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ABSTRACT

Several specific success stories are included here from institutions that have had energy conservation programs long enough to establish meaningful statistics. They illustrate why it is not unreasonable for most institutions to meet the federal objective of a 15% reduction in energy consumption, even if 1973 is used as the base year, but with some allowance made for new space added that year. A comprehensive list of suggestions primarily taken from existing programs at approximately 35 institutions is suggested as a cross-fertilization of energy conservation ideas. Other ideas solicited from federal agencies, utility associations and private industry are included. The suggestions are categorized broadly. There is no attempt to separate the design/construct ideas from those that can be applied with little or no capital outlay through budgeted operating funds. (Author)

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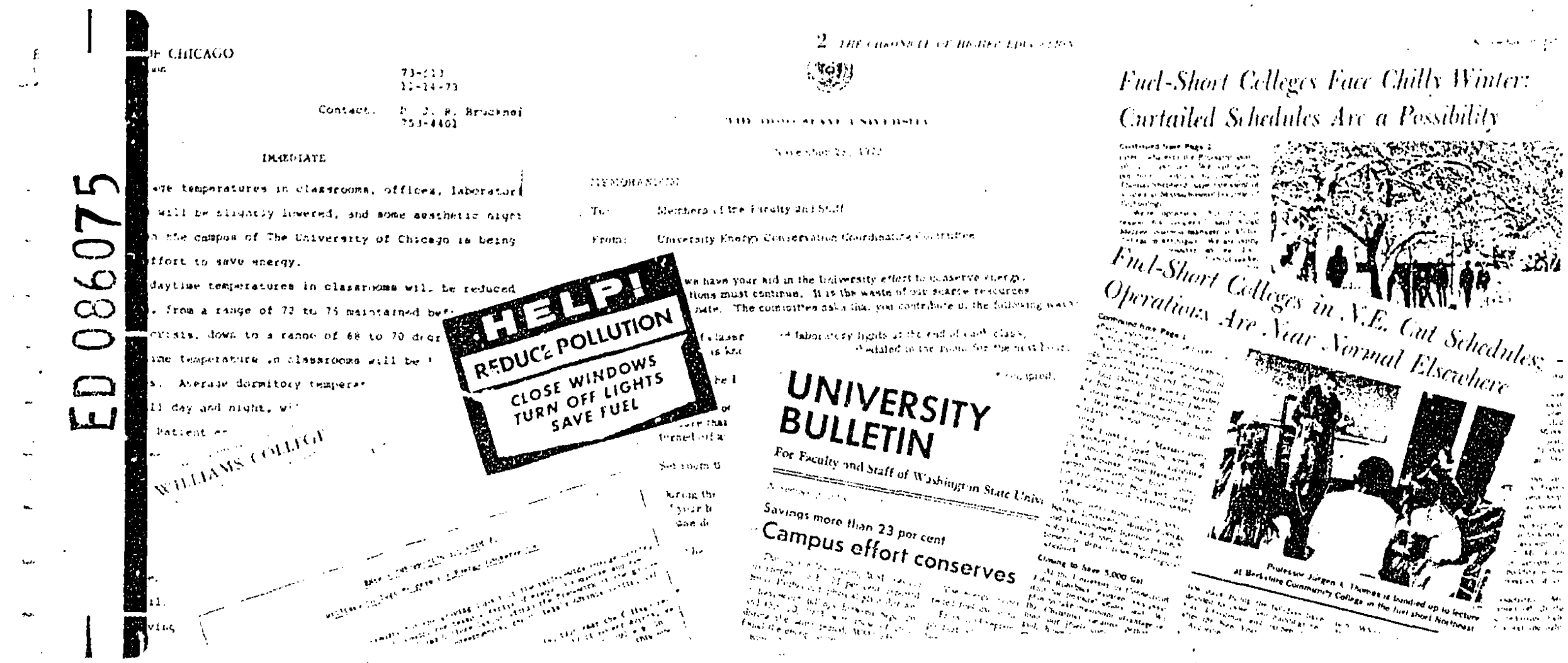
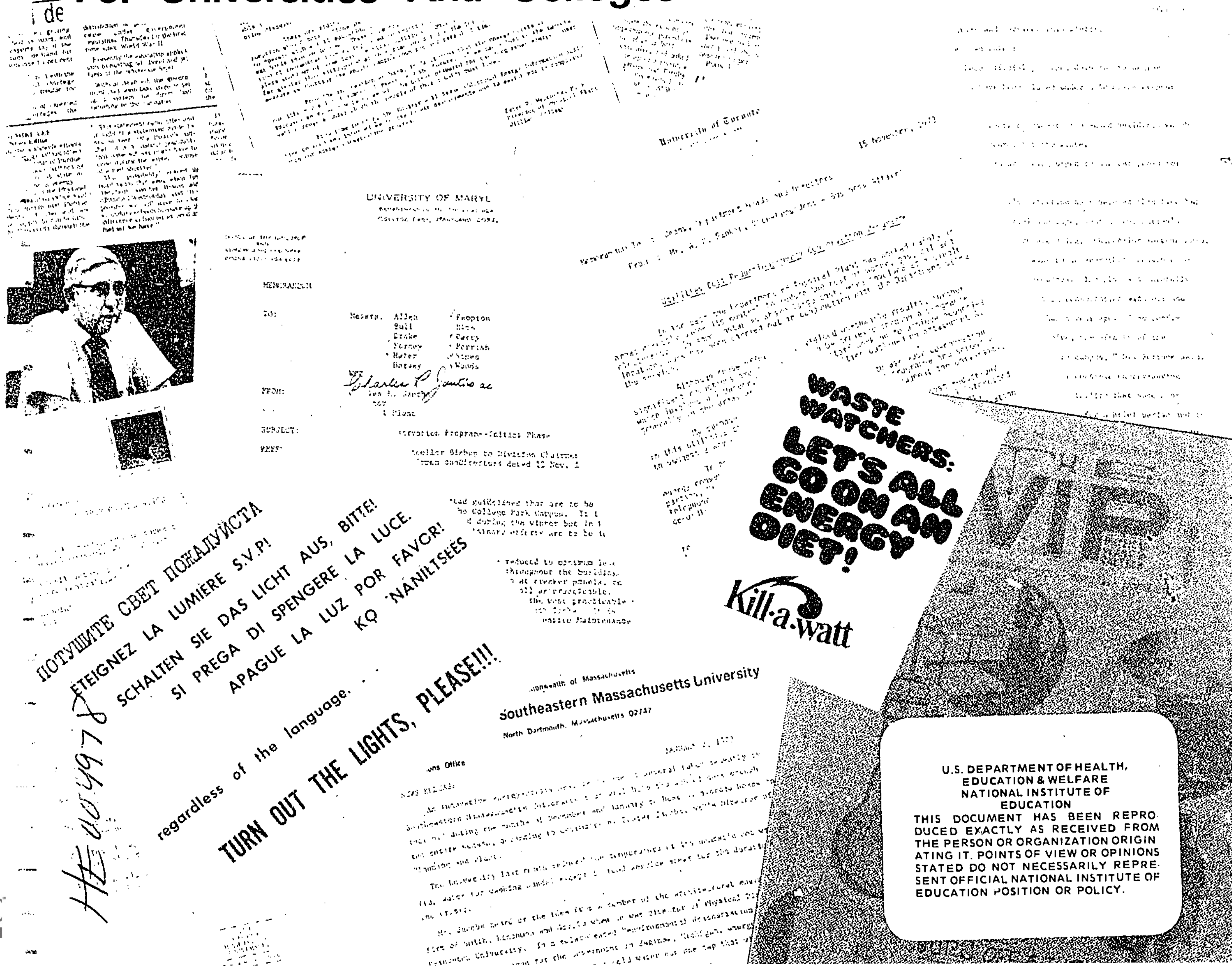


