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ABSTRACT

This handbook on energy cost reduction for automotive service facilities consists of four sections. The importance and economic benefits of energy conservation are discussed in the first section. In the second section six energy cost reduction measures are discussed: relamping interior areas; relamping and reducing interior lighting; setting back heating temperatures; repairing cracks and holes in doors, windows, and walls; improving the combustion efficiency of oil burners; and repairing leaks in compressed air systems. A description of each of these procedures as well as suggestions for their implementation and examples of their effectiveness are provided. In the third section nine other energy-savings recommendations of a more general nature and the electrical costs for operating six various pieces of equipment in a typical repair shop are presented. A final section contains information on the benefits of and procedures for conducting an energy audit. A sample chart for recording monthly energy use and expenditures is supplied. (MN)

ENERGY COST REDUCTION FOR AUTOMOTIVE SERVICE FACILITIES

PROVIDED AS AN INDUSTRY SERVICE
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ENERGY COST REDUCTION FOR AUTOMOTIVE SERVICE FACILITIES

This handbook was developed to help automotive service facilities cut the cost of energy in their business establishments. It shows how to recognize and act on energy waste in:

- Lighting,
- Space Heating, and
- General Shop Maintenance

Most of the energy use in automotive service shops is for lighting and heating. Lighting for interiors and storage areas may consume from 30-70% of total energy costs. Heating and air conditioning costs make up most of the remaining energy outlay. These are important areas for potential savings in auto service shops, and are the major areas of emphasis in this handbook.

ENERGY IS ONE COST YOU CAN SUBSTANTIALLY REDUCE

A 20-30% net cost reduction is possible by applying these recommendations. Unlike some other major costs such as labor and supplies, energy is a cost you really can do something about, without risking loss of sales or employee discomfort.

ENERGY REDUCTION IS A GOOD LOW-RISK INVESTMENT

Energy costs are not going to go down. Since 1973, you have seen your utility bills skyrocket. The higher the cost of energy rises, the more sense it makes to conserve it.

Reducing energy costs need not require spending a lot of time and money. Most of the recommendations given here involve no complicated engineering, depend on no new products or technology, and will not require heavy capital investment. They can be implemented using in-house skills and labor, or local contractors. Savings can be achieved through better maintenance, closer control of operations, and a positive attitude about conservation. Common sense is one of the most essential ingredients in any successful cost-reduction program.

Many of the recommendations cost nothing to implement, and most involve only small investments, with very profitable returns in the months and years ahead. By implementing the recommendations, the typical small auto service facility can save over a thousand dollars per year in reduced energy costs. The same recommendations can be applied to larger shops, where energy savings would be even larger. The table on page 3 summarizes these savings for the 6 major recommendations. These represent costs and savings in typical auto service shops. Because of the enormous variations in shops and in utility rates across the country, these figures should not be interpreted as "averages" or "expected costs and savings."

The recommendations in this handbook were developed from detailed energy usage analyses of automobile service facilities located in different areas of the nation. These energy audits were performed by an engineering firm specializing in energy cost reduction. Specific recommendations were made for each shop. All of the engineering results were then reviewed, and from them the energy cost reductions for this handbook were developed, based on:

- Short payback period - the recommendations pay for themselves quickly and begin generating actual savings within a short time.
- Wide range of applicability - most service facilities can and should consider implementing them.
- Ease of implementation - most of the recommendations can be implemented without engineering help.

In selecting these recommendations, particular emphasis was placed on including only the most effective ideas which will save both money and energy. There are, of course, other energy cost reduction opportunities which are not included in this handbook. Some of these would require major capital investment or would have had extremely long payback periods; others would involve state-of-the-art technology. It is not the intention of this handbook to provide a long "shopping list", but to present the major savings opportunities.

Only you can determine which of these energy cost reduction ideas are best for your particular business. But when asking yourself, "Can I afford to do this?" remember to ask also, "What with ever rising energy costs, CAN I AFFORD NOT TO?"

