BREEDER FEEDER INDEX

Independent development of a new Self Replacing Index:

AbacusBio was contracted by the AWA to develop a custom self-replacing commercial index in July 2023. The goal of the project was to produce a fully customised Wagyu index that is:

- **Easily interpretable** – that is, built on a scale which sensibly reflects bull economic values.
- **Technically robust** – built on economic values derived from AWA data, current Industry information, and peer-reviewed scientific literature. It also incorporates modern index theory, including non-linear approaches and discounted genetic expressions (DGEs), while still allowing flexibility for desired gains approaches for traits that are harder to define economically.
- **Future-facing** – modular and easily altered to incorporate new data or concepts, capable of being updated to include new traits or changing economic values as required.

In particular, AbacusBio was asked to focus on developing solutions to:

- **Birth Weight.** The previous linear approach did not sufficiently discriminate against sires with unacceptably high or low Birth Weight EBVs. An AbacusBio non-linear approach to birth weight aims to reduce the incidence of calving difficulties (i.e., penalising overly large calves) while preserving calf survival (i.e., penalising small calves).
- **Carcase Weight.** Although the Wagyu breed has excellent carcase weight data, prior Wagyu Indexes use growth traits as an indirect proxy for Carcase Weight. The AbacusBio index allows Carcase Weight EBVs to be incorporated directly into the index.
- **Milk.** The previous SRI places negative pressure on Milk EBVs. The Breeder Feeder Index implements a bent linear approach to penalise negative Milk significantly and reward positive Milk gradually.
- **Mature Cow Weight.** Wagyu is a moderate Mature Cow Weight breed. Driving genetic gain for growth rate and carcase weight has had implications for increasing Mature Cow Weight. The Breeder-Feeder Index is designed to increase carcase weight whilst maintaining low negative pressure on Mature Cow Weight.

Economic Model Construction and Inputs:

AbacusBio custom indices consist of modules that calculate the change in profitability associated with a one-unit change in each trait. The final model provided to the AWA can be updated and modified (with support from AbacusBio) to develop new future selection indexes (eg. Fullblood Terminal and F1 Terminal) using the same base model construction. This simplifies future index development and implementation and enables routine updates to key economic parameters as required.

AbacusBio developed the Wagyu Breeder-Feeder Index using extensive economic and biological data, along with parameters developed by the Australian Wagyu Association that were used for prior indexes including the Self-replacing Index (SRI) as shown in Table 1.

Criteria	Value
Weaning Rate	85%
Feedlot Entry Weight	
Steers	330 kg
Heifers	270 kg
Days on Feed	
Steers	550 days
Heifers	450 days
Slaughter Age	
Steers	32 months
Heifers	29 months
Carcase Weight	
Steers	435 kg
Heifers	385 kg
Carcase Price at MS5	
Steers	$8.25/kg
Heifers	$8.25/kg
Marbling Score	~$1.00/MS[1]

Table 1. Key economic and biological inputs used in development of the AbacusBio Wagyu Breeder-Feeder Index.

This data was fitted within a customised and expanded full economic production model:

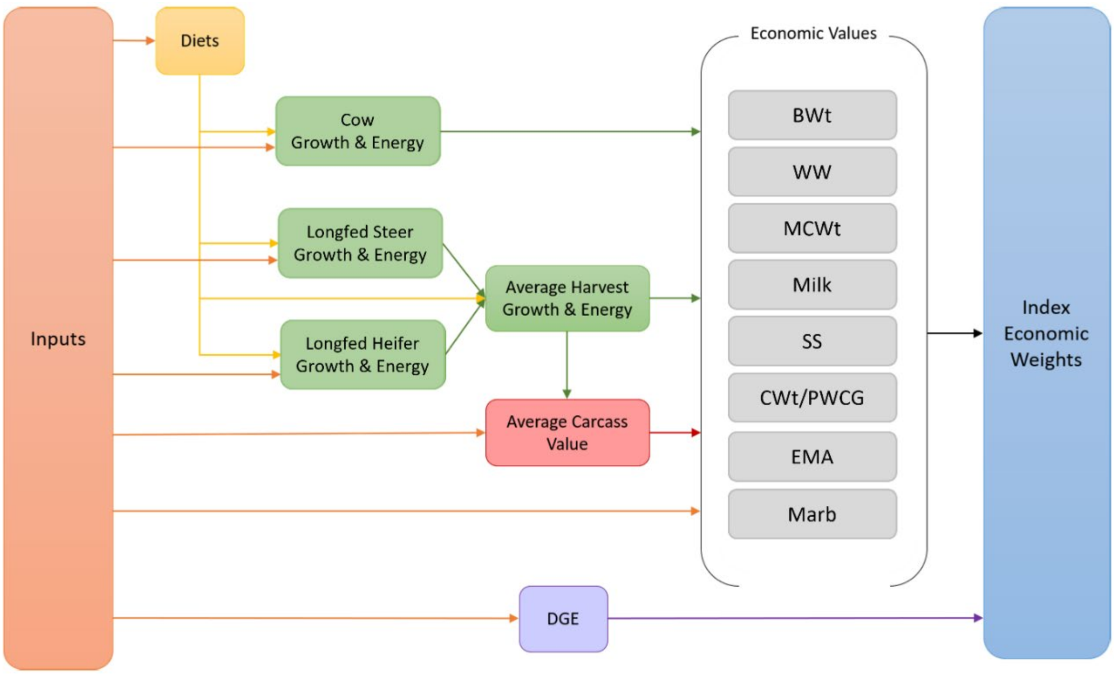


Figure 1. The AbacusBio economic framework model overview as applied to the Wagyu Breeder-Feeder Index.

Selection emphasis Breeder-Feeder Index compared to the Self Replacing Index:

The purpose for revising the AWA's Self Replacing Index and the focus of the AbacusBio Wagyu Breeder Index development considered:

a. Inclusion of the Carcase Weight EBV directly

b. Penalising very high and very low Birth Weight

c. Rewarding high Milk and penalising low Milk

d. Penalising very high Mature Cow Weight

e. Removing negative emphasis on Birth Weight and Scrotal Circumference

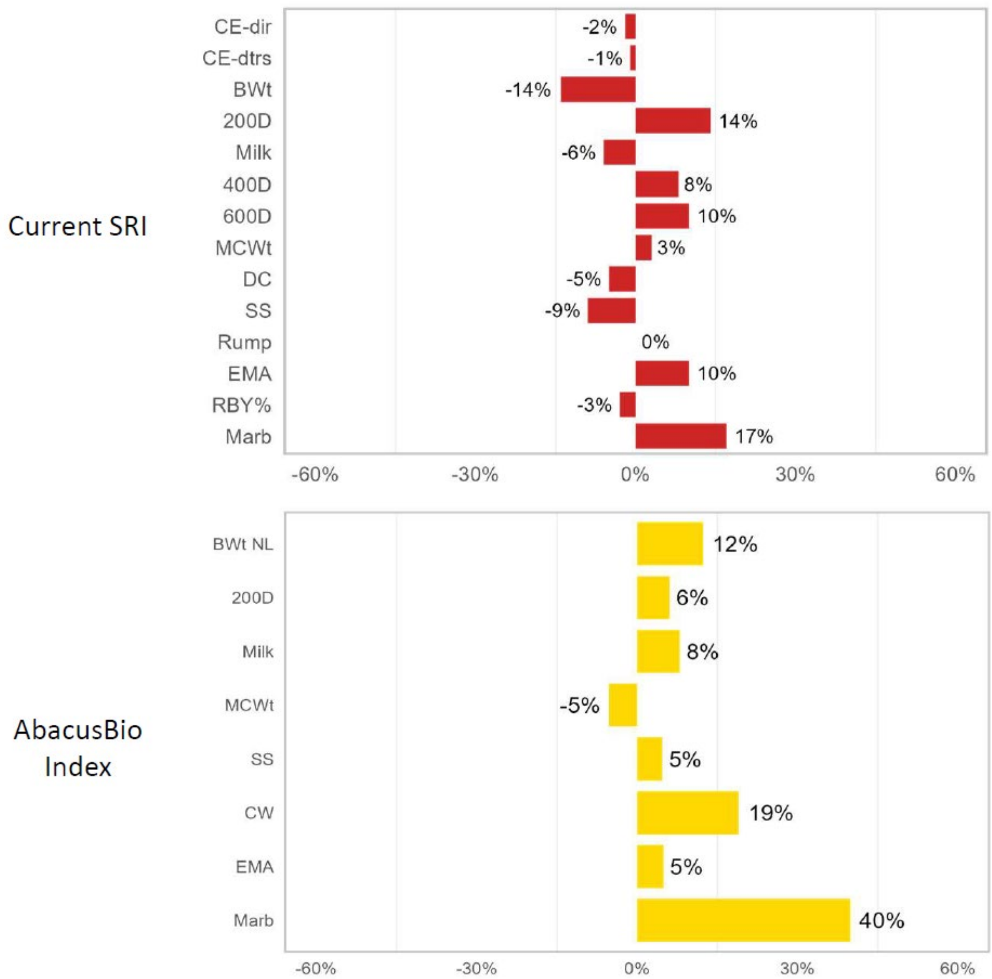
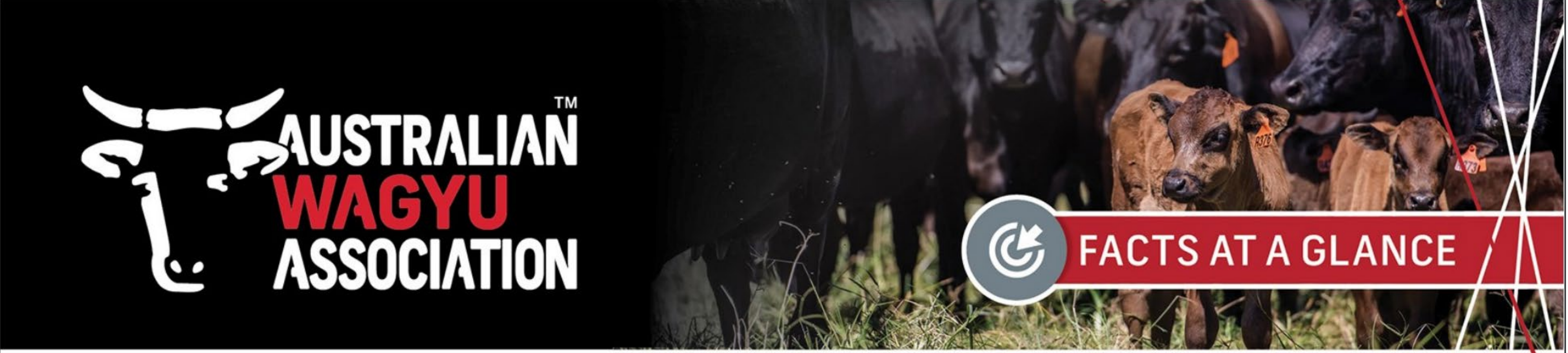


Figure 2: Comparison of Index selection emphasis for the current Wagyu SRI (Top graph – red bars) vs the AbacusBio Breeder-Feeder Index (bottom graph – yellow bars).

The Wagyu Breeder-Feeder Index:

- Places strong emphasis on keeping Birth Weight at intermediate levels, thereby reducing the number of extreme Birth Weight EBV sires (both high and low) at the top of the index rankings
- Balances the emphasis on Marble Score and growth traits, with an emphasis on Carcase Weight as the better measure of economic growth performance
- Positively emphasises Milk and Scrotal Circumference (which were negative in the prior SRI)
- Balances an emphasis on growth via Carcase Weight with moderate downward pressure on Mature Cow Size
- Has a correlation of 0.78 with the current SRI



Economic Model for optimal birth weight:

The birth weight economic value is derived from a non-linear formula that penalizes both high and low Birth Weight EBVs.

Economic data are used to determine an expected cost for each calving difficulty score (4 for surgical assistance, 3 for heavy pull, 2 for light pull, and 1 for no assistance). Genetic and phenotypic data are then used to determine the average expected cost due to calving difficulties for a given Birth Weight EBV.

The expected percentage of calf deaths due to low birth weight is used to fit the function impacting low Birth Weight bulls. An increase of 2% in calf mortality per 1 kg decrease in Birth Weight EBV below a base of 0 is utilised to provide expected calf loss data.

A non-linear polynomial is then fitted around the economic losses due to high birth weight (more calving difficulties) and low birth weight (reduced calf survival). The Birth Weight EBV optimum is 0 to +3, with economic loss penalties increasing with extreme high or low birth weight.

