

# Modelling the future VEET certificate market for Residential-type measures

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## Overview

Sustainability Victoria developed a spreadsheet model to predict the future behaviour of the VEET certificate market for residential-type measures under a range of certificate price settings. The model was developed initially for the VEET Business Impact Assessment (2007) and has been updated and improved for subsequent VEET target modelling exercises undertaken between 2011 and 2017, as well as for the current modelling exercise.

The *VEET Regulations 2018*, and companion *Victorian Energy Upgrades Specifications 2018*, have 20 Parts which set out eligible energy efficiency measures which can generate certificates when implemented at residential premises. Most of these measures can also be undertaken at non-residential premises, although in this case the same number of certificates is generated as in a residential installation. Only a small proportion of the certificates for these residential-type measures are generated in non-residential premises, as shown by Table 1 below.

**Table 1: Percentage of VEET activities undertaken in non-residential premises – July 2017 to June 2018**

Type of Residential Measure	Certificates Created	Activities Undertaken
Water Heating	1.7%	1.2%
Space Heating / Cooling	0.1%	0.2%
Building Shell Upgrades	0.0%	0.0%
Lighting	2.6%	0.7%
Appliances	0.8%	0.9%
Energy Saving Devices	0.0%	0.0%
<b>Total</b>	<b>2.0%</b>	<b>0.8%</b>

The current version of the model developed by Sustainability Victoria covers the residential-type measures which can be undertaken at both residential and non-residential premises. It takes into account changes to the measures and certificate algorithms that resulted from the *VEET Regulations 2018*, which came into effect from 10 December 2018. In many cases, this led to a reduction in the number of certificates allocated for the measures. Also, some upgrade measures were removed from the scheme<sup>1</sup>, or were flagged to be removed at a future date<sup>2</sup>, and some measures underwent substantial changes<sup>3</sup>.

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<sup>1</sup> Activities relating to solar retrofit kits for electric water heaters, solar pre-heater for gas water heaters, ceiling insulation, gas clothes dryers replacing an electric clothes dryer, and standby power controllers were removed from the scheme. The ceiling insulation measure may be re-introduced at a later date.

<sup>2</sup> The measure relating to the destruction of pre-1996 refrigerator or freezer is to be removed in December 2020.

<sup>3</sup> The measure relating to the replacement of an existing electric water heater was changed to treat replacement with a heat pump and electrically-boosted solar water heater separately. There were significant changes to the measures relating to the installation of high efficiency heaters. A new measure covering the

In addition to the existing VEET measures, the model includes several possible new measures<sup>4</sup>:

- Insulation of an uninsulated ceiling. While this had been a measure in the scheme (although with a Discount Factor set to zero), it was removed in the *VEET Regulations 2018*;
- A high efficiency heat pump water heater replacing an existing gas water heater (from the 2021 target year);
- A high efficiency room reverse-cycle air conditioner replacing an existing gas room heater (from the 2021 target year);
- A measure which would generate certificates related to the heating and cooling energy savings for new houses built to exceed the current minimum 6 Star NatHERS rating – separate measures for 7 and 8 Star houses have been included in the model;
- A measure for new dwellings which have lighting installations which are significantly more efficient than the minimum requirements set out in the building code – separate measures for class 1 and class 2 dwellings have been included in the model;
- A measure which covers the installation of wall insulation into an existing uninsulated external wall cavity;

The possible new measures can either be excluded from or included in the modelling and, if included, the target year in which they are first introduced can be selected using the “profiling factor” (see below).

The model covers the 2019 to 2025 “target years”<sup>5</sup>. While the current target-setting exercise covers the period 2021 to 2025, it is necessary to model from the current target year to understand what the pool of opportunity for the scheme is likely to be at the start of the 2021 target year. Currently, the VEET scheme is ahead of schedule. The 2019 target year commenced in February 2018 and is expected to be completed around May 2019. This means that the target years are not aligned with calendar years. The model assumes that once the 2019 target year is completed, the target years will last for one year.

