

On-farm Energy Savings for Field Operations

Mark Hanna
Extension Ag Engineer
Iowa State University

Field energy savings

1. Is this trip really necessary?

Save 100% of fuel

2. Necessary field operation

Maintenance

Shift up/throttle back

Ballast/tire inflation



Field operation	Diesel, gal/ac
Subsoil	1.7
Field cultivate	0.7
Plant	0.6
Spray	0.2
Harvest	1.4



Maintenance schedule

- **Follow manufacturer recommendations**
- **Filter and fluid changes**
- **Missouri study: 99 tractors**
- **After changing fuel and air filters:**
 - **Power increased by 3.5%**
 - **Fuel savings estimate of 100 gal over 500 h**

Gear up/Throttle down

- **Similar to over-the-road travel**
- **Lighter drawbar loads (<65% rated power)**
- **Strategy not suitable for PTO work**
- **Fuel savings can be significant**
 - **5 – 15% at 75% power**
 - **15 – 30% at 50% power**
- **Don't lug engine**

Deere 7600, 111 Hp, MFWD

Pull	Hp	Gear	Fuel use, gal/h
75%	80	7(B3)	5.60
75%	80	10(C2)	4.97
50%	54	7(B3)	4.50
50%	54	10(C2)	3.73

Deere 8570, 208 Hp, 4WD

Pull	Hp	Gear	Fuel use, gal/h
75%	150	8(C1)	9.82
75%	150	13(B4)	8.98
50%	102	8(C1)	7.63
50%	102	13(B4)	6.63

Comparing tractor size for same operation

	Small MFWD	Large 4WD	Large 4WD
Throttle setting	Full	Full	Reduced
Percent load	100%	50%	50%
Drawbar hp	100.6	101.7	101.5
Fuel, gal/h	6.48	7.63	6.63



Lb/Hp

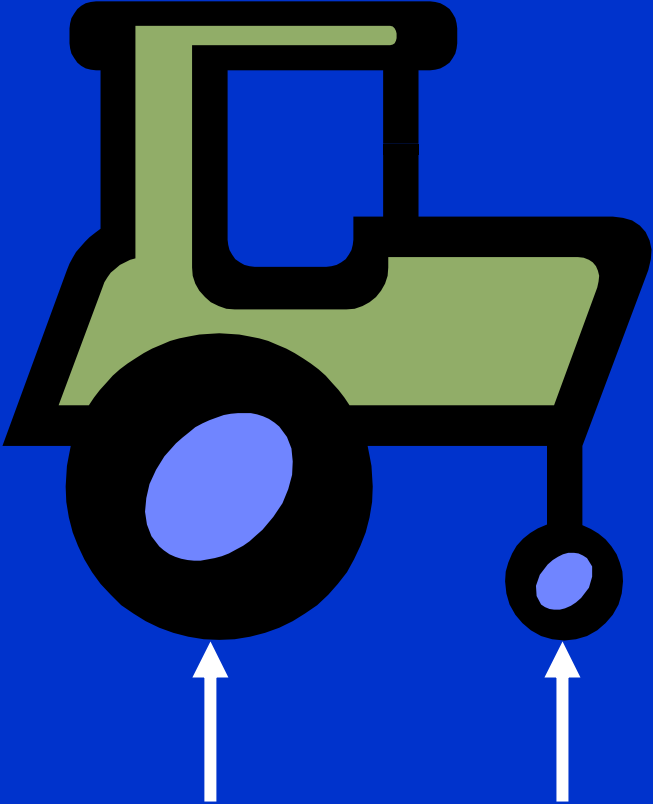
Speed

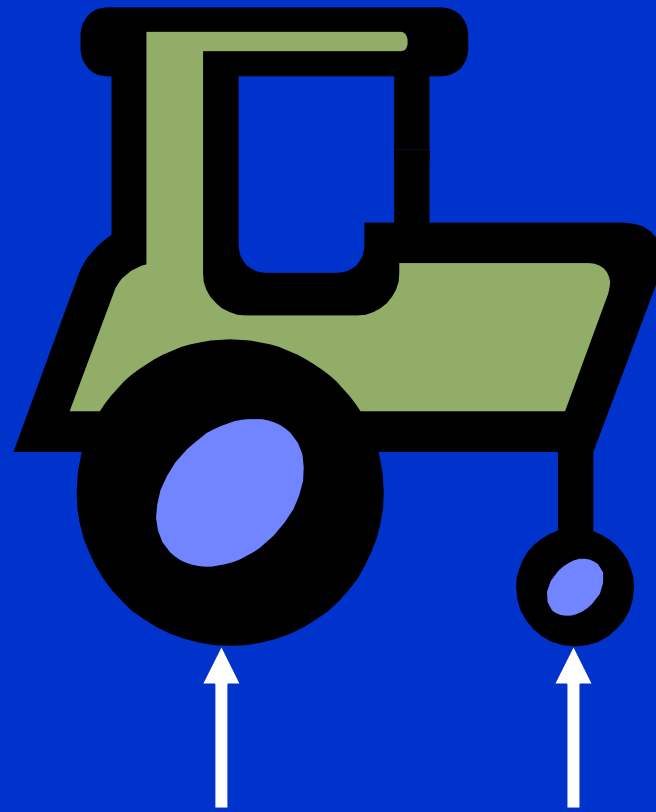
Tractor type	Speed		
	< 4.5 mi/h	5 mi/h	> 5.5 mi/h
2WD	130	120	110
FWD	130	120	110
4WD	110	100	90

