

Finding the Right Machine for the Job:

Compact Power Equipment

Need help in deciding whether to purchase or rent a machine—or hire a contractor to do a job? We're talking about outdoor power equipment—mowers, compact tractors, chain saws, trimmers, or even perhaps compact loaders and utility vehicles. This publication will help you

- Determine owning and operating (O&O) costs
- Compare the costs of owning versus typical rental charges
- Arrive at the best solution for your operation.

If you are thinking about purchasing outdoor power equipment, follow these four steps:

Step 1. Clearly define the requirements for the machine.

Step 2. Determine which attachments are needed before deciding on the tractor or power unit.

Step 3. Match the correct power unit to the job with those attachments.

Step 4. Calculate costs. Budgeting should involve calculating what things cost

to own and operate (O&O). Choose the most economical route—it may be cheaper to rent a machine or hire a contractor than to own and operate the equipment yourself. There are hidden costs to owning.



You may be proud to have that machine parked on your lot, but can you justify the owning and operating costs? If it's a job you don't do too often, you might save by renting or bringing in a contractor. (Photos from Kubota and Deere Web sites)

Step 1. Clearly define the requirements for the machine.

Take mowing for example. Mowers are made and marketed based on the size of the mower deck. As a general rule, mowers with deck sizes below 24 inches would be used on gardens and lawn areas less than an acre. As you see in Figure 1, an acre would take almost two-and-one-half nonstop hours to mow with a 24-inch deck at 2.5 miles per hour (mph). For 1 to 2 acres, a 42- to 54-inch deck would be desirable. Mowers 54 inches and above match an area of 3 or 4 acres, and for larger areas and professional activities, mower decks of more than 60 inches wide would be the choice. The narrower the deck size, the easier it is to maneuver. Deck size will dictate engine power, but there are several types of transmissions available, which affect engine power. The stick shift transmissions are cheaper than the automatic and hydrostatic drives, but slower over the duration of the job.

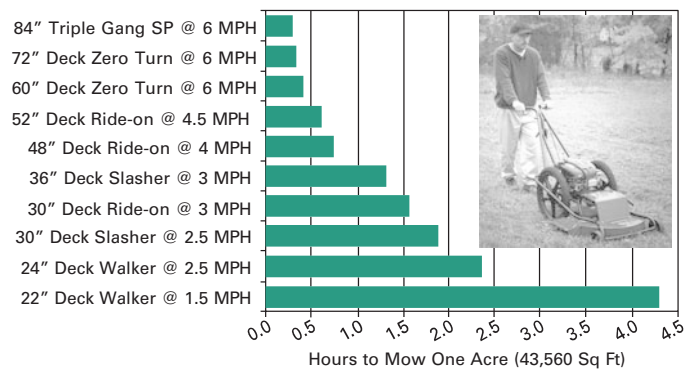


Figure 1. Time it takes to mow an acre with different mowers, from a small hand-push-type through a self-propelled sophisticated three-gang 7-foot-cut machine. A field efficiency of 70 percent was assumed throughout to calculate the productivity of these machines.

Figure the capacity and size of equipment needed to accomplish your task:

Operating width of the mower machine in feet = $8.25 \times \text{acres per hour} \div \text{average working speed (mph)}$

Alternatively, field capacity (in acres per hour) = $\text{machine width (ft)} \times \text{average speed (mph)} \div 8.25$. If you need to work in square feet, there are 43,560 square feet in an acre.

These are theoretical values; in practice the actual rates of work are reduced by a factor called field efficiency.

Case Study 1. There is a 2-acre mowing job, and we assume 70 percent efficiency because of the amount of maneuvering time, equipment overlap on each pass, operator and other delays, etc. The capacity of a walk-behind mower with 48-inch deck averaging 2 mph would be 0.68 acres an hour. It would take almost 3 hours to cover the 2 acres each time the grass is mowed with that machine.

On the other hand, if it were a 48-inch ride-on machine, it could be done at an average speed of 4 mph and that would take half as much time. One manufacturer sells a zero-turn mower that is rapidly convertible from ride-on to walk-behind mode, for working under trees or in awkward re-entrant corners.

