Review of Dairy Market Indicators

May 2025: Final

A report produced by Ken Burgess Consulting on behalf of AHDB

Contents

Executive Summary

This report sets out the findings of an independent review of the AMPE and MCVE market indicators. The review was commissioned by AHDB to revisit the outcome of the previous major review in 2014, and a more recent interim update in 2020.

A key feature of the market indicators was reconfirmed in that they are what “they say on the tin”, i.e simply indicators rather than absolute values. The value of market indicators is as a basis for identifying trends, and to attempt to use them for more precise purposes goes beyond the limits of their scope and accuracy.

The review covered three elements of the make up of the indicators:

I) The commodities used and the sourcing of prices,
II) Conversion factors
III) Processing costs

The current use of UK spot wholesale prices for butter, skimmed milk powder and cheese received widespread support as the appropriate source of economic information for these products. This met the criteria of producers and processors alike in terms of closeness to the UK market, openness and transparency, straightforwardness and timeliness to reflect current trends.

For similar reasons, there was no desire expressed to change the sources for whey powder and lactose prices, or for the inclusion of prices based on long term contracts.

The possible inclusion of a profit margin in the indicators found some support, but caution was also expressed in terms of the practicalities of establishing a consistent and acceptable value, and the risk of adding complexity. In a similar way, some respondents would find later publication an advantage if more of the month’s data could be included, while others would not want it any later because of the timing of communications with producers.

In both these areas there was not sufficient overall balance of view to warrant making changes to the existing arrangements.

Suggestions were also made concerning other products that should be included within the indicators. This was against the feeling expressed that cheese was now a much more important part of the dairy products market than was the case when the AMPE and MCVE indicators were established. In this regard, the rapidly increasing importance of Mozzarella was repeatedly mentioned and to a lesser extent Cheddar curd.

A review of the market indicator conversion factors revealed that the current values are broadly correct within the natural variations of milk composition and manufacturing efficiency. However, there have been increases in the composition of milk components since the 2014 and 2020 reviews, and these have been incorporated into a set of revised conversion factors.

The revised conversion factors for the four main commodities are 19,200; 10,470; 8,860; 16,700 litres/tonne for butter, SMP, mild cheddar and whey powder respectively. These compare with 19,900; 10,600; 9,100; 16,700 litres/tonne in the 2020 review, and represent reductions of 3.6, 1.0, 2.7 and 0% respectively.

For the cheese conversion factor, it was noted that a proportion of the Cheddar cheese made in the UK is standardised whereby the fat and/or protein contents of the milk are adjusted prior to cheesemaking. This can be achieved in a number of different ways, e.g by cream removal/addition and/or protein addition, so it is not possible to establish a single model for cheesemaking from standardized milk.

It is therefore not considered practical to account for both the conventional and standardised scenarios, so only the current conventional scenario is used in this review.

Processing cost estimates for the market indicators have always posed several challenges. There are significant variations between plants in terms of energy efficiency, labour flexibility, technological advancement and plant utilisation and throughput. All of these factors impact on processing costs and any estimate that captures the broad breadth of industrial practice will by its nature sit between the highest and lowest cost plants.

Direct collection and collation of processing costs proved even more challenging than in previous reviews because of the increasingly confidential nature of commercial cost information. For this reason, cost estimates for the key commodities were generated from factored cost estimates, and cross checked for robustness against information from industry sources and published US data.

The estimates provided must therefore be seen in this context as broad, general estimates rather than actual production costs at specific plants. Their key value as part of a market indicator is to provide a base against which trends in wholesale product prices can be translated back into a milk equivalent.

The factory based manufacturing costs for butter, SMP, mild cheddar and whey powder were estimated at £335, £420, £425 and £455 per tonne respectively at 2024

Q4 prices. Skimmed milk powder also incurs a cost of approximately £60/tonne for lactose standardisation.

The processing costs estimates for butter, SMP, cheese and whey powder represent reductions of 2, 25, 7 and 14% respectively compared to the 2024 Q4 AMPE & MCVE figures.

The relatively larger reduction in processing cost for SMP is a result of two factors: an overestimate of energy costs in the 2024 Q4 figure, accounting for 30% of the reduction, and production efficiencies, accounting for 70% of the reduction. The latter were largely due to the much-changed manufacturing base with two major manufacturing sites now dominating the sector, with each operating two driers using more efficient evaporation and drying technologies.

Finally, a series of recommendations are made summarising these findings. It is also recommended that a schedule and protocol be established for future reviews of the AMPE/MCVE structure. The significant review interval should be no more than 5 years and provision should be made for capturing efficiency and productivity gains as well as cost inflation.

1. INTRODUCTION

1.1 Background to the review

AHDB publish market indicators for the dairy sector to provide broad, general estimates of market returns. They are not intended to be correct for every plant but instead aim to be indicative of the industry.

AMPE and MCVE are widely used by industry to help with identifying and understanding trends in the current value of milk based on the value of dairy products in British commodity markets. To use them for more precise purposes goes beyond the limits of their scope and accuracy.

AMPE (Actual Milk Price Equivalent) is an indicator of the factory gate value of a litre of milk used for butter and skimmed milk powder (SMP), while MCVE (Milk for Cheese Value Equivalent) assesses returns from mild Cheddar, whey powder and whey butter.

The two indicators have now been in place for several years. AMPE was adapted from the earlier Intervention Milk Price Equivalent (IMPE) indicator in approximately 2000, and MCVE was developed by DairyCo in approximately 2005.

The background to the development of the two indicators is set out in a previous review report, found on the AHDB website (1).

In 2013 the processing costs and conversion factors were reviewed externally and updated to reflect changes in cost structure. This report was published in 2014. A further internal review was undertaken by AHDB in 2020 to reflect changes in energy and labour costs in particular together with the impact of improved milk composition (2).

AHDB have committed to review the indicators every few years to ensure these are up-to-date and accurate as possible, particularly regarding processing costs and yields. As a result, AHDB have now commissioned a further independent review, some 10 years after the first one. This report sets out the results of that review.

1.2 Review objectives

The overall aim of the review involved assessing the existing AMPE/ MCVE formulas and their components, and providing recommendations on whether, and if so how, the market indicators should be changed.

More specifically the aim of the review is to provide a comprehensive analysis of the following questions:

i. Are the estimated production costs in the formulas accurate and representative across the breadth of the industry?

ii. Are the yield conversion factors within the formulas representative of what is achieved by industry across the UK and Europe?

iii. We expect that the utilisation of capacity within plants will have a significant bearing on efficiency. What level of utilisation is there across plants for the different products? Should there be an assumed level of utilisation going forward?

iv. Does the use of UK (general spot) wholesale prices for butter, powder, whey and Cheddar provide a helpful measure of the market? Are there alternatives to these prices, such are using a blended price to factor in those companies who sell product forward on contract? Should we be looking at other dairy products?

v. Are the current sources of prices for whey and lactose the best ones? For example, prices reported by the EU milk observatory (incumbent) for whey deviate significantly from the Netherlands price.

vi. Should the indicators include or exclude estimations of profit margin (re turn on capital)?

An additional question was added at the beginning of the review:

vii The AMPE & MCVE are currently issued on the 25th of the month. Issuing on the 28th would enable the inclusion of an extra week's data. Would this cause operational problems users?"

These individual objectives can be grouped into three distinct area:

i) The methodology involved in the construction of the AMPE & MCVE indicators, ie pricing aspects of the commodities and the issues of other products, profit margin, and communication issues (objectives iv to vii),

ii) The conversion factors used in AMPE & MCVE calculations (objective ii), and

iii) The processing costs used in the AMPE & MCVE formulas (objectives I and iii).

