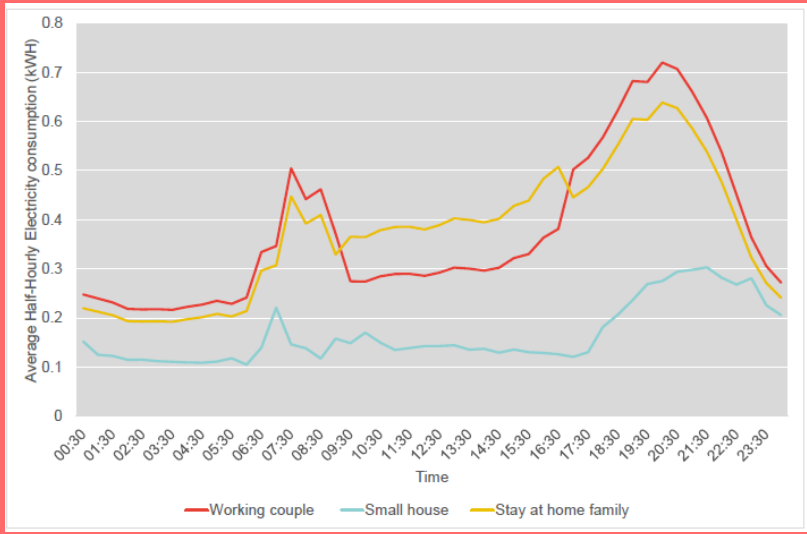
Summary of Frontier recommendations and ATA response

May 2017

Key recommendations

Principle	Frontier Economics recommendations and response pathway – Key recommendations	ATA response
Models/Scenarios should reflect household across the key households (or customer archetypes) in the NEM	The consumption assumptions (both total household consumption and 'end-use' appliance) consumption) are not representative of household consumption in the NEM. Over the longer term we recommend estimating consumption via a top down approach (rather than trying to build up the energy required for each end-use appliance) using actual data from publically available sources such as IPART's 2015 household survey (which contain information on the relationships between household energy consumption and key household characteristics by climate zone) and the AER's consumption benchmarks.[1] Over the short term we recommend including an estimate of the number of hours of space heating in the estimation of a household's heating load. The total energy assumed for electric space heating is materially understated when compared to actual data (say IPART's 2015 household survey). ✔	***We will build a heating and cooling model that uses NatHERS and E3 data along with 30-minute temperature data to determine heating and cooling energy requirements and add them to the interval data for each household type and location.*** This enables us to add daily heating loads to *Gasulator* and 30-minute heating and cooling loads to *Sunulator* in order to most accurately model heating and cooling energy usage for the various household types.
Models/Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	The models would benefit from using actual consumption data (either total consumption or 'end-use' consumption) to ensure the assumed household consumption figures (both total consumption and the pattern of consumption throughout the year and day) reflect the significant diversity in consumption that exists across household types. In the short term we recommend using actual consumption data to ensure that the consumption profiles are broadly in line with actual household consumption. ✔	***All profiles used in the modelling are based on actual interval data.*** These have been selected to reflect the different household types and because they don't include the loads we are modelling..

[1] While there are a number of methodological flaws in the AER's 2014 energy consumption benchmarks, the AER may address these issues in its 2017 update.

Principle	Frontier Economics recommendations and response pathway – Key recommendations	ATA response
Models/Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	It is not clear that the scenarios or customer archetypes capture the variability in residential household consumption across key households (or customer archetypes) in the NEM. This variability across the NEM occurs in terms of total consumption and end-use consumption (in annual, seasonal and hourly profiles). The variability that currently is assumed between some scenarios is not representative of actual household consumption in the NEM or cannot be explained by the key drivers of household consumption. As shown in Figure 8 and Figure 9 the underlying consumption profiles (consumption excluding hot water heating, space heating and cooking) don't seem to reflect the relativities between household types. For instance, a small house has more people than a working couple (and are likely to be at home more than a working couple), yet the consumption profile is significantly lower than the working couple at all times, despite the fact that they live in the same size house. The models would benefit from using actual consumption data (either total consumption or 'end-use' consumption) to ensure the assumed household consumption figures reflect the significant diversity in consumption that exists across household types. Household scenarios would benefit from: • The inclusion of an apartment household archetype • Using Climate Zones to capture most material differences across household consumption driven by location. In the short term we recommend including an apartment household type ✘ and adding an additional zone in South Australia. ✔  	**Alignment of descriptors with profiles** ***We have revised the compositions of household types to reflect the actual compositions of the profiles they are based on.*** (This rectifies some errors made in the original revisions to the methodologies.): • "Stay-at-home family" and "Working couple" are now "Medium home – young family" and "Medium home – older family" respectively, each with two adults and two children and, respectively, regular and low weekday usage. • "Small house" is now "Small and frugal" and has two adults with a low consumption profile, matching the demographic notes on the profiles used for it. • "Large home" and "New build" are both two adults and three children with high and moderate-high (respectively) consumption profiles. **Apartments** We omitted apartments from the modelling because apartment dwellers typically have less fuel choice due to limited choice of fixed appliances for many, and high incidence of tenancies. ***Our results will not apply to apartments; we will consider adding an apartment household type to any future reiteration.*** **Climate zones** Our heating and hot water modelling uses location-specific information to determine energy loads. ***Our new model will add more granular heating and cooling loads using E3, NatHERS, and BoM data to more accurately reflect locational differences in underlying profiles and heating loads.*** ***We will add an extra South Australian location to capture the cooler climate zone.***