Energy Conservation Checklist
For Universities And Colleges



ENERGY CONSERVATION CHECKLIST FOR UNIVERSITIES AND COLLEGES

Compiled and published by
The Association of Physical Plant Administrators
of Universities and Colleges

in cooperation with

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Long before an energy crisis was recognized there was an economic crisis facing many colleges and universities. With institutions spending approximately two billion dollars annually on maintenance and operation of their facilities, a sum second only to instructional expenses, it was logical for increased attention to be focused on reducing costs in this area. Since utility costs have been averaging about 20% of physical plant operating budgets and increasing at an astronomical rate, it was likewise logical for physical plant departments to concentrate their cost-cutting attentions on reducing fuel and electricity requirements.

Now that an international energy shortage is upon us, higher education has a two-fold justification for establishment of a comprehensive energy conservation program. Many institutions have done so, in some cases expanding upon existing time-tested policies and procedures. Others have met the challenge by launching crash programs, in some cases to forestall immediate shortage situations.

Several specific success stories are included here from institutions that have had energy conservation programs long enough to establish meaningful statistics. They illustrate why it is not unreasonable for most institutions to meet the Federal objective of a 15% reduction in energy consumption, even if 1973 is used as the base year, but with some allowance made for new space added that year. Some credit should also be given to those that had effective programs during 1973 and have already made a substantial contribution to energy savings.

Recognizing that there has not been extensive cross-fertilization of energy conservation ideas, APPA has assembled a comprehensive list of suggestions primarily taken from existing programs of approximately 35 institutions, as solicited by APPA and the National Association of College and University Business Officers. Other ideas solicited from Federal agencies, utility associations and private industry are included.

The suggestions are categorized broadly. There has been no attempt to separate the design/construct ideas from those that can be applied with little or no capital outlay through budgeted operating funds. There may be some duplication and overlapping. No effort has been made to test the suggestions -- some of them may not work at all. Obviously, many of them may not be applicable to your particular institution. Some may be last-resort measures. From these suggestions it should be possible for all colleges and universities to establish a working energy conservation program or expand upon an existing one.

CASE HISTORIES

WASHINGTON STATE UNIVERSITY, Pullman, saved an estimated 23% in electricity and 7% in fuel in November as a result of conservation efforts, an outgrowth of preliminary plans made the previous spring. Bruce Rutherford, physical plant director, said the comparative savings could be as high as 30%, since several new buildings were added since 1972. "We have not curtailed any instructional or research program yet because of the plan," he adds, "but extended fuel shortage may cause us to lower temperatures in buildings even more."

CARLETON UNIVERSITY, Ottawa, Ont., Canada, in the first stage of a long-range energy conservation program, has reduced fuel consumption by 20% over the previous year. The cost savings from all phases of electrical energy reductions will be 12%. This amounts to a total dollar saving of $160,000 per year. To accomplish this, Physical Plant Director James E. Whenam reports an expenditure of less than $10,000 in adjustments to various systems. He continues to explore ways of reducing peak demand load through improved controls of major electrical equipment and major changes to existing inefficient mechanical systems, adding that the substantial costs of major surgery can be recovered in savings in a few years.

INDIANA UNIVERSITY, Bloomington, saved approximately $150,000 last September through implementation of an energy conservation plan primarily concerned with reduced lighting and thermostats. Much of the credit is being given by Physical Plant Director Howell Brooks to the formation of a Utilities Conservation Committee of students last Spring and its subsequent cooperation in obtaining student support for the plan.

PURDUE UNIVERSITY set a goal to save $180,000 in 1972-73 utility costs. It saved $212,689, which was described to employees as money that could now go for pay increases instead of "up the stack." Physical Plant Director Walter Wade has now developed a ten-point program to reduce utility costs another 5% for 1973-74.

CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, demonstrated that it can contribute to conservation by reducing electricity consumption in November by 17%. Now it is well into the companion problem of cutting heating and automotive fuel requirements. Phil Rector, physical plant director, is confident that with continued academic and non-academic support substantial savings will result.

UNIVERSITY OF WISCONSIN, Madison, found that by shutting off 12,000 hallway lights, thus reducing the footcandles to 5 or less, a saving in electricity occurred equal to the amount of energy used by 800 residential units in the city of Madison. Physical Plant Director Frank Rice, Jr., reports that faculty, staff and students consider this lighting level adequate.

UNIVERSITY OF MINNESOTA, Minneapolis, through its foresight and extensive conservation efforts, may be able to release at least 2,500,000 gallons of No. 2 fuel oil from its present mandatory allocation for redistribution by the State Office of Civil Defense for hardship priority needs. Physical Plant Director Warren Soderberg reveals that this will not be easy, in that the university has recently added almost a million gross square feet of buildings, primarily in the Health Sciences with extremely high energy demands.

MICHIGAN STATE UNIVERSITY, East Lansing, launched a voluntary conservation program two years ago that was keyed primarily to cost reduction. Ted Simon, assistant vice-president for physical plant, reports savings of $250,000 a year since. "Unfortunately," he adds, "these savings have been largely eroded by rising costs, such as the rise of coal from $18 to $25 a ton."

OHIO STATE UNIVERSITY, Columbus, found last July that it was consuming an equivalent of 1.36 billion KWH of electricity during 1972-73 and that electricity, fuel and natural gas has been increasing at the rate of 17% a year. As a result of this study and the national energy crisis, Ohio State has adopted a comprehensive 13-point program of both long- and short-term economies. Walter Hartman, director of physical plant, reports that a detailed study of energy consumption in 35 selected campus buildings is underway under the supervision of Professor Charles Sepsy of mechanical engineering and Dallas Sullivan of the physical plant. Funded at $90,000 per year, the objective is to find ways of making substantial cuts in campus energy use beyond the emergency measures now being undertaken.

SOUTHEASTERN MASSACHUSETTS UNIVERSITY, North Dartmouth, has taken steps to save enough fuel oil during December and January to heat 34 average homes for the entire season, estimates Foster Jacobs, SMU's director of planning and plant. The most drastic measure was the closing down of the school from December 20 to January 28, which accounts for 70,300 gallons of oil or 52.5% of the savings. His area was extremely hard hit by the fuel oil shortage.

UNIVERSITY OF ILLINOIS, Urbana, removed 7,400 lamps, as of December 3, with a corresponding KW reduction of 315. Director of Physical Plant L. G. Hernecheck points out that not only will electricity be saved but substantial replacement lamp costs. "Fluorescent tubes are evaluated as they are removed. Those with at least a half-life expectancy are returned to stock; old tubes are discarded."

UNIVERSITY OF CHICAGO has instituted conservation measures that will save an estimated million therms of natural gas fuel, used in the heating plant, and 5.5 million KWH of electrical energy between last November and next July 1. E. L. Miller, physical plant director, points out that this goal will only be reached with full cooperation of everyone on campus.