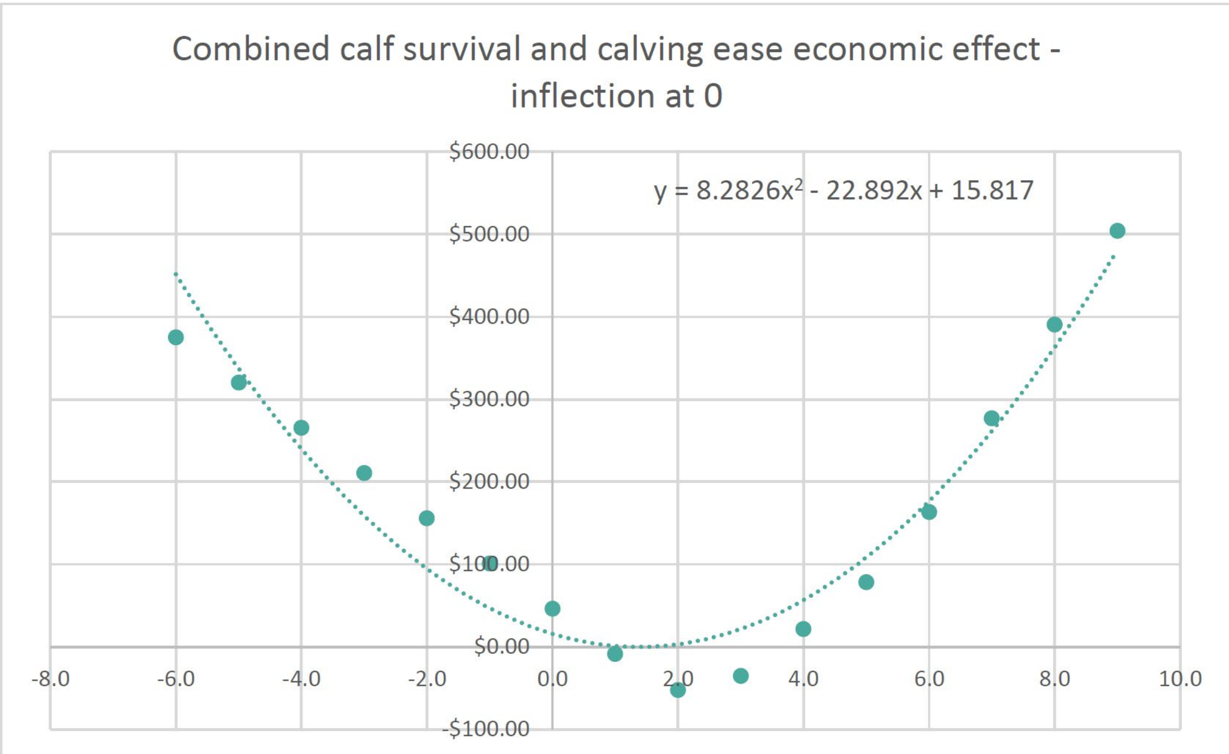


Figure 3: Calculated economic impact (points) and polynomial function (dotted lines) per birthweight EBV.

Economic Model for positive milk:

The Milk EBV represents the maternal component of the 200-day weight trait EBV. It is expressed in kg of weight gain in the calf measured at weaning (approximately 200 days of age).

The base milk economic value is derived from the impact of a 1 kg heavier calf at weaning due to increased milk production of the dam. This calculation includes the added value of a heavier calf and the added cost required to maintain the heavier calf and produce more milk.

Extra economic impact was added for low Milk EBV (milk EBV < 0) to include the consequence of lower calf survival from dams with poor milk production. This was done by incorporating a 0.25% increase in calf mortality for each 1 Milk EBV less than 0.

The inclusion of both economic aspects results in a “bent stick” distribution when comparing the Milk EBV to the economic impact per Milk EBV, as shown in Figure 4.