The report is structured to deal with each of these areas in turn.

1.3 Approach

In order to address these objectives a range of information gathering exercises were undertaken before analysing the feedback and collating this report.

Following project initiation meetings with AHDB, a number of in person and telephone meetings were held with personnel from:

1. Dairy Industry organisations including the Society of Dairy Technology, UK Committee of the International Dairy Federation, DairyUK, and policy officers from the farming unions.
2. Processing organisations involved in the manufacture of milk powders, butter and cheese.
3. Personal industry and academic contacts in the UK, Ireland, Denmark, Canada and the USA.

The academic and commercial technical literature was also reviewed in depth with particular emphasis on the relationship between milk composition and product yield, and key elements of product cost structure.

The remainder of this report is structured into three main chapters which present findings from the review.

Chapter 2 considers aspects of the methodology used in compiling the indicators. The sources of cost information for the commodity products are reviewed, together with the questions of the inclusion or not of other products and a profit margin.

The communication of the updated indicators also comes within the scope of this chapter, both in terms of timing and frequency.

Chapter 3 then reviews the updating of the conversion factors in the light of improved milk composition since previous reviews in 2014 and 2020.

The processing related aspects of AMPE and MCVE are covered in Chapter 4, considering plant utilisation and processing costs.

Chapters 5 & 6 then deal with the conclusions of the review and the key recommendations.

2. AMPE/MCVE METHODOLOGY ASPECTS

2.1 Commodity product prices

Product commodity prices are obviously the starting point for the calculation of the AMPE and MCVE indicators, and the prices used need to reflect the reality of the marketplace in which the indicators are used.

The UK dairy commodities sector operates extensively in both domestic and export markets. The UK also has a large enough domestic market to enable the collection of a representative mix of wholesale prices covering sales of commodities to wholesalers, brokers, manufacturers, food service and retail packers.

2.1.1 Butter, cheese and skimmed milk powder

Discussions with industry personnel on the source of price information for butter, cheese & SMP revealed strong support for the existing use of spot UK wholesale prices.

It was considered very important to use product prices as reflective of the UK market as possible, especially in the light of the The Fair Dealings Obligations (Milk) Regulations (FDOM24) which set out the rules for how milk purchase contracts must operate. FDOM24 is designed to make these contracts fairer and more transparent across the dairy industry so the availability of real, verifiable UK market information will be even more paramount.

Similarly, there was no preference expressed for the inclusion of prices based on long term contracts. It was felt that spot prices represent short to medium term trading and were therefore more in line with the purpose of the market indicators in terms of identifying trends.

There was also a concern that including some element of forward contracts would be difficult to incorporate on a consistent basis, and that it was much better to keep the data set as straightforward as possible.

In terms of other alternatives to spot UK wholesale prices, several industry contacts mentioned using other sources of pricing information for their own internal purposes. These sources include EEX (7) and Vesper (8) which both require a subscription to access. While these are useful to individual organisations, they are not verifiable or transparent or openly available to everyone in the industry, so are not considered suitable as a source of price information for AMPE/MCVE.

It is therefore concluded that the current mix of UK spot wholesale prices for butter, skimmed milk powder, and mild Cheddar are the most appropriate sources of information as the basis for the AMPE and MCVE indicators.

However, there was significant feedback concerning the context of the butter wholesale prices and the relatively large range of prices sometimes quoted. There was a perception by some respondents that some prices being submitted in the month may have been forward contract prices from a number of months previously.

There were also issues raised about the level of compliance with the AHDB specification for unsalted butter. For instance there were concerns that salted butter prices may sometimes be submitted rather than unsalted product, or that red tractor standards may not have been met.

It was suggested that the situation on butter prices might be addressed by requiring spot prices to be for product for sale within, say, the next 3 weeks, and an auditing process like that for cream.

The AHDB published wholesale prices for butter and cheese in particular are clearly used by many in the industry as a key source of market intelligence and valued very highly in that context.

2.1.2 Whey powder

In the absence of a fully working marketplace for whey powder in the UK, AHDB use the whey powder price from the EU Milk Market Observatory (MMO,9).

The MMO calculates EU whey powder prices by averaging national prices for whey powder and providing data on trends and changes in those prices. The biggest producers of whey powder are France, Germany and the Netherlands and in fact EEX uses an average of these three in its whey price formula.

The industry uses both this source of price for whey powder, and also the Netherlands price from Zuivel NL (10). The Dutch price is usually the lower of the two, partly because Dutch quotes are usually for bulk supply while German, for example, are for product packed in bags. However, the Dutch price is often the preferred source as it is felt that most whey contracts are linked to it.

There is a view that the Dutch price is lower partly due to the quality of product offered on the Dutch as opposed to German and French markets. German whey prices “are higher for example because they have a number of high-grade producers making good volumes. On the other hand, production in the Netherlands is quite low and the quotes rely on producers who are buying in whey powder from cheaper sources like Poland.” (11).

On balance, the MMO can therefore be seen as the preferred pricing source in the context of a milk market indicator like MCVE. Any anomalies in individual countries are balanced out by averaging across the EU, and the point was also made earlier that AHDB should only change if a source of product prices can be seen to be more reflective of the UK market.

This being the case, there is no imperative to move away from the MMO as the source of whey powder prices.

2.1.3 Whey butter and buttermilk powder

<u>Whey butter</u>

Previous reviews of the AMPE cost structure have assumed that price of whey butter is £300/tonne below the AHDB published butter prices. This was not questioned by anyone commenting during this review.

As a comparator, CDFA (12) use a whey butter price of $0.1/lb below butter price in their Class 4b milk pricing system. This amounts to a discount between 3 and 4%.

Over the past two years, the UK the butter wholesale price has varied between £3710 and £6730/tonne so the £300/tonne discount amounts to between 4 and 8%.

In view of the improvement in quality in whey cream and whey butter in recent years, it therefore seems appropriate to consider a reduction in the whey butter discount. The current discount of £300/tonne amounts to 5% of the current butter price, and a practical approach would be to maintain this percentage discount level going forward.

<u>Buttermilk powder</u>

Buttermilk powder has traditionally commanded a slightly lower market price than SMP itself. In 1997 the OFT estimated this difference at £120/t, while in the year prior to the 2014 AMPE/MCVE report, Global Dairy Trade data gave an average difference of £103/t.

The subject of buttermilk powder price was not raised in the feedback from industry, but In the absence of timely market data it seems appropriate to continue to link the buttermilk powder price to that of SMP.

GFT data (13) indicates that on average BMP price was lower than SMP price by $270/tonne (£217/tonne) in 2023, while the situation in 2024 was somewhat reversed with the average BMP price higher than SMP price by $57/tonne (£45/tonne). BMP price has been higher than SMP since July 2024 until March 2025.

Over the two years then the average discount of BMP below SMP was £85/tonne, and in view of the variability there seems to be no significant need to change the current assumption.

2.1.4 Lactose

The lactose price is used in the standardised SMP AMPE formula and is relatively more volatile than that of the higher volume dairy commodities.

Currently the USDA price is used (14): the figure used is the average of the maximum and minimum of the “Mostly Range – Non-Pharmaceutical”.

Other sources of lactose price include Vesper EU and US prices, and the Global Dairy Trade (Oceania). Since Q2 of 2023 the USDA price and these have been in a relatively narrow band as exemplified by mid-Jan 2025 prices; €869, 835, 900 and 825 for GDT Oceania, Vesper US, Vesper Europe and USDA respectively.