Principle	Frontier Economics recommendations and response pathway – Key recommendations	ATA response
Models/scenarios should capture the seasonal nature of household consumption	The models would benefit from calculating bills on a consistent, annual basis, as calculating some bills on a monthly basis and some on an annual basis will not capture the significant variability in household consumption across the year. In the short term we recommend using a consistent approach to calculating bills across all four models. ✔ Over the longer term we recommend integrating the four models into a single model.	***We will calculate all bills quarterly*** *(except Victorian gas bills, calculated bi-monthly)* ***to ensure consistency*** and to help reflect the effect of total consumption and tariff blocks on the marginal energy cost.
Models/scenarios should capture the material variability in solar PV generation across the key households (or customer archetypes) in the NEM	Models / scenarios would benefit from the option to: • have the solar PV system power a household's energy consumption regardless of the end-use driving the consumption; • incorporate different panel sizes such as 1.5 kW, 3 kW and 5kW; • the use of actual PV output data (e.g. data from IPART's household survey). In the short term we recommend incorporating different panel sizes. ✔ Over the long term, we suggest using actual PV output data and allowing the solar PV system to power a household's energy consumption regardless of the end-use driving the consumption.	***The new heating/cooling model will ensure that heating, cooling, and hot water are all included in solar calculations.*** Cooking loads will continue to be separately calculated (at the appropriate tariff rate) – they are so small that excluding them from solar generation is insignificant. 5 kW is typical of new solar installations but not existing ones. ***We have adjusted the solar modelling to use 5 kW for new systems but 2.5 kW for existing ones.*** ***Sunulator accounts for solar variability and sub-optimal conditions*** by using detailed weather data and by de-rating output by 12 per cent.
Models/scenarios should capture the uncertainty in future energy tariff structures and levels over the forecast period (25 years)	The models would benefit from the use of scenarios in forecasting future tariffs given the uncertainties covering the cost of retail gas and electricity supply (incl. climate policy and fuel costs) and tariff structures. In the short term, we recommend using publically available data to inform trends and scenarios in future energy tariffs (including AEMC price trends, and AEMO assumptions). ✔ Over the longer term we recommend considering getting specific advice around forecasting future tariff prices.	The index used to estimate future price changes is based on the most recent AEMO forecasts ***We are confident this approach is no less accurate than any other.*** ***We will undertake sensitivity analyses using higher and lower indexes.*** We note that while consumers are most sensitive to short-term changes, the cost-effectiveness of fuel choice is more dependent on the longer-term trends.
Models should capture the interactions between tariff levels and consumption and vice versa	The models do not consistently calculate bills to incorporate the interactions between tariff levels and consumption and vice versa. The models would benefit from having one section/model calculate the relevant electricity and gas consumption and another section/model calculate the relevant bills, rather than having multiple models calculate household consumption and bills. In the short term we recommend using the Sunulator and the Gasulator to calculate total consumption with and without solar (rather than calculating a household bill with and without solar) and calculating the household's relevant bills in the fuel cost model. ✔ ✘ In the long term, we recommend consolidating the four models into one.	We agree that calculating partial bills in Sunulator and adding cooking and heating costs at the marginal tariff rate risks missing the impact of block tariffs. ***Our new heating/cooling model means that Sunulator will calculate all household quarterly consumption*** *(except for cooking, which will be added to quarterly consumption at the appropriate tariff rate).* Gasulator is needed to calculate gas bills because it incorporates the seasonal nature of most gas tariffs. ***We will continue to calculate gas bills in Gasulator.***

