Challenge

Energy is an essential resource for Fort Carson's training and deployment missions, and its availability and cost affect the quality of life of soldiers and families. Energy sources at Fort Carson are primarily nonrenewable; therefore, availability will decrease over the long-term. Inefficient energy use increases operational cost and environmental degradation from resource extraction, climate change, and air pollution.

Finally, the cost of energy has doubled over the past decade. How can Fort Carson ensure a reliable supply of energy and reduce costs and environmental impacts so that the mission is not compromised?

Key Considerations

- **Energy Conservation** – Many opportunities for reducing energy consumption in existing facilities and operations are available. Fort Carson needs to find the financial resources to invest in these opportunities and the management time to initiate and manage retrofit projects.
- **New Construction** – Significant new construction is underway on Fort Carson. The energy consumed in new facilities will likely remain relatively constant over the 50+ years these buildings are in operation.

  New buildings can be designed to be substantially more efficient than most buildings constructed today, and more efficient than the inventory of buildings now on Fort Carson. Given the lifetime of new facilities, and the difficulty in radically improving energy efficiency in buildings after construction, energy efficiency needs to be a top-level priority for all new Fort Carson facilities.
- **Energy Independence** – Future energy costs will fluctuate to an even greater degree given recent deregulation of the gas and electricity markets. On-site generation of electricity from renewable sources (e.g., solar and wind) would help stabilize energy costs and improve energy supply reliability.

  Installation distributed energy sources (e.g., renewable energy and small, distributed generators such as microturbines and fuel cells) can help ensure a reliable energy supply.
- **Green Energy** – The pressure to move to renewable energy sources is significant and growing. Fort Carson can support the development of renewable energy sources by increasing its efforts to buy energy from renewable sources. The adoption of multifueled vehicles that can use biofuels

would be another
important step toward energy independence and reduced environmental impact.

Importance to Fort Carson

Mission – Reliable, affordable energy is essential to Fort Carson's mission to train, mobilize, and
deploy Army ground forces in defense of the nation.

Quality of Life – Good quality of life depends on sufficient heat, hot water, cooling, and clean air.

Cost – Fort Carson spent $4.5 million for electricity and $2.8 million for natural gas in 2000. In
2001, Fort Carson spent $5.7 million for electricity and $6.9 million for natural gas.

Environment and the Community – Energy use at Fort Carson in FY01 resulted in the emission
of an estimated 27,410 tons of carbon dioxide (CO_2); 699 tons of nitrogen oxides (NO_x); 753 tons of
sulfur oxides (SO_x); and 0.38 tons of mercury, cadmium, and lead from Colorado Springs Utilities.

These estimates are based on standard calculations for converting energy used per kilowatt-hour
(KWH) to emissions produced (http://www.cleanerandgreener.org/pollution-from-electricity.htm).

Colorado Springs Utilities has made great strides in reducing emissions; therefore, these pollution
estimates may be higher than the actual emission levels due to the use of innovative pollution-control
technologies. While Fort Carson and the surrounding area are in an "attainment" area—violations of
National Ambient Air Quality Standards (NAAQS) have not lasted longer than one day in the
previous year—special weather and geographic considerations put the area at risk. Atmospheric
inversions occur when an upper layer of warm air traps a layer of cool air close to the surface,
stagnating the air and preventing pollutants from dispersing. Another important factor is the
proximity of the mountains, which block the dispersion of pollutants from the area.

While no air-related environmental enforcement actions have been taken at Fort Carson in the past
five years, there are several critical considerations related to energy production and use.

- Over the past 10 years, average carbon monoxide concentrations in the United States have
decreased by 37 percent. Due in part to the efforts of Colorado Springs Utilities, carbon monoxide concentrations in Colorado Springs have decreased by 55 percent in that timeframe.