## How the residential model works

The model estimates the likely uptake of the various residential-type energy efficiency measures in each target year modelled, *based on a certain certificate price* (the independent input to the model), and therefore also estimates the number of certificates generated for each measure and the total number of certificates generated in the VEET Scheme. In addition to this, the model estimates the cost of creating the certificates, the consumer financial contribution which is required for the energy

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installation of a high efficiency ducted air-to-air heat pump in a new home was added. The measure relating to gas room heating was changed, so that certificate allocation was based on the type of heater being replaced – hard-wired electric, gas or plug in electric. Similar changes were made to the measure relating to room air-to-air heat pumps. The measure relating to replacing inefficient light globes, was modified to allow both incandescent/halogen and compact fluorescent lamps to be replaced with high efficiency LED lamps.

<sup>4</sup> Note that the inclusion of new measures in the modelling does not necessarily mean that these *will* be adopted in the VEET Regulations in future.

<sup>5</sup> The VEET Scheme establishes annual targets for the number of certificates that need to be created and surrendered to the scheme administrator. However, certificate creation does not necessarily have to align with this. A “target year” is the time period required to create enough certificates to satisfy the VEET target for that particular calendar year.

efficiency measures taken up, as well as the total annual electricity and gas savings generated over the lifetime of the energy efficiency measures which are implemented.

The model contains a number of key input parameters, and in most cases the input assumptions used for each parameter depend on the specific energy efficiency measure being modelled. The key input parameters used in the model are described in Table 2.

**Table 2: Key inputs to the residential model**

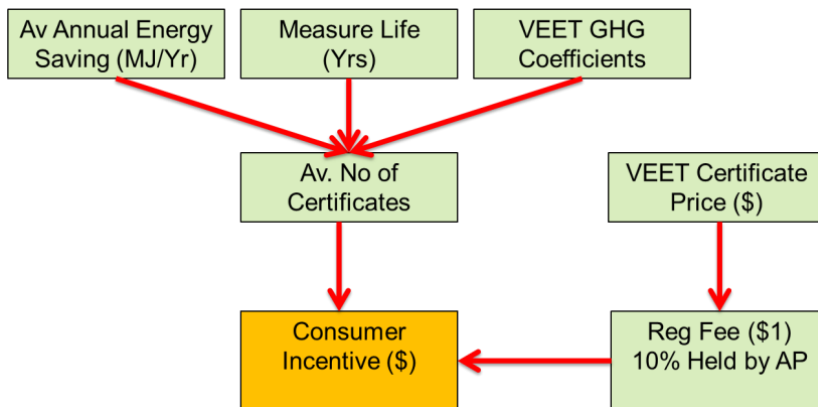
Input parameter	Description
Pool of opportunity	<p>The estimated total number of times a measure could be implemented in the context of the VEET market, based on the expected situation at the end of the 2018 target year. For example, this could be the total number of houses with electric water heaters or the total number of halogen downlights. In the case of measures which target the sale of high efficiency appliances (e.g. televisions or fridges), it represents the estimated total sales of the appliance over the 7-year period being modelled. Estimates of the pool of opportunity are based on a range of data sources, including Australian Bureau of Statistics ABS4602 reports, Gfk appliance sales data, BIS Shrapnel reports, reports produced for the Equipment Energy Efficiency (E3) Program, and the 2015 update of Sustainability Victoria’s bottom-up residential energy end-use model.</p> <p>Where different VEET measures target the same energy end-use (e.g. electric water heaters, halogen downlights), the pool of opportunity for the different measures is adjusted to ensure that there is no double counting. This takes into account the historical data on the replacements under the VEET Scheme.</p> <p>In most cases, the pool of opportunity is around 20% less than the total pool identified for the measure in question, because 100% uptake of any measure is very unlikely.</p> <p>The pool of opportunity is updated every year in the model, to account for both business-as-usual (BAU) uptake and any VEET uptake in the previous target year.</p>
Maximum uptake rate	<p>The estimated maximum number of installations of the measure which would take place in a year <i>if the VEET incentive to the consumer provided a 100% subsidy</i>, e.g. where the installation of the measure is free to the consumer.</p> <p>Where possible, the maximum uptake rate assumptions are based on rates observed previously in the VEET Scheme, and/or have been tuned<sup>6</sup> so that they reflect the actual level of activity observed in the VEET market in 2018.</p> <p>Where the pool of opportunity for a given measure is likely to decline over time, due to a combination of BAU uptake and VEET uptake (e.g. electric water heaters or halogen downlights), the maximum uptake rate for 2019 was converted into a percentage, and this percentage was applied to the remaining pool of opportunity, in each year, to estimate the maximum uptake rate for that year.</p>

<sup>6</sup> The maximum uptake rates for the various measures were adjusted so that the modelled results matched the expected level of activity for the 2019 target year.