Walk the hill; ride the distance. This convertible mower offers the speed and productivity of a zero-turn ride-on, with the convenience of rapid convertibility into a walk-behind. This provides flexibility and safety in tight situations such as under trees, in



or on steep slopes. Inset shows how the entire control module swings over for the conversion. (Rich Manufacturing, Inc., Thorntown, Indiana, www.convertiblemower.com)

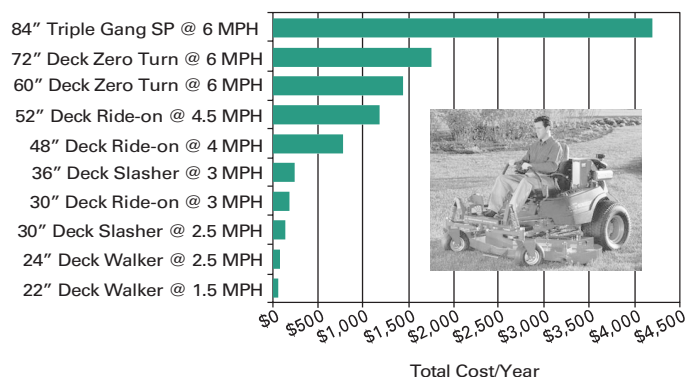


Figure 2. Total costs to mow an acre 20 times in a season with the same mowers described in Figure 1. Note that labor cost is not factored in here—with the bigger equipment the labor component becomes critical in a business. This comparison is somewhat unfair to the larger mowers, which would be used on much bigger areas.

Case Study 2. Mow an acreage with a 6-foot wide belly-mounted mower under a compact tractor at an average speed of 5 mph at 80 percent field efficiency. An operator with that machine at that rate will cover 2.9 acres an hour (Actual Field Capacity = Theoretical Field Capacity \times 0.80). When the overall acreage to be covered is known, you have to decide how much time you will allow for the job. If you have 12 acres to mow with that 6-foot deck machine, it will take $12 \div 2.9$, or about 4 hours of work. (Time in hours = Total Area in acres divided by Actual Field Capacity in acres per hour)

Step 2. Determine which attachments are needed before deciding on the tractor or power unit.

The categories of equipment and their attachments are wide and the range within categories is extensive. Seek help and use common sense in the decision-making. There are Web sites with loads of information (for examples, see page 8). Then there are resources at dealer stores and in public extension agencies. For this bulletin, mowers will be used for case studies. There are more than 30 brands of mowers available in North America.

Mowing jobs can be categorized as follows:

a. Rough cut scrub, weeds, or uneven terrain, with the likelihood of encountering stones or other obstacles: use a slasher, a flail-type chopper, or a heavy-duty rotary mower.

b. Heavy pasture, free of stones but with gopher mounds or anthills: use a rotary disc-type mower.

c. Pastures or borders that do not need to be cut too close to the ground: use a sickle-bar, disc, or rotary mower—these are sometimes called ‘Rough cut’ mowers. Machines with multiple disc blades leave a neater, more uniform finish than a single spindle rotary mower, and they follow contours better.

d. Trimming big lawns where a good finish is desired. ‘Scalping’ is of concern here. Use multi-blade rotary, or gangs of single-spindle units, or reel-type mowers; these may be called finishing or grooming mowers.

e. The home/backyard lawn: a push or walk-behind, or self-propelled mower, commonly a single vertical spindle rotary, or reel type.

f. Portables, such as yard trimmers, with metal, plastic, or fiber cutter heads.

Machine attachments may be trailed and PTO-driven, or semi-mounted, or fully mounted on the tractor’s three-point linkage. Alternatively, they may be self-propelled or fully mounted on the machine chassis (as in some zero-turn mowers); rear-, mid-, or front-mounted.

Step 3. Match the correct power unit to the job with those attachments.

Data on the power requirements for attachments are usually available from manufacturers’ literature and specification sheets. The cylinder-type or reel mower needs the least power; slashers and flail mowers need the most power. Ride-on rotary mowers, for example, require up to 3.5–6 horsepower per foot of cut, depending on transmission type.

Step 4. Calculate costs.

Costs need to be whittled down to the bottom line; that is, a cost per hour of use (\$/h), or per unit of area (\$/acre). The important thing is to compare costs of private ownership with relevant rental, leasing, or custom-contract costs. The graphs that follow give some examples—a garden tiller, a popular-sized ride-on mower with 38-inch mower deck, a chain saw, a New Holland compact tractor with front-end loader and slasher combination, and a snow blower (see Figures 3–7). The methodology for calculating owning and operating (O&O) costs follows at the end of this bulletin. Note the effect that hours of use has on costs per hour.