- A new natural gas and steam power plant is being built south of Colorado Springs. Originally expected to address area population growth to 2020, new estimates based on faster-than-expected growth show that the plant will only be able to supply sufficient power until 2012.
- Four horizontal-axis washing machines are being used in barracks at Fort Carson. Compared to standard top-loading washing machines, these machines use 50 percent of the electricity and natural gas, reduce dryer time, and are less harsh on clothing. While more expensive at the outset, life cycle costing may show a long-term savings.

Introduction

Fort Carson's utilities are supplied by Colorado Springs Utilities (CSU). The Directorate of Public Works (DPW) is in charge of utility acquisition and system repair and maintenance. The Directorate of Environmental Compliance and Management (DECAM) coordinates the energy program, which provides education, awareness, and management support to Fort Carson. The Environmental Quality Working Group (EQWG), which includes energy conservation as part of its program, monitors consumption, sets goals, and recommends action. Support for energy conservation includes the DPW Utilities Manager, DPW Energy Savings Performance Contract Manager, DECAM Energy Assistant (half-time), DECAM Energy Manager (position has been open for a while), and five Inspectors that do Energy Inspections as well as HM/Compliance Inspections.

Background

As a community-owned and -operated utility, CSU keeps rates low by reinvesting revenues into operations. Nonetheless, Fort Carson spent an additional $4 million for natural gas and electricity in fiscal year 2001 (Figure 3.1) due to the quadrupling of natural gas prices and an extremely cold winter (Fort Carson used 40 percent more natural gas in November of 2001 than in November 2000). Fort Carson is expected to spend $200,000 more for electricity in FY02. As of July, 2002, prices of natural gas have gone down and the

Installation has spent $1.8 million less on natural gas. New housing at Fort Carson, in addition to continued demand for air conditioning, computers, communications, and other electronic applications, will contribute to increasing demands for energy in the coming years. Energy prices and use are expected to rise over the next decade, especially with the new family housing expected to be built during that time.

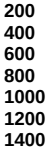
Regulations At A Glance

Numerous energy policies are relevant to energy use on Fort Carson. State and federal performance standards exist for building design, equipment, and appliances.

Executive Order 13123, *Greening the Government through Efficient Energy Management* – President Clinton issued this June 1999 Executive Order, which identifies requirements for reducing energy consumption and greenhouse gas emissions and revokes earlier energy conservation goals. Two key requirements of the Order are that each agency shall (1) reduce energy consumption per gross square foot by 30 percent by 2005 and 35 percent by 2010, relative to 1985; and (2) reduce greenhouse gas emissions attributed to facility energy use by 30 percent by 2010, relative to 1990. Other Executive Order goals include specific energyconservation objectives for industrial and laboratory facilities, an emphasis on renewable energy, a focus on reducing consumption of petroleum and water, and an emphasis on reducing source energy consumption (even at the expense of greater site energy consumption). The Defense Authorization Act for Fiscal Year 2002 establishes the 2005 and 2010 goals as law and requires annual progress reports.

The Sustainable Project Rating Tool (SPiRiT) is a selfevaluation tool to determine the extent to which a building is “green” or environmentally friendly. A 100-point system assigns ratings on four levels: Bronze (25–34 points), Silver (35–49 points), Gold (50–74 points), and Platinum (75 or more points). SPiRiT points are heavily weighted on energy conservation, with site selection next; additional criteria include water efficiency and materials used. An Army Construction Engineering Research Laboratory (CERL) team can qualify a building, but it is expensive. The Installation can use SPiRiT to do its own evaluation, but the building will not be certified.

Figure 3.2 – Energy Consumption (BBTU/yr)



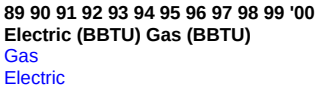
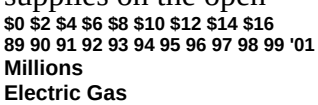


Figure 3.1 – Annual Energy Costs*

*Includes reimbursable costs, which are costs that are spent at the Installation, but reimbursed by tenants in metered facilities.