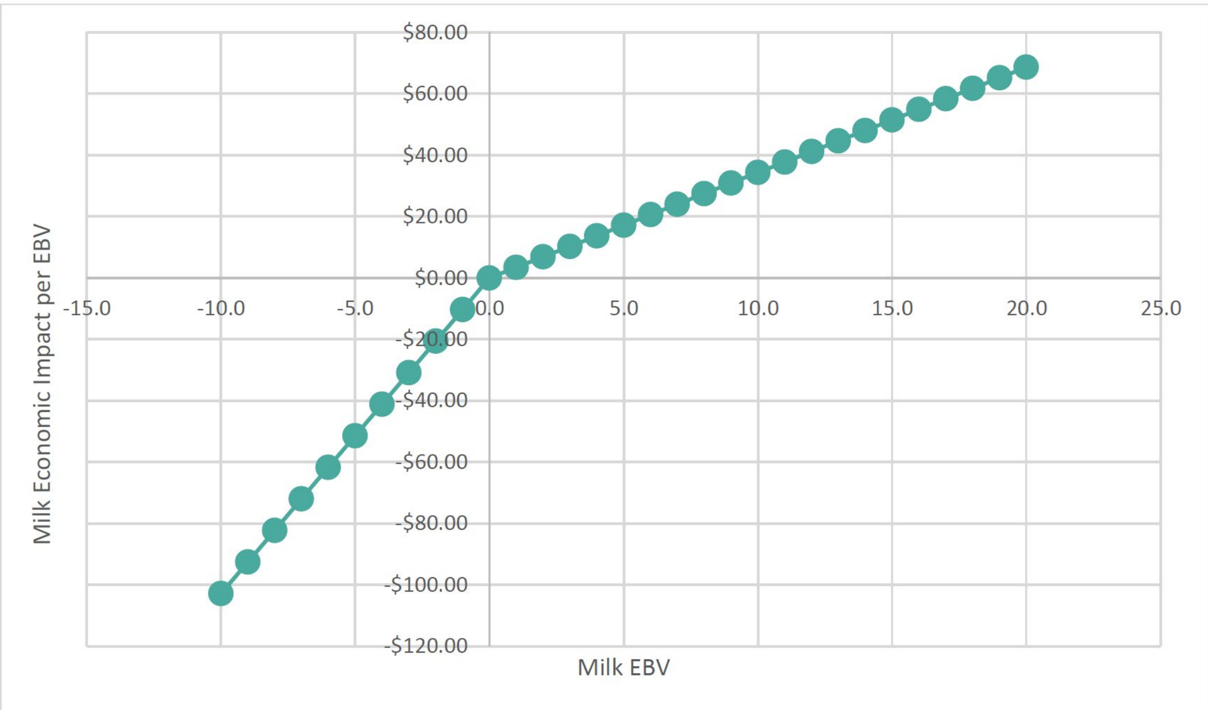


Figure 4: Calculated economic impact (points) and “bent linear” function showing the response per milk EBV unit.

Economic model for Mature Cow Weight:

The mature weight economic value comprises three different economic values: the extra feed cost required to grow to a replacement heifer to a 1 kg heavier mature weight, the extra annual feed cost required to maintain the 1 kg heavier mature cow weight, and the extra salvage value received for a 1 kg heavier cull cow.

Figure 5 shows the modelled mature cow weight difference between 2 example cows, one at 480kg mature weight and a second at 500 kg mature weight. The economic model estimates the energetic difference to grow and maintain the 500kg cow compared to the 480kg cow up to 4 years of age, with maintenance energy costs calculated each following year.