Some feedback expressed a preference for a European price rather than US but the only European price is Vesper. While some organisations use Vesper, again this requires a subscription and is not transparent in a way required by the context of the AMPE market indicator.

Other feedback had emphasised that AHDB should only change source of pricing if it is more reflective of the UK market.

For these reasons it is apparent that the current source of lactose pricing, the USDA, is the most appropriate for AMPE purposes.

2.2 Possible inclusion of profit margin

In the early days of AMPE, and its predecessor IMPE, a profit margin of 2% was included in the AMPE formula. Similarly, when the MCVE was conceived a profit margin was also included - a fixed value of 0.75 ppl (equivalent to around 3.7% at the time).

These profit margin factors were removed by AHDB when the AMPE/MCVE were last reviewed in depth in 2014.

The AMPE was originally the basis of a quasi-regulatory system in the setting of milk prices between the DTF and Milk Marque, so the presence of a profit margin was understandable in this context.

A regulatory context is also the one in which the USDA milk pricing system works and in this, a return on investment figure rather than a profit margin is included in the make allowance.

However, in the context of milk price indicators, which AMPE & MCVE clearly are, there is clear precedent for excluding a profit margin or ROI as seen in other European (15) and World indicators (16) which do not include it.

Of those that expressed a view, slightly more thought that such a provision should be included than not. However, several issues were raised by respondents as to reasons for not including a profit margin:

i) The first is the practicality of including a profit margin or ROI in the processing cost. Profit margins for these dairy products are particularly volatile so it is likely that it would be hard to find an agreed figure that would stand the test of time,

ii) The same applies to interest rates which would again impact on what was an acceptable profit margin. A profit margin of e.g. 2% may be acceptable when interest rates are low but not in periods of high inflation and interest rates,

iii) Further, an ROI figure would require processors to share information on residual asset values of plant and equipment and from previous experience there would be considerable reluctance to doing this,

iv) Others made the point that it was unwise to change the structure of the formulas because of the risk of confusion.

The point made in ii) above are exemplified in two USA surveys of processing costs in 2021 and 2023. They use the Moody’s Baa Corporate Bond Index to calculate a ROI, and this moved between 3.2% and 5.7% in the two-year period.

In view of the absence of a significant desire for change and the complicating aspects of practicality, it seems that the existing approach of excluding a profit margin in the AMPE and MCVE formulas is the most appropriate one.

2.3 Timing of AMPE/MCVE publication

The AMPE & MCVE are currently issued on the 25th of the month. Issuing on the 28th would enable the inclusion of an extra week's data and the question was asked as to whether this would cause operational problems for some organisations.

There was support for keeping the publication date as the 25th of the month, with one respondent in particular making the point " it is important that AHDB reports its data on/about the 25th of the month to provide inclusions in FDOM24 compliant contracts which depend on market data (more critical than ever). Leaving the publication until later in the month does not allow for any discussions between farmers and their processors."

The opposing view was also expressed with some respondents making the point that publishing on the 25th inevitably means including some of the previous month's data, thus precluding it from being an actual monthly figure.

The importance of giving time for review and discussion therefore seems to balance any benefit of the inclusion of a further week's data, and there is no significant weight of preference either way.

2.4 Alternative products for inclusion

There were no suggestions for the inclusion of alternative products into the AMPE formula.

However, for MCVE there were consistent suggestions regarding the inclusion of Mozzarella and cheddar curd. This was supported by the observation that increasing volumes of milk are going into Mozzarella manufacture in particular with Leprino, Dairy Partners and soon to be Arla at Taw Valley.

To a lesser degree, mature cheddar and whey cream also suggested for inclusion.

2.5 Communication

Feedback here related to what is being communicated, when and how frequently it is done.

Related to 2.3 above, the communication of wholesale prices was felt to be overly biased in favour of milk as opposed to cheese.

For example, the four quoted products are cream, butter, SMP and cheese. This is in spite of cheese accounting for more than 60% of the UK milk to manufacture, and the UK “no longer being dominated by liquid processing.”

On a wider point there was a view that AHDB doesn’t make the most of communicating the breadth of its data every month. The importance of the critical transparency of AHDB’s marketing intelligence was emphasised and especially in relation to FDOM24.

The comment was also made that more could be done to promote AMPE/MCVE and the monthly wholesale data and raise the prominence of these useful tools, especially to farmers.

The other aspects of communication touched upon were the frequency and timing of publication. For example, some felt that the information was already out of date by the time is was published and that more frequent publication, I.e. weekly, would be more useful as a timely indicator of change.

3. CONVERSION FACTORS

3.1 Milk composition

Conversion factors have been used in the dairy industry over several decades to relate the yield of product from a given quantity of milk. In this format they are expressed as litres of milk per tonne of product.

This approach is simple to calculate and useful for indicative purposes. However, for precision a litres per tonne conversion factor must be accompanied by:

I) reference to the milk composition, in particular fat and protein,

II) reference as to whether the product has been standardised for composition.

The AHDB standard litre reflects the average GB farm and from May 2025 is based on a composition of 4.25% butterfat, 3.40% protein (1).

Some industry contacts questioned the current AHDB approach to selecting a composition for milk based on a national average, rather than the standard 3.3% protein, 4% fat used in liquid contracts.

However, since the AMPE/MCVE indicators are meant to represent an overall UK position, then the use of the average milk composition seems appropriate. Also, it has been stated before that the context of the market indicators is just that, i.e. as indicators and not a basis for pricing purposes.

The AHDB standard litre composition is therefore used as the basis for calculation of conversion factors in this review.

The discussion below deals with average values only, so does not take into account variations on a seasonal or regional basis.

The scope of the conversion factors is assumed to be that of commodity rather than specialised products.

3.2 AMPE

3.2.1 Skimmed milk powder

In the UK no distinction is made between skimmed milk powder made from unadjusted milk, and skimmed milk powder made to a standardised protein to SNF ratio. The latter has been permitted since 2008 and allows processors use either lactose powder or milk permeate to adjust the protein to SNF ratio to a minimum of 34%.

The first option requires the buying in of lactose powder and while the second is much preferable from a cost perspective, it is only possible if a source of permeate is available. In the absence of commercial intelligence as to which option is being used, any cost modelling must be based on the use of lactose.

This was the approach taken for the 2014 review, and the same approach is taken in this review. The calculations are summarised below, while the detailed calculations and assumptions are given in Appendix 1.

Starting with 100 kg milk (4.25% fat, 3.4% protein, 8.87% SNF), this generates 89.51 kg skimmed milk on separation, with composition 3.55% protein, 0.06% fat, 9.26% SNF.

This gives 8.29 kg SNF which on standardisation by lactose addition becomes 9.14 kg SNF, and 9.19 kg total solids (SNF and fat).

Using a solids to powder conversion factor of 1.03 (17), together with an overall process loss of 2%, this gives 9.27 kg powder.

A yield of 9.27 kg powder from 100 kg milk gives a litres/tonne yield of 10,470. The 2020 review reported 10,600 litres/tonne.

The same calculation process detailed in Appendix 1 gives a lactose requirement of 93 kg/ tonne powder, compared with 85 kg in the 2020 review.

3.2.2 Butter

A number of international butter conversion factors are given in the Table below. The published figures do not specify whether they apply to salted or unsalted butter, or a mixture of both.

