variability of year-on-year change in annual energy.

Actual energy consumption in both Darwin-Katherine and Tennant Creek in 2017-18 was close to forecast, while in Alice Springs, annual consumption was over-estimated by 1%. It is difficult to say whether there is a systemic shift in annual energy in Alice Springs or if the deviation from forecast is within the natural peaks and troughs.

Table 5 has been used to assess the starting point of the energy forecast (forecast for 2017-18 relative to actual 2017-18) by putting the difference between the 2017-18 forecast and actual (last column) in the context of year-on-year variability of prior historical years which generally exhibit a larger degree of variability.

Table 5 Year-on-year variability in annual energy

Network	Actual 2015-16 relative to actual 2016-17	Actual 2016-17 relative to actual 2015-16	Actual 2017-18 relative to actual 2016-17	Forecast for 2017-18 relative to actual 2017-18
Darwin-Katherine	5.2%	-3.9%	-1.0%	0.14%
Alice Springs	-1.0%	-0.9%	-1.1%	1.00%
Tennant Creek	2.4%	-2.8%	1.3%	-0.08%

2.4. Industrial demand affecting starting point

[redacted]

AEMO notes there are potential increases in industrial demand recorded in PWC's load log, however these are uncommitted and therefore not considered for the forecast.

2.5. Relationship between population and annual consumption

The impact of changing population projections on annual energy is presented in Table 6. The impact estimated by AEMO's forecast model is calculated to be -0.75% for PWC's regulated networks, which is within natural year-on-year variations. Changes are evaluated at year 2023-24, as this is the year in the determination period where the largest differences occur.

The greatest impact is on Tennant Creek, although this system is relatively small compared to Darwin-Katherine, and therefore the impact on annual energy across the three networks in estimated to be only a 0.12% reduction.

[redacted]

Table 6 Population projection impacts on energy

Network	Change in energy (GWh) at year 2023-24	Change in energy (% relative to old forecast) at year 2023-24
Total regulated networks	-13.8	-0.75%
Darwin-Katherine	-8.4	-0.5%
Alice Springs	-3.2	-1.6%
Tennant Creek	-2.2	-7.2%

To put the differences shown in Table 6 in context, the impact on the regulated networks is a 13.8 GWh decrease, [redacted] ssuming a typical load factor of 0.8, this equates to 2.0 MW, which is -0.6% of maximum demand.

2.6. Relationship between GSP and energy consumption

GSP (Table 4) is used as an indicator of large industrial Darwin-Katherine energy consumption. As it is a Territory-level measure, it is not applied to Alice Springs or Tennant Creek. This is because changes in Territory-wide GSP are not strongly driven by changes in economic activity in these smaller systems, given their economic size relative to Darwin-Katherine.

The estimated impact, using the existing forecast models, of the new GSP projections on the consumption in Darwin-Katherine is a decrease of 5 GWh by year 2023-24. This reflects lower GSP in the immediate near term (at 2018-9 and 2019-20 for example) but higher GSP growth in the longer term (2020-21 and 2020-22), which partly nets out. Also, GSP is only used as a driver of industrial and large customer demand in the forecast model, and therefore has a limited influence on total Darwin-Katherine consumption.

2.7. Rooftop photovoltaics (PV)

The 2017-18 forecast of installed capacity for commercial PV systems was higher than actual installed capacity by approximately 0.5 MW.

The 2017-18 actual rooftop PV installed capacity outpaced the 2017-18 forecast of installed capacity made mid-last year by 3 MW. Relative to the forecast year-on-year growth in installations of approximately 6 MW, this difference of 3 MW is broadly equivalent to bringing forward installations by six months.

Converting to annual energy, the difference would reduce the annual energy by approximately 5 GWh, equivalent to 0.3% of Darwin-Katherine consumption. For maximum demand, Darwin-Katherine demand would fall by roughly 2 MW or less than 1% in the forecast year.

No key changes to drivers of the forecast of rooftop PV are identified, however AEMO notes there is uncertainty in the forecast of rooftop PV related to the possible removal of feed-in tariffs (suppressing installations) and other initiatives (promoting installations), as mentioned in the Renewable Energy and Electricity Market Reform Implementation Plan[8].

[redacted]

A1. Responses to stakeholder comments on March submission

A1.1 The apparent inconsistency between level of economic activity and customer connections

The apparent inconsistency between level of economic activity and customer connections. For the Darwin-Katherine network it seems inconsistent to forecast a decline in economic activity and an increase in customer connections in line with the historic trend. For the Alice Springs network it seems inconsistent to forecast a reduction in population and a slight increase in customer connections over the 5-year reset period.

Economic activity as measured by GSP is increasing (overall) in the outlook period, as presented in Table 4. The revised connections forecasts reflect this increase through growth in customer connections in the Darwin-Katherine network. GSP is only available at the territory-level and not disaggregated into subregions, hence population is used as the key drivers of underlying energy consumption for the smaller systems (Alice Springs and Tennant creek). The revised Northern Territory Treasury population projection for Alice Springs (- .8% per annum) is reflected in the revised connections forecast, with AEMO now projecting a connections decline of 0.28% per annum.

A1.2 Are the population forecasts too optimistic?

Are the population forecasts too optimistic? AEMO uses forecasts of population increase and Gross State Product which are sourced from Northern Territory 2017-18 Budget papers. More recent Northern Territory Treasury data forecasts lower growth.

Analysis suggests the changes in the updated population and GSP projections will have a weak impact on the demand and consumption forecasts. This is because the changes to Darwin-Katherine projections are small relative to the larger swings in Alice Springs and Tennant Creek, and Darwin-Katherine dominates total PWC energy and demand. The analysis concludes the changes are not material, in the context of total PWC consumption relative to natural variability in year-on-year changes.