In each of these graphs, the rental rate line intersects the O&O line at a certain point, the break-even point. If your O&O costs are higher than the rental or contractor’s rate, then you will save money by hiring or renting and not owning. But if you run up enough hours to operate cheaper than that break-even level, then you can justify private ownership, along with all that entails.

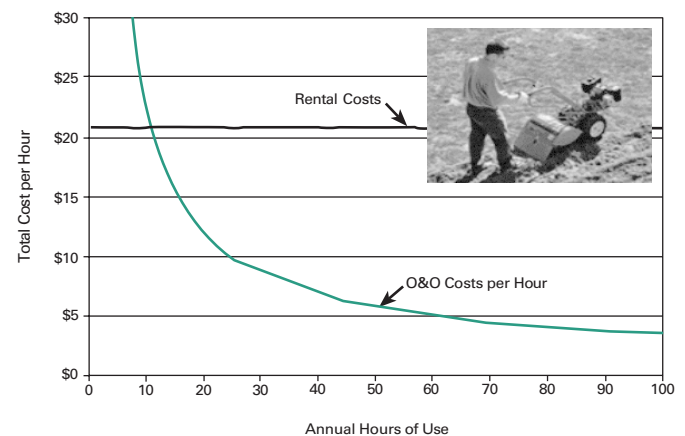


Figure 3. Example of O&O costs for a small home garden tiller (Troy-Bilt).

In Figure 3 the break-even point is 11 hours of annual use. If you are doing less than that a year, it would be cheaper to rent the machine at \$20 an hour (plus running costs) and not have to store it for the rest of the year.

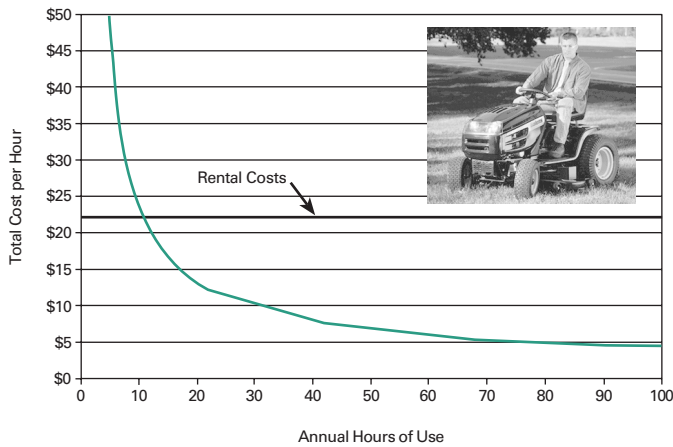


Figure 4. O&O costs for a Bolens ride-on mower, 38" deck width.

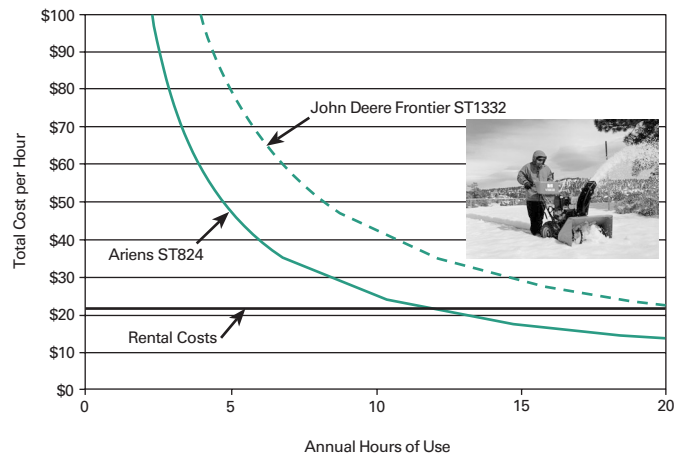


Figure 7. Frontier and Ariens brand snow throwers are marketed at Deere outlets. The break-even point for the smaller machine is above 20 hours of use per year. Rental is uncommon on snow throwers however.

