



# **FY 2015 Base Milk Price Energy Inputs Review**

**A report for  
The Commerce Commission**

**Strata Energy Consulting Limited**

**31 July 2015**

*This report has been prepared to assist the New Zealand Commerce Commission (the Commission) with its assessment of the 2015 Base Milk Price.*

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*In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the Dairy Restructuring Act or other legal instruments.*

*The report contains Strata's comments, views and opinions based on its understanding of the methodology used to determine the energy input values. Our views and opinions have been formed from our interpretation of information provided, discussions with Fonterra and on the related experience of our consultants.*

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### **About Strata**

*Strata Energy Consulting Limited specialises in providing services relating to the energy industry and energy utilisation. The Company, which was established in 2003, provides advice to clients through its own resources and through a network of Associate organisations. Strata Energy Consulting has completed work on a wide range of topics for clients in the energy sector both in New Zealand and overseas.*

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# 1 Headlines

- 1 The Commission required Strata to:
  - a) review the approach used by the Milk Price Group (MPG) to determine standard energy unit costs and resource usage rates;
  - b) review the practical feasibility of the standard energy unit resource costs and resource usage rates assumed in the milk price model; and
  - c) review the independent audit approach adopted by Aurecon New Zealand Limited<sup>1</sup> (Aurecon) in reviewing Fonterra's energy audit.
- 2 The following headlines provide a summary of the key findings of our review in relation to the Commission's specific requirements.

## 1.1 The approach used for the base milk price inputs

- 3 We have reviewed and assessed the methodology through which the energy inputs to the base milk price are determined. We have found that the approach and Excel workbook energy inputs model (EI model) are sound and fit for the purpose set out in the Dairy Industry Restructuring Act 2001 (DIRA).
- 4 We have noted that the EI model used to determine the input values is subjected to ongoing continuous improvement and validation. This process provides confidence that the outputs of the EI model can be considered to be reliable and current.
- 5 To provide additional assurance, we suggest that the EI model (Excel workbook) used to calculate the energy inputs is subjected to an independent audit and that a formal procedure is documented and applied for the development and approval of any changes.
- 6 We have noted some areas where delays in integrating improvements into the model have occurred and consider that increased priority of these issues is desirable.

## 1.2 Practical feasibility of the assumed energy costs

- 7 We have found that the energy unit cost derived through the EI model has been calculated in accordance with the described methodology.
- 8 We have found that the rates were calculated using Fonterra's budgets. The model therefore applies electricity, gas and coal prices based on

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<sup>1</sup> <http://www.aurecongroup.com>

Fonterra's overall contract prices and short term purchasing arrangements. Therefore the model assumes that the notional milk price producer<sup>2</sup> would hold the same contract and short-term price positions as Fonterra.

- 9 The unit rates for electricity have been tested against market prices and our assessment against disclosed electricity contract prices supports the rates used.
- 10 For steam, we have found that the coal and gas unit prices were derived from budgeted Fonterra unit costs and that these align with forecast prices for 2015/16.
- 11 We have found that the resulting prices are consistent with MBIE information of forecast coal prices. We consider that the variable steam unit cost assumed in the notional milk price producer model is practically feasible if the notional milk price producer had access to Fonterra's fuel contract rates.
- 12 We have found that the EI model calculates gas fixed costs using Fonterra's budgeted costs, scaled to match the milk volumes and production capacity of the notional milk price producer. We have noted that steam is purchased on fully variable rates and that no fixed unit costs apply to this fuel.
- 13 We have concluded that:
  - (a) the electricity variable and fixed unit costs assumed in the EI model are practically feasible; and
  - (b) the steam variable and fixed costs assumed in the EI model are practically feasible.
- 14 On resource usage we have found that the steps taken by Fonterra when establishing and validating and calibrating the modelled resource usage for the notional milk price producer is reasonable and should produce an input value that is a reasonable estimate of that which a notional milk price producer would achieve.
- 15 Based on our review of methodology used to establish resource usage rates and taking into account the use of the validation of the values against actual production figures, we have found no reason to conclude that a notional milk price producer could not achieve the inputs.
- 16 We therefore conclude that the usage rate values are practically feasible. However, we suggest that the use of other options such as a production-weighted age profile are considered, rather than the proposed average of the ED3 (Edendale dryer 3) and DD1 (Darfield dryer 1) audits to determine the energy usage production rates for the EI model.

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<sup>2</sup> The hypothetical dairy producer used to establish the milk price to be paid to farmers

### 1.3 The Audit approach used by Aurecon

- 17 At the commencement of this review, our understanding was that the EI model had been constructed to provide energy inputs for a notional Milk Price Producer . The main components of the production plant were modelled using equipment manufacturers' information and other reliable data. We understood that periodic audits of actual operating plant would provide information that could be used to validate and, as necessary, update the EI model. We expected to see the adjustments being undertaken at a component level in the EI model<sup>3</sup>.
- 18 In practice, the MPG applies the audited data at the gross level and this is effectively overwriting the component based equipment supplier derived data. In other words, the EI model is becoming irrelevant as the energy inputs are essentially production volume adjusted average Fonterra loss survey production figures and the energy unit rates are average Fonterra rates. Loss survey data is only available for WMP and SMP. energy inputs for BMP and AMF remain to be determined from equipment supplier full plant capacity data with adjustments made for partial loading.
- 19 The implications of the above observations are beyond the scope of this review.
- 20 We have observed that the audit of ED3 included the metering and measurements recorded for the appropriate ED3 milk powder production plant. Where the recorded information did not include processes that were included in the EI model and/or the DD1 audit, we observed that adjustments were made by MPG to reflect these differences.
- 21 We consider that the ED3 and DD1 production plants are likely to reflect the performance of relatively old and new milk powder production plant respectively.
- 22 We have noted that MPG recommends the use of average performance metrics derived from these audits in the EI model. In our view, the use of the average of the two audits is not appropriate and we suggest that MPG considers applying an adjustment that is scaled to reflect the production-weighted age profile of Fonterra's milk powder production plants.
- 23 It is likely that this would result in a lower energy input per unit of production to that proposed by MPG.

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<sup>3</sup> The equipment supplier information in the EI Model are relatively high level, main component gross, values



## 2 Introduction

### 2.1 Purpose of this report

- 24 The purpose of this report is to provide advice to the Commerce Commission (Commission) on specific aspects of its Statutory Review of Fonterra's base milk price calculation. The Commission previously identified a cost component of the base milk price calculation that required the input of an expert in the field. Accordingly, the Commission engaged Strata Energy Consulting Ltd (Strata) to provide advice on specific aspects related to the energy input components of the base milk price calculation.

### 2.2 Context

- 25 The Commission is required to undertake two statutory reviews of Fonterra's base milk price-setting in each milk season under the 2012 amendments to the Dairy Industry Restructuring Act 2001 (DIRA). The base milk price is the price paid by Fonterra to dairy farmers for raw milk. It is also known as the 'farm gate' milk price.

- 26 DIRA (section 150A(2)) requires that:

*... any notional costs, revenues, or other assumptions taken into account in calculating the base milk price are practically feasible for an efficient processor.*

- 27 DIRA requires that Fonterra must maintain and publish a manual (the milk price manual) that sets out how the base milk price is calculated.

- 28 DIRA requires that the Commission must, for each season, review and report on the milk price manual. The report must set out the Commission's findings on the extent to which the milk price manual is consistent with the purpose of section 150A of the DIRA.

- 29 In its final report on the 2013/14 base milk price manual the Commission considered it was:

*... unable to conclude, based on differences in approach between Fonterra and our independent expert. Our expert on energy costs identified that Fonterra's assumption regarding manufacturing plant on product time (OPT) is higher than his analysis suggests is feasible. In his view, additional energy costs are required to operate at the assumed 95% OPT. In its submission on our draft report, Fonterra has provided further information which arguably better supports its approach to calculating energy costs. We intend to further review the information in our 2014/15 calculation review*

- 30 The Commission had questions regarding the effect that its conclusions on energy cost components may have on other components of the base milk price calculation and on the calculation in aggregate. Accordingly, the Commission decided to undertake a further review of the energy cost data. This review, to be completed as part of the 2015/16 calculation review, was to include an assessment with MPGs of its assumptions on the level of required ancillary plant, such as boilers, for consistency with MPG's plant availability assumption.