However, the Denmark and EU figures are known to apply to unsalted butter (the product specified for AMPE):

Reference	Kg butter/kg fat	Equivalent litres/tonne
AMPE pre-2014 (1)	1.19*	20273
AMPE 2014 (1)	1.19*	20273
Australia (16)	1.21	
Canada (18)	1.22	
Denmark (17)	1.190	
EU Commission 15)	1.19*	20325
USDA (19)	1.21	

* for milk of 4% fat

At the 2014 review, the existing conversion factor (20,273 litres/tonne) at the time was central within the range of published data and the existing factor was therefore retained.

That figure, equivalent to 1.19 kg butter/kg fat, is the median of the published factors above and is therefore also used as the basis for this review.

Using the AHDB standard litre fat figure of 4.25%, this gives 5.057 kg/100 kg milk. This is equivalent to 19,200 litres/tonne to 3 significant figures.

This compares to the 2020 figure of 19,900 litres/tonne when a milk fat figure of 4.1% was used.

3.2.3 Buttermilk powder

Data on the yield of buttermilk powder from butter and skimmed milk manufacture was more limited. Nonetheless, published figures were obtained from Australia (16) and the US (20) for buttermilk powder yield in terms of kg powder/kg SNF in the original milk. An average of these two figures (0.052, 0.056) was therefore used in this study, i.e 0.054 kg/kg milk SNF.

This gives a buttermilk powder yield of 0.479 kg/kg milk SNF, equivalent to a conversion factor of 202,700 litres/tonne. The figure for 2020 was 203,600 litre/tonne.

3.3 MCVE

3.3.1 Cheese (mild Cheddar)

Cheese yield conversion factors are more variable than for butter and SMP because the product composition is much more loosely defined, and it depends on several factors:

I. the fat and protein content of the raw milk

II. the extent, if any, to which the fat and protein contents of the milk are standardised prior to cheesemaking,

III. the moisture content of the cheese,

IV. the degree of recovery of the fat and protein into the cheese.

With cheese, the distinction needs to be made between conventional and standardised manufacturing processes.

Conventional Cheddar is made using milk as delivered to the cheese factory. Variations in milk composition are managed by adjusting cheesemaking conditions. However, a proportion of the Cheddar cheese made in the UK is standardised whereby the fat and/or protein contents of the milk are adjusted prior to cheesemaking. This can be achieved in a number of different ways, e.g by cream removal/addition and/or protein addition, so it is not possible to establish a single model for cheesemaking from standardized milk.

It is therefore not considered practical to account for both the conventional and standardised scenarios, so only the current conventional scenario is used in this review. This is the same approach taken in the 2014 and 2020 reviews.

Published values for cheese conversion factors are therefore of very limited use as they don’t specify whether the milk has been fat standardised, don’t specify the moisture content, and because of their historical nature don’t reflect the recent increases in content of protein and fat in UK milk.

Of the values that are in the public domain, the range goes from 9,751 litres/tonne (Ireland, 21) to 9,100 litres/tonne (Australia, 16).

A more accurate approach is to use the Cheese yield calculated from the Van Slyke and Price equation. This is the most widely used Cheddar cheese yield prediction model in the industry, is based on mass balance principles, and is also the one used by the USDA in their pricing calculation.

Yield of cheese, kg per 100 kg milk,

= (fat and casein recovery into cheese) x 1.09/ (1 - Cheese moisture content)

The fat and casein recovery percentages used are 88% and 96% respectively, as these are representative of industry practice (22). (Note: casein is 78% of total milk protein). The target moisture content of mild cheese is taken as 37.5% as current industry practice.

For conventional cheddar, using the milk composition 3.4% protein, 4.25% fat, Cheese yield = (4.25 x .88 + 3.4 x 0.78 x 0.96) x 1.09/0.625 = 10.96 kg cheese/100 kg milk. This equates to 8,860 litres/tonne.

This is in line with the 2020 review cheese yield of 9,100 litres//tonne. Yields (litres/tonne) can be adjusted for milk composition using the formula:

Yield 2 = Yield 1 * (fat + protein in milk 1) / (fat + protein in milk 2)

In 2020 milk composition was 3.35% protein, 4.1% fat compared with 3.4% protein and 4.25% fat in MCVE 2025. Applying the formula gives:

MCVE 2025 yield = MCVE 2020 yield * (3.35 + 4.1) / (3.4 + 4.25) = 8,860 litres per tonne.

Cheese yield may vary quite substantially from factory to factory, as a result of a number of factors including fat recovery. However, if fat is lost in the cheese making process, then there should be a compensating gain in fat recovery into whey cream/butter and vice versa. The key factor is that between 98.5% and 99% of the fat in the milk should be recoverable between the cheese, whey butter and whey powder.

3.3.2 Whey powder

Published values of conversion factors for whey powder are summarized in the table below, and range between 16,000 and 17,000 litres/tonne . The median of these values is 16,644 litres/tonne, very close to the MCVE 2020 figure of 16,700 litres/tonne:

Source	Yield, litres/tonne milk
MCVE 2014 (1)	17,000
MCVE 2020 (2)	16,700
Dairy Facts & Figures, 1980 (23)	16,644

Dairy Facts & Figures, 1992 (24)	16,500
Dairy Australia (16)	16,080

This conversion factor for whey powder was cross-checked via a mass balance approach. The whey streams from Cheddar manufacture make up 88% of the original milk, and at 6.6% solids (25) this amounts to 5.81 kg whey solids from 100 kg or original milk.

After allowance for lost salty whey and process loss (3%), this gives 5.8 kg whey powder from 100 kg milk, equivalent to 100/1.03/5.8 = 16,700 litres/tonne to 3 significant figures.

This is the same as the existing figure from the 2020 MCVE.

3.3.3 Whey butter

Whey cream available for manufacture of whey butter can be found by difference between the fat in incoming milk and the fat in cheese, whey powder and fat process losses. The latter are 88, 1.3 and 1.5% of the original milk fat respectively.

For this level of fat recovery into cheese, the whey cream therefore contains 9.2% of the milk fat, I.e 0.39 kg from 100 kg milk. This is equivalent to 0.975 kg cream (40% fat).

Using a conversion factor of 2.1 kg cream/kg butter (17), this gives 0.46 kg whey butter. Converting this to litres/tonne gives 100/1.03/0.46 = 211,000 litres/tonne.

This is in line with the 2014 MCVE figure of 218,000 litres/tonne after allowing for the increased milk fat content.

3.4 Summary of changes

The new conversion factors are compared with the AMPE/MCVE 2020 figures in the table below:

	AMPE/MCVE 2020	AMPE/MCVE 2025
Butter	19,900	19,200
SMP	10,600	10,470
BMP	203,600	202,700
Mild cheddar	9,100	8,860

Whey powder	16,700	16,700
Whey butter	205,000	211,000

Note: Conversion factor for SMP accompanied by lactose powder addition at 93 kg/tonne

4. PROCESSING COSTS

4.1 General

The processing costs considered here represent estimates in the context of the UK industry situation. A number of industry features have changed significantly since the 2014 review, with their impacts on processing costs moving in both directions.

Manufacturing Efficiency

Manufacturing efficiency within the industry has generally increased for two main reasons. Several older plants running at relatively lower throughputs have been taken out of service, while there have been several instances of increased process efficiency through more energy efficient pumps, heat recovery systems, plant automation etc.

In addition to the use of more energy efficient process technology, there have been general gains in energy efficiency and management through more effective measurement and monitoring, where the drivers have been sustainability and cost management.