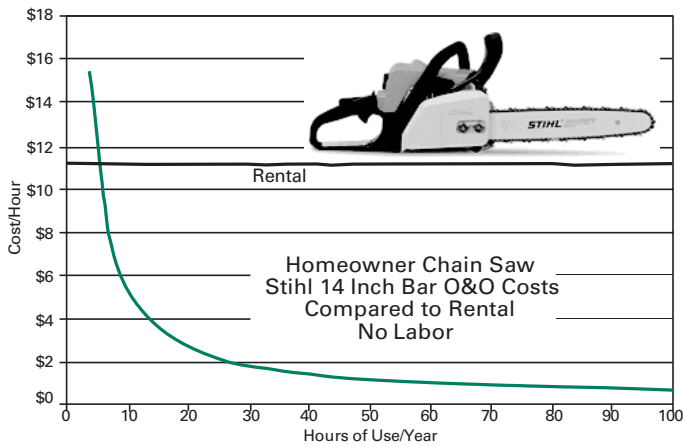


Figure 5. Private ownership of a chain saw—a residential-size saw with 14" bar.

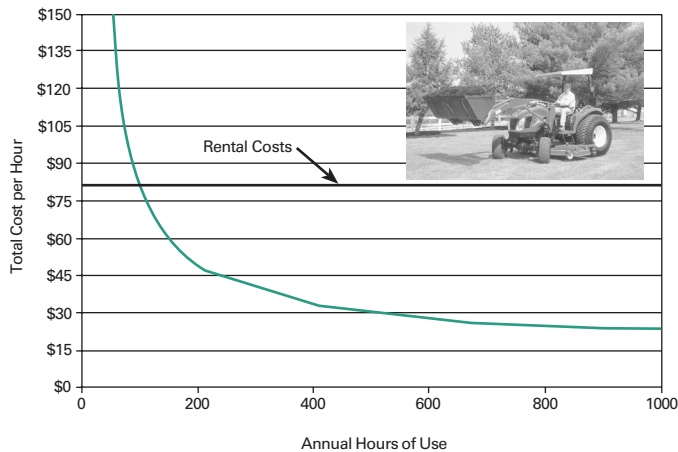


Figure 6. The break-even point for the compact tractor front-end loader (FEL) and 6-foot mower combination is 100 hours. In other words, if an operator plans to run more hours than that in a year, then private ownership can be economically justifiable compared with typical rental costs.

How were these Ownership and Operating (O&O) costs calculated?

There are three main cost categories:

- Ownership or Fixed costs
- Operating or Variable costs
- Timeliness costs

The sum of these make up the Total Costs of operating equipment.

Table 1 is the short-cut version in a chart for calculating these costs. A bigger machine gets the job done faster but has higher O&O costs. Equipment costs are often a lot higher than people realize—or perhaps want to face up to. It's the Ownership costs—also known as Overhead costs or Fixed costs—particularly that hurt! Ownership costs mainly include annual depreciation plus interest lost on the capital tied up in machinery (capital recovery costs). These Fixed costs accumulate day by day, even if the machine never leaves the garage. While Fixed costs are practically independent of hours used per year, Operating costs (fuel, oil, repairs, labor, etc.)—also known as Variable costs—increase in direct proportion to hours of use.

In a business, the main way to reduce unit costs, that is, costs per hour, is by amortizing the fixed charges over more hours of use. For example, if a new compact tractor with front-end loader is used for just 100 hours a year, it would cost about \$70/hour, whereas if a contrac-

tor used the machine for 800 hours a year, the O&O costs drop to \$20/hour. A sample set of calculations and a column to do your own figuring are included in Table 1. You need to enter purchase price, hours per year, years of ownership, and salvage or residual value. Note that in the mass marketing or consumer market there are no trade-ins on small lawn mowers or chain saws, for example, so you may have to enter zero for the residual value of the used machine if you keep it for a number of years.

Renting Equipment

Owning implies the need to service machines, with the tools and shop to go with it. With rental there is no need to have a service shop, spare parts, or special tools. Outsourcing eliminates those hassles. Renting a specialized piece of equipment can often be cheaper than buying outright.

If that is the path you want to take, the critical first step is to tell the rental shop what you need to accomplish rather than what you want to rent. Reputable rental staff have considerable expertise. They may even volunteer answers to questions you didn't think to ask. One situation involved a customer who went into the store intending to rent an expensive electric chipping hammer. At first sight, the electric-powered unit seemed cheaper and easier to handle than the larger compressed-air hammer recommended by the store clerk. However, the customer found out on the site that the air hammer did the job in a fraction of the time, with far less effort.