SUMMARY OF SAVINGS

Recommendations	Implementation Cost	Payback (Years)	1st Year Reduction	10-Year Savings
Relamp Interior Areas	$492	1.0	$512	$7,287
Relamp and Reduce Security Lighting	-0- 25	-0- 0.2	166 149	2,522 2,239
Set Back Heating Temperatures	300	0.5	574	9,238
Repair Cracks and Holes in Doors, Windows, and Walls	100	0.7	143	2,572
Improve Combustion Efficiency of Oil Burners	100	1.2	185	1,393
Repair Leaks in Compressed Air System	-0-	-0-	105	1,595

Note: The "1st-Year Savings" is the gross amount saved -- the "off-the-top" savings on utilities during the first year.

The "10-Year Savings" is the projected net amount saved over a a 10-year period, before taxes. It takes into account the initial implementation expense, annual maintenance costs (if any), estimated 6% annual rate of inflation, and anticipated increases in energy costs of 9% per year.

ENERGY COST REDUCTION RECOMMENDATION #1

RELAMP INTERIOR AREAS

Description: Replacement of lamps with low-energy types and selective removal of lamps will significantly reduce lighting costs, without affecting lighting quality.

Implementation: Change lamps to low-energy types; reduce the number of fixtures; and shut off lights when not necessary for work.

EXAMPLE: An auto service shop in Delaware operates out of three buildings: a main shop, a small annex, and a truck shop. A lighting survey in the buildings indicated that relamping could produce significant electric savings. A total of 354 fluorescent tubes were replaced with low-energy fluorescents. With nearly the same level of illumination, approximately 16% less electricity was used. The cost of the replacement bulbs was $492, but the new lamps paid for themselves in less than a year, by saving $512 in electric costs the first year (9,907 KWH). Over 10 years, net savings could be over $7,000.

Cost	$ 492
1st-Year Savings	$ 512
Payback (years)	1.0
10-Year Savings	$7,287

SUGGESTED ACTION:

* Replace fluorescent lamps with new mechanically and electrically interchangeable lower energy types. These new tubes consume 14-18% less electricity, the cost of which more than justifies lamp replacement. They are available from the major manufacturers of bulbs. In most cases, incandescent lighting should be replaced with either fluorescent or interior metal halide lighting. Where this is not feasible, incandescents can be replaced with lower wattage, more efficient bulbs. Although the different wattage bulbs may have the same initial price, their life cycle costs can be substantially different, as shown in the chart below.

* Eliminate unnecessary fluorescent lamps in areas where lighting is excessive. Remember that in most cases fluorescents lamps must be removed in pairs and that ballasts should be disconnected to take full advantage of savings. All fixtures should be shut off when not in use. It is no longer true that fluorescents should not be switched off during the working day. Recent studies show that if lighting is not required for as little as 10 minutes, it pays to shut it off. Consider turning off most lamps in areas unoccupied during lunch hour.

* In offices, reduce overall light levels and add task lighting where necessary. A good fluorescent desk lamp is both energy efficient and comfortable for office work.

* Clean the bulbs and fixtures once a year, or at least when you relamp. A heavy buildup of dust and dirt can block as much as 20% of the usable light.

THE REAL COST OF A LIGHT BULB

Description		Initial Cost	+ Energy Cost (.05¢/KWH)	= Life Cycle Cost
Standard Bulb:	100 Watts 1460 Lumens 2500 Hours	40¢	$12.50	$12.90
Standard Bulb:	75 Watts 970 Lumens 2500 Hours	40¢	$9.38	$9.78
Low-Energy Bulb:	69 Watts 970 Lumens 2500 Hours	40¢	$8.63	$9.03

ENERGY COST REDUCTION RECOMMENDATION # 2

RELAMP AND REDUCE SECURITY LIGHTING

Description: Removal of selected security lights and redirection of lamps will save electricity while maintaining a suitable level of security lighting.

Implementation: Remove lamps in areas where lighting is excessive, redirect lamps to obtain the maximum amount of light coverage, and reduce the number of lights burning at night.

