Fuel Economy and Wide Area Mowers

The wrong choice could cost you an extra $10,000 in fuel over the life of the mower.

When was the last time you purchased a new or used car without noticing the fuel economy sticker in the window or at least being aware of the fuel economy rating? When buying a car or truck, most, if not all of us consider fuel mileage as a factor in our purchase decision. If that's the case, why don't turf professionals give the same consideration to wide area mower purchases? Buying patterns suggest that when it comes to purchasing a wide area mower few turf professionals consider fuel economy as a major factor when making a purchase decision. Most would be surprised to know that picking one mower over another could not only double the amount of fuel required to cut an acre of grass, but also increase their labor costs.

How do you find the most fuel efficient wide mower for your application? You may be surprised to know that it has little to do with the efficiency of the engine. All manufacturers of wide area mowers utilize state-of-the-art fuel injected engines that offer similar fuel efficiency ratings. The minor variations in fuel consumption rates from one engine to another are insignificant when compared to other variables. If it isn't the engine that determines fuel consumption, what does?

The most significant factor in determining the overall fuel economy of a mower is the efficiency of the deck drives. The efficiency of the deck drive is the most significant factor to determine overall mower efficiency because more than three quarters of the engine horsepower used by a mower drives the cutting decks. The greater efficiency of the drive, the less fuel it burns to do the same work. Some mowers waste over a third of the engine horsepower before it even reaches the blade.

While often overlooked, the second most important difference in the overall fuel economy when comparing one mower to another involves the ability to eliminate non-mowing time while the engine is running. The more time the mower is cutting during any given period, the less fuel is wasted. A zero turn drive mower typically burns less fuel than one with a steering wheel because it spends a greater percentage of the day cutting grass when compared to a mower with conventional steering. This advantage dramatically improves overall fuel efficiency.

While it is virtually impossible to calculate the number of acres a single gallon of gas can cut in all types of grass, heights, and types of terrain, there are a few simple factors that can be measured that make one mower more productive than another in any cutting situation. Several manufactures list "acres per hour" in their specifications, but be careful when comparing one company's claims with another. The amount of grass being cut, the species of grass, the height of cut, and the size of the area all impact overall fuel efficiency, cutting rates, and productivity. Lightly grooming a golf course rough requires less fuel per acre than when the same deck cuts five in. of grass at a park that hasn't been mowed after three weeks of rain.

If you can't compare one manufacture's claim with another, how can you compare fuel efficiencies? The answers are found in physics and common sense. Physics explains how the mechanical and frictional losses of one deck drive, when compared to another, can account for significant differences in fuel consumption. Common sense in field tests shows that if one mower spends a higher percentage of time cutting than another in a given period, it will cut more grass per gallon of fuel. These factors can allow one mower to cut twice the grass as another on a given

amount of fuel. A look at the various options on the market will illustrate the differences.

Wide area mowing decks use one of four types of drives: hydraulic pumps and motors, belts and pulleys, electric generators and motors, or gearboxes and drive shafts. Each drive type has its advantages from a functional standpoint and they all have different efficiencies that impact fuel consumption. When it comes to fuel economy, the more efficient the drive is, the less fuel burned.

Hydraulic Deck Drives…High Tech, but Inefficient. Hydraulic deck drives are used by many wide area mowers, especially ones that offer articulating decks. The reason hydraulic drives are used in these applications is that the flexible lines between the hydraulic pump on the tractor and the individual motors on each deck allow the decks to follow the contours of the ground. This type of drive allows a wide range of deck configurations and enables decks to be folded and raised for transport by simply flexing a hose.

Unfortunately, hydraulic drives are the least efficient drives utilized to power wide area decks. The greatest inefficiency of this drive is caused by the heat losses generated by the pumps and motors…the byproduct of frictional loads in the system. Using fuel to burn a fire produces heat in much the same way as fuel is used to produce heat through friction. The more heat produced, the more fuel consumed. The heat released from these mowers by large radiators and cooling fans could otherwise be used toward powering the blade. In optimal conditions about 30 percent of the horsepower is lost by heat losses in a hydraulic drive system and as air temperature rises, it is possible for these drives to lose up to 50 percent of the usable energy through heat loss.