Figure 3.2 shows Fort Carson's energy consumption over the past decade. Purchases by CSU of short-term or "spot market" electricity when equipment fails or demand exceeds supply accounts for the majority of Fort Carson's electric rate increases. Spot market purchases accounted for only seven percent of electrical purchases in 2001; however, at several hundred dollars per megawatt hour, they drove the overall cost up considerably.

Fort Carson purchases interruptible gas on the open market and locks in prices for periods of time to ensure the lowest cost possible. Natural gas is used primarily to heat facilities; heating fuel is used as a back-up source at the heating plants. Although negotiating prices and purchasing interruptible supplies on the open



market are strategies that reduce the volatility of utilities costs, they may not always save money and could, in fact, increase total energy costs.

Activities and Impacts

Fort Carson cannot accomplish its mission of training, mobilizing, and deploying combat-ready troops without energy. Soldiers and civilians must be comfortable while performing administrative, maintenance and other activities and barracks need to be kept at a reasonable temperature. Figure 3.3 provides a generic look at energy sources, major areas of energy use, the flow of energy at the Installation, and some of the pollutants generated. Energy is obtained mainly from Colorado Springs Utilities. The generation and delivery of energy and heat to the installation create air pollutants while providing lighting, hot water, and building comfort.

Figure 3.3 – Major Energy Sources, Uses, and Impacts

The Human Perspective

For pollution prevention methods in power generation, Colorado Springs Utilities (CSU)

is considered one of
the best utilities in the country. CSU, which has an output capacity of 623 megawatts (MW) per day, gets its

power from two coal-fired plants, the Ray D. Nixon and Martin Drake power plants. These power plants
have the lowest mercury emissions of coal burning power plants in the county, emitting six and nine pounds
per year, respectively (http://www.ewg.org/pub/home/reports/brainfood/plants/CO.html). CSU built two 33-
MW natural gas turbines in 1999 to use during peak periods and has recently partnered with Coastal
Corporation to construct a 480-MW combined-cycle unit fueled from natural gas, which is expected to
support Colorado Springs' needs through the next decade. CSU is also researching the use of cleanerburning
coal from Wyoming, which has the potential to reduce emission of sulfur dioxide by 30 percent and
nitrogen oxides by 35 percent.
Production of electricity using nonrenewable resources is the leading cause of industrial air pollution in the
United States (http://www.green-e.org/what_is/what_is_index.html). According to the American Lung
Association, 50,000 to 100,000 deaths per year are caused by air pollution. Studies performed by the U.S.
Environmental Protection Agency (EPA) have demonstrated that, for every dollar spent on pollution
controls, $45 are gained in health benefits. Sulfur dioxide, nitrogen oxides, ozone, particulate matter, carbon
dioxide, and mercury are the primary pollutants caused by electricity generation that affect human health.
Respiratory illness, aggravated cardiovascular disease, lowered resistance to infections, and liver and
nervous system damage are among the health problems associated with pollutants from electricity
generation.

Beyond the Pikes Peak Region

Even though other forms of electrical generation are available from Colorado Springs Utilities, by far the
least expensive and most used is coal. The burning of coal for electricity gives off more carbon dioxide per
unit than any other type of fossil fuel. On a worldwide scale, coal combustion contributes 30 to 40 percent
of the total carbon dioxide emissions generated by fossil fuels (http://www.iclei.org/efacts/coal.htm).

Carbon dioxide and other oxides of carbon are associated with global warming.
Coal mining causes environmental damage to the air, land, and water. Waste materials from mining and
sludge from coal washing and preparation are placed outside the mine, where rain percolates through,
leaching heavy metals and acid into surface water and groundwater. Erosion and runoff of these materials
add excessive sediment to streams, altering habitats. Dust from surface mines adds particulate matter to the
atmosphere. Most of the environmental costs are not accounted for in the kilowatt per hour price to purchase
electricity. Restoration of ecosystems disturbed by coal mining is difficult and often results in completely
different habitats (http://www.clnatf.org/resources/reports/).
Transportation of coal to the Pikes Peak Region also contributes to air pollution and ecological damage.
Truck and train transport add the pollutants from burning liquid fossil fuels into the atmosphere. Clearing
rights of way for transportation causes soil compaction, which increases stream sediment loading, habitat
destruction, and herbicide contamination from maintenance.