Energy efficiencies have also been achieved through investments in technologies like CHP, biomass fuelled boilers and methane generation from dairy waste and permeate. These initiatives have been difficult to incorporate into the revised cost figures because they are very site specific. However, the direction of travel has been captured in the published information on specific energy use for the different commodities.

The UK Dairy Industry Roadmap (3), managed through AHDB and DairyUK, has seen UK industry energy efficiency improvement of 20% in 15 years, with a further commitment to achieving a 25% figure. In the Netherlands a 20% improvement was seen in the 14 years to 2019 (4).

Another aspect of increased productivity is the scale economies associated with increased site throughputs. For example, cheddar cheesemaking has seen site capacities increase by over 20% over the past 10 years (5, 6). Even higher increases in production were seen in milk powder plants in the same period.

Compliance costs

Acting in the opposite direction from efficiency improvement is the increase in compliance costs to meet ESG requirements. This includes the procedural and services costs of managing regulatory obligations and taxes and levies such as the climate change levy and the forthcoming increase in NI contributions.

Cost inflation

Cost inflation was particularly high in the post-Covid period and AHDB have already incorporated these into the AMPE/MCVE cost models through inflation factors for labour, energy and general inflation.

These are currently updated quarterly to maintain the timeliness of the cost estimates.

4.1.1 Availability of commercial information

With respect to the availability of processing cost information, this has become less transparent since the 2013 review, with less overall availability of information on UK processing costs.

Because of restrictions on commercial data availability, cost information from other sources was also reviewed in order to add to the body of knowledge of product manufacturing costs and their elements.

In 2014 there was a limited amount of data available from the EU because of the need for this in managing the intervention system. However in 2015 the quota system was abolished and the EU has not published any commodity cost data since. Independent EU sources such as Kiel, IFCN and Vesper (8, 26, 27) do not share their processing cost information.

In spite of the lack of freely publicised processing cost information in Europe, there is useful information available from the USA.

4.1.2 USA cost information

The most comprehensive USA information on dairy product manufacturing costs has been published by the California Department of Food and Agriculture (CDFA, 28). The State Code provides for the carrying out of cost studies to gather information on manufacturing costs and the Agriculture Department had a Manufacturing Cost Unit which undertakes thorough cost audits of participating sites. This set of cost data was particularly valuable because it is based on audited information, and is available over a number of years.

The products covered are butter, cheese, nonfat dried milk and whey powder. In the US distinction is made between skim milk powder (SMP) and nonfat dried milk (NFDM); SMP can be protein standardised while NFDM cannot. Around 25% of US production is SMP and most of it is exported.

Although this exercise ceased in 2016, a number of further cost of processing exercises were carried out in the USA between 2021 and 2023 as preparation for a proposed revision of the USDA make allowances:

I) Historic CDFA data from 2006 to 2016, forecasted forward to 2022 using regression analysis (Dr Bill Schiek, 35)
II) A survey of 51 plants by Dr Mark Stephenson of University of Wisconsin in 2021 (29)
III) A survey of 57 plants by Dr Mark Stephenson of University of Wisconsin in 2023 (30)

All three sets of data were submitted as evidence in the USDA hearings, and in January 2025 the USDA also reported their revised make allowances.

The data as reported include a provision for a return on investment (ROI) so for the purposes of this review an estimate of ROI has been subtracted to leave a processing cost comparable with AMPE/MCVE data. The data have also been converted from cents/pound to £ per tonne.

	Butter	Cheese	NFDM[2]	WP
Scheik[1]	376	485	421	446
Stephenson (2021)	239	413	486	402
Stephenson (2023)	491	403	423	510
USDA 2025[1]	393	437	451	460
Average	375	435	445	454

[1] Note: ROI based on average of 2021/2023 surveys
[2] Note: In the USA NFDM refers to the unstandardised dried skim milk, & SMP to standardised dried skim milk (In the USA around 75% of dried skim milk is NFDM)

Care needs to be taken when making comparison between these figures and the UK in view of the differences in energy and labour costs between the two countries.

In broad terms this makes little difference to the butter and cheese processing cost estimates, but for the powder products using UK energy and labour rates could increase these figures by some 10 to 15%.

The USA data also illustrate the relatively wide range of costs seen in dairy manufacturing costs, even when surveyed on a standardised and consistent basis. This had the biggest impact on the butter cost structure where the two exercises resulted in one being over twice the estimate of the other. This not only emphasises the importance of in-plant cost allocation on cost estimation, but also the inherent variability of cost estimates in general.

Even within the same survey there is significant variation between individual plants. The 2023 survey was the one most widely used by the USDA in the make allowance revision process. This gave data on the highest and lowest 50% cost plants:

	Butter	Cheese	NDM	WP
2023: Lowest 50%	413	331	378	422
2023: Highest 50%	632	488	471	610

The average difference between highest and lowest groups was £219/tonne for butter, £157 for cheese, £93 for NFDM and £188 for WP. This again exemplifies the great range in estimates for total processing cost.

4.1.3 Cost Engineering approach

The processing cost estimates used for the new AMPE/MCVE were built up using a cost engineering approach similar to that set out in the 2014 review and then updated in the 2020 review. Cost elements were rounded to the nearest £5.

These were then sense checked against comparable published information, and a sample of processors.

The key cost components have been simplified to the following:

- Energy
- Labour

- Raw materials (ingredients, packaging)
- Maintenance
- Depreciation
- Other processing costs
- General & administration

The cost engineering approach builds up a factored cost estimate from estimates of these individual components. The data assumptions and method of calculation of the cost elements are set out in Appendix 2.

The category “other processing costs” includes the costs of water, water treatment, waste, storage, chemicals & smaller miscellaneous items.

To continue to report these separately would be to assign undue precision to what are broad estimates.

It should be remembered that processing costs can vary widely from site to site depending on a number of factors; process technology, scale of operation, degree of automation and the way in which costs are allocated between different products on the same site.

It is inevitable that what is considered a representative figure will lie between the highest and lowest operating cost group for each commodity.

The processing cost estimates given here should therefore be seen in this context and as broad “mid-range” figures rather than precise values.

4.2 AMPE

4.2.1 Plant utilisation

Processing costs are also dependent on the degree of utilisation of the process plant. One of the cost data sources (28) from 2017 clearly demonstrates this.

For butter, the ratio of highest to lowest labour cost per tonne was 2.9:1, and 3.1:1 for processing non-labour. For SMP the corresponding ratios were 5.7:1 and 2.4:1. In terms of labour cost, this represents a range for example of £50 to £145 per tonne for butter and from £50 to £285 for skimmed milk powder.

Part of these differences are accounted for by economies of scale and part by the degree of plant utilisation. The differences between butter and SMP confirm the author's experience that SMP plants often run at a lower plant utilisation than butter; butter plants often operate using brought in cream.

Industry feedback indicated a range of 55 to 70% for AMPE products. A "middle ground" level, 65% was therefore assumed in this study (the same as in 2014) as being reasonably representative.

Related to plant utilisation is the total plant throughput, ie production capacity as both impact on the tonnage of product produced. Labour costs in particular benefit from higher throughputs resulting in more product per unit labour.

4.2.2 Processing costs

Summaries of the new cost estimates are given below, with individual cost elements given to the nearest £5/tonne. Further details are given in Appendix 2.

4.2.2.1.Butter

The factored cost estimates for butter are summarised in the table below, alongside the existing AMPE cost structure for 2024 Q3.