UNIVERSITY OF WASHINGTON, Seattle, hopes to save as much as 20% this coming year in energy consumption through a comprehensive conservation program. "However," Physical Plant Director John Heinz anticipates that the savings accrued will not enable the university to break even from the cost standpoint." The school has ordered 12,000 tons of "black gold" from Utah mines, enough to get through this winter. But he expects an additional $800,000 to be necessary in order for the utilities budget to meet the rapidly rising costs of energy.

CLARKSON COLLEGE, Potsdam, N.Y., has launched energy and money saving plans in anticipation of saving up to 20% of the fuel budget ($26,000). G. C. Gonyea, physical plant director, reports additional savings estimated are $11,000 in water, $22,000 in electricity. This is expected in spite of the addition of 200,000 square feet of new buildings this year.

DREW UNIVERSITY, Madison, N.J., found that by installing three heating boilers with a total heating surface of 5,970 square feet instead of one large boiler with 12,000 square feet of heating surface, so far, even under the coldest of weather, only two of them have been necessary, with generally one boiler sufficient. Ralph Smith, director of physical plant, reports fuel consumption cut by 15% saving about $1,200 the first year. He is now investigating similar situations elsewhere on the campus that lacks a central heating plant.

FLORIDA STATE UNIVERSITY, Tallahassee, shaved up to $50,000 a year off its electricity bill as a result of actions begun more than a year ago. Ray Green, physical plant director, says that most of the ideas came from touring the campus with particular attention to the lighting and air conditioning systems and cooperation of custodial and security personnel as "energy watchdogs."

HEATING/VENTILATING/AIR CONDITIONING

Heating

1. Shut off the heat to dormitory buildings sometime between 9 and 10 a.m. in all living spaces not designated as emergency quarters. Restore the heat at approximately 3 p.m. or at such other time before that as the interior temperatures threaten to go below 60 degrees.

2. All heat input into academic and administrative buildings can be shut off at approximately 3 p.m. each day and turned on at approximately 6 a.m. the following workday unless there are indications that the interiors of such buildings indicate a drop to or below 60 degrees. Some institutions suggest 55 degree minimum; others 50 degrees.

3. In those buildings with central ventilation systems or centralized temperature control systems, they should be set for 65 degrees and maintained at that point consistently. It might be necessary in the future to secure such systems during evening hours.

4. In buildings where critical research or other activities are being conducted which would be affected by reduced or fluctuating temperatures, systems should be operated so as to provide a maximum of 68 degrees.

5. In the public spaces of all buildings, which will include lobbies and corridors as well as stairwells, vestibules and multi-use rooms, the following conservation procedures should apply: Where heat is provided by unitary terminal equipment, such equipment should be valved off completely in all corridors and should have the handles removed from control valves. As an added insurance where balancing cocks are included, these should be turned to the "off" position. In lobbies or multi-purpose spaces, half of the number of units present should be cut off. All but the unit located at the bottom of each stairwell should be cut off. Units located in vestibules or foyers should be adjusted to a minimum heating position before removing the handles.

6. In all instances precaution should be taken to prevent or preclude freezing of pipes. This shall include reducing and locking off of outdoor air dampers where existing. Units having outdoor air intakes should have their heating capacities throttled down to a minimum flow position rather than closed off completely.

7. On systems where radiators are closed off in the spring, it should be remembered that the steam supply pipes still radiate heat. Ensure that, wherever feasible, heat is turned off at the source.

8. Temperatures can be reduced somewhat in recreational and training swimming pools, but not in therapeutic pools.

9. Keep exterior doors shut at all times. Do not prop open exterior doors even if only a slight crack is involved. Keep vestibule doors closed. Keep office and all room doors closed whenever possible. The less chance for air travel throughout a building the better.

10. Forced circulation hot air, from a comfort standpoint, generally responds to increased thermostat settings after the "turn back" most rapidly, with forced circulation hot water next, and steam heat last. Electric heat responds slowly except when accompanied by forced air fans. Encourage space users to be patient.

11. Your heating system, particularly baseboard radiators and low level warm air supply, will work better if it is not blocked by furniture. Keep radiators free from blockage. If nothing else, allow at least a foot of air passage in front of convectors or radiators.

12. Introducing moisture into the air helps in comfort at lower temperature levels.

Make sure that humidification equipment is working properly and efficiently.

13. It may be possible to shut down certain buildings and facilities entirely for the winter season, particularly those of a seasonal nature such as golf clubhouses, outdoor tennis courts, pools. In such cases water pipes should be drained, electricity disconnected except for minimum security lighting (with other security measures to compensate). Football facilities, with certain exceptions, can be shut down for a few months at the close of the season.

14. Evening athletic, cultural events can be curtailed or rescheduled to reduce heating, lighting requirements, as an emergency measure.

15. Installation of time clocks on certain interior and exterior lighting circuits, ventilation fans, and outdoor air dampers can produce substantial savings and reduce labor requirements of manual operations.

16. Horticulture material can be consolidated into a minimum number of greenhouses and soil sterilization by steam only permitted when outside temperature is above 65 degrees.

17. All thermostats should be under the control of a designated person within each department of building. It should be that person's responsibility to see that the minimum temperature necessary for health and comfort is maintained. The physical plant department should be notified if any thermostat seems to be operating improperly.

18. Insulation of heating pipes in utility tunnels should be checked, repaired or additional insulation installed.

19. Convert to coal as a heating fuel, if you can get it in sufficient quantity and quality. Retain capability of burning oil and/or natural gas as alternate fuels as insurance. Check with appropriate EPA regulations and code requirements to see if high sulfur coal will be permitted before ordering same. Get approvals in writing.

20. Install or convert to several smaller boilers instead of one large one. Use only those needed to meet immediate requirements.

21. Use an outside temperature sensing unit to modulate hot water heating systems by increasing water temperature as outside air drops and decreasing water temperature as outside air rises. When fan coil units are used to provide both heating and cooling, the hot water should be modulated down to a maximum temperature of 75 degrees F when the ambient temperature is 60 degrees F.

22. Provide a positive shut-off of heating systems when outside air temperature reaches 65 degrees F. In well insulated buildings, cut-off can occur at 60 degrees F.

23. Explore use of infra-red heaters in large bay areas and warehouses. It provides comfort and prevents condensation on stored materials.

24. Emphasize boiler maintenance. Cleanliness of the heating surfaces (both on the water side and on the fire side) and maintenance of the proper air-fuel ratio at the burner are two important variables impacting on boiler efficiency.

25. Monitor stack temperature and the concentrations of composition of flue gases from combustion processes. A stack temperature that is excessively high means

wasted heat. Presence of carbon monoxide in the flue gas indicates incomplete combustion. Oxygen should be kept below 2% and carbon dioxide should be minimized in the range of about 8-12%, depending on the fuel used.

26. Check steam systems regularly for leaks and poor insulation and provide steam traps where needed.

Ventilation

1. Ventilation fresh air can be reduced in all buildings, except where undesirable for research or other special reasons. Maintaining a minimal level of approximately 10% will reduce the cost of heating or cooling ambient air substantially. Get approval for code variations in writing.

2. Laboratory hoods require 1,000 cubic feet of air per minute during operation. In air conditioned areas, replacement air costs 9 cents per hour per hood at design conditions to satisfy room conditions. Shut hoods off when not needed.