Existing Buildings

Varied building types and functions require different amounts of energy for mission accomplishment. The
types of buildings, number of buildings, and percentage of building types are shown in Figure 3.4. The
graph does not include data on family housing, which has been privatized at Fort Carson (data are not readily

available). The installation currently operates a Utility Control System, which monitors and controls the
temperature for 140 buildings. This system provides for some energy savings, but it is not utilized fully and
does not monitor all of the 908 buildings on the installation. A comprehensive approach will require analysis
of all buildings to determine needed improvements for energy savings.

Figure 3.4 – Types of Buildings at Fort Carson

New Construction

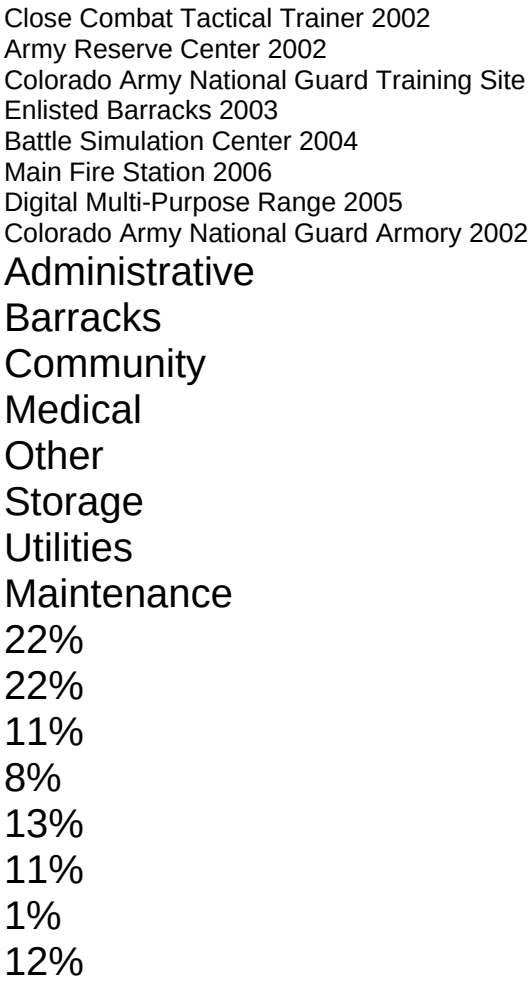
Plans for new construction on the Installation are extensive. If new buildings with energy-saving measures
replace some of the current buildings, energy costs and the pollution resulting from energy production will
decrease. Currently, an experimental building that incorporates sustainable principles is being constructed
near the Specker and Polio intersection. Over the next two years, Fort Carson plans to

spend over $140
million on new military construction, and build three child development centers and a car care center.

Forecast

Plans for new construction on the Installation are shown in Figure 3.5. While these new buildings do not
incorporate the SPiRiT standards *per se*, the construction company has used energy efficiency technologies.
Fort Carson's energy manager is working to verify the energy efficiency of the new construction.

Figure 3.5 – Plans for New Construction



In April of 2002, Fort Carson signed up for the Super-Peak (Kilo watcher) Option Agreement. This
Agreement provides an opportunity for Fort Carson to save on its annual electricity bill by cutting back on
use during peak periods. The cost of electricity is lowered during normal periods, but

greatly increased
during peak periods (no more than 100 hours per year), providing incentive to reduce energy consumption
during periods of high use in the region. The normal cost for electricity is approximately 4.5 cents per
kilowatt hour; with the Kilo watcher Option, normal cost is between two and four cents per kilowatt-hour.
During super peak periods, electricity cost is 17.5 cents per kilowatt-hour. Figure 3.6 shows the percentage
of hours typically used by Fort Carson for each pricing tier. If Fort Carson does not change its utilities
usage, the yearly cost for electricity will remain the same, but a reduction in use during peak periods will
reduce total costs (the reverse is also true). This plan enables Colorado Springs Utilities to reduce peak load
during periods of high demand and low supply, thereby reducing costs and improving reliability.