A1.3 Have improvements in energy efficiency/energy productivity been considered?

Have improvements in energy efficiency/energy productivity been considered? One of the major uses of electricity in the Territory is for air conditioning. Discussions with two major users in the Darwin area pointed to their significant investment in improved chiller technology over 2017-19 that in one case had already reduced their consumption by 30% in 2018 in one of their major sites. It is not clear how energy efficiency/energy productivity, and particularly this type of step change, has been considered in the AEMO modelling.

Energy efficiency improvements in appliances and buildings are implicitly considered in the forecast through the effects of these drivers in the historical trend, suppressing the relationship between population growth and energy consumption. Since 2009, at the territory-level there has been a reasonably constant improvement in the energy efficiency of appliances and buildings. This supports the use of a trend-based approach developing models from data no older than 2012.

A1.4 Is the growth rate on behind the meter renewables too pessimistic?

Is the growth rate on behind the meter renewables too pessimistic? The Northern Territory has a relatively low penetration of solar PV compared to other States and Territories. The NT Government's Roadmap to Renewables report (September 2017) made a number of recommendations for Government action to facilitate the transition to 50% renewable energy in the Territory by 20303 and PWC points to this as a reason to roll-out smart meters. In light of these considerations the growth projection may be a little modest.

Incentives for residential uptake of rooftop PV in the Territory are among the highest in Australia with 1-to-1 feed-in tariffs. Purchase and installation costs are acknowledged to be higher than southern states, attributed to materials transport and a smaller customer market. These two competing forces have led to current penetration levels in the regulated networks.

In 2017-18, actual rooftop PV installations were ahead of forecasts by around six months (3 MW above forecast), while forecast uptake of commercial PV systems was slightly higher than actuals (0.5MW below forecast).

The recent release of the implementation plan for the NT Government's Roadmap to Renewables indicates that many options are on the table. At this stage the most likely pathway to increasing renewable generation in a large way is through large-scale solar farms and this type of generation is considered a generation source rather than behind-the-meter generation The current forecast of rooftop PV is expected to increase in line with current trends and it is acknowledged that actual installations may experience a degree of variability (month-to-month) as changes to feed-in tariffs are discussed and potentially implemented. Reductions to incentives generally lead to a short-term increase in installations (a rush to get in), followed by a longer-term level of subdued installation levels reflecting relatively poorer financial benefits to customers.

A1.5 Anonymous submission raising issues with connection forecasts

PWC engaged the Australian Energy Market Operator to produce the forecasts of demand and consumption for the next period. The forecast method considers the forecast number of new connections to the PWC networks. Apart from some known large load movements, the underlying assumption appears to be that the existing connections continue their consumption and demand patterns. This assumption may lead to over-estimation of the forecasts because it does not take into account the vacancy rates in rental properties, which are likely to increase significantly with the end of a significant construction project in Darwin in 2017-18. These rental properties are unlikely to be filled and, as investment properties, unlikely to be sold for permanent accommodation. Consequently, the consumption and demand of these vacant properties will fall to zero. It is expected that new residential connection will continue unabated.

Recent reports suggest vacancy rates rose to 6.3% by the end of 2017 in Darwin, reflecting a scaling back of industrial construction activity. Recent assessments indicate this may be improving as the vacancy rate was 5.6% in the June quarter 2018. Nevertheless, population projections from the Northern Territory Treasury, for Darwin and Katherine areas, are still positive (1.8% per annum growth), indicating potential for increasing underlying customer energy consumption. When combined with continuing energy efficiency trends and rooftop PV uptake, the forecast growth is dampened. Implicitly, the use of population as a forecast driver is

considered to capture changes in energy that are linked to changes in rental tenancy rates. As the demand and consumption forecasts are linked to population growth, the forecasts are judged to be appropriate.

A2. Connections forecast methodology update

The methodology adopted for this 2018 update follows the 2017 method, but has been improved to reflect region-specific population projections. Previously, historical ratios of customer numbers between regions were applied into the future, but this did not allow for varying region-specific trends. The customer connections methodology is summarised as follows:

1. Derive a relationship between total number of customers in each customer category (RES, C&G, C&I, Total) and GSP and population.
2. For RES customers:
    a. Apply the Total RES relationship to forecast Total RES connections for the PWC regulated networks.
    b. Derive the forecasts of Alice Springs and Tennant Creek RES customers using the population coefficient of the Total model, and region-specific population projections to drive the forecast.
    c. Derive the forecast of Darwin-Katherine RES customers as Total less Alice Springs less Tennant Creek.
3. For C&G customers:
    d. Apply the Total C&G relationship to forecast Total C&G connections for the PWC regulated networks.
    e. Calculate the ratio of residential-to-commercial customers for Total.
    f. Derive the forecasts of Alice Springs and Tennant Creek C&G customers applying the ratio to the forecast changes in RES customers for each network.
    g. Derive the forecast of Darwin-Katherine C&G customers as Total less Alice Springs less Tennant Creek.
4. For C&I customers:
    h. The Tennant Creek forecast is derived by hand adopting historical levels in the long-term, given the numbers are so small.
    i. The Darwin-Katherine forecast is derived from the Total C&I forecast using the same relative rates of change as the Total forecast.
    j. Alice Springs' C&I forecast is derived as Total less Darwin-Katherine less Tennant Creek.
5. Verification of forecasts was performed by assessing the future ratios of customers in each power system, relative to how that changed in history. This evaluation found trends observed in the forecast were consistent with historical trends and confirms the appropriateness of the forecasts.

Attachment 1

Please see attached file *Connections forecast 20181018_V2.4.xlsb*.