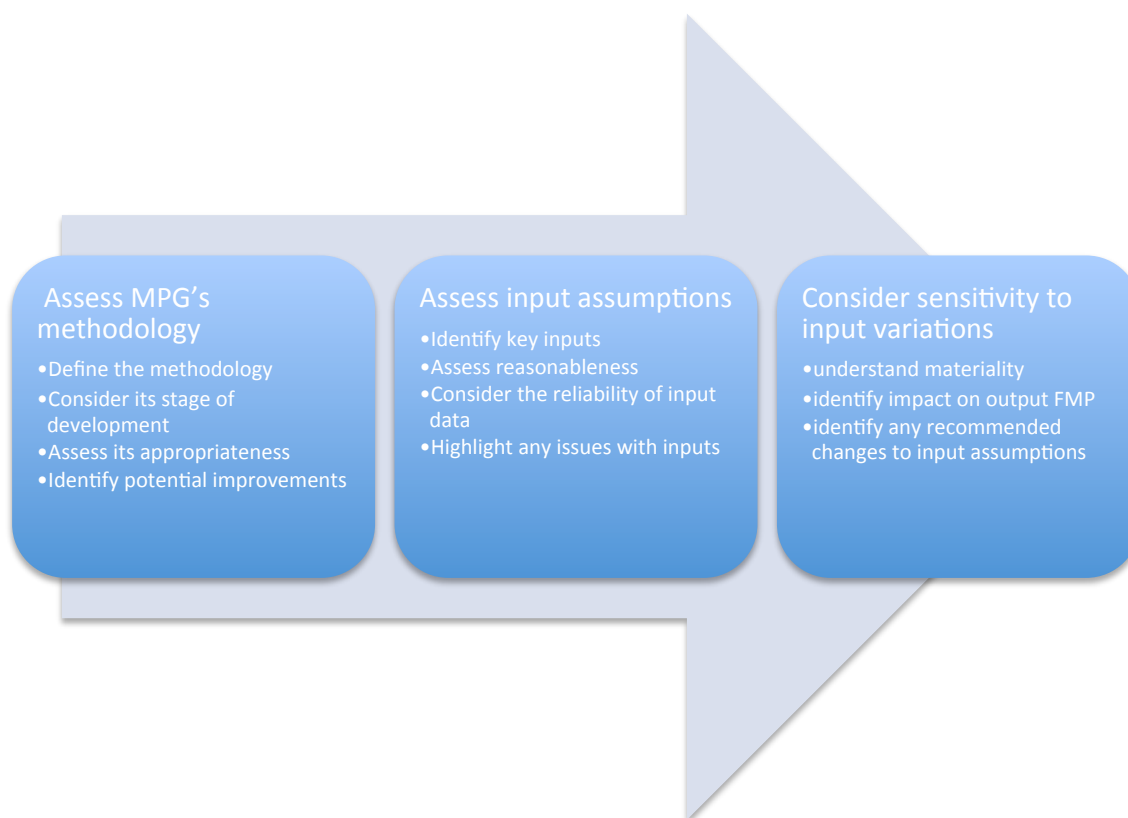
## 2.3 The scope of the review

- 31 The Commission required Strata to provide technical advisory services to:
- a) review the approach used by the Fonterra team to determine standard energy unit costs and resource usage rates;
  - b) review the practical feasibility of the standard energy unit resource costs and resource usage rates assumed in the milk price model; and
  - c) review the independent audit approach adopted by Aurecon in reviewing Fonterra's energy audit.
- 32 The Commission had previously encountered challenges in resolving some issues through detailed 'bottom-up' analysis and modelling. Accordingly, it required Strata to use an alternative 'top-down' approach for testing the validity and sensitivity of MPG's assumptions on energy costs. It was expected that the alternative approach would provide a more qualitative perspective in addition to the quantitative analysis undertaken by the Commission.
- 33 In particular, the Commission expected that the findings would inform its consideration of the notional 'efficient producer' model used by MPG.
- 34 The Commission required that the information considered in the review and the findings needed to be clearly communicated to people with diverse interests and technical knowledge. Accordingly, the presentation of the information was to be in a format that provided clear communication of technical concepts to a non-technical audience.

## 2.4 Strata's approach to the review

- 35 To meet the Commission's first two requirements (to assess the practical feasibility of the energy cost usage used in the manual and the approach taken by MPG); Strata adopted a standard three-step top down approach.

**Figure 1: Our 3 step approach**



- 36 To define and assess the methodology used by MPG to establish the total energy cost per unit of reference commodity product (RCP), we developed and set out our understanding of MPG's methodology. We then checked our understanding of the methodology with MPG and revised this as necessary.
- 37 Once MPG had validated our understanding of the methodology we assessed its appropriateness. In doing this we took into account the requirements of DIRA, the stage of development the methodology had attained and consistency with good practice.
- 38 Having considered the overall methodology, we then identified and assessed the key inputs into the energy component of the milk price calculation. Our consideration included the sources of data, the reliance that could be placed on the data and any assumptions made by MPG when setting the values used.
- 39 We undertook a review of the Excel workbook model that MPG has developed for the notional milk price producer. Our review of the model was limited to tracing output values to input precedents through the formulas and links. The purpose of our review was to gain an understanding of the extent to which the methodology described had been applied in practice in the model. We did not undertake a comprehensive audit of the model.
- 40 We have found that MPG validates its input values and assumptions through analysis of actual plant production figures, including through

periodic audits of specific production plants. Our approach to address the Commission's third requirement (which was to review the independent audit approach adopted by Aurecon) was to assess the most recent audit of the Edendale dryer ED3 undertaken in February 2015 and consider the appropriateness of any actions taken by MPG subsequent to the audit.

## 2.5 Structure of this report

- 41 In section 1, we have provided a summary of our findings, in the form of headlines, in relation to the Commission's requirements for the review.
- 42 The scope of the review and important background information is provided in this section 2.
- 43 In section 3, we set out our understanding of the methodology used by MPG to determine its energy input values for the calculation of the base milk price. We also provide our assessment of the methodology.
- 44 In section 4, we provide our assessment of the methodology used by MPG to determine the energy unit cost values and consider the practical feasibility of those values. We have structured this section to provide a description followed by our assessment for each component of the methodology.
- 45 In section 5, we provide our assessment of the methodology used by MPG to establish the resource usage values and our assessment of the practical feasibility of those values. This includes consideration of the on product time (OPT) value used by MPG in its base milk price calculation.
- 46 In section 6, we provide our assessment of the ED3 audit and how the results of the audit are used to validate the assumed values in the calculation of the base milk price.
- 47 In section 7, we summarise the main conclusions arising from this review.

### 3 The energy inputs methodology

48 In this section, we consider the methodology used by MPG to determine the energy inputs for the base milk price calculation.

49 It is important to understand the distinction between the methodology and the input values used to calculate the base milk price and the energy input values for Fonterra’s actual production. Whilst Fonterra’s energy input values are used to inform the energy inputs to the base milk price, the methodology calculates the energy inputs for an efficient notional producer and not for Fonterra.

50 Throughout this report the term ‘methodology’ refers to the method used to calculate the base milk price for the efficient notional producer as required by DIRA.

#### 3.1 Overview

51 The methodology used by MPG and as set out in section 1.3 of the Milk Price Manual, has two main energy cost components:

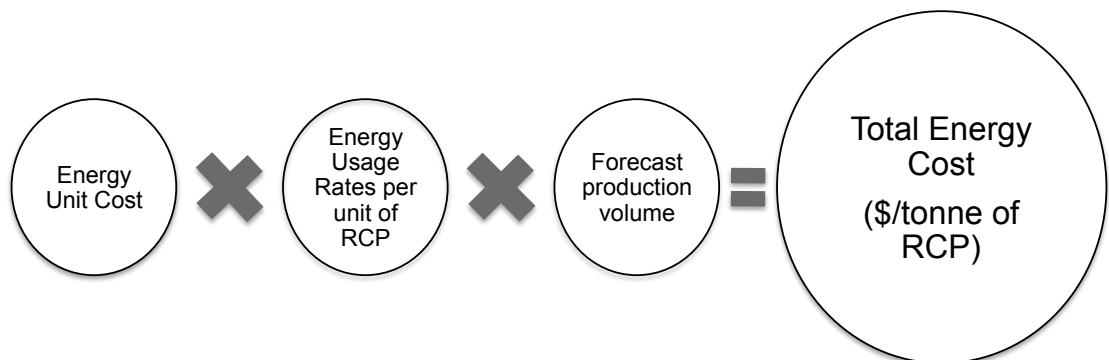
1. The Allowable Unit Resource Costs (AURC) e.g. energy unit cost (\$cost per unit of energy); and
2. Resource Usage Rates (RUR) (energy units consumed per tonne of reference commodity product (RCP) produced)

52 Section 1.3 of the Milk Price Manual defines energy costs as:

*For a Year, the amount Fonterra would incur if the Base Milk Price Product Mix was produced, given:*

1. *the Resource Usage Rates for each Standard Plant; and*
2. *the Allowable Unit Resource Costs.*

53 Total energy cost (\$ per tonne of RCP) is calculated as:

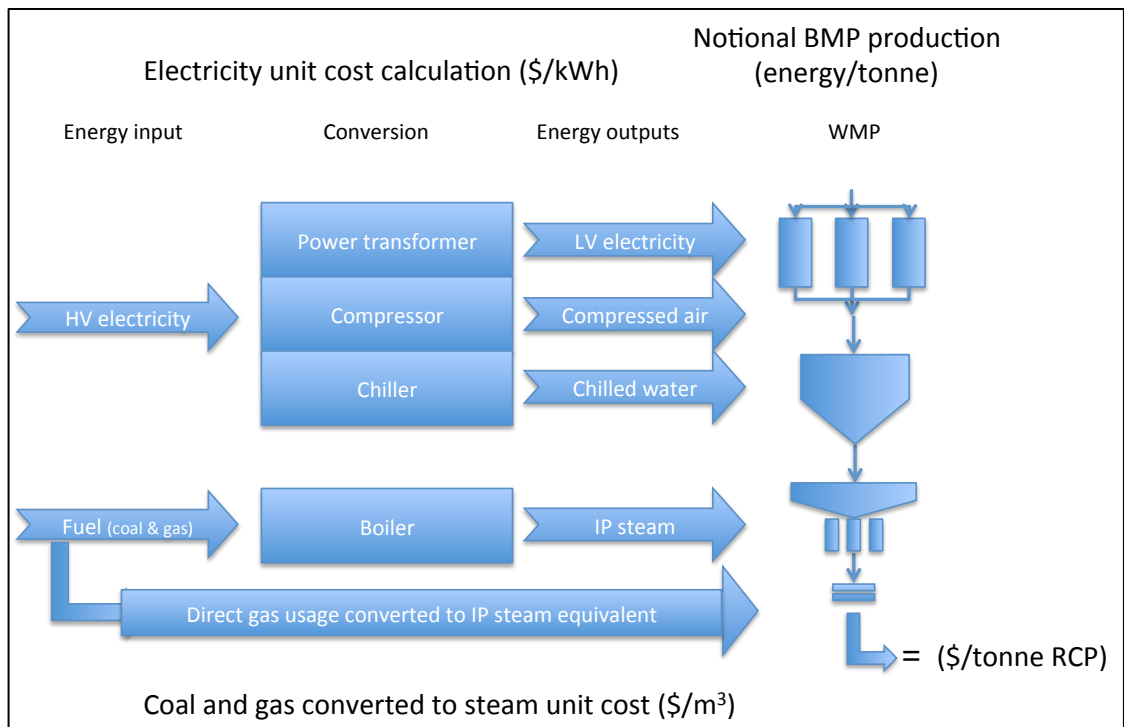


54 When forecasting production volumes, MPG takes into account the expected non-productive periods (this is mainly downtime due to plant

cleaning and fault repairs etc). Thus, modelled production volumes are adjusted for OPT. OPT is further considered in section 5.