EXAMPLE: An auto service facility in the Midwest used six 400-watt mercury, vapor lamps to provide security lighting for the shop's outside lot. The lights were mounted in such a way that the beams of adjacent lamps overlapped. By redirecting selected fixtures, it was possible to achieve a suitable level of lighting while removing three of the lamps. During the first year, this change in outside lighting saved 6,652 KWH of electricity, valued at $166. No investment in replacement lamps was required. Over 10 years, potential savings may add up to about $2,500.

Cost	-0-
1st-Year Savings	$ 166
Payback (years)	-0-
10-Year Savings	$2,522

Another shop in California reduced the number of security lights left on at night in the garage area. By reducing night lighting from four fixtures to only one, the shop saved $149 on its electric bill in one year. Some rewiring was required so that one fixture could operate independently in the center of the shop area. This rewiring cost about $25. In 10 years, projected electric savings from night lighting alone total over $2,200.

Cost	$ 25
1st-Year Savings	$ 149
Payback (years)	0.2
10-Year Savings	$2,239

SUGGESTED ACTION:

- Review existing security and lot lighting to see whether lower light levels will adequately serve security needs. A careful review may conclude that certain fixtures can be removed, while maintaining acceptable lighting levels.

- Turn off unnecessary lights after work hours and during all periods when the shop is unoccupied.

- If you are lighting outdoor areas with incandescent or fluorescent lamps, consider relamping with metal halide or high-pressure sodium lamps. High-pressure sodium is the least expensive type of lighting. This lighting, with its pink/yellow tint, is more than adequate for security and storage purposes. The cost of new fixtures will pay for themselves through reduced electric costs.

The table below summarizes the combined electricity and bulb costs required to light a 5,000 square foot lot to acceptable security standards. Note the significant savings possible from high-pressure sodium lamps.

THEORETICAL ANNUAL ENERGY AND BULB COST
FOR A 5,000 SQUARE FOOT LOT
(SECURITY LIGHTING: 2-4 FOOTCANDLE AVERAGE)

Lamp Type	Electricity Usage (Watts)	Electricity Cost (4380 Hours of Operation)				
		$.02/KWH	$.04/KWH	$.06/KWH	$.08/KWH	$.10/KWH
Fluorescent	2,700	$237	$473	$710	$946	$1183
Mercury Vapor	585	51	102	154	205	256
Metal Halide	350	31	61	92	123	153
High Pressure Sodium	314	19	37	56	75	94

ENERGY COST REDUCTION RECOMMENDATION # 3

SETBACK HEATING TEMPERATURES

Description: A properly operating thermostat will control heating temperatures. During unoccupied periods, a temperature of 45° F is sufficient to prevent freeze-ups.

Implementation: Check to make sure thermostats are operating properly. If not, replace them with heavy-duty manually operated thermostats or with an automatic temperature setback system. Set temperature to 45° during unoccupied hours.

EXAMPLE: An auto service shop on the Atlantic Coast had 5 thermostats which were not operating properly due to breakage or being plugged with dirt. Even though the thermostats were set at a fairly low temperature, they were not actually regulating the heat, causing a loss of valuable oil and gas. By replacing all 5 of the thermostats with new ones with lower limits of 45°, the shop owner saved $574 in heating costs during the first year, or 10% of expected costs for gas and oil. The new thermostats allowed the owner to maintain temperatures at 62° during the day and to reduce temperatures to 45° after working hours. The cost of the new thermostats was $60 each (installed). They paid for themselves in only 6 months. A savings of more than $9,200 could be achieved over a ten-year period from the thermostat investment.

Cost	$ 300
1st-Year Savings	$ 574
Payback (years)	0.5
10-Year Savings	$9,238

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[illegible] RECOMMENDATION # 5

[illegible] COMBUSTION EFFICIENCY
[illegible] BURNER

[illegible] Boilers operating at less than peak [illegible] rate the fuel that fires them. Boilers [illegible] set for maximum combustion and maintained [illegible] at peak efficiency.

[illegible] Boilers cleaned and adjusted [illegible] tested for emission at least once a year.