3. Access to controlled humidity areas should be kept to an absolute minimum. The "price" of opening a single door between a controlled humidity area and a corridor or uncontrolled area is 2 cents.

4. Shut ventilating fans down overnight, weekends and holidays.

5. Shut off bathroom exhaust fans at night.

6. Eliminate all outside air during first half hour of heating/cooling start-up and shut-down.

6. To forestall worries of suffocation, etc., explain that buildings traditionally leak air through cracks, joints and wall openings and doors are opened to outside frequently enough to prevent serious oxygen depletion.

7. Encourage enforcement of no smoking in buildings to maximum extent.

8. Clean or replace filters as part of preventive maintenance program as dirty filters impede air flow.

9. Eliminate all outside air in unoccupied buildings.

Air Conditioning

1. Keep doors closed between air conditioned and non-air conditioned areas. Check to see that automatic door closers are working.

2. Set thermostats on window air conditioners to shut down when not needed.

3. Window air conditioning units should be covered and sealed in winter to reduce air leakage through and around them.

4. Steam or electric reheat can be either eliminated or reduced drastically in all multi-zone air conditioning systems. This means that in the areas served by such systems there will be extremes in temperatures. At times the space will seem chilly. At other times it will seem to be a little too warm. This will be because of the wide variation in humidity control. Building personnel should be alerted to any system alterations and these temporary effects.

5. Instruct those responsible for window air conditioners in proper operation, urging them to use the thermostatic controls rather than "constant cold" setting and to turn them off when not needed. Discourage purchase of additional window units.

6. Air conditioning systems can be turned off earlier and turned on later.

7. Chilled water temperatures can be raised, thus reducing the amount of steam used to maintain temperatures, but, as a result, relative humidity will be increased slightly.

8. Chemical cleaning of heat transfer units can improve efficiency and should be coupled with more intensive maintenance during down time. Systems should be properly balanced to maximize efficiency.

9. Insulate HVAC ducts where they extend through uncontrolled space and all hot and cold water pipes. Check for leakage and seal all ductwork.

10. Installation of mirrorized pressure-sensitive sheeting on window glass can reduce solar heat introduction. Other coatings can be applied to reduce glare as well so that daylight can be better utilized.

11. Use the run-around, air-to-air regenerative heat recovery wheels or heat pipes to reduce air conditioning and heating loads due to make-up air.

12. Use single stage evaporative coolers as pre-cooler for outside air make-up in air conditioning systems in arid zones.

13. Use air cooled condensers in series with cooling towers to minimize equipment sizes and reduce electrical consumption. Use a small cooling tower in series with a large air cooled condenser for peak shaving particularly in arid zones.

14. In residences, use thermostats with a maximum factory setting of 75 degrees F for heating and a minimum setting of 75 degrees F for air conditioning.

WATER CONSERVATION

1. Turn off water-using laboratory equipment when not in use.

2. Domestic hot water should be cut off to all academic and administrative buildings except where necessary for research or health purposes. Domestic hot water to other buildings should be reduced in temperature or cut off as feasible. Suggested temperatures range from 110 degrees up to 130 degrees, 140 degrees maximum for special purposes.

3. Every effort should be made to minimize the requirement for make-up water for heating/cooling. The temperature difference between inlet and outlet on exchangers should be maximized. In all situations where water is used to cool equipment, or has its temperature raised due to the addition of energy, there may be opportunities to conserve energy.

4. Flow of apparantly clean water into drains is suspect and should be investigated with possible reuse in mind.

5. Dripping taps or valves may seem to be a little thing, yet they result in significant waste. One drop a second can add up to about 200 gallons a month down the drain.

6. Encourage a limitation on student showers to no longer than five minutes and preferably three minutes. Do not let hot or cold water run constantly while washing, shaving, rinsing hair, etc. Fill the washbowl or shut the faucet off intermittently.

7. Use air conditioning cooling and condensate water for lawn sprinkling when required by climactic conditions.

8. Laboratory aspirators use two gallons of water per minute. The cost of providing water to the aspirator and of disposing of the effluent is 60 cents per day per aspirator. Turn them off when not needed.

9. Provide automatic electric valves for urinal flushing operations rather than continuous water flow system.

10. Use of artificial snowmakers can be curtailed with resultant savings in water and diesel fuel.

11. Install single tap at wash basins that will provide water at a tepid temperature, except for food service and others involving health or research services.

12. Reduce thickness of ice for hockey arenas to 1 1/2 inches.

BUILDING MAINTENANCE/CUSTODIAL

1. Schedule sandblasting, weather stripping, caulking and tuck pointing work for as soon as weather will permit, particularly when survey of buildings reveals substantial heat loss as evidenced by unstable, fluctuating temperatures, drafts, etc.

2. Preventive maintenance personnel should check all buildings to insure that outside door closers are working properly; that weather seals are intact or installed in other locations where practicable. They should inspect all corridor and public area windows to see that they are kept in the closed position when the buildings are in the heating or cooling mode.

3. When embarking upon an energy conservation program involving a reduction in lighting as well as heating, it is most efficient to adjust the lighting before the heating. In cases where there is discovered an obvious excess of lighting, heat from this lighting may affect the room temperature as much as two degrees when reduced. If the heating system is adjusted first, it may be necessary for it to be adjusted upwards after extreme overlighting is corrected. Clean all lamps and fixtures thoroughly to achieve maximum lighting efficiency. Some fluorescent fixtures have space for storage of the removed lamps. If a worn out lamp is revealed during the process, replace it with a usable lamp from the same fixture. Depending upon the fixture lens better uniformity of lighting can be achieved by removing the extreme lamps rather than those at the center of the fixture (as for example, in a four-lamp fluorescent fixture).

4. Lower wattage incandescent lamps can be installed to replace more powerful lamps where practicable, particularly where their function is primarily decorative.

From an appearance standpoint it is best to use the same wattage lamps uniformly when the fixtures are spaced in close proximity. Another alternative is to unscrew the unneeded lamps according to a prescribed pattern, but leave the lamps secure in the sockets. This same effect may be possible by circuit adjustments at the junction box or through switching changes.

5. Inspect all wood sash windows for leakage and install storm windows particularly on north and northwest sides of buildings.

Custodial Services

1. Adjust janitorial/custodial services to daytime shift only or split shift so that building heating, cooling, ventilating, lighting can correspond to normal building operation hours.

2. Where night cleaning is to be continued, custodial personnel should utilize a minimum number of lights and make sure they are turned off as areas are cleaned.

3. Encourage custodial personnel to be on the lookout for energy wastage, with incentive awards to recognize cooperation and contributions.

4. Schedule custodial/janitorial work involving electrical equipment, such as buffers, scrubbers, vacuums, etc., at other than peak demand period.

5. Require faculty, staff, students to empty waste baskets into container in corridor.

6. Reduce major custodial services to every-other-day or even weekly, if severe cost-cutting is required. If trash pick-up schedule is reduced, the trash might just as well go uncollected as be collected and stored to await delayed pick-up.

LIGHTING

1. Reduce all lighting levels to suit tasks performed, with cooperation and approval of those to perform the tasks.

2. Clean lamps and fixtures to improve lighting output/efficiency.

3. Improve lighting switching for increased flexibility and reduced usage.

4. Reduce exterior lighting within feasible security parameters.

5. Use "Lights Out" reminders at switches, office and building exits.

6. Eliminate decorative lighting.

7. Realign working hours, including custodial service, to maximize daylight hours.

8. Remove alternate lights in building corridors as possible within safety and security parameters.

9. Increase public relations/publicity efforts to stimulate faculty, student and administrative support for use of lights only as needed.