- 55 To undertake the base milk price energy inputs calculation, MPG has developed a mathematical Excel workbook-based model (the EI model). Conceptually, the EI model can be considered to include the various components of energy inputs and production energy demands.

**Figure 2: Energy and usage components**



- 56 Energy input unit costs are based on Fonterra’s budgeted national average energy input cost for all sites. The relevant energy sources are electricity (including usage for compressed air and chilled water), coal and gas.
- 57 Coal and gas fire boilers to produce steam. Gas is also used directly as a heat source. When used directly, gas consumption is converted to a steam equivalent value for the EI model.
- 58 Initial development of the EI model used manufacturers’ specifications for the energy usage rates of various plants and for the contribution to peak demand costs. Aurecon independently assessed the values used.<sup>4</sup> These inputs are reviewed and revised annually as audit-sourced data becomes available.
- 59 The methodology used for determining the energy inputs for other RCPs (i.e. skim milk powder (SMP), butter milk powder (BMP) and anhydrous milk fat (AMF)) follows the same approach (and EI model) as used for whole milk powder (WMP). We note that the audits undertaken at Darfield

(2014) and Edendale (2015) have been carried out on dryers that were producing regular general trade WMP at the time.

### 3.1.1 Adjustments made to EI model inputs

- 60 The EI model values are adjusted to account for conversion efficiency and losses (e.g. electricity voltage transformation losses and fuel conversion losses in producing steam). Other adjustments are made to take into account specific characteristics of the Fonterra plant that are not included in the notional milk price producer production plant (see section 3.1.2). The output from this part of the model is the assumed AURC.
- 61 A further adjustment is made to account for on-site delivery losses (e.g. internal electricity and steam distribution losses). As the base milk price uses production usage rates of energy, and Fonterra budgets on units of energy purchased or produced (e.g. electricity co-generation plant output), allowances for onsite losses need to be accounted for in the EI model.
- 62 Adjustments are made to the model to compensate for variations in production across the Fonterra production plant portfolio. For example, the Tirau site utilises biogas produced from the metabolism of whey by micro organisms. As the notional milk price producer does not produce whey it is not able to utilise biogas in principle. The derivations of the notional milk price producer inputs include an adjusted Tirau energy budget to reflect this. Similarly the Te Awamutu, Edendale and Waitoa sites have steam turbine generators onsite, which the notional milk price producer does not have. An adjustment to the electricity budgets at these sites has been made to reflect this difference.

### 3.1.2 EI model validation and calibration

- 63 The EI model is validated and calibrated through annual reviews of key input assumptions and budget accuracy and considering measurements at selected actual RCP production plants during annual audit processes.
- 64 As the EI model uses adjusted Fonterra budgeted values, the EI model is effectively validated and calibrated annually against expected real life conditions. We have also observed that the budgeting methods have been subjected to review and improvement and that this review process is ongoing.
- 65 We have observed that annual reviews of specific components of the EI model take place and MPG recommends changes to the EI model input assumptions to the Milk Price Panel (Panel). If it is considered necessary and appropriate by the Panel, MPG makes model adjustments. In this way, the base milk price can be considered to be in continuous improvement, with a governance structure for regulating changes to the EI model.
- 66 We have noted instances where market comparisons have been used to validate energy unit costs. For example, when developing the F15 electricity inputs, competitive market proposals from alternative electricity

suppliers were obtained and used to determine appropriate adjustments to the EI model variable electricity prices.

- 67 Annual audits of actual production plants are used to provide both validation of the EI model input values and to calibrate the values using actual plant performance.

### 3.2 Our assessment of the methodology

- 68 In concept, the EI model and the energy inputs are relatively straightforward. However, due to the number of site energy usage components and validation steps, the model itself has necessarily evolved to be quite complex.
- 69 We consider that the design of the model is sound and meets the requirements set out in DIRA. We consider that the following features of the model provide a degree of assurance that the model will produce energy inputs that can be reasonably expected to be achieved by the notional milk price producer:
- (a) the use of adjusted budgeted Fonterra costs and quantities scaled for the notional milk price producer;
  - (b) the establishment of input values based initially on manufacturers' specifications and subsequently validated and calibrated through audit and analysis of actual production;
  - (c) the use of internal experts and independent specialists to undertake reviews of specific EI model components and input values; and
  - (d) the use of periodic audits of actual production plants to obtain reliable data and information that is used to inform, validate and calibrate the EI model and its continuing development.
- 70 We have some concerns regarding the pace of development of the EI model. For example, MPG has set provisional onsite delivery losses with input from the Energy & Utilities Group obtained in 2012. Subsequently, Aurecon was asked to provide loss estimates that were to be used to update the initial loss values. However, these were obtained too late in the process to be included in the F13 EI model and do not appear to have yet been used in F15. The F15 values of [ ]% electricity, [ ]% steam and [ ]% chilled water and compressed air are unchanged from the F13 provisional values.
- 71 We have formed the view that if further development of the EI model were given a higher priority, improvements in the model would be accelerated and confidence in its outputs would be enhanced.
- 72 In addition to the above, we suggest that the EI model (the Excel workbook) used to calculate the energy inputs is subjected to an independent audit



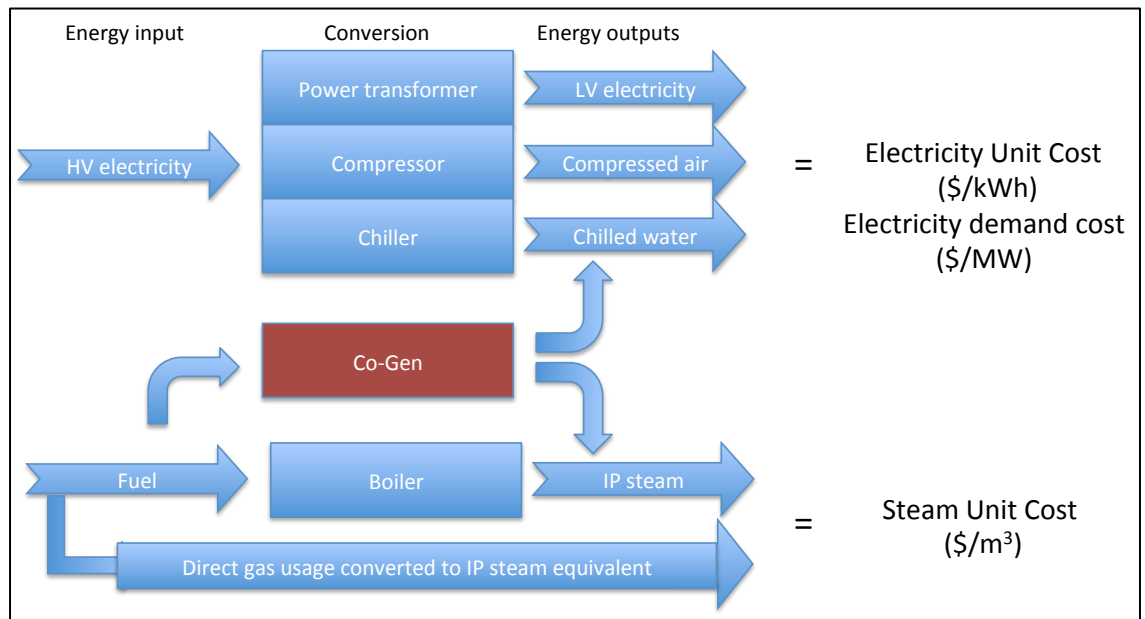
and that a formal procedure is documented and applied for managing the development and approval of future changes.

- 73 Notwithstanding the above suggestions, our overall assessment is that the base milk price model for the notional milk producer is well designed and fit for purpose. We consider that, if the input values are practically feasible, then the outputs from the model should also be practically feasible and fall within the range of what a notional milk price producer should be able to achieve.

## 4 Practical feasibility of the energy unit costs

74 In this section we consider the practical feasibility of the energy unit costs applied by MPG in the base milk price calculation. Figure 4 provides a high level view of the main components to be discussed.

**Figure 3: Energy input components**



75 MPG uses Fonterra’s budgeted aggregated costs for all production sites (including both RCP and non-RCP production plant) to provide the average energy costs expected to be incurred in the following year. This assumes that budgeted costs will be consistent with actual costs.

76 The methodology assumes that a notionally efficient competitor (the notional milk price provider) would incur the same energy costs as Fonterra does across its portfolio of production plants including:

- electricity and fuel purchasing arrangements (e.g. hedges, contracts, peak demand and delivery costs);
- infrastructure (e.g. transformers, fuel handling, boilers, pipes and wires);
- cost variations due to location of plant (e.g. Fonterra’s average locational costs<sup>5</sup>); and

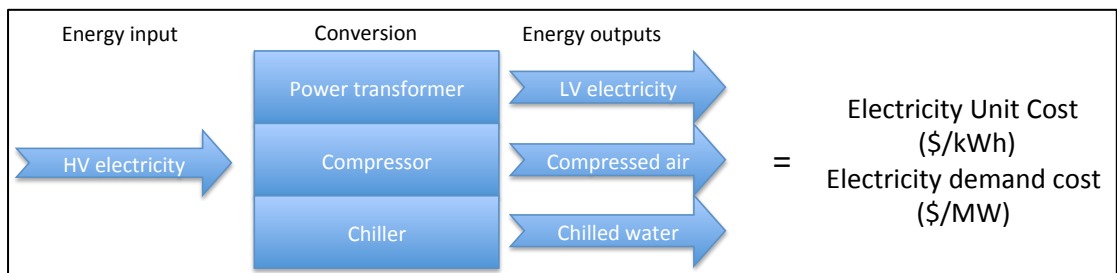
<sup>5</sup> In the 2012/14 Milk Price Calculation Report (section U13) the Commission sets out that the notional milk producer may assume that the assumed units of processing capacity approximate to the average size of Fonterra’s actual units of processing capacity.