If a task is infrequent or seasonal, the justifications for renting are:

- A diverse range of equipment to select from, including best brands
- Up-to-date and well-maintained equipment that you don't have to service
- Usually immediate replacement if anything goes wrong with the rented machine
- Advice and training on how to use the equipment
- Delivery may be a part of the rental
- If you only need an item for a few hours a year, better to rent.

- Renting is a good way to become familiar with a piece of equipment to see if it fits in with your long-term program.
- Less bookkeeping and good cost control.
- Tax advantages. Personal property taxes and registration costs do not apply to rented equipment. Rented equipment does not appear as a liability on a balance sheet.
- Less to worry about. Renting allows you to concentrate on what you do best. Renting frees your capital for more profitable uses.

Under a rental agreement, you pay for a service, that is, the short-term use of equipment. You may rent by the hour, the day, or longer, usually with discounts for monthly or quarterly rates and even better rates for six-month rental. A word of warning about rentals: you have a limited time and if you overshoot, your costs go up substantially or the machine can be repossessed, so be sure the machine is matched to the task. Finally, be sure to pre-check the machine for any dents or marks, and clarify whether delivery is a part of the contract.

Custom Operators

Custom contractors usually bring with them a lot of experience and operating skills. And they are taking a larger piece of the action—in some places the majority of residential lawn mowing is being done by landscape contractors. Hiring a contractor has similar advantages to renting—less hassle for you.

In their particular line of work, contractors have expertise, they generally use modern equipment that will get the job done better than you could do it, and often they will save you money—provided that you can get the contractor onto your job at the time you need it done.

Owning or Purchase Loan

Maybe you've decided that it's essential to own. Ownership has certain advantages. Full responsibility for the machine comes with ownership and that likely will ensure that the machine is better cared for. There is unrestricted use, you can modify or add attachments, and paint it your colors.

—continued on page 8

Table 1. Calculator for Estimating O&O Costs, with a Worked Example.

Use the right-hand column to do your own figuring.

Sample Calculating Ownership and Operating (O&O) Costs SELF-PROPELLED ZERO-TURN MOWER, 6-foot cutting width

Part A: Ownership Costs (also known as Fixed or Overhead costs)

These costs exist whether the machine does any work or not. Ownership includes interest charges on the average invested capital, depreciation, local taxes, insurance, and machine storage-related costs.

		<i>Insert Your Own Numbers</i>	
Purchase Price (PP)	\$11,000		_____
Anticipated hours of use, 100 hours per year	500 hours in 5 years		_____
Trade-in or resale value (RV) after 5 years	\$3,630 (33% of PP)		_____
Calculated average value (AV)	$(\$11,000 + \$3,630) \div 2 = \$7,315$		_____ = _____
Annual interest costs @ 7%	$\$7,315 @ 7% = \512		_____ = _____
Interest cost per hour	$\$512/100 = \$5.12/h$		_____ = _____
Annual depreciation (PP–RV) ÷ Number of years	$\$7,370/5 = \$1,474/y$		_____ = _____
Hourly depreciation	$\$1,474/100h/y = \$14.74/h$		_____ = _____
Insurance at \$10 per \$1,000 AV	$\$7,315/100 = \$73.15/y$		_____ = _____
Insurance cost/hour	$\$73.15/100 = \$0.73/h$		_____ = _____
Housing or shedding cost @ 1% PP	$\$11,000/100 = \$110/y$		_____ = _____
Shedding cost/hour	$\$110/100 = \$1.10/h$		_____ = _____
Registration and workshop costs (also @ 1% PP)	$\$110/y = \$1.10/h$		_____ = _____
Add any local tax rates here, if applicable			_____
Total ownership/fixed or overhead costs	\$29.79/h		_____

Part B. Operating or Variable Costs

These costs vary according to machine use and include operator wages, fuel, lubricants, and expendables.