10. Reduce corridor lighting in all buildings to minimum levels necessary for

emergency evacuation and movement throughout the buildings. This is accomplished by shutting off switches at breaker panels, removing bulbs or tubes, removing ballasts or fuses, all as practicable.

11. Replace incandescent street lights with mercury vapor lamps, which are more efficient and produce more light with less energy.

12. Reduce parking lot lighting to minimum safety requirements; access to certain lots may be prohibited (entrances, exits barred) during evening hours so that all lighting can be eliminated in those areas.

13. Remodel light switches in all classrooms to provide for key operations so that they can be shut off after class and only turned on again by individual with key.

14. Remodel lighting switches in auditoriums, other large lecture halls, to provide for on-off operation by faculty.

15. Remodel lighting switches where large bays of lights are on one switch, so that only lights needed in a specific work area can be turned on. Have master switch as over-ride for the individual switches.

16. Install time devices or photoelectric cells to turn lights on and off automatically, particularly exterior lights.

17. Illuminate only a small portion of an area such as a gym floor during the time when the custodial crews are cleaning the floor area.

18. Turn off outside stairwell lights during the daytime.

19. Have custodial staff clean buildings one floor at a time and use only lights on that floor during cleaning process. Make sure it turns them off as work progresses to another floor.

20. Turn off alternate sets of corridor lights, if buildings are designed such that alternate lights are on different circuits for reliability purposes.

21. Have security personnel check for excess lighting left on after departure of custodial personnel and instruct them to turn off those lights discovered and report those which they cannot control.

22. Check to see that correct wattage is used in exit lights, restrooms and around building entrances. Replace with lower wattage lamps as possible or so-called long-life bulbs that use less electricity.

23. Take advantage of natural daylight in your survey of lighting requirements, and instruct personnel to do likewise as a habit.

24. When light switches are conveniently located at restroom entrances, encourage them to be used as needed.

25. Schedule lighting maintenance and relamping programs for other than during peak demand period.

26. For most night cleaning, 20-25 footcandles of light is sufficient. Lighting switches providing only this amount of light can be marked and only these will be turned on while the area is being cleaned, and turned off when the work is finished. The same system can be employed for large areas such as auditoriums and gymnasiums.

NON-LIGHTING ELECTRICAL

1. The electrical bill is made up of two components: Total energy consumption (kilowatt hours) and demand charge (kilowatt). Under peak loading, any additional consumption is very expensive since the demand charge far outweights the energy cost. Electrical peaks are established generally between 10 a.m. and 3 p.m. (may differ from campus to campus). If possible during this period, switch off equipment or at least refrain from starting additional equipment. Power on the off hours, i.e., past 3 p.m. or prior to 10 a.m. is less expensive and it may be that some activities could be carried out during other than that in which the peak occurs. The highest peaks occur in summer on hot and humid days, in winter on cold and dark days.

2. Cold rooms, environmental rooms, refrigerators, freezers, ovens, and similar equipment not in productive use should be turned off.

3. Review electricity metering system to consolidate meters as much as possible and reduce electricity input for campus to single meter if possible.

4. Reduction in heating/cooling/ventilating requirements will also contribute to electricity usage since many pumps, fans and other related equipment is electricity powered.

5. Electric heaters should not be permitted except by special authorization, such as in areas where 68 degrees cannot be maintained otherwise. Direct resistance type heating elements, including hot plates, electric emersion heaters, toaster, electric blankets, are among the heaviest consumers of electric power.

6. Post signs near electricity consuming machinery urging it be used sparingly and preferably during off-peak hours.

7. The use of laboratory equipment having large energy requirements should be reduced or curtailed. If necessary, it should be used other than during peak demand periods (10 a.m. to 3 p.m.).

8. All refrigerated water fountains can be disconnected electrically and still be usable.

9. It may be possible for line voltage to be reduced without harm to the electrical distribution system.

10. "ON" schedules should be established for office equipment such as copying machines, calculators, typewriters, etc. The practice of turning on a copier the first thing in the morning and leaving it on all day is convenient but creates a significant drain on electricity. Early afternoon hours should be avoided in scheduling.

11. There should be a policy established to screen requests for purchase of additional energy-consuming devices. The addition of a unit should be justified by the person making the request, approved by the department head and the dean of the school or by the director of the department before a requisition is placed. The endorsements of justification and approval should accompany the requisition to the purchasing office.

12. Disconnect electric resistance-heating snow melting systems and have snow cleared manually by custodial personnel.

13. Closely review electrical distribution system for such things as excessive line loss. Portable fans blowing on over-loaded transformers and switchgear should be eliminated by reducing the load or by replacing with proper sized equipment.

14. Use of natural gas and oil can be reduced by selectively shutting down campus turbines at the central power plant with correspondingly larger purchases of coal-generated electricity from the local power company.

15. Use three-phase transformers particularly in large substations to reduce transformer losses.

16. Use higher voltage motors to reduce initial cost of electrical service and equipment. The proper choice of such motors can improve power factor.

17. Where possible, consideration should be given to carrying high voltage electric current to the load centers where it is required. 2,300 to 4,160 volt current nearest its point of use will reduce voltage drop, permit smaller wiring and conserve power.

VEHICLES/TRANSPORTATION

1. Establish and enforce a maximum speed of 50 miles per hour for all school-owned vehicles.

2. Replace standard-size vehicles with compact cars wherever possible.

3. Organize a car pool with central coordination by campus volunteers or paid staff.

4. Adjust carburetors for leanest fuel mixture possible.

5. Keep engines in fine tune through regular preventive maintenance.

6. Urge departments or schools to consolidate local trips for package pickup where possible. Set up a departmental or school pickup system if volume warrants.

7. Consolidate field trips.

8. All proposed travel should be screened with the question: "Is this trip necessary?"

9. Charter bus service may be reduced.

10. Elimination of all motor pool practices, except for medical, police and maintenance.

11. Charge people in car pools reduced parking fees.

12. Encourage use of campus bus system.

13. Prohibit anyone living within six (?) blocks of campus from parking on campus.

14. "Wednesdays are for walking" program.

15. Put "conserve fuel" stickers on auto dashboards.

16. Explore use of three-wheel motor carts for physical plant personnel on campus. Post office may have surplus vehicles for sale.

17. Follow octabe requirements specified in vehicle manuals. Higher octane than specified is wasted.

18. Make sure tires are inflated to manufacturer's specifications and that wheels are aligned.

19. Don't let operators leave vehicle idling while they run in for maintenance calls, no matter how brief. Encourage them not to "gun" the engine when starting; nor should they allow for long warmup periods.

20. Encourage drivers to avoid jackrabbit starts and sudden stops.

21. Reduce sanitation pickups, other services requiring gasoline-powered vehicles.

GENERAL IDEAS

1. Prepare on-campus sign showing by thermometer/graphics the current energy use compared to the same month of previous year. Can be shown by BTU's consumed (billions) or by dollar costs. Electricity, fuel, natural gas and possibly gasoline can be included, together or separately. Degree days for each month can also be indicated for valid comparison purposes.