Principle	Frontier Economics recommendations and response pathway – Key recommendations	ATA response
Calculations that rely on results from other calculations should be integrated into the same model	The models would benefit from consolidation. In the short term, care should be taken to ensure that each model uses exactly the same assumptions as the other models and calculates bills in the same way across the four models. ✔ In the long term, the four models should be consolidated into one model.	***We will ensure that assumptions and calculations are done consistently across scenarios.***
General comment	The models would benefit from correcting the Vlookup formula in the ResultsSS tab in the fuel cost model as per the QA log. In the short term, correct the vlookup formula as per the QA log. ✔	***We will correct this formula and others noted in the QA log.***

Overall modelling approach

Principle	Frontier Economics findings and recommendations – Overall modelling approach	ATA response
Economic relationships		
Models/Scenarios should reflect household across the key households (or customer archetypes) in the NEM	The consumption assumptions (both total household consumption and 'end-use' appliance) consumption) are not representative of household consumption in the NEM. As shown in Figure 8 and Figure 9 the underlying consumption profiles (consumption excluding hot water heating, space heating and cooking) don't seem to reflect the relativities between household types. For example, as shown in Figure 9 the models assume working couple households in Sydney have electricity consumption of over 9,000kWh, however, results of the IPART 2015 household survey suggest that the average electricity consumption across all households in Sydney was only 7,788 kWh. A small house has more people than a working couple (and are likely to be at home more than a working couple), yet the consumption profile is significantly lower than the working couple, despite the fact that they live in the same size house. It is likely that during the day, a working couple's consumption more closely reflects the consumption of a small house (as neither have members of the household at home for long periods of time during the day), while during the morning and evening a small house and a stay at home family will have similar profiles. The models would benefit from: • including an estimate of the number of hours of space heating in the estimation of a household's heating load. The total energy assumed for electric space heating is materially understated when compared to actual data (say IPART's 2015 household survey). ✔ • estimating consumption via a top down approach (rather than trying to build up the energy required for each end-use appliance) using actual data from publically available sources such as IPART's 2015 household survey (which contain information on the relationships between household energy consumption and key household characteristics by climate zone) and the AER's consumption benchmarks.[2] ✘	We have corrected demographic descriptors of household types, and reflected this in household composition as used in formulas in the models We will build a heating and cooling model that uses NatHERS and E3 data along with 30-minute temperature data to determine heating and cooling energy requirements and add them to the interval data for each household type and location. This enables us to add daily heating loads to Gasulator and 30-minute heating and cooling loads to Sunulator in order to most accurately model heating and cooling energy usage for the various household types, including capturing the differences between stay-at-home and low-weekday-usage household types.

[2] While there are a number of methodological flaws in the AER's 2014 energy consumption benchmarks, the AER may address these issues in its 2017 update.

Principle	Frontier Economics findings and recommendations – Overall modelling approach	ATA response
Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	As shown in Figure 7, the underlying consumption profiles (consumption excluding hot water heating, space heating and cooking) seem to have unusual patterns of peaks and troughs. Given they represent electricity consumption associated with appliances other than hot water heating, space heating and cooking it is unlikely that they would be as variable throughout the year. The models would benefit from the use of actual consumption data to sense check the results. ✔  	Underlying consumption profiles are derived from actual data of households without electric space heating, hot water and cooking, and with cooling absent or removed. Variability is found in all profiles and reflects variable behaviour with all other appliances, incidental use of supplementary heating and cooling, irregularities in time spent in the dwelling, and so on.
Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	As shown in Section 4.1.1, the models and scenarios are unlikely to accurately capture the variability in residential household consumption across household types and locations in the NEM. Household scenarios would benefit from: • The inclusion of an apartment household archetype ✘ • Using Climate Zones (rather than numerous existing gas/electricity zones) to capture most material differences across household consumption driven by location ✔	Apartments were omitted because fuel and fixed appliance choice is typically more constrained. Our results will not be applicable to apartment dwellers. Our models use NatHERS climate zones for energy loads and gas/electricity pricing zones for tariffs. The new model will add locationally specific cooling loads to our underlying consumption profiles to improve their representativeness