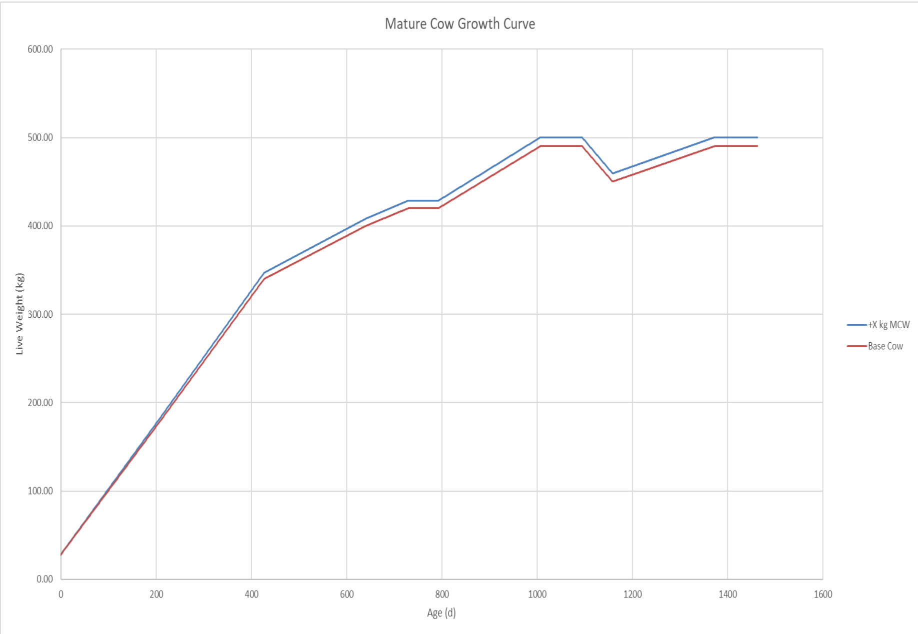


Figure 5: Modelled mature weight in two cows, one at 480 kg liveweight and one at 500 kg liveweight.

The breakdown of economic valuation for the Mature Cow Weight trait is shown on the next page. The economic impact of increasing the Mature Cow Weight EBV by +1kg in breeding to produce replacement females is -$1.10 within the Breeder Feeder Index calculation. This is driven by increased replacement heifer feed costs and annual mature cow feed costs, offset by increased salvage value from higher carcase weight in the cow when culled.

	Value per Expression	Discounted Genetic Expression Factor	Component Economic Value
Replacement Heifer Feed Cost	-$2.16	0.3	-$0.65
Annual Cow Feed Cost	-$0.61	1.26	-$0.77
Increased Cow Carcase Value	$1.46	0.22	$0.32
		Overall Economic Value per Kg Mature Cow Wt	**-$1.10**

Breeder-Feeder Index expanded economic range:

The following data is a summary of Breeder-Feeder Index calculations based on July 2023 Wagyu BREEDPLAN EBVs extracted for 374 high accuracy sires. The range of economic values expressed by the Breeder-Feeder Index is increased compared to the prior AWA published Self Replacing Index. This is mainly due to increased economic weight being placed on traits like Birth Weight and Milk, as well as direct economic value being placed on Carcase Weight.

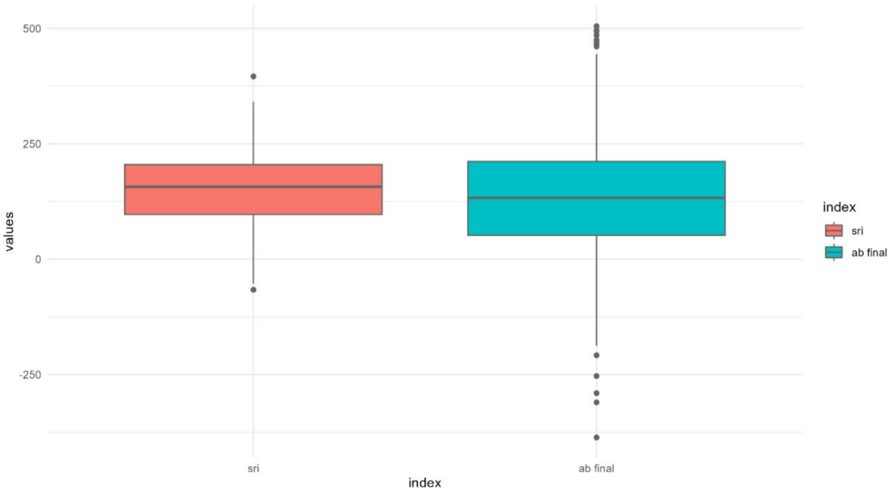


Figure 6: Box and whisker plot showing the mean and range of the SRI values (red) and AbacusBio Breeder-Feeder Index values (blue) for 374 high accuracy Wagyu sires.

Comparing the SRI to the Breeder-Feeder Index, we can see that although the average values for the 374 high accuracy sires are similar for both indexes, there is significant additional range in the Breeder-Feeder Index resulting from the expanded AbacusBio economic models developed specifically for Wagyu.

Index	**Self Replacing Index (SRI)**	**Breeder-Feeder Index (BFI)**
Top Value	$396	$505
Average Value	$152	$136
Bottom Value	-$66	-$386
Range	$462	$891

The expanded economic range for the Breeder-Feeder Index will allow AWA members to better identify superior high value genetic merit animals for use within their breeding programs.