Profiling factor	<p>This factor is set between 0 and 1 for any given year from 2019 to 2025. It is set to 0 for any years that the measure is excluded from the scheme, and is set to 1 for the years in which the measure is fully active in the scheme. Where a new measure is introduced into the scheme, it can be ramped up over a few years (factor set between 0 and 1), if it is believed that the measure will not be fully active right from the start.</p>
Annual electricity and gas savings	<p>The estimated <i>average</i> annual electricity and gas savings (in MJ/yr) each time that a particular measure is implemented (e.g. water heater or light globe replaced).</p> <p>In general, these savings take into account the electricity and gas saving assumptions contained in the <i>VEU Specifications 2018</i>. Where appropriate, recent VEET installation data from the Essential Services Commission was also used to take into account the likely size and efficiency bands of the measures being installed, as well as their location.</p>
Measure lifetime	<p>The assumed lifetime of a particular energy efficiency measure in years. Except for the new measures, this is taken from the <i>VEU Specifications 2018</i>.</p>
Greenhouse coefficients	<p>The average energy savings are multiplied by the greenhouse gas coefficients to calculate the annual greenhouse gas abatement, and this is multiplied by the measure lifetime to calculate the average number of certificates created each time a given measure is implemented.</p> <p>For the 2019 and 2020 target years, the coefficients used are those which are currently used as the basis of the VEET certificate generation algorithms: electricity – 1.095 kg/kWh; gas – 0.05523 kg/MJ.</p> <p>For the 2021 to 2025 target years, the model uses the new greenhouse gas coefficients specified by DELWP: electricity – 0.576 kg/kWh; gas – 0.05523 kg/MJ. The lower greenhouse gas coefficient for electricity from 2021 significantly reduces the number of certificates created for those measures that mainly save electricity.</p>
Adjustment factor	<p>As noted above, the <i>VEET Regulations 2018</i> were introduced in December 2018 – this was around 80% of the way through the 2019 target year. For many measures, the 2018 Regulations led to a significant change in the number of certificates created for a given measure. To account for this, where relevant, an Adjustment Factor was applied to the certificate calculation <i>for 2019</i>, so that the number of certificates created matched the average for 2018. The average energy savings for all measures were held constant, so that after the 2019 target year, the certificate creation was consistent with the 2018 Regulations until the 2021 target year, when new greenhouse gas coefficients were applied.</p>

Total additional cost	<p>The estimated average additional cost of implementing the specific energy efficiency measure compared to business-as-usual, taking into account the context of the VEET scheme. For low cost measures, such as light globe replacements, VEET acts like a bulk buy scheme, and the product costs can be much lower than the retail costs.</p> <p>In the case of high efficiency appliances, the additional cost is the differential cost between the high efficiency appliance and the market average appliance which is currently sold.</p> <p>The additional cost assumptions in the model were reviewed, and revised where necessary. Where the cost of the products is likely to reduce over time (e.g. high efficiency LED light globes, or heat pump clothes dryers), this is taken into account by applying a learning rate, which reduces the cost over time.</p>
Uptake Rate Function	<p>This is a non-linear function which describes the relationship between the VEET consumer financial incentive, expressed as a percentage of the total differential cost of a particular measure, and the maximum uptake rate. When the incentive is low, the uptake rate is well below the maximum. As the incentive approaches 100%, the uptake rate rises quickly, so that at a 100% subsidy it is equal to the maximum uptake rate.</p> <p>Two uptake rate functions are used in the model, one for the low-cost measures that consumers are likely to expect to be free (e.g. light globe or shower rose replacements), and one for the higher cost measures where consumers are likely to be happy with a subsidy (e.g. water heater and heater replacements, insulation). <i>See below for further discussion.</i></p>