Figure 3.6 – Kilo Watcher Option Table

Super Peak $0.1750
Forecasted temperature exceeds 90
degrees and/or critical period as
defined by CSU
1%
Normal
Peak $0.0375
Summer (April through September)
11:00 a.m. to 6:00 p.m.
Winter (October through March)
4:00 p.m. to 10:00 p.m.
27%
Off Peak $0.0200 All other hours plus legally observed
holidays (see tariff) 72%

Current Sustainability Activities

Fort Carson has several energy conservation measures, activities, and programs in place. A strong energy
program requires command support and a proactive champion. The DECAM serves as the energy
coordinator and point of contact on all energy matters, per Army Regulation 11-27 and the Energy Policy
Act. Additional support is provided by the Fort Carson Energy Manager, pollution prevention personnel,
Staff Assistance visits, and Building Energy Monitor and Environmental Protection Officer training.
Current measures to conserve energy at Fort Carson resulted in the energy reductions shown in Figure 3.7.
Comparing the black line to the red target reduction line reveals Fort Carson’s progress toward its energy

goals. Several recent energy conservation efforts are listed on the following pages.
43

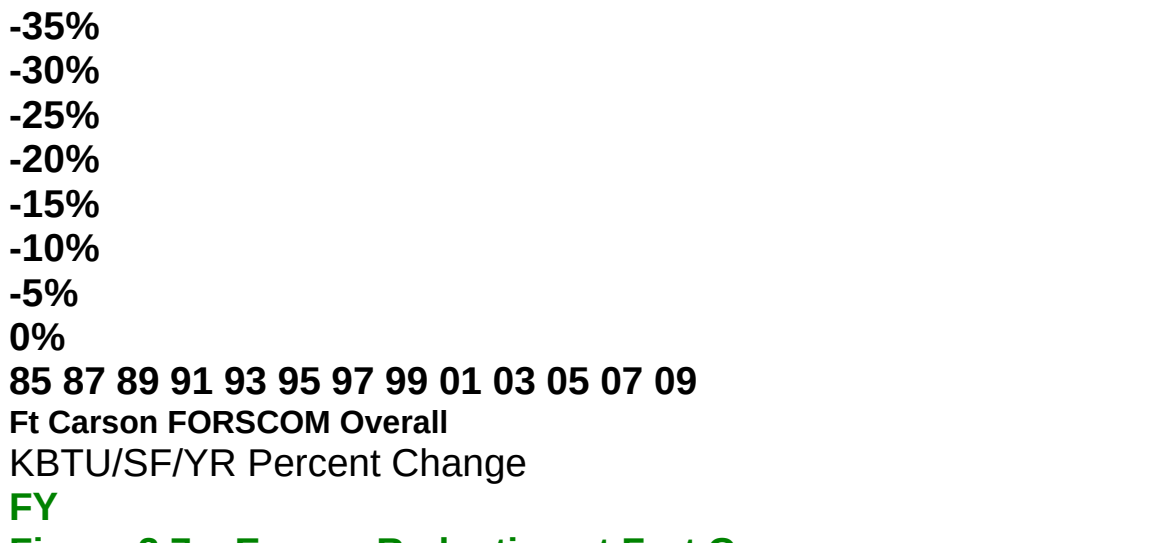


Figure 3.7 – Energy Reduction at Fort Carson

Environmental Quality Working Group – This group, which consists of the Deputy Director, DECAM;
representatives from most other Directorates on the Installation; and representatives from military units,
meets monthly. They analyze energy use, discuss opportunities to conserve energy, explore operational
improvements that will lead to energy savings, and review construction projects for energy efficiency and
energy regulation compliance.

Awareness Campaign – Spearheaded by DECAM, the awareness campaign places energy awareness
stickers near lights, writes articles on energy conservation, publishes weekly conservation tips in the
Mountaineer and via email, and places posters throughout the installation. There is no attempt to gauge the
success of the campaign.