2. All physical plant employees, students, faculty and administrators should be encouraged by various communications to make suggestions that can increase the effectiveness of efforts to conserve energy.

3. All campus personnel should be encouraged to report: Any malfunctioning heating or cooling equipment, drafty windows, doors, or open chimneys to unused fireplaces; locations and conditions where space is too hot in winter or too cool in summer as such conditions waste energy. Opening doors and windows increases the waste, except for rare occasions between seasons when separate heating/cooling systems are being adjusted. In the latter cases, attempts to adjust thermostats to proper comfort level should be made first.

4. Faculty and administrators should be encouraged to utilize blinds and curtains to help insulate buildings from outside heat or cold. Closed blinds and curtains on South and West exposures will keep a building cool in summer, while raising the blinds or opening the curtains will help in the winter to bring some heat in during the daytime.

5. Efforts can be made to achieve uniform opening and closing hours for the maximum number of campus buildings. To achieve this may require a committee representing each administrative and academic department, or, at most, a representative of each major building. These hours should be posted and publicized. Doors should be locked during hours closed.

6. Regularly scheduled evening classes can be concentrated into a few buildings where possible through coordination of the departments involved.

7. It should be emphasized that unless the approved <u>minimum</u> conservation measures are

enforced, more stringent requirements may be forthcoming, with further inconvenience and discomfort to individuals. On the positive side, it should be noted that the conservation program will be continually monitored and certain of the measures will be relaxed at such time that either they are found not to result in appreciable energy savings or the supply of energy itself allows for more moderate measures.

8. Encourage the wearing of warmer clothing by everyone to compensate for lower temperatures.

9. Students should not be permitted to use idle classrooms indiscriminately as study halls, but alternate facilities should be provided, such as consolidation into a single unscheduled classroom rather than several.

10. Periodic checks should be made of student residence halls to see that unnecessary electric use is curtailed, that bathrooms do not have leaking or running faucets or other water facilities.

11. The cooperation of students should be requested to eliminate the traditional water fights and use of shower rooms for steam baths.

12. A Student Energy Advisory Group should be established and represented on an Administrative/Faculty counterpart group to provide other energy-saving input as well as ways to solicit student cooperation in campus-wide conservation projects.

13. The physical plant department should screen its available operating cost statistics and provide brief items giving specific savings that are or can be accrued from energy conservation efforts. These items can be inserted in university publications, newspapers and memos for general distribution to students. faculty, administrators and other campus personnel. There should be a constant flow of such information to keep this subject before the campus public. Emphasize that energy conservation is not a temporary situation but a way of life one should get used to.

14. Student residences that are not fully occupied should be surveyed to ascertain if consolidation will enable an entire building to be shut off.

15. Letters should be sent to all sororities and fraternities and others tied into the campus heating/cooling system asking their cooperation in energy conservation measures and including sufficient information to enable them to comply.

16. The physical plant department should designate one member of administrative staff as key contact for energy conservation information or assistance. Generally, this should be the superintendent of utilities, if any, except for electrical service.

17. Prepare at least one general press release for local and campus newspapers

18. There should be a narrative report submitted that describes briefly any conservation action taken in each building toward compliance with the approved plan.

19. Cost data should be accumulated for charges to physical plant budgets required to implement and maintain this program.

20. Weekly statements of fuel and electrical energy consumption should be maintained for comparison purposes and to estimate usage.

21. Institute daily reports on efficiency in all heating plants. Check closely the percentage of makeup water at the plants. This is a check on returns being dumped out in the system or leaks in the system.

22. Have close communication with room scheduling and review regular reports and upgraded reports in order to reprogram systems on and off on central control console in accordance with space needs.

23. Prepare chart or graph on which to plot daily hour-by-hour electricity requirements to ascertain peak demand period. This should be done for two- or three-week periods at various times of year, if not done daily.

24. Develop detailed shut down program for maximizing energy savings during holidays and semester breaks, and an abbreviated program for over weekends.

25. Develop a comprehensive energy conservation plan in several phases, beginning with measures that can be taken immediately with resources at hand, then to those measures requiring increasing outlay of time, effort and money, and concluding, in the final phases, with those requiring extensive budget alterations or additions. The plan should include an emergency plan including measures to be taken immediately in case of power failure, fuel unavailability, etc.

26. Prepare an energy conservation checklist for architects/engineers bidding on new construction projects. Physical plant department should be involved at project inception and at all review stages to check compliance with this as well as other specifications.

DEPARTMENT OF DEFENSE SUGGESTED ENERGY CONSERVATION TECHNIQUES

Since the physical plants of military bases and installations have many similarities with college and university facilities, APPA and the Department of Defense have mutually agreed to exchange energy conservation information. Initially this consists of the following list of 37 ideas which may or may not be applicable to your particular situation. Future developments will be processed for your information as received.

1. Use correct orientation of building to minimize solar heat loads and/or prevailing winter wind effect.

2. Use minimum glass and window area on south and west to reduce air conditioning loads. Use minimum glass and window area on north or prevailing winter wind direction to reduce heating loads.

3. Use roof overhang, "eyebrows" and other structural solar shading devices over glass areas to reduce air conditioning loads and where possible, permitting heat gain from low-angle winter sun through glass areas.

4. Use tinted and other heat reflecting glass, solar window screening, and window coatings to lower solar load on air conditioning systems.

5. Use double glazing to reduce heat transfer in both summer and winter.

6. Use white or aluminum coated roofs to reduce solar heat gain and lower air conditioning operating costs.

7. Use the economy cycle based on low enthalpy of outside air to reduce loads on air conditioning equipment.

8. Use programmed control through clocks or other systems for night, weekend, and holiday temperature set back (or cut off) to reduce air conditioning and heating loads. Normally air conditioning for personnel comfort will be cut off during unoccupied hours and heating reduced by 15 degrees F.

9. Use the run-around system, air-to-air regenerative heat recovery wheels or heat pipes, to reduce air conditioning and heating loads due to make-up air.

10. Install insulation in existing buildings to levels specified in DoD Manual 4270.1-M.

11. Use single stage evaporative coolers as precooler for outside air make-up in air conditioning systems in arid zones.

12. Use an outside temperature sensing unit to modulate hot water heating systems by increasing water temperature as outside air drops and decreasing water temperature as outside air rises. When fan coil units are used to provide both heating and air conditioning, the hot water should be modulated down to a maximum temperature of 75 degrees F when the ambient temperature is 60 degrees F.

13. Provide a positive shut-off of heating systems when outside air temperature reaches 65 degrees F. In well insulated buildings, cut-off can occur at 60 degrees F.

14. Use no outside (ventilation air) for unoccupied buildings to achieve rapid acceleration to proper temperature (air conditioning or heating) e.g. to bring air conditioned building down to temperature in the morning (0600 to 0730) before workers arrive.

15. Provide reduced amounts of outside air since most ventilation air supplies are excessive. Prohibit smoking in large assembly areas and classrooms.

16. Use built-up water-to-air or air-to-air heat pumps in larger buildings. Use diesel or combustion turbine drive and collect waste heat as noted in 19 below. Note that screw machines can be air cooled.

17. Use heat pump principle in winter to transfer excess heat from windowless interior space to perimeter space or to cool high heat gain areas such as EDP space in winter and use waste heat in exterior offices.