[illegible] Two oil-fired boilers in an auto repair shop were tested for combustion efficiency. The tests showed that the hot [illegible] for the office area was 71 3/4% efficient, and the low-[illegible] steam boiler for the shop area was 73% efficient. By consulting with the boiler manufacturer, it was learned that the combustion [illegible] of the burners could be improved by 5% if they are cleaned [illegible] annually. By spending about $100 to have the boiler combustion tested, burners and stacks cleaned, and hot air fans cleared of [illegible], the boilers saved 395 gallons of fuel oil during the year, which amounts to $185. In spite of the annual expense for inspection and cleaning, this shop owner will still realize a net savings of about $1,300 over the next 10 years.

Cost	$ 100
1st-Year	$ 185
Payback (years)	1.2
10-Year Savings	$1,393

SUGGESTED ACTION:

Most boilers in use today have never been set for maximum combustion and are not properly maintained for maximum efficiency. Even those boilers which were properly tuned once will degenerate over a period of time. Oil burners should operate at a minimum of 80% combustion efficiency; packaged gas burners at 75%.

- Weekly - Check stack temperatures. Make a note of the reading when the boiler is properly set. Any significant temperature increase (50° F or more) is symptomatic of a problem that should be corrected. If the thermometer which came with the boiler is broken or missing, get a new one.

- Monthly - Examine your monthly fuel bill. If the quantity of fuel used suddenly increases, it could indicate a boiler problem. (Remember to take into account any extra fuel used for heating during the winter months.)

- Yearly - The boilers should be thorougly inspected, cleaned and repaired by a qualified technician (your state may require this person to be licensed).

The manufacturer or distributor of your boiler can provide you with detailed information and operating specifications for your particular model. They usually will be glad to recommend qualified and experienced boiler repair technicians.

ENERGY COST REDUCTION RECOMMENDATION # 6

REPAIR LEAKS IN COMPRESSED AIR SYSTEM

Description: Loose fittings or valves in compressed air systems cause air leaks, which waste electric energy.

Implementation: Detect and repair leaks by tightening fittings or valves.

EXAMPLE: Several leaks were located in the compressed air system of a Midwestern auto service shop. The leaks were mostly in quick connectors or valves. Because the system is run at a high pressure, the leaks were costly -- wasting over 4,000 KWH of electricity per year. A small effort to repair the leaks was well rewarded by savings of $105 during the first year. 10-year savings may total $1,595.

Cost	-0-
1st-Year Savings	$ 105
Payback (years)	Immediate
10-Year Savings	$1,595

SUGGESTED ACTION:

Most compressed air systems have leaks. They are odorless, invisible, and often go unnoticed.

Leaks are most easily detected after hours when the shop is closed and quiet. With all other devices turned off, listen for the hissing sound which will indicate the source of the leak. Swabbing soapy water around joints makes even small leaks apparent by the resulting bubbles. Repair leaks as soon as possible. The method used for leak repair will depend upon its nature. However, many leaks are caused by loose connectors or valve packings so that simple tightening will usually be sufficient. Occasionally a new fitting or piece of hose will be required.

The cost of leaking air has been considered insignificant in the past. However, at the current high cost of electricity, correction is almost always justified. To help make a judgment as to the value of air-leak correction, the waste associated with a single 150 psi 0.015 inch diameter leak is calculated below:

Hole diameter	.015 inch
Free air waste 100 psi:	111,000 cubic feet
Annual KWH electricity wasted:	300 KWH
Annual potential savings (at 6c/KWH)	$18.00

OTHER ENERGY SAVINGS:

The 6 recommendations already described are those which are most cost-effective for the auto service facilities in this study. Other energy savings are possible by applying recommendations of a more general nature. These are described below:

- Reduce Temperatures During Heating Season

  Significant energy can be saved by reducing heating temperatures to lower, more economical levels. President Carter has recommended that no space be kept over 65° F. Savings from temperature reduction are large because they are on a 24-hour basis, unlike temperature setback which involves only 8 to 10 hours. Reducing temperatures by 5° F will achieve savings that range from 12% of fuel costs in a cold area like Minneapolis up to 24% in a warmer area like Dallas. Reducing temperatures more than 5° F will result in even larger savings.