Principle	Frontier Economics findings and recommendations – Overall modelling approach	ATA response
Models/scenarios should capture the seasonal nature of household consumption	As shown in Figure 10 and Figure 11 household consumption varies significantly by season. As such, the models should estimate bills on a quarterly basis to reflect the seasonal nature of consumption. However, some models calculate bills on an annual basis. The models would benefit from consistently calculating bills on an ~~annual~~ quarterly basis. ✔	All bills are calculated quarterly (except Victorian gas bills, calculated every two months) to ensure seasonal differences in marginal costs are reflected and tariff blocks are correctly calculated.
Models/scenarios should capture the differences in the way gas and electric appliances are used	The models assume that a household with gas will use an electric appliance the same way as a household with electricity would use that appliance (i.e. households use the appliance in the same way regardless of what other appliances they may have). The models would benefit from further consultation with the reference group to ensure that they accurately capture differences in the use of electric and gas appliances.	We agree that incorporating the different ways household use different types of appliances would improve the robustness of the model; but it is a task beyond our resources. Our approach, comparing the economics of delivering the same outcome (i.e. amount of heating or hot water) with different fuels, does not predict exact outcomes but still provides useful information for households facing fuel choice decisions.
Models/scenarios should capture the uncertainty in future energy tariff structures and levels over the forecast period (25 years)	The *Gasulator* assume a 3% increase in gas tariff levels each year regardless of tariff type and location. As shown in Section 4.1.2, given the significant uncertainty around future tariffs, this is unlikely to be representative of tariff levels into the future (for example, in the medium term it does not account for changes in network tariffs following recent AER's decisions). The models would benefit from the use of scenarios in forecasting future tariffs. ✔	The index used to estimate future price changes is based on the most recent AEMO forecasts We are confident this approach is no less accurate than any other. We will undertake sensitivity analyses using higher and lower indexes. We note that while consumers are most sensitive to short-term changes, the cost-effectiveness of fuel choice is more dependent on the longer-term trends.
Models should capture the interactions between tariff levels and consumption and vice versa	The model does not accurately capture the relationship between consumption and tariff levels, nor the significant uncertainty in forecasting future tariff levels (for more detail see Section 4.1.3). The models would benefit from having one section/model calculate the relevant electricity and gas consumption and another section/model calculate the relevant bills, rather than having multiple models calculate household consumption and bills. ✔	We agree that calculating partial bills in Sunulator and adding cooking and heating costs at the marginal tariff rate risks missing the impact of block tariffs. Our new heating/cooling model means that Sunulator will calculate all household quarterly consumption (except for cooking, which will be added to quarterly consumption at the appropriate tariff rate). Gasulator is needed to calculate gas bills because it incorporates the seasonal nature of most gas tariffs. We will continue to calculate gas bills in Gasulator.

Principle	Frontier Economics findings and recommendations – Overall modelling approach	ATA response
Modelling techniques and practices		
Calculations that rely on results from other calculations should be integrated into the same model	Utilising different models to calculate inputs for other models and hard-coding the results from one model in another makes it difficult to check any results and increases the risk of failing to update the model with the correct inputs. It also makes it difficult to ensure that the models account for all the factors influencing household energy bills, such as the interactions between tariff levels and consumption. The models would benefit from consolidating the four models into one model.	We will ensure that hard-coded results are entered accurately. We will integrate the models as part of any future reiteration of this project.
Tabs and cells should be coloured to indicate whether they contain inputs or calculations and they should only contain inputs or calculations (not both)	Tabs that contain both assumptions and calculations makes it harder for another person to QA. Across the models, many tabs have a mixture of assumptions and calculations without any indication of whether the cell contains a calculation or assumption. Ensuring that the model is set up in a way that makes it easy to QA will assist in ensuring a robust, defensible estimate.	This will be addressed in future versions of the model
Any assumptions should be correctly documented	In order to ensure a robust, defensible estimate, any assumptions used should be documented to allow others to check the process.	Assumptions are documented in the accompanying methodologies documents. We will revise the methodologies to ensure they are explicit about all assumptions
The models should only include information relevant to the calculation process	The models use a variety of locations in their estimation process, many of which are not used in the final fuel cost model. Including them in the other models makes it difficult to QA. The models would benefit from the removal of irrelevant data.	The models are used for a range of purposes, not just for this project. Therefore, all possible locations are included. This will be more explicitly documented in future, integrated versions of the model.