- peak demand costs (e.g. Fonterra’s aggregated electricity peak demand costs).

- 77 Use of the budgeted costs implicitly includes all energy costs expected to be incurred across the production season and therefore takes into account the seasonal ramp up and down production variations.
- 78 Co-generation costs and benefits are included in the national average values and are therefore implicit in the output values. This means that the electricity unit cost will include the budgeted effects (both positive and negative) of the Fonterra co-generation portfolio, i.e. the model assumes that a new co-op would have the same gains or losses from co-generation as Fonterra.
- 79 Input prices for electricity and fuel are as delivered to the factory gate.

## 4.1 Electricity unit cost methodology

**Figure 4: Energy unit cost components**



### Variable electricity costs

- 80 Budgeted electricity costs for each Fonterra site are used to calculate a national average electricity unit cost (budget costs are assumed to be consistent with actuals). Each year Fonterra verifies that its budgeting is aligned with actual electricity unit costs.
- 81 For F15 MPG has derived a variable electricity price of [ ]/MWh for the base milk price model.
- 82 For F15 the following calculation steps have been made to establish the electricity price input of [ ]/MWh:
- The total \$/MWh is calculated from each Fonterra site’s budgeted process electricity demand (MWh) and budgeted electricity expenditure (\$). This produces a budgeted weighted variable electricity rate.
  - Using the above data selected by island (i.e. NI and SI \$/MWh) a Fonterra budget weighted variable electricity rate is calculated for each island.

- (c) The budgeted NI and SI milk supply is then used to adjust the Fonterra budget weighted values to produce a national average electricity rate for the notional milk producer.
- 83 The above calculation produces a national average electricity price for the notional milk price producer of [ ]/MWh (NI [ ], SI [ ]). This price is 0.66% lower than the Fonterra budget weighted average electricity price of [ ]/MWh. This difference is due to the different rates of budgeted production between the notional milk price producer and Fonterra.
- 84 This calculated electricity price is 2% below the electricity price used for FY14. This means that Fonterra production plants are budgeting for a reduction in variable electricity prices.
- 85 Fonterra purchases and budgets its electricity on the following basis:
- (a) wholesale spot price ([ ]% of electricity purchases) – this was recently changed to be managed internally by Fonterra’s Commodity Risk and Trading (CR&T) division and converted to a fixed price, variable volume (FPVV) contract and ‘sold’ internally (and budgeted) on an arms-length FPVV price basis. The price at which electricity is sold internally was based on a recent Request for Proposals (RFP) from external electricity suppliers that showed a decrease of 11% from the previous purchasing arrangements;
- (b) fixed price contract with an external electricity retailer – a production price index (PPI) escalator in the contract increased electricity unit costs on this contract by [ ]% above FY14 costs; and
- (c) Whareroa Co-generation - pricing from the co-generation has decreased as part of a correction made to the prior year budget. Fonterra states that the pricing used in the current year is now more aligned to the longer-term rates.<sup>6</sup>
- 86 However, as the CR&T purchasing arrangement is new and yet to be accepted for F15, MPG is not including this component (e.g. the forecast savings) in the notional milk price producer calculation. The notional milk producer price includes a component that has been set at the price discovered in the RFP process.
- 87 The 2% price reduction to Fonterra’s budgeted electricity expenditure has been derived from a combination of the existing contract prices and the application of the RFP process run for the CR&T arrangement.
- 88 The model assumes that electricity is metered at the high voltage (HV) side of the main transformer and that the notional milk price producer owns the

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<sup>6</sup> Paper to the Milk Price Group: *Energy costs – FY15 data verification*, page 6

main transformers. Therefore transformer losses are inherent in the budgeted \$/MWh unit cost (i.e. losses are included in the quantities purchased from electricity suppliers). A capital sum is included in the model for the transformers.

- 89 In reality, Fonterra's actual connection configurations for its sites vary with some connections being on the low voltage (LV) side of the transformers, and ownership of the transformers being with the local electricity distributor. When budgeting electricity costs at sites where the local electricity distributor owns the transformer, Fonterra makes an adjustment for transformer losses so that all sites are budgeted on the same basis (i.e. losses are consistently included in purchases from electricity suppliers).
- 90 These arrangements implicitly assume that Fonterra's electricity purchasing arrangements (including transformer type and size) are consistent with those of the efficient notional provider.
- 91 Internal electricity distribution system losses are applied to the unit cost calculation by applying 1.5% uplift to the purchased quantities of electricity. The 1.5% distribution loss adjustment has been derived from actual measured site data and calculated as the national average for Fonterra production plants.
- 92 Fonterra's electricity purchase prices are used for calculation of unit costs and are therefore assumed to be what a notionally efficient supplier would pay.

### Fixed electricity costs

- 93 Peak electricity demand for the notional milk price producer is determined through plant manufacturers' specified peak electricity demand for specific plant items.<sup>7</sup>
- 94 Fonterra has provided the following explanation of the method it used to establish the fixed electricity cost input for the notional milk price producer:
1. *The peak demand charge comprises the F15 budgeted network charges divided by the FY14 actual peak demand for the site (being the last available actual peak information).*
  2. *The F15 budgeted network charges (Aug'14 to Jul'15) were cross checked by comparing it with the 2014 tariff year charges (Apr'14 to Mar'15) from the individual network companies (being the latest available indication of charge information at the time the validation check is done).*
  3. *In the case of F15 budget, 90% of the budgeted costs (\$[ ]M) were checked and the budget was 5.9% (\$[ ]M) higher than the network company tariff charge rates for the sites checked.*

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<sup>7</sup> The peak demand data has been sourced and assessed by Aurecon.

4. *Of the variance \$[ ]M was at one site (KRI) where the transparency of pass through of Transpower charges results in quite high volatility of annual charges (e.g. interconnection variation from \$[ ] to \$[ ]M due to timing of RCPD and co-incident with site demand). This makes prediction of likely charges very difficult to get right.*
  5. *If the KRI site is excluded, the average error at the other sites was 2.3% only.*
- 95 To determine a peak demand charge input, MPG uses the production plant manufacturer's data/specification to derive the notional plant peak loading. The notional peak loading is multiplied by the budgeted national average MW peak demand charge. The calculation assumes that the notional plant has no ability to manage electricity demand to reduce costs (i.e. production is driven by the available milk input and customer demands and not by time-of-use electricity costs).
- 96 Total electricity fixed charges for F15 are calculated to be \$[ ]m, which produces a peak demand rate of \$[ ]/MW.

## 4.2 Our assessment of the electricity unit cost methodology

### Variable electricity costs

- 97 We consider that the methodology produces a reasonable budget rate for Fonterra.
- 98 We have reviewed the Excel workbook<sup>8</sup> used by MPG to calculate the electricity rates and have found that the calculation is consistent with the described methodology. We confirm that:
- (a) the electricity unit rates are calculated from the average Fonterra site budgeted electricity rates (total electricity charges divided by forecast electricity consumed); and
  - (b) scaled using the forecast NI and SI milk supply to the notional milk price producer.
- 99 The unit rate implies that that the notionally efficient supplier would have the same historical contracted position as Fonterra as the starting point for its electricity arrangements, i.e. that it would have made the same decisions as Fonterra has made. The historical decisions made by Fonterra include investment in co-generation and contracting longer-term for electricity with PPI escalation.
- 100 Only a portion ([ ]%) of the electricity price has been subjected to comparison with current electricity price offers. It would be preferable if the budgeted average Fonterra site unit rate were benchmarked against published electricity contract rates for example, through the Electricity Authorities online hedge contract tool.<sup>9</sup> The use of such a tool would highlight any material differences between Fonterra and market electricity costs.
- 101 MPG has indicated that it may consider inclusion of the CR&T wholesale purchase model in the EI model in future years. The CR&T approach effectively replaces an external electricity retailer with an internal electricity retailer. If this were done, consideration would need to be given to how the cost of risk is allocated. Whilst it is not within the scope of this review, we consider that inclusion of the CR&T approach in the EI model would require detailed consideration.

### Fixed electricity costs

- 102 The calculation of peak demands for production plant uses plant manufacturers' specifications and expected plant performance (e.g. coefficient of performance for specific production plant). Fonterra's energy team has developed plant performance values and, whilst we have not undertaken a detailed study and assessment of the values, we consider

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<sup>8</sup> F15DrftBgdtNRGRatesV27.xlsm

<sup>9</sup> [www.electricitycontract.co.nz](http://www.electricitycontract.co.nz)

they appear to be aligned with a reasonable range of expected performance for the type of plant.

### 4.3 Practical feasibility of electricity unit costs

#### Variable electricity costs

- 103 We have observed that variable electricity unit rates reduced overall by 2% from FY14 rates. We have sought to understand the reason for this. Fonterra has informed us that variable price charges for North Island sites changed very little (approximately 0.7% increase) and that most of the reduction was due to decreases in variable unit rates for the South Island sites (a decrease of 7%). This was due to the end of a long-term fixed price contract allowing achievement of a reduced price.
- 104 The alternative variable unit price in the model included the current contract prices for Fonterra sites plus a benchmark against market prices for the component that came off the long-term contract. The market price benchmark was established through an RFP process that achieved a result that was 11% below the current Fonterra contract rate.
- 105 The electricity hedge contract search tool provided by the Electricity Authority<sup>10</sup> indicates that the average price of 475 disclosed FPVV contracts is \$87/MWh with a maximum price of \$115/MWh and a minimum price of \$69/MWh. This high-level analysis indicates that notional base milk price input values of \$[ ]/MWh (North Island) and \$[ ]/MWh (South Island) fall within a practically feasible range.
- 106 Given that the price is based on the actual Fonterra contract electricity prices with a proportion set by a market process, and that the resulting prices fit within the range of disclosed electricity hedge contract values, we consider that the variable electricity unit cost assumed in the notional milk price producer model is practically feasible.