Fuel costs 1.5 gallons an hour @ 1.70/gal	1.5×1.70	= \$2.55/h	_____	= _____
Engine oil cost 2.0 gallons @ \$2.50/gallon every 100 hours		= \$0.05/h	_____	= _____
Lubricating, cooling, and transmission fluids 5 gallons @ \$3/gallon, changed @ 400 h		= \$0.04/h	_____	= _____
Filters \$20, changed @ 100 h		= \$0.20/h	_____	= _____
Tires—turf specials: one set of tires changed in 5 years @ \$200 total		= \$0.40/h	_____	= _____
Batteries: one set in 5 years @ \$100		= \$0.20/h	_____	= _____
Repairs, Maintenance, and Downtime (RM&D) over the life of the machine. Calculated here @ 20%* of PP		= \$4.40/h	_____	= _____
Operator's labor rate where charged		= \$12.00/h	_____	= _____
Total Operating or Variable costs		= \$19.84/h	_____	= _____
TOTAL COSTS OF OWNERSHIP & OPERATION				
(TOTAL HOURLY O&O)		= \$49.63/h	_____	= _____
TOTAL O&O COSTS WITHOUT LABOR OR CONTRACTING				
ALL AT 100 H/YEAR		= \$29.53/h	_____	= _____
For contracting out, add profit and contingencies. Calculated @ 25% of overhead		= \$7.45/h	_____	= _____
Therefore Contractor Charge-Out Rate per Hour**		= \$57.18/h	_____	= _____

* The RM&D costs over time are highly dependent on the way the machine is used or abused.

** The contract rate does not include ancillary business equipment or towing vehicles, etc.

If used on an acreage or earthmoving, etc., calculate the unit costs (i.e., cost per acre or cost per ton, etc.) as well.

Field Capacity can be calculated from $FC \text{ (Acres/hour)} = \text{Width of cut (ft)} \square \text{ Speed (mph)} \square \text{ Efficiency} \div 8.25$

Next comes the decision: buy new or used? New equipment is more reliable and comes with a warranty, usually one year. Some reputable companies offer qualified two- or even three-year warranties on bigger-ticket items. The moment the new machine is taken out to work from the show room floor, however, its value depreciates sharply. Used equipment, on the other hand, doesn't depreciate at such a rate. People with mechanical skills may prefer to buy used and take care of repairs themselves. Obviously, the older an item is, the higher the probability of a breakdown. Owning brings with it the need to store the machine and to repair and maintain it. Storing equipment under a roof pays off: not only is the resale value higher, but, by one estimate, downtime is halved by storing machinery under a roof compared with leaving it exposed to the elements.

Repair and Maintenance (R&M) costs: you can anticipate from 15 percent to 45 percent of purchase price (PP) for reasonable private use of mowers. R&M levels depend entirely on operator skill and the abuse the machine is subject to. By one estimate, 70 percent of equipment failures are user-induced.

Whatever the situation, it's worthwhile to keep service records. Machine service records are important when it comes to selling the machine. Records also help with decisions on replacement or new equipment investments.

Buy from a brand-name dealer or mass merchandiser? Be alerted that mass marketers do not service products, nor do they offer trade-ins—unlike machinery dealerships. Some equipment, such as Deere's consumer products, are exactly the same price at either type outlet.

Summary

This publication has outlined pros and cons of buying, renting, or contracting for compact outdoor power equipment. Ownership costs are significant. This may serve as a wake-up call about how much capital is tied up in your shed or garage. There are times when renting makes more sense. A self-help table is provided for you to determine the costs of owning and operating a piece of equipment. Do the numbers—it will pay you to be well informed. However, if you are buying for recreational use, then simply enjoy!

Additional Resources

Extension publications available from Iowa State University Extension

Acquiring Farm Machinery Services, PM 787

Farm Machinery Selection, PM 952

Estimating the Field Capacity of Farm Machines, PM 696

Estimating Farm Machinery Costs, PM 710

Useful Web sites

www.naeda.com

www.tractorbynet.com/classifieds/

www.equipmenttraderonline.com

www.acresusa.com

(General acreage magazine)

www.farmequipmentguide.com

(Hotline publications with specifics on values)

www.yesterdaytractors.com

(Antiques and oldies)

www.smallfarm.com

www.farmersdigest.com

www.progressivefarmer.com

(*Progressive Farmer Magazine*)

www.agriculture.com

(*Successful Farming Magazine*)

www.farm-equipment.com

(*Farm Equipment Magazine*)

www.toro.com

www.deere.com

www.farmershotline.com

Disclaimer: No endorsement of products or firms is intended, nor is criticism implied of those not mentioned. The graphs are representative using pricing figures in early 2004—variations will occur with different inputs.

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... and justice for all

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