Example:

300 hp 4WD tractor pulling subsoiler/ripper at 5 mi/h

$100/\text{lb}/\text{hp} \times 300 \text{ hp} = 30,000 \text{ lb total tractor weight}$





%Front/%Rear

Hitch

Tractor type	Pull type	Semi-mounted	Vertical load
2WD	25/75	30/70	NR
FWD	35/65	35/65	40/60
4WD	55/45	55/45	65/35

Example:

300 hp 4WD tractor pulling subsoiler/ripper at 5 mi/h

$100/\text{lb}/\text{hp} \times 300 \text{ hp} = 30,000 \text{ lb}$ total tractor weight

Front-axle weight = $0.55 \times 30,000 \text{ lb} = 16,500 \text{ lb}$

Rear-axle weight = $0.45 \times 30,000 = 13,500 \text{ lb}$

When is maximum drawbar power needed?

Primary tillage?

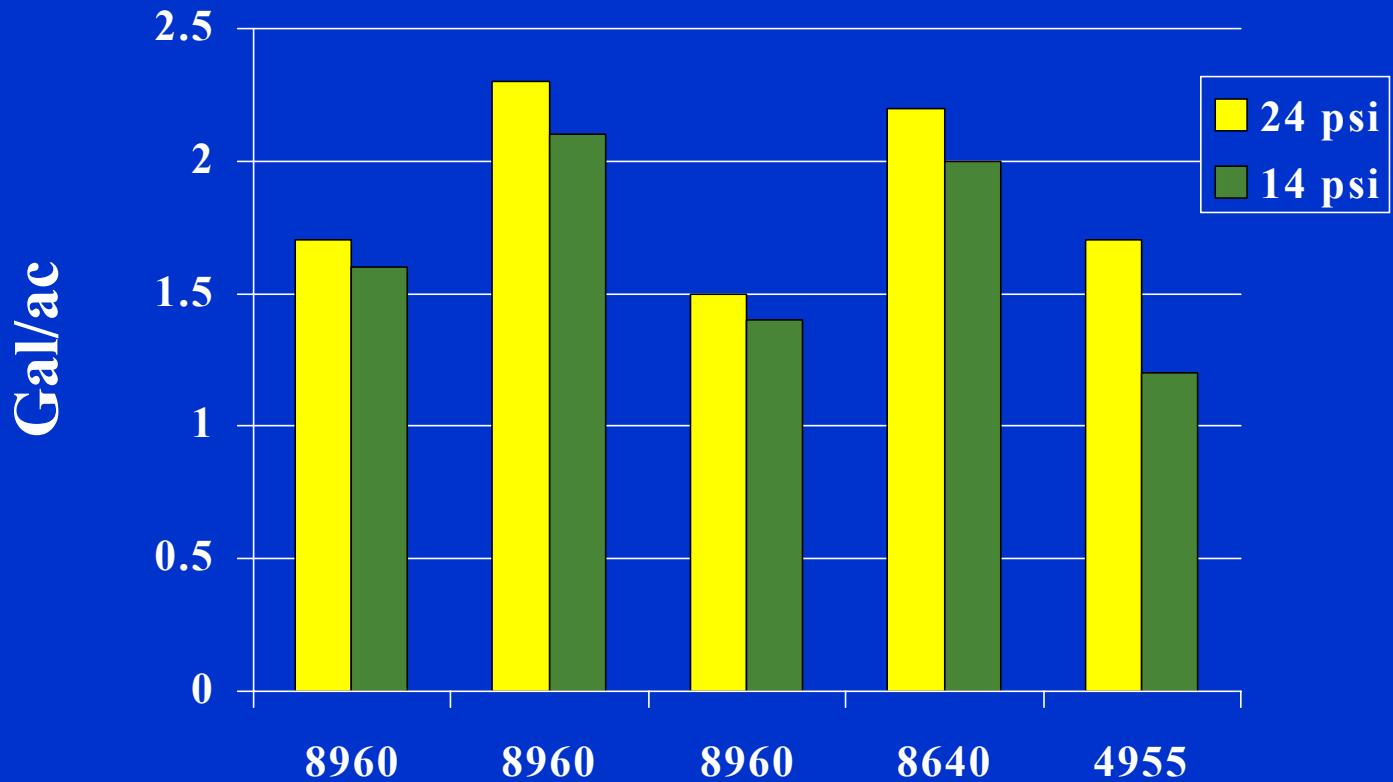
Secondary tillage?

Strip tillage?

Planting?

Spraying?

Fertilizer application?



Tractor

Wood & Mangione, 1994



Biodiesel use in farm tractors

- **Supported by major manufacturers up to B5**
- **Biodegradable fuel**
- **Challenges:**
 - **storage**
 - **cold weather**
 - **filter maintenance**
 - **seals**
 - **water affinity**
 - **paint**
 - **blends, ASTM standards**

Summary

- **Is trip necessary?**
- **Follow good maintenance schedule**
- **Gear up/throttle down with lighter drawbar loads**
- **Manage tractor ballast**
- **Manage tire inflation pressure**

www.abe.iastate.edu/machinery.asp