18. Use air-cooled condensers, indoor sumps on cooling towers or temperature actuated cooling tower by-pass to eliminate the heating of cooling towers in below freezing weather.

19. Use total energy (TE) systems whereby electric power is generated by a diesel engine or combustion turbine and all heat from the oil cooler, engine jacket (ebullient cooling) and exhaust gases (waste heat boiler) is used for domestic hot water, space heating and air conditioning (absorption refrigeration).

20. Use diesel engines or combustion turbines to drive centrifugal or screw machines for air conditioning, industrial pumps, etc. to reduce electrical load and to reduce electrical demand charges. Use waste heat boilers and/or heat exchangers to recover and use heat as noted in 19 above.

21. Use absorption refrigeration where heating plant operates in summer or where heating plant can be operated at less cost than total electrical cost (energy plus demand).

22. Use double effect absorption refrigeration machines.

23. Use piggy-back refrigeration system to reduce electrical load. A piggy-back unit is a balanced combination of a steam turbine driven centrifugal refrigeration machine exhausting into an absorption refrigeration machine.

24. Use water cooled lighting fixtures to reduce air conditioning loads and possibly to transfer heat to exterior areas in winter or use as reheat source in air conditioning systems.

25. Design air conditioning systems so that all return air passes through louvers in lighting fixtures to prevent lighting and ballast heat from entering the occupied space. Because this method eliminates the lighting heat at the source, it is possible to use smaller air handlers, coils, and duct work since the room load has been lowered. Use this warm air as reheat in air conditioning systems.

26. Design facilities to provide a high power factor.

27. Maintain a base wide power factor of not less than 95%.

28. Use air cooled condensers in series with cooling towers to minimize equipment sizes and reduce electrical consumption. Use a small cooling tower in series with a large air cooled condenser for peak shaving particularly in arid zones.

29. In personnel living spaces, use thermostats with a maximum factory setting of 75 degrees F for heating and a minimum setting of 75 degrees F for air conditioning.

30. Use centrally located Supervisory Control Systems. Such systems are particularly useful in hospitals and other large buildings or building complexes and provide extremely rapid identification of utilities problems including safety, lighting and temperature control. Such systems offer the possibility of large manpower savings through the elimination of roving utility patrols and close control of utility usage.

31. Use double bundle condensers with centrifugal refrigeration machines to permit the use of heat which would otherwise be wasted to cooling towers.

32. Use large energy storage systems (such as water tanks) to store "waste heat" from lights and air conditioning condensers when air conditioning must be operated in the winter time for interior spaces, EDP equipment or other high gain areas.

33. Use three-phase transformers particularly in large substations to reduce transformer losses.

34. Use higher voltage motors to reduce initial cost of electrical service and equipment. The proper choice of such motors can improve power factor.

35. Use higher voltage and/or higher frequency fluorescent lighting to reduce wire sizes and to provide longer lamp life.

36. Use water storage tanks to store chilled water generated during off peak periods and use water storage capability to reduce size of refrigeration equipment.

37. To provide the greatest resistance to heat flow downward, use aluminum foil backed insulation, or aluminum foil backed gypsum board facing upward or outward and facing a closed air space.

HOW TO GET THE ANSWERS TO FUEL ALLOCATION QUESTIONS

If and when the Office of Energy Programs addresses itself specifically to institutions of higher education most questions concerning the availability of scarce petroleum products will be answered. Until that time, however, it is necessary for each institution to interpret existing Federal regulations for itself.

Guidelines for making this unofficial interpretation will be provided as new regulations appear or existing ones are amended.

If you should find certain questions unanswered by the guidelines issued by various educational associations, you may wish to contact the following:

Office of Petroleum Allocation (OPA), key decision center, in Washington, D.C. (202) 254-8046

OPA regional numbers:
Atlanta (404) 526-4911
Boston (617) 223-5195
Chicago (312) 353-8390
Denver (303) 234-2596
Houston (713) 226-5487
Kansas City (816) 374-2037
New Orleans (504) 527-6681
New York City (212) 620-6711
Philadelphia (215) 597-9330
San Francisco (415) 556-7651
Seattle (206) 442-7261

Ask for the regional director when you call, or request the name of state officials who can help you.

As a last resort you should address your problem, preferably in writing, to Office of Energy Programs, U.S. Department of Commerce, Washington, D.C. 20230.

MEETINGS/CONFERENCES/WORKSHOPS

February 3-7--American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1974 Semiannual Meeting, Convention Center, Los Angeles, Calif. For information, write to ASHRAE, 345 E. 47th St., New York City 10017.

February 12-14--Energy Conservation for Commercial and Institutional Buildings Seminar. For information, write to Continuing Engineering Education Program, George Washington University, Washington, D.C. 20006, or phone (202) 676-6106. Registration fee: $250. Other related seminars to be sponsored later.

June 2-5--61st Annual Meeting of The Association of Physical Plant Administrators of Universities and Colleges. Theme: Improved Utilization of Energy and Other Resources. For information, write to APPA, Suite 510, One Dupont Circle, Washington, D. C. 20036.

TO ALL EMPLOYEES OF PURDUE UNIVERSITY

A year ago, we asked each of you to join in a cooperative, volunteer effort to help Purdue save $180,000 in 1972-73 utility costs--funds which could be used for other programs, pay increases and needed supplies.

The evidence is now in and it clearly shows that you not only cooperated but went well beyond an original expectation that economies in our utility usage--water, power lights, heat, air-conditioning, natural gas, and so on--could mean as much as a $180,000 reduction in utilities cost to be made available elsewhere in the university.

Take a bow! The combined savings in our utilities budget exceeded 5 per cent, actually totaling $212,689! What does that mean individually? At a time when the university's operating funds are critically short, it means that many employees who received pay increases would not have gotten them because these funds otherwise would have literally gone up the stack!

And in that battle against economic and ecological waste, the amount of water saved (and thus power used to pump it out of the ground and distribute it) was a phenomenal 207,000,000 gallons, a 10 per cent reduction for a period in which the Physical Plant Department had expected a sharp increase.

Our power usage increased by only 20,000 kilowatt hours in 1972-73. That is a drop in the bucket, really, since the university used 129,400,000 KWH and traditionally has experienced a 6 to 7 per cent annual increase in purchased and Purdue-generated power usage.

Of course, other factors enter into the saving, but our engineers have analyzed the entire situation by several methods and now conclude that, overall, the primary reason is because people did respond to the request and did cooperate in frugal use of all of our utilities.

So, thanks to all of you, Purdue did win the battle in 1972-73--yet, the "war" goes on and in 1973-1974 we look forward to your continued cooperative effort to help save the university's resources.

Here's some of the things we are already doing: Hundreds of time clocks have been installed to assist in the most efficient use of fresh-air ventilating systems, to save up to $20,000 annually. The Physical Plant staff is also conducting what eventually will be a campus-wide survey of interior lighting to reduce light to recommended levels wherever possible.

As an example of how dramatic that can be, fluorescent tubes were removed from every other fixture on the second floor of the Administrative Services Building. Light levels are not only sufficient, but many persons have said the reduction has eased eye strain. The calculated saving in a year's time, if this reduction is extended to the rest of the building, is amazing: Reducing light levels to 100 foot-candles in this one building would mean:

--A reduction in coal burned (to produce power) of 452.5 tons and a resultant reduction in sulphur dioxide pollutants of 11.8 tons!