There are two other fuel consuming impacts that contribute to the inefficiency of hydraulically driven decks. The first is caused by the added weight of the drives because the additional weight requires more energy to move. The second is that the inefficiencies require a higher horsepower engine to apply the same amount of power to the blade as a lower horsepower efficient drive. Field tests show that it is possible for a 33-hp mower utilizing more efficient drives to cut at similar heights, widths, and speeds as hydraulically driven mowers with 50 to 60 hp.

Ten Overlooked Variables that Consume Fuel

- Mulching decks consume up to 30 percent more fuel than decks that discharge grass.
- High lift blades burn up to 20 percent more fuel in some cutting conditions than low lift blades.
- Every minute of maneuvering time burns almost 75 percent as much fuel as cutting time.
- A narrower deck can cut more grass, more efficiently in the right application.
- Lower engine RPM can reduce fuel consumption by 20 percent or more without impacting cut quality.
- Cutting wet grass can double the fuel consumption rate when compared to cutting dry.
- All other things equal, a lighter weight mower burns less fuel than a heavier mower.
- Hydrostatically driven mowers burn more fuel than belt driven mowers with similar power.
- Failure to clean accumulated grass from under a rotary deck burns more fuel than if cleaned.
- Cutting in extremely hot conditions reduces engine and drive efficiency and burns more fuel.

Belt Drives are Simple, but Efficient. Belt drives have been around for over a century and are viewed by many as yesterday's technology, but when it comes to fuel efficiency, they are still the most efficient drives available to power any wide area mower. They limit some level of design flexibility offered by hydraulic drives, but in defined configurations accomplish the same function.

When you think of belt drives today, don't necessarily think "low tech." The advancements in belt materials, life, and reliability have taken quantum leaps in the last few decades. Million dollar vehicles, modern aircraft, and robotic devices rely on belts to deliver power. Today's wide area mowers utilize bullet proof materials, like Kevlar, and special synthetic compounds to deliver reliable power from the engine to the deck at the highest efficiencies of any drive.

The key to the efficiency of the belt drive is that heat and mechanical losses are insignificant when compared to other drives. A belt relies on its surface contacting a groove in a pulley to transfer power from one deck to another. This produces little heat and frictional loss of power. Over 95 percent of the horsepower from one deck is transferred by a belt to the next. A belt drive is also the lightest weight drive of the four types. A lighter weight mower consumes less fuel to move and the greater efficiency of the drive allows a smaller engine to power the deck. Field tests show that some belt driven mowers consume half of the fuel to cut the same amount of grass as hydraulically driven mowers of the same width.

Electric Drives Hold Promise. Electric drives are not currently being used as deck drives on a significant number of wide area rotary mowers. While some electric drives are used on green and fairway mowers, the higher horsepower requirements and current cost of these drives prevent them from being applied to most wide area mowing applications. Several manufacturers are investigating electric drives for their decks and are experimenting with various voltages, generators, and motor combinations that may prove to offer viable options in the future. If proven to

be successful, these drives can see efficiencies above 80 percent from generator to motor and hold promise to offer fuel efficiency gains over hydraulic drives.

Gearboxes…Great for Rigid Pan Decks. Many traditional "bat wing" type wide area mowers use drives that transfer power through gearboxes and drive shafts. They typically power a central spindle on each deck that uses belts to power additional spindles on the same rigid pans. The primary reason that they aren't used on wide area mowers with smaller articulating decks is that they are costly and limited in how the higher number of smaller decks can be configured.

