# Growing Profit by Understanding Cow Maintenance Efficiency and Maintenance Requirement in an Animal and Systems Context

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**Introduction and Background**

A statistic often used to illustrate the importance of cow maintenance requirements is that the feed associated with maintaining the cow herd accounts for roughly 60% to75% of the total feed used in the cow calf herd and in some cases for overall beef production—a range that is well supported by scientific literature (Ferrell and Jenkins, 1984; Gregory, 1972; Heitschmidt et al., 1996; BIF, 1981). Given the magnitude of the costs associated with cow herd maintenance, cow feed intake is clearly an economically relevant trait—a trait directly related to the costs and therefore profit of beef production. In addition to its economic importance, differences in maintenance requirements have been shown to be heritable ($h^2 = 0.52$; Hotovy et al., 1991), which allows reduced maintenance requirements to be a clear target for selection and genetic improvement. Yet, the availability of these selection tools for genetic improvement of cow maintenance requirements is limited due to the expense associated with measuring maintenance requirements directly. Even with this difficulty, there are tools currently available that aid in the selection for improved maintenance requirements.

**Tools for Selection**

Cow energy needs can be divided up into four general categories: energy for gestation of the calf, growth, lactation, and maintenance (e.g. locomotion, temperature regulation, protein turnover, etc). Literature evidence also suggests the latter 2 items (lactation and maintenance) are not completely independent (Jenkins and Ferrell, 1983; Ferrell and Jenkins, 1984). Currently available expected progeny differences (EPD) useful for genetic improvement of maintenance requirements are largely comprised of those categories. These EPD focus on "maintenance energy" and make the assumption that a relationship between lactation and maintenance requirements exists.

The EPD related to maintenance energy requirements are based primarily on mature cow weight, height and body condition score, leveraging data on traits easily recorded and reported by breeders. Given the relationship between lactation requirements and maintenance energy, milk EPD are also often used as a piece of the maintenance energy puzzle. In most cases, EPD for mature weight and height are available to use in selection with increases in mature weight indicating greater maintenance requirements. In some instances information on mature weight and the resulting mature weight EPD are combined with the milk EPD to produce the $EN (American Angus Association, 2016) and the maintenance energy EPD (e.g. Red Angus Association of America, 2016). However, one of the challenges associated with the calculation of these EPD is the relative low reporting rate for mature weight and body condition score observations. Often the number of mature weight observations may represent only 2 to 5% of the number of weaning weights stored in breed association databases. Admittedly, weaning weight numbers include observations on both male and female calves, yet given the opportunity to leverage repeated mature weight and BCS measures on cows, increased reporting rates would greatly enhance the accuracy of these evaluations.

One of the other challenges associated with genetic evaluation of ME is the time required for observations to be collected and the amount of time needed for EPD accuracy increases to be realized. The most useful data for the evaluation of ME comes from 2 year old and older cows, although in some instances weaning and yearling weights are used in multiple trait analyses as a correlated trait to provide some indication of mature size at an earlier age. An alternative to "waiting" for mature cow observations would be the development of genomic markers predictive of maintenance requirements. Markers associated with maintenance requirements could be used to increase accuracy of selection at younger ages and to identify maintenance energy requirement differences not expressed through mature weight alone. These markers would provide information earlier in an animal's life span, but given the current state of knowledge, they would not eliminate the need to weigh and body condition score females. Research is underway to identify DNA and protein markers predicative of differences in maintenance energy requirements such as reported by Cooper-Prado et al. (2014) and as indicated in the USDA-NIFA funded National Program for Genetic Improvement of Feed Efficiency in Beef Cattle (see: http://www.beefefficiency.org/).

**Interpretation and Use**

The EPD for improvement of maintenance energy requirements must be used in the context of the beef production system and never independent of that context or as the focus of single trait selection. With that perspective, EPD representing maintenance energy would be much like birth weight. Continued downward selection pressure on birth weight would ultimately result in calves with lowered survival rates. As with many traits maintenance energy likely has an intermediate optimum, where too low or too high is not a preferred outcome and is liable to result in reduced profitability.

Interpretation of mature weight and mature height is relatively straightforward with units in pounds (kg) or inches (cm) depending upon location (e.g. American Hereford Association and American Angus Association). However interpretation of maintenance energy EPD can be less straightforward with the particular breed deciding on the appropriate unit for interpretation. For instance, the Red Angus Association of America has chosen to express that EPD (I.e. ME EPD) in terms of Mcal/month where animals with lower EPD produce progeny requiring less feed input for maintenance than animals with higher EPD. This EPD combines knowledge of mature cow metabolic weight (thru the EPD for that trait) with knowledge of the milk production level of the cow as indicated by her milk EPD using an approach similar to that reported by MacNeil and Mott (2000), with increases in milk EPD resulting in increases in overall maintenance requirements. In the end, mature size accounts for approximately 91% of the variability in maintenance energy requirement while milk production level accounts for roughly 9%. The differences represent expected differences in the metabolizable energy requirements of daughters at a body condition score of 5. Translating the ME EPD into an amount of a specific feed source requires knowledge of the net energy of that feedstuff. However, no matter the feed source, animal ranking will not change for both ME EPD and predicted differences in metabolizable energy requirements. The American Angus Association has taken a slightly different approach, combining knowledge of genetic differences in mature weight and milk production with the economics of production into a dollar value, $EN. Representing the "an expected dollar savings difference in future daughters of sires" (http://www.angus.org/Nce/ValueIndexes.aspx) with larger values associated with larger savings in feed costs.

In the end, selection for maintenance requirements is undertaken with the goal of increasing profitability. The American Angus Association has taken the next step. Generally, maintenance energy is related to overall body size with heavier cattle having greater maintenance requirements. The challenge for cattle breeders is to balance lowering feed costs/input with the increased salvage value of larger cull cows. This balance is typically accounted for in the development of maternal-focused indexes where the value of changes in maintenance energy requirements is balanced with the increased income associated with larger cows and greater salvage value. Application of this knowledge in the public domain is limited with Melton (1995) and a few others reporting specific values for selection for improved efficiency or maintenance energy requirements. As adoption of economic selection indexes and the genetic and economic research increases, valuing differences in maintenance energy requirements will become more straightforward and likely use more precise genetic predictors than only mature weight alone.

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