--A maintenance savings--new tubes, fixtures, etc.--of $2,210 and an operating utilities savings in one year of $10,182, or a total of $12,392.

It is not too difficult to imagine the large savings which we can make with little effort in other buildings across the campus.

A word about water: We pumped 207,000,000 gallons less last year than in the previous year. Cutting out unnecessary water usage saves not only our supply of clean water but dollars, too. We calculate that it costs 5 cents per 1,000 gallons to pump and distribute water through our campus mains. A small sum? Perhaps, but we must also get rid of that water and we pay 19 cents per 1,000 gallons to let it pass through West Lafayette's sanitary disposal plant. That doesn't include, of course, some air-conditioning cooling water on the central campus which we save to water our vast campus lawns.

This, in part, is what the university is doing to help save on utility costs. Here's what you can do:

1. Stay on sidewalks. Why? The university annually sods about 10 acres of new lawn because of construction work and similar reasons. But one unnecessary cost is the $4,000--at about 10 cents per square foot--spent to "repair" lawns where pedestrian paths have been worn.

2. Protect air-conditioned and heated areas from unnecessary temperature change loads. For example, doors left open between air-conditioned and nonair-conditioned areas cost about $27 per year per door. Keep such doors closed.

3. Windows left open in air-conditioned areas cost even more--$124 per year per window. On the subject of windows, window air-conditioners should be set so the thermostat can operate. For example, leaving a window air-conditioner on the "constant cool" mark means the conditioner runs full blast, whether it needs to or not. Set the conditioner so the thermostat works and the compressor shuts down when not needed. Figure savings at about .2 cents per hour. There are at least 1,700 window units installed on campus.

4. Lights in a typical Purdue classroom cost about six cents per hour to use. Turn them off when a room is not occupied.

5. Lights in a typical residence hall room cost one half cent per hour. Consider the hourly savings if the use in each of the more than 6,000 rooms was reduced one hour per day.

6. Laboratory aspirators use two gallons of water per minute. The cost of providing water to the aspirator and of disposing of the effluent is 60 cents per day per aspirator. There are more than 540 aspirators available in the Pharmacy Building alone, not to mention the others in other university facilities. Turn them off when not needed.

7. Laboratory hoods require 1,000 cubic feet of air per minute during operation. In air-conditioned areas, replacement air costs nine cents per hour per hood at design conditions to satisfy room conditions. Shut hoods off when not needed.

8. Access to controlled humidity areas should be kept to an absolute minimum. The "price" of opening a single door between a controlled humidity area and a corridor or uncontrolled area is 2 cents.

9. Consider the added cost of setting your room thermostat at 72 degrees rather than 75 in summer and 80 degrees versus 75 in winter: A typical classroom

with the thermostat at 72 degrees summer and 80 degrees winter, as against a year-around 75 degree setting, costs $35 per year more and about $25 per year more for the average Purdue office.

10. Scheduling anticipated large electric power loads during off-peak load periods can save hundreds of dollars annually. Example: A 25 h.p. electric motor run for one 30 minute period during the peak-load periods costs $41.60 more for energy per month than if run during an off-peak period. The peak-load periods here occur between 8:30 and 11:30 a.m. and from 1:30 to 4:00 p.m. on weekdays. You should reschedule anticipated large and small electrical loads to miss peak-load periods whenever possible.

If it seems that the university expends much power and water on lawn sprinkling, remember--that is one of the prices of maintaining lawns and landscaping in this climate. But remember also that the university uses air-conditioning, cooling and condensate water whenever possible for lawn sprinkling--water that otherwise would be wasted down the drain and which could create thermal pollution in the university's drainage pond on the south edge of the Agriculture Campus. Such sprinkling is considered an ecological plus.

Most of the items mentioned here would appear to be an insignificant factor in a total utilities budget of $4.1 million when considered individually. But consider them together and we estimate that the above 10 measures alone could save 5 per cent of the total utilities expenditure in 1973-74.

A goal of 5 per cent reduction in utilities cost by extra care on the part of all of us is not unattainable and the effort has a real dollar payoff, as we so vividly learned in the last year.

So close a door, turn off a light, shut down equipment when not in use, leave that thermostat at a constant setting. It will save <u>your</u> budget dollars. And there is another plus:

> Power used at Purdue, like power used anywhere, is creating pollution for someone, somehow, someplace on this planet. When you save power, you are literally saving your environment!

L. J. Freehafer
Vice President and Treasurer

BIBLIOGRAPHY

The following publications are available as indicated. Please order as instructed and include check or money order--no stamps or cash please. Allow ample time for receipt since many of these publications are much in demand at present and supply may be depleted.

TECHNICAL OPTIONS FOR ENERGY CONSERVATION IN BUILDINGS (C13.46:789)--A 175-page report of the National Conference of States on Building Codes and Standards and the National Bureau of Standards Joint Emergency Workshop on Energy Conservation in Buildings held last June in Washington, D.C. Order by number and name from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price: $2.35 domestic postpaid.

DESIGN CONCEPTS FOR OPTIMUM ENERGY USE IN HVAC SYSTEMS--Booklet published by Electric Energy Association, 90 Park Avenue, New York City 10016. Price: 40 cents postpaid.

COST AND ENERGY SAVINGS OPPORTUNITIES WITH HEATING, AIR CONDITIONING AND LIGHTING SYSTEMS IN SCHOOLS--Booklet published by Electric Energy Association, 90 Park Avenue, New York City 10016. Price: 40 cents postpaid.

A GUIDE TO MONITORING AND CONTROLLING UTILITY COSTS by Seymour G. Price--Includes forms and procedures for recording, analyzing, and reducing utility costs with step-by-step instructions. Charts and tables for use in estimating, comparative costing, and budgeting are also provided. BNA Books, 1231 25th St., N.W., Washington, D.C. 20037. Price: $12.50.

THE ECONOMY OF ENERGY CONSERVATION IN EDUCATIONAL FACILITIES--An 82-page manual containing detailed information on the subject, emphasizing cost factors. Includes excellent bibliography of additional sources. Educational Facilities Laboratories, Inc., 477 Madison Avenue, New York City 10022. Price: $2.00.

REPORT OF AD HOC COMMITTEE ON ENERGY EFFICIENCY IN LARGE BUILDINGS TO THE INTERDEPARTMENTAL FUEL AND ENERGY COMMITTEE OF THE STATE OF NEW YORK--Report based upon meetings of this committee in 1972 published in March, 1973. Limited number of copies available or accessible through Office of General Services, State of New York, Albany, N.Y.

INSTALLATION LEVEL ENERGY CONSERVATION HINTS--Prepared by the Defense Energy Task Group of the Office of Assistant Secretary of Defense. Copies should be accessible through civil engineering or comparable offices of nearby military installations.

ENERGY UTILIZATION IN BUILDINGS USING LIFE CYCLE COST-BENEFIT ANALYSIS--To be published in BUILDING RESEARCH, a quarterly publication of Building Research Institute, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. Price: $5.00 to non-members, free to members. (Members of the Association of Physical Plant Administrators will automatically receive free copies as co-sponsor of the conference at which these papers were presented.)

ENERGY CRISIS BIBLIOGRAPHY by A. Peter Opperman. Published by American Institute of Architects, 1735 New York Avenue, N.W., Washington, D.C. 20006. Price: $2.00 postpaid.