The Full Picture of Cow Efficiency

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Beef production is a critical component in U.S. and global food security because cattle upcycle plant components into high-quality human edible protein. Furthermore, most of the beef production cycle occurs on land not suitable for raising crops. From this perspective, grazing cattle contribute to global food security because they have the unique ability to convert sunlight, water, and carbon dioxide into a nutritious human food source.

However, access to grazing land and supplemental feed costs remain the overriding factors driving profitability in U.S. cow/calf operations (Miller et al., 2002; Bowman et al., 2019). For example, the Kansas Farm Management group reported $1,404 total fixed and variable costs per cow in 71 operations enrolled in their program during 2023. Pasture and feed costs averaged $680.09 per cow, accounting for 74% of variable costs and 48% of total costs. In fact, the cow/calf sector of the beef industry uses 74% of the total feed energy required to produce one pound of carcass weight (Rotz et al., 2019). Reducing costs associated with grazing and other supplemental feed by the cow/calf segment will improve economic, environmental, and social sustainability.

Gross et al. (2024) reported that mature cow body weight is one of three factors having the greatest impact on beef cow feed intake. Therefore, mature body weight has an important influence on ranch-level feed efficiency due to its impact on a given land base's carrying capacity or stocking rate. When adjusted to a live weight basis, cow carcass weight trends since 1978 suggest that cow weights have increased at the rate of about 7.3 pounds per year. Consider that if a rancher, over a 30-year career, had selected herd sires with industry-average growth and mature weight genetics, mature cow size would have increased by about 219 pounds. This equates to a 13% reduction in cow numbers to achieve the same grazing pressure on the land base.

But do the bigger cows produce bigger calves? There is growing evidence that the ranch environment limits the expression of genetic potential for weaning weight in some operations or regions of the country (Lalman et al., 2019, Ramsay et al., 2021). In fact, this phenomenon may be occurring in seedstock operations. For example, in the Charolais and Angus breeds, the adjusted weaning weight trend appears to be stabilizing over time (American Angus Association, 2024; American International Charolais Association, 2024). The important point is for each manager to know what is going on in their own system. Obviously, if cow weights are increasing and the response in calf weaning weight is minimal, emphasis should shift from increasing output (growth) to controlling cost (cow weight). Certainly, a plan to retain ownership or otherwise capture the value of superior genetic potential for post-weaning traits should be in place.

The energy metabolism diagram shown in Figure 1 provides an approximated view of energy partitioning, loss, and retention in beef cows consuming moderate-quality forage (60% digestibility). This overview provides perspective for the mechanisms driving feed intake and energy utilization in individual animals. Gross energy intake is determined by measuring feed intake and multiplying the amount of feed consumed by the feed's caloric value. The various sources of energy loss in Figure 1 are highlighted in yellow and account for about 70% of the gross energy consumed in this example. Researchers have determined that variation in energy loss from each of these pools explain a portion of the biological variation in feed efficiency between contemporaries (Kenny et al., 2018). Cow efficiency can be improved by controlling feed intake, selecting for, or managing for improved diet digestibility, reducing enteric methane emissions, and improving the metabolic efficiency of converting metabolizable energy to net energy.

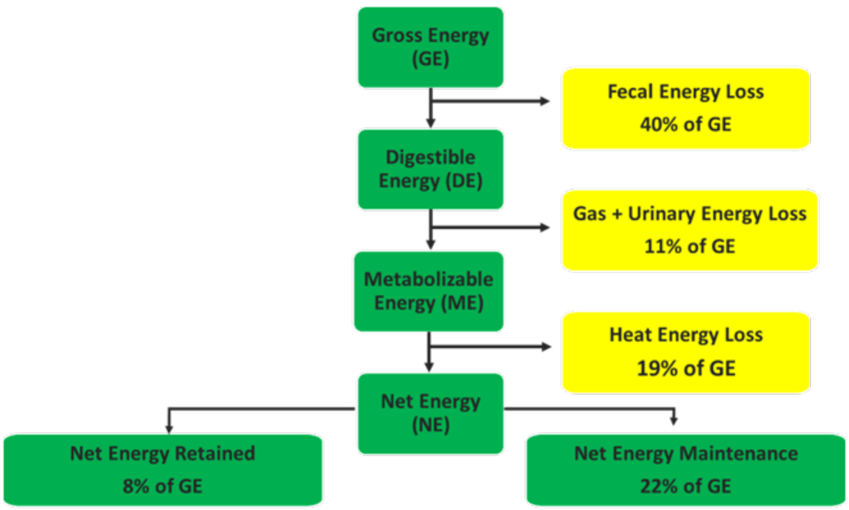

Figure 1. Approximated energy flow in lactating beef cows with stable body weight and consuming a diet with 60% digestibility.

Another factor contributing to efficiency in cattle is the amount of energy required for maintenance, shown as net energy for maintenance in Figure 1. The maintenance requirement is defined as the energy needed to achieve no net loss or gain of energy retained in the tissues of the animal's body (NASEM, 2016). Maintenance has been shown to be heritable (r = 0.31) and highly variable in beef cows (Freetly et al., 2023). This suggests that substantial progress can be made in cow efficiency by selecting for cows that are productive but have moderate to low maintenance energy requirements. Lower maintenance leaves more net energy available to be used for milk production or maternal tissue gain (Briggs et al., 2022).