#### Fixed electricity costs

- 107 MPG has determined a fixed electricity price rate of \$[ ]/MW.
- 108 We consider that the methodology with which the maximum demand for the notional milk price producer is determined is sound. Our reasons for reaching this view are:
- (a) much of the base data is sourced from dairy equipment supplier specifications;
  - (b) it is based on equipment supplier data adjusted against actual Fonterra plant performance information (e.g. boiler efficiencies, coefficient of performance for chillers etc.);

<sup>10</sup> [https://www.electricitycontract.co.nz/hedge/list\\_hedges](https://www.electricitycontract.co.nz/hedge/list_hedges)



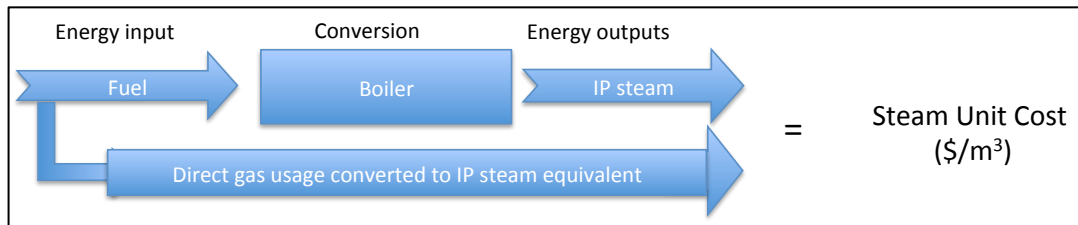
- (c) the peak demands are scaled using the notional milk price producer total peak milk volumes/total available milk volume;
- (d) the budgeted F15 peak demand rate is applied to Fonterra actual peak demands for the previous year to produce a budget peak demand rate; and
- (e) comparative analysis between Fonterra and the notional milk price producer is undertaken.

109 We have noted that the \$[ ]/MW unit cost correlates with the current Transpower interconnection rate set for 2015/16 and is below disclosed fixed line charge rates of a sample of electricity distributors. The reason for the lower unit cost calculated for the notional milk price producer is due to the portfolio of plants, including some that did not incur full interconnection charges. This was due to the site peaks not being coincident with regional peaks and therefore not incurring interconnection charges. We consider that this is also an appropriate outcome for the notional milk price producer.

110 Accordingly, we have concluded that the fixed unit cost for electricity assumed in the notional milk price producer model is practically feasible.

#### 4.4 Steam unit cost methodology

**Figure 5: Steam unit cost methodology**



111 Across its sites, Fonterra uses coal and gas in its boilers to produce steam for its manufacturing processes. Gas is also used directly in some areas of production.

##### Variable steam cost

112 The average cost of steam is derived from the budgeted total expenditure of gas and coal at each Fonterra site. Depreciation, emissions trading scheme (ETS), replacement and maintenance (R&M) and fixed fuel costs are excluded from the variable steam cost total, as these are included in other parts of the base milk price calculation. The aggregated steam expenditure total (gas and coal) is then divided by the total steam consumption (in metric tonnes (MT)) to produce a steam rate value (\$/MT). Steam rate values are produced in the same way for North and South Island plants.

- 113 As the steam rate values take into account all steam produced at the boiler, steam line losses are implicit in the derived steam rate (e.g. it is a 'delivered to process' rate).
- 114 For the EI model inputs, the direct gas usage is converted to a steam equivalent. This value is added to the calculated steam output from the boilers to produce a total energy (coal and gas) steam value.
- 115 Fuel cost is the budgeted price to Fonterra, as delivered to the factory gate. For coal, the freight to site cost is added to the ex-mine price to produce a total delivered coal cost. This assumes that a notional milk price producer would purchase coal at the same budgeted price as Fonterra does for its sites. Therefore, any advantage or disadvantage inherent in Fonterra's contract positions and other purchasing arrangements is assumed to also apply to the notional milk price producer.
- 116 As the conversion from fuel to steam uses the Fonterra budgeted production profile and expenditure forecast to produce a national average cost per unit of production for the notional milk price provider, it implicitly includes both efficient and inefficient boiler plants e.g. it assumes that the notional milk price producer has a similar boiler fleet (type, configuration, age, condition and performance) to that of Fonterra.
- 117 There are linkages here between the use of national average steam conversion costs, the availability of plant, capital value of boiler plant and the OPT. All of these must be derived on the same basis (i.e. the national average) for the EI model to be internally consistent. An example of this can be seen in the assumptions made for steam boilers where the model includes for multiple boilers in both its energy conversion losses and capital costs. This is consistent with the OPT as, in practice, all Fonterra sites are multiple boiler sites.
- 118 Budgeted costs are used in the calculation of the steam unit cost. Fonterra validates its budgeted cost through comparison with actual costs. It makes improvements to its future budgets if actuals diverge materially from budget.
- 119 The use of the national average across a year means that the ramp-up and ramp-down production seasons are included in the average. The use of a national average also implicitly accounts for plant downtime (e.g. breakdowns, cleaning periods etc.).

#### Fixed steam cost

- 120 The steam fixed cost calculation takes account of gas fixed costs (essentially peak demand driven delivery charges) only. The reason for this is that, under Fonterra's contract, coal is totally volume related and incurs no fixed costs (i.e. delivery based charges which are 100% variable). Accordingly, the EI model does not include a coal fuelled steam-related peak demand component.
- 121 The EI model calculates a fixed rate for steam in a similar way to the calculation of fixed electricity costs. The total peak steam derived from

Aurecon specifications has a scaling factor (peak milk/milk capacity) applied to derive a notional milk price producer peak volume equivalent.

- 122 The peak steam value for the notional milk price producer is then multiplied by the peak demand gas cost to produce a total fixed cost of steam.

## 4.5 Our assessment of the steam unit cost methodology

- 123 We have reviewed the Excel workbook<sup>11</sup> used by MPG to calculate the steam rates and have found that the calculation is consistent with the described methodology. We can confirm that:

- (a) the steam unit rates are calculated from the average Fonterra site budgeted gas and coal rates;
- (b) the EI model appropriately accounts for boiler efficiencies and steam distribution losses by including an adjustment in the calculation or by including them in the usage quantities;
- (c) the method of converting direct gas use to an equivalent steam demand is reasonable; and
- (d) the output values are scaled using the forecast NI and SI milk supply volumes and capacity for the notional milk price producer.

- 124 The steam input cost methodology applies the budgeted Fonterra fixed and variable costs of steam and, through scaling, produces the expected base milk price production. The use of Fonterra scaled budgeted steam demand and expenditure to calculate steam unit rates for the notional milk price provider is reasonable, if it is accepted that the base milk price producer would have the same contracted position and purchasing arrangements as Fonterra.

## 4.6 Practical feasibility of steam unit costs

### Variable steam costs

- 125 Variable steam unit costs have increased by 6% above FY14 values. The increases are largely due to Fonterra's renegotiation of coal contracts.
- 126 The EI model has average coal prices of \$[ ]/GJ<sup>12</sup> (excluding Edendale which has a long term contract for lignite). The prices included in the model are consistent with the industrial coal price analysis and forecasts in the 2013 COVEC report to the MIBE *Coal Prices in New Zealand Markets: 2013 Update*.<sup>13</sup>

<sup>11</sup> F15DrftBgdNRGRatesV27.xlsm

<sup>12</sup> Consistent with the MBIE Energy Outlook we have referenced the Australian export values of 27GJ/tonne for thermal coal

<sup>13</sup> <http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/energy-data-and-modelling/technical->

- 127 We note that COVEC shows the contract price of lignite for a new purchaser is higher than the long-term Edendale contract price. Therefore, if the Fonterra contract price were not available to the notional milk price producer, the unit rate for steam in the EI model would need to be higher.
- 128 Given the price is derived from budgeted actual Fonterra contract coal and gas unit rates, and that the resulting prices are consistent with MBIE information of forecast coal prices, we consider that the variable electricity unit cost assumed in the notional milk price producer model is practically feasible, if the notional milk price provider had access to Fonterra's contract price for lignite.

#### Fixed steam costs

- 129 Fixed steam unit costs have increased by 10% above FY14 values. As with variable steam unit cost increases, this is attributed by MPG to a slight increase in gas transmission charges.
- 130 We have reviewed how the EI model calculates both the gas and coal fixed charge components and consider that, on the basis of Fonterra's budgeted costs, the steam fixed cost of \$[ ]m is practically feasible.

## 5 Practical feasibility of the resource usage rate

131 In this section we consider the practical feasibility of the resource usage rate applied in the base milk price calculation.