	AMPE 2025	AMPE 2024 Q4
Energy	65	83
Labour	90	97
Raw materials	30	26
Maintenance	25	25
Depreciation	35	37
Other processing	55	37
General & administration	35	37
Total	335	343

The largest changes relate to energy, labour and other processing.

The unit energy (kwh/tonne) for butter has been updated according to a broader mix of published figures, resulting in a reduction in estimated energy cost of 20%. This was in line with overall energy efficiency changes seen in the industry since 2014.

The labour cost category has also changed to reflect the improved productivity seen in the industry. For butter, a figure of 6% has been used to reflect the average UK manufacturing figure for productivity for the period (34).

The “other processing” cost was raised slightly from the current AMPE figure as a result of feedback from industry colleagues which indicated that elements in this category had increased since the 2014 review.
The net result of these changes is minor, with the revised total only £8/tonne lower than the existing (2024 Q4) value.

4.2.2.2 Skimmed milk powder (SMP)

AMPE 2024Q4

The current AMPE value for SMP processing cost (2024 Q4) is actually overstated because of the way the energy cost was adjusted in the 2020 review. At that time it was assumed that the energy mix was 50:50 electric to fuel whereas the original energy figure in 2014 was based on 30:70 at 2014 energy prices.

Using the 2014 specific energy (kwh/tonne) and mix together with current energy prices gives a revised energy cost of £227/tonne. This gives a revised total processing cost of £518/tonne, compared to the £560/tonne published figure

AMPE 2025

The factored cost estimates for SMP are summarised in the table below, alongside the revised AMPE cost structure for 2024 Q4. The published 2024Q4 figure is included for the sake of completion.

	AMPE 2025	AMPE 2024 Q4 (revised)	AMPE 2024 Q4 (as published)
Energy	170	227	268
Labour	70	97	97
Raw materials	30	26	26
Maintenance	25	31	31
Depreciation	45	62	62
Other processing	45	38	38
General & administration	35	37	37

Total	420	518	560

The energy cost for SMP has seen a substantial reduction from the published 2024Q4 figure (37%) for two main reasons.

The overstatement of energy costs in the 2024Q4 AMPE accounted for around a third of this. The remaining two thirds was due to improvements in energy efficiency.

The larger part of the substantial reduction in energy cost therefore relates to the efficiency of the drying plant mix in 2025 compared with the time of the last main review (2013). This equates to a 25% reduction compared to the revised 2024Q4 figure, and this is similar to the pattern seen in US milk powder energy cost over a similar period (28).

SMP manufacture in GB is now dominated by 2 large scale spray drying sites, each comprising two drying operations. These evaporator/drying plants utilise MVR evaporation technology and integrated fluid bed drying technology which are significantly more energy efficient compared with the TVR and single stage dryer technology installed in the 1970’s to 90’s.

Further energy reductions have been seen through the adoption of combined heat and power (CHP) systems and the use of other energy saving measures like heat recovery systems.

More recent reference values for energy use in milk drying reflect these changes and give an updated energy cost per tonne of £170.

For SMP a labour utilisation model was used similar to that developed by Teagasc (51, see Appendix 2). This resulted in a labour cost of £70/tonne, only £5 more than that reported in 2014. Most of the labour inflation has been negated by the improvement in tonnes/person resulting from increased automation and significantly higher throughput.

As was the case with butter, the “other processing” cost was raised very slightly from the current AMPE figure as a result of feedback from industry colleagues which indicated that elements in this category had increased slightly since the 2014 review.

The updated processing cost estimate for SMP amounts to £420/tonne, a reduction of some 25% from the published 2024Q4 AMPE and of 19% from the revised AMPE 2024 Q4 figure. This significant reduction was primarily as a result of the impact of the reduced energy cost category, together with a lower labour cost arising from higher throughput, more automated plants.

4.2.2.3 Buttermilk powder

It is again assumed that buttermilk powder processing cost is the same as for SMP.

4.2.2.4 Comparison with published figures

To put these updated cost estimates into context, the range of values that could be expected with ranges of accuracy of +/- 10% and +/- 15% (rounded to nearest £5) are compared with the USA average in the table below:

	Butter	SMP
AMPE 2025	335	420
AMPE 2025 +/- 10%	300 - 370	380 - 460
AMPE 2025 +/- 15%	280 - 385	360 - 480
USA average[1]	375	445

Notes: 1; From table in 4.1

The AMPE 2025 processing cost for butter is slightly below the USA but the latter is within the +/- 15% range. However, this is not considered significant given the variability in the USA butter cost figures mentioned above.

For SMP, the AMPE2025 +/- 10% range includes the average USA figure.

Both the AMPE 2025 estimates for butter and SMP were within the bounds of the lower and upper expectations of industry colleagues.

4.3 MCVE

4.3.1 Plant utilisation

Plant utilisation in cheese manufacture is significantly higher than for butter and SMP, with figures of 85% or higher. For MCVE products, plant utilisation is therefore a much less significant issue than for AMPE products.

4.3.2 Processing costs

4.3.2.1 Mild cheddar

The factored cost estimates for the MCVE indicator are summarised in the table below, alongside the existing MCVE cost structure for 2024 Q4.

	MCVE 2025	MCVE 2024 Q4
Energy	70	97
Labour	95	104
Raw materials	75	76
Maintenance	30	31
Depreciation	50	52
Other processing	70	52
General & administration	35	43
Total	425	456

As with AMPE, the unit energy (kwh/tonne) for cheese has been updated according to a broader mix of published figures, resulting in a reduction in estimated energy use by around 27%. This was in line with overall energy efficiency changes seen in the industry since 2014 and in particular the implementation of significant energy beneficial investments at a number of cheese sites.

The labour cost category has also changed to reflect the improved productivity seen in the industry, as described above for butter; a figure of 8% has been used.

The “other processing” cost was raised slightly from the current MCVE figure as a result of feedback from industry colleagues which indicated that elements in this category had increased since the 2014 review.

These changes result in the MCVE processing cost for mild Cheddar falling from the 2024 Q4 figure of £456 to £425, a reduction of 7%.

4.3.2.2 Whey powder

<u>MCVE 2024Q3</u>

The current AMPE value for whey powder processing cost (2024 Q4) is actually overstated slightly for the same reason as described for SMP earlier.

Using the 2014 specific energy (kwh/tonne) and mix together with current energy prices gives a revised energy cost of £244/tonne. This gives a revised total processing cost of £510/tonne.

These revised figures are therefore the appropriate base for comparison with the 2025 figure.

MCVE 2025

The factored cost estimates for whey powder are summarised in the table below, alongside the revised MCVE cost structure for 2024 Q4. The published 2024Q4 figure is included for the sake of completion.

	MCVE 2025	MCVE 2024 Q4 (revised)	MCVE 2024 Q4 (as published)
Energy	190	244	265
Labour	90	97	97
Raw materials	30	26	26
Maintenance	25	31	31
Depreciation	40		
Other processing costs	45	38	38
General & administration	35	74[1]	74[1]
Total	455	510	532

Note: [1]: Includes depreciation

The unit energy for whey powder has also seen a reduction, but the extent of reduction in energy cost is less than that observed for SMP.

The move towards the most efficient evaporation and drying technology has been much less marked in the whey drying sector than in skimmed milk drying. This is partly because the bulk of recent whey investment has been in whey protein products rather than in whey powder itself.

The labour cost category in whey powder has also been changed to reflect improved productivity seen in the industry, in the same way as for butter mentioned earlier.