Building Energy Monitors – Each building is required to have a DECAM-trained Building Energy Monitor
who reports to the Energy Conservation Officer and the Commander on the conservation or consumption
activities of building occupants. The Environmental Protection Officer is trained in energy matters.

Energy Savings Performance Contract – In 1999, Sempra Energy Services was contracted to explore
energy savings opportunities throughout the Installation. So far, the contractor has performed several
activities, including replacing old chillers with less consumptive chillers and conducting a

study to replace
lights with energy-efficient fluorescent lighting. Payment issues and contract paperwork are slowing down
the implementation of retrofit activities.

Target Reduction to Meet Goals

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Periodic Inspections – Environmental Compliance Technicians, who operate out of the Hazardous Waste
Staging Yard, conduct unit Staff Assistance Visits for energy conservation activities and report findings to
commanders, the Environmental Quality Working Group, the Garrison Commander, and the Commanding
General.

Staff Duty Officer – The nighttime Staff Duty Officer is required to report lights left on in buildings and
other violations of Army and Installation conservation policies to commanders.

Installation Design Guide – DECAM is very involved in the preparation and update of the Installation
Design Guide (IDG). Energy conservation requirements include compliance with energy use budgets for
efficient design; renewable energy considerations; efficient heating, ventilation, and air conditioning
(HVAC) and lighting; and landscaping conservation criteria. While the Guide is mandated at Fort Carson, it
is not adhered to or enforced, and many sustainable options are not included. Environmentally friendly
building materials, construction waste recycling measures, and life-cycle energy costing are examples of
sustainable design basics that are not included in the Installation Design Guide.

Sustainable Development Planning Charrette – DECAM coordinated a sustainable planning meeting for
the Installation in September 2001. The meeting was sponsored by the Department of Energy, Federal
Energy Management Program, and the National Renewable Energy Laboratory. The leaders were two
architectural firms; attendees included representatives from the Fort Carson Directorate of Public Works and
their contractors, Colorado Springs Utilities, the Omaha District Corps of Engineers, and other local military
installations. Three teams were set up to examine three areas—water; energy; and materials, waste and
recycling—for sustainability at the installation. The teams developed short-, middle-, and long-term goals.
Short-term goals included to incorporate sustainable ideas into predesign conferences,

enforce use of the
IDG for all projects, take advantage of and mandate proper solar orientation, use day lighting for new
facilities and renovations as much as possible, set warehouse temperatures at 55 degrees and put people into
offices, and distribute the green air federal facilities guide to all relevant staff. Mid-term goals were to put
efficiency into performance specs, use solar or photovoltaic (PV) power wherever cost-effective, improve
efficiency of proactive design stock, establish design competitions, increase training class education of staff,
include an energy class in the standard training regime, and establish an energy sustainability review team.
Long-term goals were production of clean, reliable power onsite and construction of new buildings that are
independent—that is, that do not rely on the power grid. These goals were not enforceable, and lead
agencies and team members were not identified; therefore, projects directed toward meeting these goals have
not been initiated at the Installation.

Energy Awareness Partnership with Colorado Springs Utilities – Fort Carson and Colorado Springs
Utilities are working together to increase energy awareness at the Installation by partnering to create,
publish, and distribute energy conservation information, tips, events, reports, and brochures, and to
communicate results of these efforts. Tips and brochures are distributed through the Fort Carson email
system. Energy conservation progress is tracked with the energy reduction graph in this report (Figure 3.7).

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the
goals established during the Installation Sustainability Workshop. To do this, participants should be exposed
to the concepts and technologies that are within the realm of possibility now and in the future. This section
provides a glimpse of what can be accomplished with existing technology and what can be expected from
developing sustainability approaches.

Energy Conservation

- **Continuous Commissioning –** This is a process of improving building performance through
independent hourly metering, monitoring, analysis, and system fine-tuning to maximize

energy
conservation. This approach, which involves comparing design intent with actual building operation, has
yielded an additional 15 to 45 percent savings beyond traditional conservation measures. For additional
information, visit http://www-esl.tamu.edu/cc/.