### 5.1 Overview

132 The resource usage rates we have reviewed are those derived in the Excel workbook file F15DrftBgtNRGRatesV27.xlsm provided by Fonterra. The resource rates derived in the workbook are:

**Table 1: Fonterra's proposed energy usage rates (pre ED3 adjustments)**

[

]

Source: Fonterra<sup>14</sup>

133 To derive the resource usage rates, MPG has engaged independent advisors with expertise in dairy production and dairy plant engineering together with its internal expert resources. The values used to initially populate the EI model were drawn from plant manufacturers' specifications informed by Aurecon's expert opinions on plant sizing and likely performance.<sup>15</sup>

134 Aurecon obtained the basic capital cost and operating conditions data for the hypothetical plant (butter, AMF, SMP, BMP and WMP production) used in the EI model plant by:

- (a) issuing specifications to suppliers;
- (b) obtaining prices for the proposed engineering work;
- (c) engaging the suppliers for the work;
- (d) receiving responses to the specification; and
- (e) seeking clarification of responses from suppliers.<sup>16</sup>

<sup>14</sup> F15DrftBgtNRGRatesV27.xlsm – Tab F15MPSum

<sup>15</sup> Aurecon Plant Capital Cost Estimates Report reference 213156-001/R1 28 July 2011

<sup>16</sup> Aurecon Plant Capital Cost Estimates Report July 2013 section 3

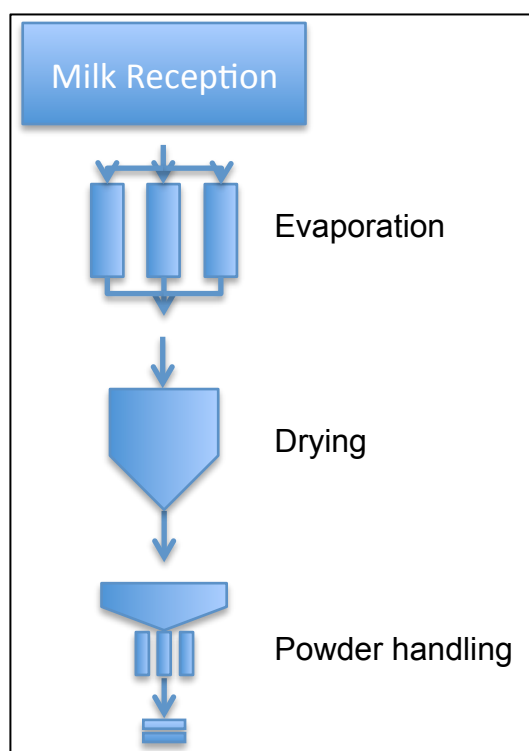
135 Subsequently, the initial data based on manufacturers' information has been validated and, as necessary, updated through site measurements of actual resource usage rates, including specific audits of individual production plants.

136 RCP production in the EI model can be considered to have four main process stages:<sup>17</sup>

- milk reception and standardisation
- evaporation
- drying
- powder handling (packaging).

137 The basic components of production are illustrated in the following diagram:

**Figure 6: WMP production process steps**



138 At reception, milk delivered to the factory in tankers undergoes a standardisation process. For the EI model, the current energy consumption per tonne of RCP has been established from plant manufacturer specification documentation. We note that the ED3 audit did not include reception/standardisation costs and that this would need to be taken into account when reconciling the variations in energy per tonne of product for that audit. The Darfield D1 Audit completed in Feb 2014 included milk reception/treatment/standardization.

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<sup>17</sup> Note that milk standardisation is excluded from the ED3 audit.

- 139 Energy inputs are metered at various points throughout the processes. The energy audit plan checks the validity of the aggregation of the various metered quantities. Energy and production volumes are metered at the audited sites and the independent audit is undertaken to validate metered data.
- 140 Energy inputs over the audit period are derived from metered quantities and divided by the total weight of RCP produced (also metered and audited over the audit period) to produce energy per unit of production (e.g. kWh/tonne and tonnes of steam/tonne) value. In the case of the ED3 audit, the dryer was producing Regular General Trade WMP.
- 141 Through the measurement and audits, the EI model is validated and calibrated against actual plant performance.

## 5.2 Assessment of the resource usage rates methodology

- 142 To ensure that the EI model and audited data are viewed on the same basis, it is necessary to account for any cleaning (CIP) and plant downtime (e.g. production breakdowns). For example, in the 2014 DD1 audit period, a production breakdown occurred and there was CIP downtime. In the ED3 audit period, no breakdown occurred but there was a single period of downtime for CIP.
- 143 The EI model does not specifically include time for breakdowns but is based on a standard RCP production plant running at [ ]% OPT and with one plant in each region operating at partial capacity to handle the increase and decrease in milk volumes across the season.<sup>18</sup>
- 144 In discussions with MPG, we noted that the model should take into consideration that the current EI model rates for energy do not allow for lower energy usage at the shoulders of the milk production season. In its report on the ED3 audit, MPG has proposed the following changes to the original energy usage rates (shown in the above table in section 5.1):

**Table 2: Adjustments to resource usage rates (post ED3 audit)**

		Current usage per mt RCP	Proposed usage per mt RCP	Variance
<b>WMP</b>	Electricity variable (kWh)	[ ]	[ ]	[ ]
	Steam variable (T steam)	[ ]	[ ]	[ ]
<b>SMP</b>	Electricity variable (kWh)	[ ]	[ ]	[ ]

<sup>18</sup> Information provided in Fonterra’s comments on Strata’s understanding paper – email from Sri Pathmanathan 6th May 2015 to Bill Heaps

Steam variable (T steam)    [ ]                    [ ]                    [ ]
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Source: Fonterra<sup>19</sup>

The above changes take into account information gained from the DD1 audit in 2014 and the latest ED3 audit in 2015. We consider that the proposed changes to the usage rates are appropriate to reflect the shoulder period production.

- 145 MPG informed us that Aurecon used linear scaling to calculate the average variable usage energy input values.<sup>20</sup> In its report, Aurecon provides the following method it used to calculate usage rates for the processing plant:<sup>21</sup>

*manufacturer's operating data / daily production = energy/tonne dry powder.*

- 146 As the above formula calculates energy usage specifically for daily notional milk price producer production, no additional scaling factors need to be applied to variable usage rates.
- 147 It was therefore only necessary to apply the scaling factor to correct for the average plant size in the model when calculating the peak usage figure. We have verified that this scaling adjustment was applied in the peak usage energy inputs calculation.
- 148 Aurecon's assessment of capital and operating costs considered information from two suppliers. Where practically feasible, the size and capacity of plant was scaled for the purposes of establishing a capital cost. We consider that the method used by Aurecon is sound and undertaken at an appropriate level of detail. In our view, the hypothetical plant proposed by Aurecon and used in the EI model can be considered to be a practically feasible production plant model.

### 5.3 Practical feasibility of usage rates

- 149 We have noted the process and analysis used by Aurecon to determine the resource usage rates for the components of the notional milk price producer. We consider the approach taken is sound.
- 150 We have observed that the capacity settings, energy usage values and plant performance have been derived from information from a minimum of two dairy equipment suppliers. We have found that the derivation of the energy usage assumptions used to populate the EI model has been undertaken through a logical process with the chosen values supported by reference to technical specifications and review by specialists within Fonterra.

<sup>19</sup> Fonterra Management Report Edendale E3 energy use per tonne WMP Draft v0.1 30 April 2015

<sup>20</sup> Email from Sri Pathmanathan to Bill Heaps 18<sup>th</sup> May 2015

<sup>21</sup> Aurecon Plant Capital Cost Estimates Report July 2011 section 5



- 151 We consider that the steps taken by MPG when establishing and validating and calibrating the modelled resource usage for the notional milk price producer is logical and reasonable.
- 152 We have observed the ED3 audit and how the measurements and analysis from the audit, and the previous audit of DD1, have been used to revise the EI model input assumptions (see section 5 for our assessment of the ED3 audit). We consider that the use of the audit information will provide over time greater confidence in the accuracy and reliability of the key assumptions relating to energy resource usage rates and on the EI model energy input values.
- 153 We have based our view of the practical feasibility of the resource usage rates on our assessment of the process used by MPG to establish the values (e.g. use on independent experts). We have also taken into account the validation of the values against actual production.

## 6 The ED3 Audit

### 6.1 Use of site audits to inform the energy usage rates inputs

- 154 MPG uses site audits to provide actual process metrics. These are gathered during a limited period of production. The information obtained from audits allows validation of the energy usage rate data in the EI model. It also requires reconciliation of differences between audit, previous audit and model data.
- 155 Two audits have been undertaken:
- (a) Darfield DD1 in 2014; and
  - (b) Edendale ED3 in February 2015.
- 156 An independent external expert from Aurecon overviewed the February 2015 ED3 audit. The Aurecon auditor is an experienced ex-Fonterra employee who also participated as external auditor for the DD1 audit in 2014.
- 157 A Strata consultant attended part of the ED3 audit (2 – 3 February 2015) for general process/plant familiarisation and to have access to audit personnel. We have since reviewed the energy audit report and the management report of audit outcomes, prepared for the MPG.

### 6.2 2015 ED3 audit background

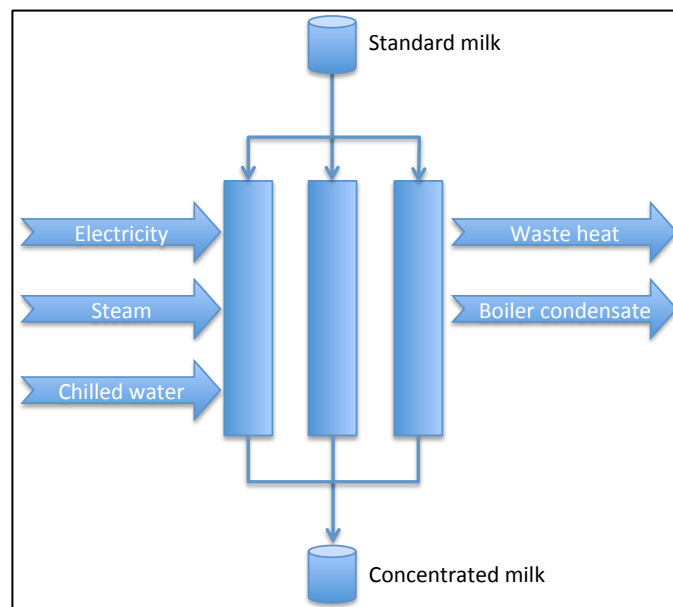
- 158 The ED3 audit was conducted from 1 – 11 February 2015 with a 3-day planning/training period run immediately prior to this.
- 159 The objective set by MPG for the audit was to provide loss, energy, and composition data for consideration in the F16 season milk price.
- 160 A dedicated Fonterra team was assigned to the audit process. One Fonterra employee was designated as audit team lead. In addition to the energy audit component, audit of product composition and waste required collection of physical samples at various stages of, and locations within, the production process. This took up a considerable portion of the 10-day audit.
- 161 The measurement stage of the energy audit was completed during the ten day audit period. We spent time with the Energy Efficiency Champion (EEC) at the Edendale plant. The EEC is responsible for planning and implementing the energy audit component of the milk price audit. The Edendale EEC's background is in process (mechanical) engineering. The EEC coordinates business improvement initiatives related to the sourcing and use of energy at the site. In that context, the EEC works with a wider energy efficiency practice group across Fonterra.