Figure 1: Calculation of the consumer financial incentive for each measure



The key driver of the residential model is the VEET consumer financial incentive expressed as a percentage of the total additional cost of a specific measure. Figure 1 is a schematic diagram which shows how the model calculates the financial incentive available to the consumer for each energy efficiency measure. The annual energy savings, multiplied by the measure lifetime, multiplied by the relevant greenhouse coefficients, gives the average number of VEET certificates which are created every time the measure is implemented. The VEET certificate (or VEEC) price, expressed in \$ per certificate, is an independent variable which can be input into the model. This is reduced by the \$1

registration fee which is payable to the Essential Services Commission, and by a further 10% which is assumed to be held by the Accredited Party (AP) and not passed on to the consumer. The remainder is multiplied by the average number of certificates created when the measure is implemented to estimate the financial incentive which is available to the consumer to motivate them to take up the energy efficiency measure. In some cases, this will cover the entire cost of the measure and it will be offered as a free installation to consumers. In other cases, it will represent a subsidy which the AP could provide to the consumer for undertaking the energy efficiency measure.

Figure 2: Estimation of the annual uptake rate for each measure

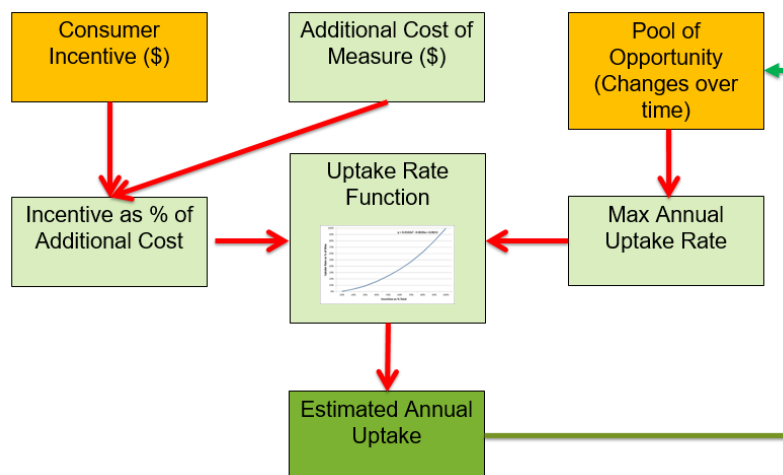
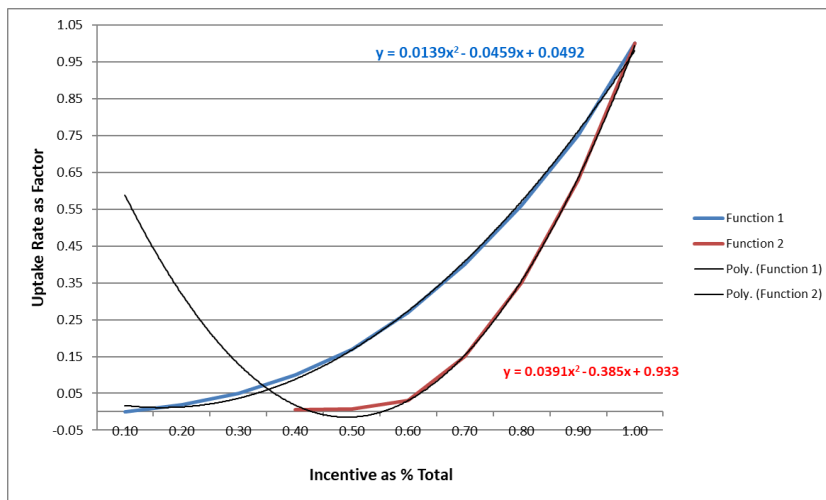


Figure 2 shows how the model estimates the annual uptake rate of each energy efficiency measure *for a given certificate price*. The consumer financial incentive depends on the certificate price entered into the model, and the characteristics of the particular energy efficiency measure in question (see Figure 1). The consumer incentive is divided by the total additional cost of the measure and expressed as a percentage of the total additional cost. (In our experience, most consumers are not motivated by paybacks – in many cases they simply cannot calculate them – but are motivated by the size of the incentive they will receive in relation to the total outlay required.) This percentage is used as an input to the Uptake Rate Function. The function returns a number between 0 and 1, which is multiplied by the maximum uptake rate to determine the uptake rate in a given year. If the output of the function is 0 there will be no uptake of the measure. If it is 1, the uptake of the measure will be at the maximum uptake rate. The pool of opportunity is updated from year-to-year to reflect the uptake of a given measure in the previous year, and any BAU uptake. When the pool of opportunity for a particular measure is exhausted, that measure will see no further uptake in the model.