The updated processing cost estimate for whey powder amounts to £455/tonne, a reduction of some 14% from the published 2024Q4 MCVE and of 11% from the revised MCVE 2024 Q4 figure.

4.3.2.3 Whey butter

It is again assumed that whey butter processing cost is the same as for standard butter.

4.3.2.3 Comparison with published figures

These updated cost estimates, together with limits for +/- 10% and +/- 15% are compared with the USA average in the table below:

	Cheese	Whey Powder
MCVE 2025	425	455
MCVE 2025 +/- 10%	380 - 470	410 - 500
MCVE 2025 +/- 15%	360 - 490	390 - 520
USA average[1]	435	454

Notes: 1; From table in 4.1.2

The MCVE 2025 processing cost for cheese and whey powder are both within 10% of the USA average figures.

As with the AMPE costs, the MCVE 2025 estimate for cheese was within the bounds of the lower and upper expectations of industry colleagues.

5. CONCLUSIONS

This report has addressed the seven objectives in the original project brief for the review of the AHDB market indicators. The conclusions are presented here grouped into three categories; methodology, conversion factors and processing costs.

5.1 AMPE/MCVE methodology

The methodology aspects of the indicators reviewed in this exercise were the sources of price information, inclusion of other products, inclusion of a profit margin, and the timing of publication.

Sources of price information

There was strong support for the ongoing use of spot UK wholesale prices for butter, mild Cheddar and SMP. This source met the various criteria mentioned by contributors, ie closeness to the UK market, openness and transparency, straightforwardness and timeliness to reflect current trends.

A corollary to this was the lack of enthusiasm for the inclusion of prices based on long terms contracts.

However, there was some concern expressed as to the range of prices seen in the butter wholesale prices quoted. Some respondents postulated that some of these extremes might be due to the inclusion of quotes which didn't reflect the AHDB specification.

With regard to whey powder and lactose, the point was made that sources for these prices should change only if the alternatives were more reflective of the UK market. In the case of whey powder the EU milk observatory captures prices in the three main whey powder producing European countries, whereas the Dutch price reflects only that on the Netherlands market.

Similarly, there is no publicly available lactose price in Europe so there is no driver to change the USA source.

Inclusion of other products

There were several suggestions for other cheese to be included in the wholesale price reporting; in the order of Mozarella, cheddar curd and mature cheddar. The case for Mozzarella in particular is strong with rapidly increasing production forecast.

Although outwith the scope of this review, whey cream was also mentioned as a candidate for inclusion in the wholesale price mix.

Inclusion of a profit margin

While there was some support for the inclusion of a profit margin in the indicators, the arguments against were more substantial. These included the volatility of actual profit margins and interest rates, the practicalities of establishing an acceptable value, the practicality of collecting data, and the risk of confusion.

Timing of communication of AMPE/MCVE

There was a balance of views on the timing of publication of the wholesale prices and indicators. Some would favour the later date because of the ability to include more in-month data, while some favoured the status quo because of the importance of giving time for discussion between farmers and processors.

5.2 Conversion factors

The product conversion factors have been updated in accordance with the changed milk composition since the previous review in 2020.

The new base milk composition was taken as the AHDB standard litre from May 2025 (4.25% fat, 3.4% protein).

The new conversion factors are tabulated below, alongside the 2020 figures

	2020	2025
Butter	19,900	19,200
Skimmed milk powder[1]	10,600	10,470
Buttermilk powder	203,600	202,700
Mild cheddar	9,100	8,860
Whey powder	16,700	16,700
Whey butter	205,000	211,000

[1] Note: Conversion factor for SMP accompanied by lactose powder addition at 93 kg/tonne

5.3 Processing costs

Processing costs for each product were estimated using a cost engineering approach.

Plant utilisation was reviewed with a number of processors and the broad consensus was that butter/powder operations were at 55 to 70% utilisation, with cheese plants at around 90%.

The updated figures were sense checked with a number of industry colleagues and with the recently updated cost surveys and the revised make allowances published by the USDA in January 2025. The estimates for SMP, cheese and whey powder were within 10% of the US figures while the estimate for butter was just under 15% lower. However, for butter in particular the two surveys used as a basis for the USDA figures were widely different as a result of the different methodologies for cost allocation in-process.

This review of USA cost data also emphasised the difficulties in providing accurate figures for processing costs, and also the large impact that the degree of plant utilisation can have on unit product costs.

The figures provided must be seen in this context as broad, general estimates that represent the breadth of the industry, rather than actual production costs at specific plants. By definition there will be some operators producing at above these estimates and some below.

Their key value as part of a market indicator is to provide a base against which trends in wholesale product prices can be translated back into a milk equivalent.

The processing cost estimates are tabulated below, alongside the 2024Q4 figures:

	AMPE/MCVE 2025	AMPE/MCVE 2024 Q4 (revised)	AMPE/MCVE 2024 Q4 (as published)
Butter	335		343
SMP	420	518	560
Mild cheddar	425		456
Whey powder	455	510	532

The processing costs estimates for butter, SMP, cheese and whey powder represent reductions of 2, 25, 7 and 14% respectively compared with the published 2024 Q4 figures.

The relatively larger reduction in processing cost for SMP is largely due to the much-changed manufacturing base with two major manufacturing sites now dominating and operating two driers each using very efficient evaporation and drying technology. This not only delivers the benefit of much improved energy efficiency, but also significantly reduced labour cost resulting from increased automation and higher throughput operation.

6. RECOMMENDATIONS

Based on the conclusions of the review and some of the issue raised within it, the following recommendations are made:

1. Make the changes to the conversion factors and processing costs listed in the conclusions section.

2. Base future conversion factors on the AHDB standard litre in use at the time. The AHDB standard litre reflects the average GB farm and from May 2025 is based on a composition of 4.25% butterfat, 3.40% protein.

3. Continue the use of UK spot prices for butter, skimmed milk powder and mild cheddar, the EU milk observatory for whey powder and USDA for lactose.

4. Consider whether the UK commodity price survey could be conducted in the same way as for cream, with volumes captured and audited. This would improve confidence in the process, especially for butter.

5. Adjust the whey butter discount from £300/tonne to a flat percentage (5%) of the unsalted butter price.

6. Consult on whether it is appropriate and practicable to include Mozarella and Cheddar curd in the wholesale price reporting mix.

7. Communicate changes to contributors and the wider industry, in a similar way as was done for the 2014 and 2020 reviews.

8. Establish a schedule and protocol for future reviews of the AMPE/MCVE structure. The significant review interval should be no more than 5 years and provision should be made for capturing efficiency and productivity gains as well as cost inflation.

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Appendix 1: Standardised Skimmed Milk Powder (SMP)

1. <u>Conversion factor for standardised SMP</u>

- milk SNF is taken as 8.85% (3.38% protein, 4.55% lactose, 0.92% minerals & acids),
- the powder protein content is standardised to a target protein:SNF of 34.8%. This ensures a minimum protein in powder of 33% (as set out in product specifications).

Starting from 100 kg of milk (4.25% fat, 3.4% protein, 8.87% SNF, SG 1.030):

Masses of milk, skimmed milk and cream represented by Mm, Ms & Mc with respective fat contents of Fm, Fs & Fc:

$$Ms = Mm \times (Fc - Fm)/(Fc - Fs)$$

For cream and skimmed milk fats of 40% & 0.06% respectively, this give a mass of skimmed milk of 89.51 kg from the 100 kg milk.

The protein, fat and SNF contents of the skimmed milk are 3.55, 0.06 and 9.26%.