Feed intake in cattle tested as weaned heifers and again as mature cows is highly heritable (0.83 in heifers and 0.53 in cows) with a strong genetic correlation (0.84) when fed the same diet at both stages of production (Freetly et al., 2020). This suggests that minimal reranking for feed intake should occur at different points along the growth curve. It also suggests the feed intake or residual feed intake EPDs and genomic values available throughout the industry should be useful to control feed intake in the cow herd.

Could the genetic tools for feed intake available be more effective to control appetite in the cow herd compared to using mature cow weight as a proxy for feed intake? Certainly, one argument against this approach is the relatively low number of phenotypes for these traits reported each year among all breeds. Nevertheless, in our research program, in every contemporary group tested for long-stem, dry grass hay intake, we find cows with below average mature weight that eat more than group average. And we find larger cows that eat well below group average. Yes, in general, bigger cows eat more feed, but we observe a lot of exceptions to this rule. The same can be seen in the Angus Sire Evaluation report (American Angus Association, 2024). Figure 2 shows dry matter intake (DMI) plotted against mature weight (MW) EPD in 177 Angus sires with DMI EPD accuracy of 0.6 or greater. On average, sires expected to produce daughters with greater than breed average mature weight do have greater than breed average DMI EPD. However, MW EPD accounts for only about 25% of the variation in DMI EPD. Notice there are several proven sires available that are expected to produce daughters with greater than breed average mature weight with lower than breed average feed intake. Considering the importance of feed intake and cow weight genetics on ranch-level feed efficiency and efficiency of beef production from a systems perspective, more emphasis should be placed on collecting and reporting these phenotypes.

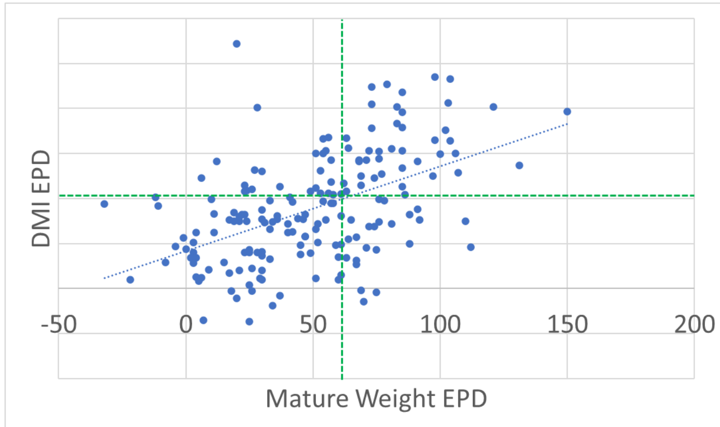

Figure 2: Relationship between dry matter intake (DMI) EPD and mature weight EPD for 177 proven Angus sires. Dashed green lines represent breed average for the respective EPD.

The National Academy of Sciences, Engineering and Medicine publishes guidelines for beef cattle nutrition (NASEM, 2016). Gross et al., 2024 recently evaluated the widely used NASEM (2016) equation to predict feed intake in beef cows. This equation is used in beef cattle nutrition software programs and may be used to generate multi-trait selection indexes related to cow/calf phase inputs. In general, the old equation predicted feed intake reasonably well when diet digestibility was low (55% TDN and lower). However, when diet digestibility was moderate to high (similar to grazing season conditions), feed intake was underestimated. Underprediction of feed intake was especially pronounced in lactating cows (Gross et al., 2024).

Genetic capacity for milk production is an important consideration in cow efficiency because of the relationship of milk yield to calf growth, feed intake in cows, and body condition in cows. Increasing milk yield is associated with increasing feed intake in beef cows (NASEM, 2016). The NASEM (2016) model adjusts cow feed intake by 0.2 pounds for every one additional pound of milk yield. This adjustment factor originated from dairy literature and has not been validated in beef cows until recently. We have documented coefficients of 0.35, 0.71, 0.45, and 0.51 (Johnson et al., 2003; Moore et al., 2023 Gross et al., 2024; Talley et al., unpublished data; respectively) suggesting that increasing milk yield has a greater impact than previously thought on feed intake and cow cost.

In summary, it is apparent that continued aggressive selection for growth has increased cow mature weight and likely cow feed intake, requiring adjustments in ranch-level stocking rate. There is growing evidence that weaning weights may have stabilized in some regions, suggesting that the ranch environment has limited capacity to support increased growth genetics through the weaning phase. While cow weight is a reasonable proxy for feed intake and thus cow costs, we submit that use of feed intake EPD's for this purpose should be further explored. Expansion of feed intake and mature cow weights (coupled with body condition scores) phenotype reporting would accelerate progress in cow efficiency in the future. Feed intake and thus annual cow costs may be underestimated in nutrition models and multi-trait selection indexes. We have also discovered that feed intake and cow costs are more sensitive to milk production than previously thought.

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