Fuel cost model

Principle	Frontier Economics findings and recommendations – Fuel cost model	ATA response
Economic relationships		
Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	The model estimates the fuel required for space heating based on the number of rooms in each dwelling and by assuming that every house in every location has the same energy rating (three stars for old house and six for a new build). However, this is unlikely to reflect the variability in dwelling insulation across Eastern Australia. Given this (and the fact that insulation is not a material determinant of household energy consumption), the models would benefit from estimating the fuel necessary for space heating using factors such as: • The number of hours of space heating used (rather than assuming the heating is operational during all heating hours10) to reflect the fact that some household types (stay at home families) and some locations (inland, colder climates) are more likely to use space heating more frequently. ✔ • The use of actual household consumption data (rather than trying to build up the energy required for space heating)	The new heating/cooling model will calculate heating loads from NatHERS data for energy required for heating and cooling in various locations, E3 analysis that estimates the heating and cooling components of the total energy load for each location, and 30-minute air temperature data from BoM. This will give us 30-minute heating and cooling data to add to household profiles, which enables us to differentiate heating and cooling use by stay-at-home and low-weekday-usage housholds. NatHERS data assigns star ratings based on relative heating and cooling energy needs, and is scalable by dwelling size. We have selected 3-star as a compromise between granularity and simplicity – representing typical performance of an owner-occupied dwelling. Individual dwellings vary significantly. Using a standard performance benchmark makes the findings comparable.
Models/scenarios should capture the variability in household appliance stocks and options available to them	Model assumes that a household must replace a gas oven and cooktop with an electric cooktop and oven (i.e. you cannot have a gas cooktop and an electric over). However, many Australian households have a mix of cooking appliances. The model would benefit from the inclusion of the option to replace a gas cooktop and oven with a gas cooktop and electric oven (and vice versa). ✔	Cooking energy usage is so low that fuel choice is unlikely to make a significant difference to overall fuel costs unless replacing a gas cooker with an electric one enables disconnection of gas supply (removing the fixed cost). We will continue to model single fuel cookers – however we will model dual-fuel cookers in some scenarios as a sensitivity analysis.
Modelling techniques and practices		
The models should only include information relevant to the calculation process	There are multiple values for household consumption for the same household type (cooking consumption is 2000MJ in the *Hometypelocn* tab across all household types while consumption in the cooking tab varies by household type). If information is not necessary it should be removed. ✔	This is an error that will be corrected.
General comment	Vlookup formula to import *Sunulator* bills is incorrect- excel doesn't treat TRUE and FALSE generated by the OR command the same as typed true or false.	We will correct this formula as noted in the QA log.

Sunulator

Principle	Frontier Economics findings and recommendations – Sunulator	ATA response
Economic relationships		
Models/scenarios should capture the material variability in solar PV generation across the key households (or customer archetypes) in the NEM	Documentation regarding the model assumes that any existing or new 5kW solar PV system will only power (in part) the hot water load. While this can be considered a helpful 'rule of thumb', it does not reflect actual household consumption patterns.	Solar generation did not offset heating and cooking loads because they were calculated in aggregate, rather than added to interval data. The new heating/cooling model will ensure that heating, cooling, and hot water are all included in solar calculations.
Models/scenarios should capture the material variability in solar PV generation across the key households (or customer archetypes) in the NEM	The model assumes households only have 5kW solar panels, which does not reflect the diversity in the size of solar PV panels on households across Australia. The model would benefit from the option to incorporate different panel sizes such as 1.5 kW, 3 kW and 5kW, particularly given that some jurisdictions have closed their subsidised gross feed-in-tariff schemes.	5 kW is typical of new solar installations but not existing ones. We have adjusted the solar modelling to use 5 kW for new systems but 2.5 kW for existing ones.
Models/scenarios should capture the material variability in solar PV generation across the key households (or customer archetypes) in the NEM	As shown in Box 1, the model assumes the 'ideal situation' around PV output (i.e. it does not capture issues associated with actual PV output that will cause some households within a city to have materially different PV output than other households). For instance, weather data is based on only one weather station in the city despite the fact that solar output would vary within the some cities (e.g. Sydney)	Sunulator accounts for solar variability and sub-optimal conditions by using detailed weather data and by de-rating output by 12 per cent.

Gasulator

Principle	Frontier Economics findings and recommendations – Gasulator	ATA response
Economic relationships		
General comment	The model uses daily consumption to calculate monthly bills (i.e. it does not multiply the consumption generated by the hot water model and the assumed daily heating and cooking consumption by the number of days in each month). The estimates of daily consumption should be multiplied by the number of days in each month to calculate the associated monthly gas bills.	We have checked *Gasulator* and verified that it correctly calculates bills.