- Increase Temperature During Cooling Season

  During warm months when air conditioners are used, turn your thermostat the opposite direction and raise temperatures to cut your electric bills. In general, raising temperature will reduce air conditioning costs by 4% for each degree. For winter and summer, thermostat guards can be purchased for about $10 to prevent employees from raising or lowering the temperature setting. Turning off air conditioners during non-working hours will further reduce electric costs. It is conservative to assume that at least 20% of air conditioning costs can be saved through this procedure.

- Pilot lights which burn during summer months waste gas, both from the pilot light itself and by allowing heating units to start up on cool summer nights. Pilot lights should be turned off at the end of the heating season and relighted in the Fall when heating is needed. Savings on your gas bill may be as much as 10% per year, depending on local climate.

- Investigate Alternative Heating Methods

  Many shops, carwashing areas, and repair areas are heated with steam, hot water, or gas-fired unit heaters. For these areas, alternative methods are possible, such as infrared heating systems. This heater does not directly warm the air in a shop, but rather sends out infrared radiation that warms an object when striking it. It is more efficient than space heating systems because (1) heating can be limited to those areas being occupied, (2) waste space in the ceiling will not be heated as much, (3) "recovery" from open doors will be quicker, and (4) lower ambient temperatures can be tolerated by workers. Savings of 20-50% may be possible. The heaters have limitations, however. They

can not be used in areas where combustible fumes or dust may be present (body shops), where combustible items are stored near the heater, or where trichlorethylene is used as a degreasing agent (possible body shops).

- Maintain Air Compressor Efficiency

  Air compressors are used extensively in repair and paint shops. Their operating cost can be substantially reduced and their efficiency increased by assuring proper pressure limits. Proper pressure for lifts is 150 psi to 170 psi. Air tools should usually be set at 90 psi, although paint sprayers will use lower pressures and tire machines require higher pressures. The life of air tools is significantly reduced by operation at higher pressures. The upper limit of pressure for compressors in auto repair shops usually need not exceed 170 psi.

- Repair Steam and Water Leaks

  Steam leaks are common in low-pressure steam heating systems. Large leaks are very apparent and are usually corrected rapidly for safety reasons. Even pin-hole leaks should be corrected for economic reasons. For example, a leak from a .05 inch diameter hole would waste 1,309 therms of natural gas or 942 gallons of oil per year. Water leaks can be costly and should be corrected as soon as discovered. The loss includes both the cost of the water itself (which sometimes includes the sewer charge), and in the case of hot water leaks, the cost of the fuel used to heat the water. A single typical slow leak, which might be expected from a faulty valve, results in an annual water loss of 52,460 gallons. If that water were heated to 160° F with gas, approximately 730 therms would be required; with oil, approximately 520 gallons.

  Detection and Correction: Leaks are usually evident to operating and maintenance personnel. Leaking steam makes a hissing sound which is most easily detected when the building is not occupied but the boiler is fired up. A visual cloud is also symptomatic of a steam leak. A one-time all out search for leaks is recommended, followed by periodic reviews at least annually. Correction, which should be part of the routine maintenance, is usually accomplished by tightening a fitting, repacking a valve, or replacing or repairing a trap.

- Install Storm Windows or Plastic Sheets

  Storm windows help keep heated air inside the building and cold air out. They save 10-20% of heating costs. During summer months, they help retain cooled air. Because the purchase and installation cost of storm windows is high, the payback period is also high, usually 3 years or more. However, as the cost of energy rises, the return on this investment will substantially improve. Storm doors technically perform the same function

as storm windows, but are more expensive to buy and maintain. Payback periods of 6 to 9 years are typical. A less expensive alternative to storm windows is polyethylene sheets, which can be tacked on to windows. Although not as attractive as storm windows, the sheets cost less than $2.00 per window, and can be used in places such as repair and paint areas where window decor and view are not prime considerations.

- Add Roof Insulation

  Many buildings have never been adequately insulated. If your building has less than 6 inches of insulation, it will probably pay to add more. The type and cost of installation will depend on the construction of your building. Consult a local contractor for advice on material suited to your building.