Masses of protein, fat & SNF in the 89.51 kg skimmed milk are 3.178, 0.05 & 8.29 kg.

The skimmed milk is then protein standardised by adding lactose to adjust the protein:SNF to 34.8%. This gives a mass of SNF in the standardised skim 3.178/0.348 = 9.14 kg. The mass of solids in the standardised milk is therefore the SNF + the fat, ie 9.14 + 0.05 = 9.19 kg.

Using a solids to powder conversion factor of 1.03 (17), and overall process loss of 2%, this gives 9.27 kg powder. A yield of 9.27 kg powder from 100 kg milk gives a litres/tonne yield of 10,470. The 2020 review reported 10,600 litres/tonne.

2. <u>Lactose requirement for protein standardised SMP</u>

The amount of lactose (assumed 97% solids) is calculated from the equation:

$$\text{Mass lactose (dry basis)} = \text{Mass protein in skim}/0.348 - \text{mass SNF in skim}$$

$$= 3.178/0.348 - 8.29 = 0.84 \text{ kg}$$

$$\text{And lactose used per tonne powder} = 0.84/9.27/.97 = 0.093 \text{ tonne} = 93 \text{ kg}$$

Appendix 2: Cost engineering

A2.1 Cost components

The cost engineering approach builds up product costs from estimates of individual components of the product cost structure, e.g labour, energy.

Changes in industry structure since 2014 (closure of less efficient plant, new plant coming on-stream, higher average throughput; mentioned in 1.4 above), have seen general increases in average energy efficiency and labour productivity.

This has been the case in the butter, cheese and SMP arenas. However, the situation with whey powder is essentially unchanged so the processing costs for whey powder are left unchanged with regard to energy efficiency and labour productivity.

Any commercially supplied energy and labour cost data was not used in the compilation of these estimates for reasons of confidentiality. A secondary reason was the difficulty in accurately allocating costs to products in the absence of a proceduralised system for doing so, such as the CATFI manual (MMB/DTF) or the CDFA audit system.

There was insufficient data to apply the same principles to building costs for whey butter and buttermilk powder so for subsequent purposes costs for these products should be assumed to be as for sweet cream butter and SMP respectively.

A2.2 Cost components

The components of the cost structure of dairy products are well known and incorporated into dairy company accounting systems. The key cost components used are:

- energy (electricity, gas, fuel oil etc)
- labour
- raw materials (ingredients, packaging)
- depreciation
- repairs & maintenance
- “other”process costs: chemicals, water & waste treatment, storage etc
- general & administration (management, accounts, bought in services, other costs).

Energy Costs

Energy cost estimations are based on the total kWh/tonne figures from several different references values for butter, SMP, Cheddar respectively. These are shown in the table below:

Table A2.1: Product energy requirements: kwh per tonne

	Specific energy, kwh/tonne					Average, kwh/tonne
Butter	792 (44)	1180 (45)	584 (41)	528 (42)	834 (43)	780
SMP	2400 (28)	2200 (43)	2694 (38)	2780 (38)		2520
Cheese	788 (28)	917 (43)	814 (39)			850
W.powder	3200 (46)	3060 (54)				3130

The energy mix for each product (electricity:fuel) was the average available from the above references together with (52). Fuel costs were taken as the average values for Industrial Energy (53). Climate change levy was assumed at the climate change agreement rate.

The fuel is assumed to be natural gas and the energy cost estimates are set out in Table A 3.2 below.

Table A2.2: Product energy requirements and costs per tonne

Product	Energy (kWh/tonne)	Energy mix (Kwh/t)	Cost, £/tonne[1]
Butter	780	30:70 electric/fuel	65
SMP	2520	20:80 electric/fuel	170
Cheddar	850	30:70 electric/fuel	70
Whey powder	3130	15:85 electric/fuel	190

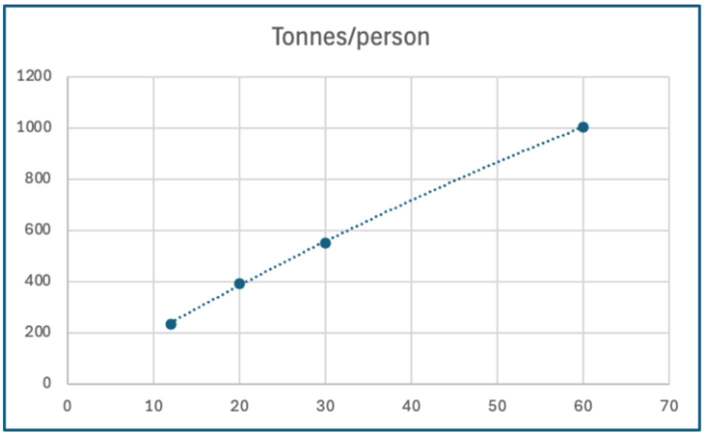
[1] Note: Energy costs average industrial as of 2024 Q4, including discounted CCL

Labour Costs

Labour costs were estimated using three methods:

i) a productivity model used by Teagasc, Ireland (47), modified on the basis of the author's experience,
ii) practical experience of the author and colleagues of manning levels in butter/powder and cheese/whey plants, and
iii) an adjustment of productivity figures from the 2014 review, assuming between 6 and 8% increase in productivity (48).

An example of the approach in I) above is shown in the graph below, plotting the tonnes/person against tonnes pa (x 1000). As a broad example, a productivity of 700 tonnes per person for SMP compares with 500 in 2014.



A labour rate of £49,000 was assumed, including allowance for all employment related overheads (49). Where labour rates were compared over time, ONS data on average weekly earnings was used (50).

The labour estimates for the commodities were as follows:

Product	Tonnes/person 2025	Labour cost £/tonne
Butter	540	90
SMP	700	70
Cheddar	510	95
Whey powder	540	90

Raw material costs

The raw material costs (ingredients and packaging) were reviewed with industry colleagues and found to be in line with the 2020 review figures.

Depreciation

Depreciation was estimated from a combination of an informal review with industry experts, and investments at a number of European capital projects (depreciated over 20 years). The averages of these for butter, and cheese were not significantly different from the current figures (2024 Q4), while the depreciation cost for SMP was reduced from £60 to £45.

Depreciation for whey powder was not reported separately in the 2014 report, but here a figure of £40 is used based on an average of inflated costs from 2014 and industry contacts.

Repairs & maintenance

Repair and maintenance costs were estimated on the basis of a factored fraction of overall overheads, an approach used by the author in previous studies.

"Other" process costs

The remaining elements of product cost structure (water, waste treatment, chemicals, storage etc) were grouped together and reviewed with a number of industry colleagues.

The consensus was that even when allowing for inflation the current "other" process costs were slightly "undercooked" for butter and cheese in particular. The current figures for "other" process costs were subsequently raised to £55 and £70 respectively and to £45 for SMP.

General & administration

General and administration costs were reduced to factor in a modest productivity improvement (5%) to reflect the increased site capacities and associated overhead dilution seen since then. A standard figure of £35/tonne was applied across each commodity.

Summary of estimated product cost structure

The estimates of the product cost elements are consolidated in the Table below:

Table A2.3: Product cost categories: £ per tonne

Cost element	Butter	SMP	Mild Cheddar	Whey powder
Energy	65	170	70	190
Labour	90	70	95	90
Raw materials	30	30	75	30
Maintenance	25	25	30	25
Depreciation	35	45	50	40
Other process	55	45	70	45
General & administration	35	35	35	35
Total	335	420	425	455