Principle	Frontier Economics findings and recommendations – Gasulator	ATA response
Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	The model calculates heating loads without reference to the likely time that household types will be at home (i.e. stay at home families are more likely to be at home than working couples, and thus require more heating time, but they are assumed to consume significantly less energy heating). The model should capture the variability in number of hours of space heating used resulting from location and household types.	The new heating/cooling model generates 30-minute heating data and enables us to credibly differentiate between stay-at-home and low-weekday-usage household types.
Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM	The model assumes that stay at home families and large families use the same amount of energy for cooking and that a working couple and a new-build use the same amount of energy for cooking, which is unlikely. The model would benefit from the use of actual consumption data.	This is an error that has been corrected. Cooking will be modelled according to household size and type, based on data from IPART and ClimateWorks
Modelling techniques and practices		
The models should only include information relevant to the calculation process	The model contains data that is not used in the model itself, or fed through to the fuel cost model. For example, Alice Springs, Ball Brunei, Darwin, Perth and Thursday Island have 200 MJ of energy for space heating every month, which seems unlikely. If the figures are not used (i.e. it is a dummy figure) it should be removed from the model or clearly identified.	These data were used in testing but not in calculations for this project. They have been removed.
The models should only include information relevant to the calculation process	The Gasulator can forecast future gas bills but the fuel cost model does not use the forecasted values (it just adjusts the bill from the current year for inflation).	Gasulator is used for other purposes than just this project. We are applying price increase indices based on AEMO forecasts to all bill calculations for consistency.

Hot water model

<table>
<tr><th>Principle</th><th>Frontier Economics findings and recommendations – Hot water model</th><th>ATA response</th></tr>
<tr><td colspan="3">Economic relationships</td></tr>
<tr><td>Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM</td><td>Some locations are unlikely to be representative of the population. For instance, one of two locations in Queensland used in the model is Thursday Island which is quite far north and unlikely to reflect a large proportion of Queensland's residents.

The model would benefit from:

• The use of more representative locations, e.g. Cairns.
• The use of Australian climate zones to reduce the number of scenarios modelled while accounting for the material drivers of household consumption and ensuring that any estimates are as representative as possible.</td><td>The hot water model is based on NatHERS climate zones. We will revise the locations chosen to better reflect typical households.</td></tr>
<tr><td>Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM</td><td>The model is based on a bottom-up approach to estimating consumption, which requires making assumptions around length of shower time and the number of times that a household uses a hand basin. However, as shown in Section 4.1.1, a bottom-up approach is unlikely to accurately estimate a household's water consumption (e.g. it assumes that every household has an 8 minute shower time except for stay at home families who have 5 minute showers, however, it seems unlikely that a stay at home family has the shortest shower time).

<table><tr><th>Household type</th><th colspan="2">2015 IPART Household survey estimates of appliance use</th><th colspan="2">ATA estimates of appliance use for all household types except working couple</th></tr><tr><td></td><td>Dishwasher</td><td>Washing machine</td><td>Dishwasher</td><td>Washing machine</td></tr><tr><td>Frequency of use (per week)</td><td>3.5</td><td>3.5</td><td>7</td><td>7</td></tr></table>Source: Frontier Economics (2016), Determinants of Household Energy Consumption: A Report Prepared for the Independent Pricing and Regulatory Tribunal; ATA.</td><td>Hot water usage activities are based on survey data. The difference in shower time between stay-at-home-households and all others was an error that has been corrected.

Dishwasher and washing machine usage is set to zero in the model, with one-per-day proposed as a sensitivity analysis.

We will still do a sensitivity analysis for a household with high hot water usage by adding hot washing machine loads (1 per 2 adults, and 1 per child, per week)</td></tr>
<tr><td>Scenarios should capture the variability in residential household consumption across the key households (or customer archetypes) in the NEM</td><td>The model uses average temperature by month, but average temperature at the time of peak water consumption is more appropriate (and could be very different to the average monthly temperature).

The model would benefit from:

• The use of average temperature at the time of peak water consumption (if possible); or
• The use of average minimum temperature.</td><td>Average water temperature by month is used because it affects the temperature of mains water, which does not fluctuate with differences in daily temperature. Mains temperature affects hot water energy use much more than transient ambient temperature.</td></tr>
</table>