The Uptake Rate Function is based on the experience of implementing energy efficiency rebate programs. In this case, there is usually little or no uptake of an energy efficiency measure when the rebate is only a small proportion of the total cost to the consumer (say 10 to 20%), but the uptake ramps up rapidly as the rebate approaches a 100% subsidy. The model uses two Uptake Rate Functions (see Figure 3 below), one for the low-cost measures that consumers are likely to expect to

be free (Function 2<sup>7</sup>), and one for the higher cost measures where consumers are likely to be happy with a subsidy (Function 1<sup>8</sup>).

Figure 3: Uptake rate functions used in the VEET residential model



## Key changes from the 2017 version of the model

The current version of the model is an update to the 2017 version of the model, developed to assist with the VEET Regulation sunset review. The main changes that have been made to the model since then are:

- As noted above, some existing measures were removed, new measures were added, and some existing measures were re-structured, to take into account changes put in place by the Dec 2018 Regulations.
- The model is assumed to start in the 2019 target year (Feb 2018 to approx. May 2019), and covers all target years from 2019 to 2025;
- Energy savings for each measure are based on the revised (Dec 2018) VEET Regulations, and also take into account the most recent measure installation data from the Essential Services Commission (e.g. size, efficiency level and locational distribution of relevant measures);
- Adjustment factors have been applied for the 2019 target year so that VEEC values are consistent with reality in that year;
- The “pool of opportunity” for each measure was updated to reflect the anticipated position at the end of the 2018 target year;
- Maximum uptake rate assumptions were reviewed and revised (“tuned”), where necessary, so that the modelled uptake of the different measures was consistent with the expected uptake in the 2019 target year;
- Measure cost assumptions were reviewed and adjusted where necessary;
- The model was updated to allow different greenhouse gas coefficients to be entered for the 2021 to 2025 target years – these coefficients impact on the calculation of the average number of certificates generated by each measure.

<sup>7</sup> Below an incentive of 10%, the uptake rate is assumed to be 0.

<sup>8</sup> Below an incentive of 50%, the uptake rate is assumed to be 0.

## Outputs from the residential model

The key outputs from the model include:

- The number of installations of each energy efficiency measure in each year of the 7-year period modelled (2019 to 2025 target years);
- The number of certificates generated by each energy efficiency measure, and the total number of certificates generated, in each year;
- The cost of generating the certificates in each year and the cost of any consumer contribution to generating the certificates;
- The annual electricity and gas savings generated by each energy efficiency measure, and the total annual electricity and gas savings generated over the lifetime of the energy efficiency measures implemented<sup>9</sup>. The VEET measures have lifetimes of between 5 and 25 years. This represents a time-series of electricity and gas savings, that builds each year as a new cohort of VEET savings is added. The model has been set up so that the energy savings for just the 2021 to 2025 target years can be separately identified. These energy savings are necessary for any subsequent modelling of the impacts on the energy supply system;
- The estimated total annual greenhouse gas abatement over the lifetime of the measures. This is based on the greenhouse gas coefficients used for the certificate calculations, and is intended as a guide only. In reality the greenhouse gas coefficients are likely to change over time, especially for electricity;
- The estimated average annual electricity and gas savings per household over the lifetime of the measures implemented. This is intended to provide insights into the impact that the certain targets will have on household energy consumption; and,
- The model includes some outputs that are intended to assist with understanding the future potential of the scheme. This includes the estimated total certificate creation potential in certain years (2019, 2021, 2023), and the estimated maximum annual certificate creation potential from 2021 to 2025.

## Integrating the residential model with the other models

The residential model is one of three models which have been created to assist with modelling the impact of possible future VEET targets. Models covering business lighting and other business measures have also been created. All models have been developed to use the certificate price as an independent input, and to return the total number of certificates generated at that price, and the time-series of projected energy savings. Used together, these models provide an estimate of the certificate price required to achieve different annual certificate target scenarios, as well as the future time series of electricity and gas savings.

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<sup>9</sup> Note that in the first year of each cohort of measures it is assumed that only half of the annual savings are achieved – these savings are added back at the end of the lifetime of the cohort's energy savings. This recognises the fact that in any year the VEET measures will be implemented throughout the year.