- Turn Off Electrical Equipment When Not In Use

  Turning on electrical equipment only when it is needed can help cut electric bills. In one repair shop, three engine analyzers that were normally left on all the time were turned on only when needed and saved $40 in one year. The equipment manufacturer confirmed that continuous standby operation was not required. The table below gives the electrical costs for operating various pieces of equipment in a typical repair shop. Total operating time represents an estimate of their use per year.

Equipment	Annual Hours	KWH	Amount (at 6¢/KWH)
Drum Lathe	400	600	$36.00
Battery Charger	300	345	20.70
Exhaust Analyzer	100	60	3.60
Drill Press	50	20	1.20
Electric Heater	100	150	9.00
Coffee Maker	1000	100	6.00

ASSESSING YOUR ENERGY NEEDS AND ENERGY WASTE

Energy use must be sensibly managed if your costs are to go down. This requires that you understand the energy needs and patterns of consumption in your shop. An Energy Audit is used to establish patterns of consumption. This will determine:

- Costs and quantities of consumption for the various types of energy.
- Trends in levels of usage over time.
- Energy costs as a proportion of operating expenses.

The Energy Audit will help predict your future energy costs and help determine whether particular energy conservation measures are worth the investment. You can carry out a simplified Energy Audit in your own shop by doing the following:

- Collect all energy bills (gas, oil, electricity) from the past year.
- Tabulate the costs and the quantities used for each type of energy, on a monthly basis (a form is provided on the next page). All the information you need is on your monthly utility bills. If you have questions on how to interpret your bill, call the utility company's customer service department.
- Keep your worksheet up-to-date by filling it out every month.
- Use this data to compare usage among different types of energy. Determine which uses in your shop consume the most energy (such as heating, lighting, various tools and equipment, etc.). Check the energy rating data on your equipment's nameplate, which appears on the back or bottom of the device. This will give voltage and amphere levels (for electrical equipment) or BTU levels (for gas-operated equipment). This will tell you the relative consumption levels of various devices. Calculate the length of time that equipment or fixtures operate every month.

Determine where energy usage can be most effectively cut by:

- Concentrating on the areas of greatest energy consumption (for example, it is better to cut heating by 2% than a small machine by 50%).
- Investigating areas where inefficiency and waste are likely to exist, such as energy use during non-working hours, improperly maintained equipment, and cracks and leaks.
- Considering low-cost changes in equipment or processes that can be easily modified to use less energy or cheaper types of energy.
- Giving priority to day-to-day operations of a housekeeping nature which can be implemented at little or no cost.

Record of Monthly Energy Use and Expenditures

1977	ELECTRICITY		GAS		FUEL OIL		WATER	
	$	KWH	$	THERMS	$	GAL	$	GAL.-CU FT
JAN								
FEB								
MAR								
APR								
MAY								
JUN								
JUL								
AUG								
SEPT								
OCT								
NOV								
DEC								

1978	ELECTRICITY		GAS		FUEL OIL		WATER	
	$	KWH	$	THERMS	$	GAL	$	GAL.-CU FT
JAN								
FEB								
MAR								
APR								
MAY								
JUN								
JUL								
AUG								
SEPT								
OCT								
NOV								
DEC								

CLOSING

This handbook demonstrates how automotive service facilities can save on energy costs. The recommendations have been tested in service shops in different parts of the country, and have proven to be good, low-risk investments. The time and expense to implement these recommendations are small, compared to the savings they return. Many of the ideas, such as relamping, can be done by your own maintenance staff.

It will pay you to consider these recommendations carefully. The possible energy savings, as reflected in the dollar savings on your utility bills, are surprisingly high considering that relatively little time and money go into making the changes. Those recommendations which require an initial investment in new parts or equipment will pay back in a short period of time, usually in less than one year. As the price of all forms of energy rises, payback will be achieved even more quickly.

You may find that you need outside help to implement energy reduction plans. Don't depend only on yourself. Check around your local community for help. Some good sources of assistance include:

Utility companies
Trade associations
Suppliers and manufacturers
Government offices of Conservation, Energy, or Planning
Contractors and Consultants
Libraries and Bookstores