- 162 We also discussed aspects of the audit with the audit team lead and the Aurecon auditor.
- 163 We found Fonterra’s approach to confidentiality, IP protection, general site access, high security area access (i.e. access to ED3) and health and safety to be highly developed and carefully managed. For example, the approach to onsite health and safety indicates a well-developed risk culture within the group.

### 6.3 The ED3 milk drying process

- 164 The ED3 milk dryer was constructed in 2003.
- 165 Energy component measurements for ED3 included energy flows into and out of the dryer and evaporator building. This the following main stages of the milk drying process:
  - (a) evaporation
  - (b) milk drying
  - (c) powder handling and packing.
- 166 Milk tanker unloading and the milk separation and standardisation processes were excluded from the ED3 audit because these process stages are common to all milk received at Edendale.
- 167 The following subsections provide a brief outline of the ED3 processes that were within the scope of the February 2015 audit.

#### 6.3.1 Evaporation

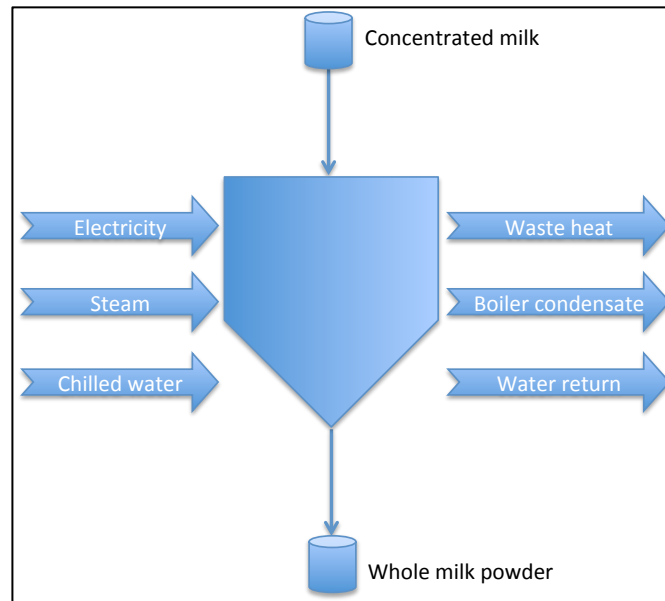


- 168 The onsite processing at ED3 commences with tanker unloading, milk separation and standardisation. These initial processing steps were not included in the 2015 energy audit of ED3. This was because ED3-specific

energy quantities cannot be readily separated from a process that supplies standardised milk to other onsite production facilities.

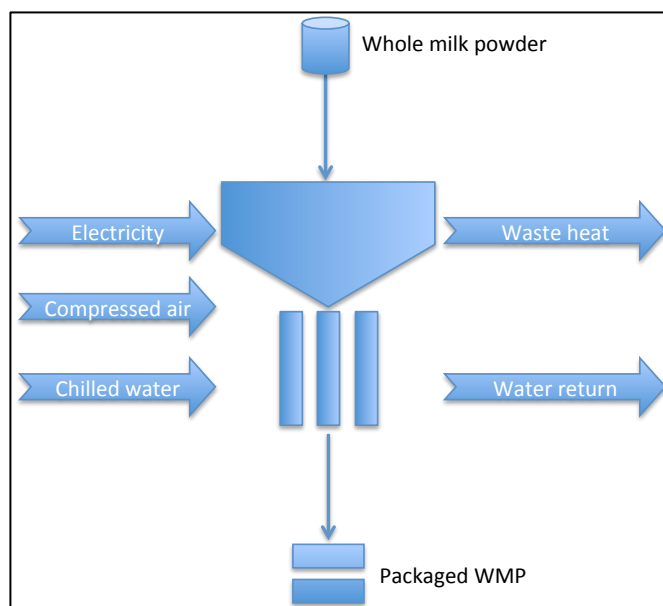
- 169 The evaporation process uses heat to remove water from the standard milk to produce concentrated milk. At ED3, electricity is sub-metered for each of the 3 evaporators. Steam is sub-metered for each of the 3 evaporators. Chilled water for evaporation is not sub-metered but is included in ED3 total metered chilled water.

### 6.3.2 Drying



- 170 The main drying process produces loose (bulk) WMP from concentrated milk.
- 171 Steam is not sub-metered for the dryer but can be calculated by subtracting evaporation-metered quantities from the total ED3 steam meter. A very small amount of steam-heated hot water is fed into ED4 from ED3. This was measured during the energy audit but is an immaterial amount.
- 172 Electricity is sub-metered for the dryer using two meters, one for the drier itself and one for the drier feed system.
- 173 Chilled water is not sub-metered for the dryer but is included in metered ED3 total chilled water. Compressed air (used for dryer auxiliary systems only) is sub-metered for the dryer.

### 6.3.3 Powder handling



- 174 Powder handling produces packaged WMP (25 kg bags) from loose WMP.
- 175 Electricity and compressed air for powder handling are sub-metered. Chilled water for powder handling is not sub-metered but is included in metered ED3 total chilled water usage.

## 6.4 ED3 audit outcomes

- 176 During the audit period, WMP was produced and there were no forced plant outages. Electricity, steam, compressed air and chilled water usage were measured during the course of the audit period.
- 177 Fonterra has found that the steam usage figures for DD1 and ED3 are similar, with a 3% variation. However, in comparison, electricity usage has revealed that ED3 is 16% higher consumption than DD1.<sup>22</sup>
- 178 Fonterra noted the following points in its ED3 management report to explain and account for variances between the ED3, DD1 and EI model resource usage values.

### On-product energy usage rates

- 179 The ED3 audit measured On-Product (under full production of WMP) energy usage rates from the evaporator through to powder packaging. Milk reception, treatment and standardisation were not measured in the audit. To adjust for this, the energy consumption from the DD1 audit for milk reception, treatment and standardisation was added to the ED3 results to provide comparable end-to-end energy consumption results.

<sup>22</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 - page 5

- 180 ED3 does  
[  
]. MPG considers<sup>23</sup> that an appropriate allowance for this capability would be a 7% reduction in the total steam demand for the ED3 audit values.

#### On-product time allowance

- 181 There was no production downtime during the ED3 audit from plant breakdowns. MPG has utilised the typical steam consumption from the DD1 audit to estimate a 'not on product' allowance for the ED3 audit results. The application of this adjustment has been made to allow the ED3 audit results to be compared with DD1 audit results and the EI model which provides an allowance for downtime through the OPT adjustment.

#### Drier CIP allowance

- 182 Clean in Place (CIP) for the ED3 dryer during the audit period was consistent with the conditions during the DD1 audit and the EI model assumptions. Accordingly, MPG has made no adjustment to the ED3 results to account for CIP.

#### Partial loading at season shoulder periods

- 183 MPG has noted that the DD1 and ED3 energy audits occurred when the plants were operating at full capacity. However, for the EI model, not all plants would be operating at full capacity for the entire production season. MPG has recommended a partial loading factor to the ED3 and DD1 values to account for this.
- 184 Taking into account previous discussions with the Commission and revising some assumptions, MPG has concluded that a partially loaded plant would use 6% additional energy usage over that of a plant running at full capacity<sup>24</sup>. By modelling the regional daily milk volumes across a season, MPG has calculated that on average approximately 5% of the plants in the notional EI model would operate as part full plants across a season.
- 185 A partial loading factor of 100.52% applied to the results of the Darfield and Edendale audits would account for differences in energy consumption between peak time audits and full season operation. We have found that this adjustment has been made in the steam energy usage rates recommended by the MPG<sup>25</sup>.

#### SMP energy usage in milk price model

- 186 To determine the energy usage for SMP production, the EI model currently uses figures based on equipment supplier specifications.

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<sup>23</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 – Page 4

<sup>24</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 – Page 6

<sup>25</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 – Table 2 Page 9

187 The audit results for DD1 and ED3 have indicated that the ratio of energy consumption on product as a percentage of the total energy consumption is 96% for both electricity and steam. However, the audits relate to WMP with no audit data yet available to establish the energy consumption for SMP while 'not on product'.

188 For F15, MPG is proposing that:

*... the equipment supplier utility usages are scaled by the 96% ratio from the WMP audits to establish the total energy cost for SMP manufacturing in the Notional Milk Price Business.<sup>26</sup>*

#### Fonterra's proposed adjustments to the milk price model input assumptions

189 MPG's calculation of the adjusted values arising from the above analysis is provided in Appendix C.

190 We have considered MPG's post-audit report<sup>27</sup> that provided recommendations related to energy use per tonne of product to the Panel.

191 Based on its analysis of the ED3 and DD1 audits, MPG has recommended to the Panel the following revisions to the EI model, equipment supplier derived input assumptions:

- (a) *the FY15 energy usage figure be updated for the average energy usage figures from the DD1 and Edendale D3 audits for WMP; and*
- (b) *that the equipment supplier utility usages are scaled by the 96% ratio from the WMP audits to establish the total energy cost for SMP in the Notional Milk Price Business for FY15.*
- (c) *The MPG has also recommended that the FY16 energy usage figures be reviewed prior to January 2016 (prior to half year results) based on further works being undertaken by the energy team at Edendale D3 and also based on the take-over acceptance report details for the New Pahiatua Drier 3 being commissioned in 2016.*

## 6.5 Assessment of the ED3 Audit

192 We have observed that the February 2015 audit of ED3:

- (a) included measurement of energy consumption over a 10-day period guided by a predetermined audit plan;
- (b) accessed energy metering equipment installed at key measurement points within the plant that allowed collection of

<sup>26</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 section 6

<sup>27</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 section 6

ED3-specific energy consumption data, including assessment of an off-process energy transfer;

- (c) measured energy consumption for the evaporation, drying and powder handling stages of the process but not the milk reception, treatment and standardisation process; and
- (d) has produced a report that analyses the data collected and makes recommendations that, if accepted by the MPG, will change some of the input assumptions used in the milk price model.