When utilized in a bat wing configuration these drives are more efficient than hydraulic drives with efficiencies exceeding 70 to 80 percent in most instances. The type of gearing inside a gearbox impacts the efficiency of the deck, with spiral gears typically producing less heat than straight gear sets. The weight of the drives is less than an equally rated hydraulic system so further fuel savings are realized by overall reduction in the fuel required to move the mower.

Zero Turn Drives

Zero turn mowers reduce the total amount of time it takes to cut an area when compared to a mower with conventional steering. This reality is compounded when the turf has landscaping features that require significant trimming and when cutting in smaller areas requiring more maneuvering and turns.

Wide area mowers with conventional steering require significantly more time and space to turn than zero turn designs. They cannot trim as closely to objects and because of this, spend less time cutting than the more maneuverable zero turn drives. Buying the right wide area mower to manage your turf obviously involves considering more than overall efficiency. The quality of cut, the initial capital investment, the long term operating costs, overall productivity, and reliability of the mower are all additional variables that should be consider when making a purchase. However, in today's world, the impact of fuel economy grows in importance when making your decision, in part because it impacts your long term operating costs, but more importantly because it is the right thing to do. Even if your budget allows for a high cost fuel guzzling mower that has features you may want, if those features come at the cost of producing twice the greenhouse gasses every day it is used, that decision impacts more than your budget. It negatively impacts us all.

Can you quantify that impact? Sure. A single wide area mower using six gallons less fuel per day, five days a week, six months out of the year burns over 750 gallons less fuel each year. In five years of useful life it will save 3,750 gallons of fuel. At a cost of $2.75 per gallon, that represents over $10,000 in fuel savings. If you consider that burning a gallon of fuel releases about eight pounds of greenhouse gasses, a more efficient wide area mower releases 30,000 lb less pollutants into the atmosphere during its useful life. If there are 10,000 wide area mowers operating around the world in any given year the total fuel savings generated by more efficient deck drives would exceed 37.5 million gallons. The combined monetary savings would exceed $100 million and 150,000 tons less greenhouse gasses would be released into the air we all breathe.

GE

Smart Routing in Los Angeles

In the predawn hours, crews from the Los Angeles, CA, Bureau of Sanitation assemble in staging areas for assignment details before their daily deployment for the removal and disposal of recyclables and waste throughout the city's vast 450-square mile service area with 1.5 million residential and commercial addresses.

In addition to its regularly scheduled pickups, the bureau's Solid Resources Collection Division (SRCD) collects bulky items, white goods (including refrigerators and washing machines), and dead animals. This service is scheduled by appointment for the 60 special-collection drivers who field more than 55,000 pickup requests each month.

Not so long ago, SRCD crews would meet with their supervisors each morning to map out the day's routes for special collections, but increasing service demands recently made it clear that the department needed a more efficient method for route planning.

After evaluating various systems, the department decided to implement a GIS that includes ESRI's ArcLogistics (www.esri.com) for point-to-point routing; RouteSmart software from ESRI Business Partner RouteSmart Technologies, Inc., for continuous routing applications; and ArcGIS Desktop and ArcGIS Server for mapping, analysis, and geodatabase management.

Now, when requests for bulk item collections and container service are received, the details are input into the central database and downloaded to PCs at the various dispatch centers. There, supervisors review the pickup requests and generate route maps before each shift. The maps and any last-minute instructions or route changes are then exported to the crews' personal digital assistants, which they pick up in the dispatch office before beginning their daily assignments. Because ArcLogistics can automatically create and maintain routing folders in collection day order, it is a big time-saver for SRCD.

The city also uses GIS to create routes for replacing old trash containers. Using GIS to analyze workload and improve productivity of existing staff saves the city $400,000 per year in salaries.

Using ArcGIS, the SRCD is also implementing the concept of operational route-based analyses on all (more than 2,500) continuous service routes and neighboring routes to fine-tune the trash pickup balance between them. Vehicle routing is a dynamic process with parameters that are in constant flux. There is always the potential for unplanned roadway construction, temporary speed limit changes, accidents, congestion, and so on.