#### Audit planning

- 193 We consider the energy audit plan adequately provided for measurement of steam, electricity, chilled water and compressed air within the ED3 dryer building. Built-in energy consumption measurement equipment for ED3 allows for direct measurement of the primary energy consumption quantities. A non-material transfer of steam from ED3 into ED4 has been recognised and assessed.

#### Metering equipment

- 194 We observed onsite most of the measurement equipment used in the ED3 energy audit. At a high level of review of a sample of metering points, these appeared to align with the details provided in the energy audit plan and plant design diagrams we were shown.

#### Audit process reconciliations

##### *Milk reception and treatment*

- 195 As noted earlier, the ED3 audit effectively 'ring fenced' the ED3 building, measuring inputs into and outputs from that building. This allowed capture of the energy consumed within the evaporation, drying and powder handling process steps.
- 196 We have noted the adjustments made by MPG to account for energy consumed in milk reception, treatment and standardisation. At around 1% of total steam and 6.5% of total electricity, we consider these are relatively small adjustments in the context of overall energy consumption for the end-to-end process.

##### *Dryer heat recovery*

- 197 MPG has assessed [ ] would account for 7% of the difference in steam consumption rates between the DD1 and ED3 audits.
- 198 We have no ability to assess or test this specific conclusion and note that this is a relatively large reconciliation discrepancy. We also note that there is a further 4.5% of steam consumption rate that is unexplained between the DD1 and ED3 audits.



## 6.6 Post-audit recommendations

### MPG's recommendations

- 199 At the time of drafting this report, the Panel had not approved MPG's conclusions from the audit process, and recommendations relating to energy use per tonne of product to be used in the milk price model.
- 200 The ED3 and DD1 production plants can be considered to reflect the performances of two WMP production plants (ED3 being relatively old and DD1 being relatively new) . MPG's recommendation to use the average of the ED3 and DD1 audits to replace the outputs from the equipment supplier derived output values. This means that the notional milk price producer is assumed to have a plant portfolio that is the average of the DD1 and ED3 plants. We note that this outcome is not representative of the average Fonterra portfolio and is also unlikely to represent what a notional milk price plant portfolio would be
- 201 MPG has identified a 16% difference in electricity usage rates between ED3 and DD1 audit values. MPG has explained 7% of the difference, thus leaving 9% unexplained. As the MPG recommends use of the average of DD1 and ED3 for the milk price inputs, the effect of the unreconciled difference reduces to 50% of 9%, i.e. 4.5% of electricity usage rates.
- 202 Whilst the use of the average of ED1 and DD1 reduces the unexplained difference between the two audit outputs to 4.5% can be considered to be below the materiality threshold, the range of unexplained values across the audited and equipment supplier values produces uncertainty. We consider that the proposed use of the average of ED3 and DD1 values for the energy inputs electricity resource usage rates has not been demonstrated to be the most appropriate approach.. We consider that, until the differences are resolved, continuing at the current energy resource usage rates is likely to be the better option.
- 203 In our opinion, even after the differences have been reconciled, the use of the average of the two audits is unlikely to be appropriate and we expect that the MPG will consider other options. We anticipate that these options will include:
- (a) use of an adjustment that is scaled to reflect the production weighted age profile of its WMP plants. It is likely that this would result in a lower energy input/unit of production than is proposed;
  - (b) use of an adjustment that is the average of the equipment supplier derived settings and the ED3 audit values;
  - (c) retention of the current settings pending consideration of data and analysis from future audits.

### Future process

- 204 We note that MPG has now completed two audits since the milk price model was established.

- 205 During our review we have observed that additional governance and procedural controls applied to the establishment of the energy inputs would greatly improve confidence in the settings. We envisage that the improvements would include the development of governance and procedural arrangements for making changes to the EI model and for the process of approving changes to input assumptions and settings.
- 206 At the commencement of this review, our understanding was the EI model had been constructed to model a Notional Milk Price producer . The main components of the production plant were modelled using equipment manufacturers' information and other reliable data.
- 207 Our expectation was that the results and findings from the periodic site based audits were to be used to validate, inform and, as necessary, improve the EI model. Our expectation was that the revisions to the EI model would be made at the detailed component level and would demonstrate why the equipment supplier's data for that particular component was not practically feasible.
- 208 What we have found is that the audit results are being used to change the EI model outputs at the gross level e.g. replacing the energy consumed per tonne of production. Therefore the EI model is not being improved but is being replaced by Fonterra average values.
- 209 The implications of the above observations are beyond the scope of this review.

## 7 Concluding comments

- 210 A summary of our findings in relation to the approach used in the EI model and the practical feasibility of the energy unit costs and resource usage rates is provided in the Headline section at the start of this report.
- 211 Essentially we have found that:
- (a) the EI model methodology is sound but still improving through each annual iteration, we suggest that the EI model is subjected to an independent audit and that a formal procedure is documented and applied for the development and approval of any changes made to the EI model;
  - (b) the energy unit prices calculated and applied in the EI model have been calculated in accordance with the stated methodology and that the derived unit costs are practically feasible;
  - (c) the energy resource rate values have been calculated in accordance with the stated methodology and that the derived values are practically feasible;
  - (d) the ED3 audit was undertaken and that the outputs from the audit have been reconciled and taken into account when setting the final proposed values in the EI model; we consider that the energy audit was conducted using a well-planned process, with care taken to select the appropriate measurement points so as to isolate the relevant measurement quantities;
  - (e) Fonterra's average resource rate values from audits at two sites are used to override the equipment supplier data originally used in the EI model. The replacement is occurring at a gross level rather than applying adjustments at a model component level. We have the following concerns with this approach:
    - (i) rather than the audits informing the updating of the EI model, they are actually being used to replace the model outputs;
    - (ii) the audits are not being used to provide model component level information and data to support detailed analysis of the variances between the EI model and the site audits; and
    - (iii) because of this, we are observing that the EI model energy usage rates are effectively being replaced by average Fonterra rates from two site audits.

- (f) We consider that the determination of the proposed resource unit rates for FY 2015 could be improved by applying other options to the use of average resource unit rates. For example:
- (i) the use of a production weighted age profile is considered rather than the proposed average of the ED3 and DD1 audits to determine the energy usage production rates for the EI model;
  - (ii) until the differences in ED3, DD1 audits and equipment supplier derived inputs have been fully analysed and reconciled, the current unit rates remain unchanged; and
  - (iii) a component by component reconciliation is undertaken and the equipment supplier data is revised where its values are proven not to be practically feasible.

## 7.1 Acknowledgements

- 212 We would like to thank all Fonterra and MPG personnel we have engaged with in this assignment for their patience and assistance when responding to our questions and requests for information.

## APPENDIX A: F15 Energy inputs

The values below are the draft energy inputs recommended to the Milk Price Panel excluding the ED3 audit review and recommended revisions.

[

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The values below are the draft energy inputs recommended to the Milk Price Panel including the ED3 audit review and recommended revisions.

[

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## APPENDIX B: EI model fixed cost calculation

The fixed cost calculation from the MPG Energy – F15 data verification memorandum is reproduced below.

[

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## APPENDIX C: ED3 adjustment summary

The following table provides a summary of the results of the ED3 and DD1 audits and how the proposed adjustments to the EI model input assumptions are derived.

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Source: MPG<sup>28</sup>

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<sup>28</sup> Management Report Edendale D3 Energy Use per tonne WMP Final 20150612 – Page 9



## Appendix D: Glossary of Acronyms and Abbreviations

Acronym	Definition
AURC	Allowable Unit Resource Costs
AMF	Anhydrous milk fat
BMP	Butter milk powder
CIP	Clean in Place
CR&T	Commodity risk and trading – a division of Fonterra
DIRA	Dairy Industry Restructuring Act 2001 and 2012 amendments
ED3	Edendale 3 milk powder production line

Acronym	Definition
EI model	The mathematical computer based model that Fonterra has developed to calculate the base milk price for the notional milk price producer
DD1	Darfield D1 milk powder production line
ETS	Emissions trading scheme
FPVV	Fixed price variable volume
HV	High voltage electricity
MPG	The Milk Price Group
NZMP	New Zealand Milk Price
OPT	On product time – the period of time when plant is manufacturing a reference commodity product
PPI	Producers price index
Panel	Milk Price Panel
RCP	Reference commodity product
R&M	Repairs and maintenance
RUR	Resource Usage Rates
SMP	Skimmed milk powder
WMP	Whole milk powder

## Appendix E: The reviewers

### Bill Heaps



**Bill Heaps** is Managing Director of Wellington based Strata Energy Consulting. Bill is an electrical engineer, business executive and company director with broad experience in major infrastructure and energy supply businesses. Bill has held senior executive positions in the generation, transmission, distribution and retail businesses.

### Clive Bull



**Clive Bull** is an electrical engineer with 30 years senior management experience in the New Zealand energy distribution and transmission sectors. His most recent engagement in the corporate sector has been a 10 year period in senior management roles at one of New Zealand's leading electricity and gas distributors. In this time, Clive has performed a number of advisory and working group roles for the New Zealand Electricity Commission, the Gas Industry Steering Group, the Gas Industry Company, the Electricity and Gas Complaints Commission and the former Electricity Market Company (EMCO).