- **Microscopic Systems** – Scientists at the Pacific Northwest National Laboratory (PNNL) and other
research laboratories are developing a family of microsized energy systems that are manufactured in a
manner similar to computer chips. Microscopic heat exchangers, evaporators, condensers, gas absorbers,
turbines, bioreactors, chemical reactors, chemical separators, pumps, and valves exhibit extraordinary
rates of heat and mass transfer. When combined into HVAC or process equipment, this translates into
very high efficiencies and minimal pollution generation. These miniature components can be combined
to create small heat pumps that can be integrated into window frames, with simple plug-in of replacement
units should the originals fail. Small biofueled fuel cells will be developed that can be located wherever
heat and electricity are needed. Miniature chemical separation units will be developed for on-site
cleanup of tanks, wells, aquifers, and other polluted systems—imagine a pen-sized device that can be
dropped into a drum of waste to eliminate PCBs.
- **Drain Water Heat Recovery** – It is estimated that up to 80 percent of water-heating bills come from
shower/bath water. An innovative technology called drain water heat recovery uses the latent heat in
drain water to preheat cold water before it is sent through a conventional water heater. Drain water is
typically 90 to 95°F when it is piped away from the shower or bath; 100 percent of that potential energy
is wasted. These systems take warm drain water and run it through tiny spiraling pipes to preheat cold
water to a higher temperature, thus reducing the total amount of energy a water heater must expend to
heat fresh water. Installing a drain water heat recovery unit can reduce overall heating bills by as much
as 40 percent. EPA estimates that, if 6 million hot water systems were outfitted with drain water heat

recovery systems, carbon dioxide emissions could be reduced by 20 million tons every year (http://gfxtechnology.com/).

- **Superconductivity** – Superconductivity, the ability of a material to conduct electricity with zero resistance and almost no loss of power, is a cutting-edge technology that may some day revolutionize the way we think about electricity (http://www.eren.doe.gov/superconductivity/). Today, almost 10 percent of all electricity generated is lost in transmission, radiated as heat from inefficient copper and aluminum wires. Superconductors will lead to the development of a number of new technologies:
  - Transmission wires will carry 100 times more current on a wire no larger than those we use now.
  - Super-efficient mass transit systems (similar to the MagLev train in Japan) will transport people at enormous speeds using a fraction of the energy required by current commuter trains.
  - Electric motors using superconductor wiring will operate at a fraction of the cost, improving industrial and residential energy efficiency while saving money.
  - Electric generators will be smaller and lighter and require less fuel to generate power.
- **Compact Fluorescent Lights (CFLs)** – A number of alternatives to traditional incandescent lights are commercially available. Compact fluorescent lights (CFLs) use between 50 and 70 percent less power than incandescent lights of the same intensity. EPA maintains a comprehensive list of CFLs at http://www.energystar.gov/products/cfls/.
- **Energy Star** – EPA maintains a database of high-efficiency appliances and office equipment. By simply investing in these readily available alternatives, businesses and homes can save hundreds of dollars in energy bills every year (http://www.energystar.gov/).
- **Desiccant Cooling Systems** – In the next few years, desiccant cooling systems could be saving offices and large commercial buildings thousands of dollars each month in electricity bills. Desiccant coolers, which are used in conjunction with traditional HVAC units, remove moisture from the outside air, cooling the air and enabling the primary unit to operate much more efficiently. For more information,

see http://www.nrel.gov/desiccantcool/tech.html.

- **Spectrally Selective Windows** – Spectrally selective and chromogenic windows represent the next generation of window technology. Spectrally selective windows have advanced coatings that filter certain wavelengths of radiation from incident sunlight, lowering overall solar heat gain significantly. Chromogenic windows are more advanced, with coatings that change their reflective properties based on ambient temperature or light conditions. Some estimates place the potential energy savings at 40 to 70 percent for electrically heated spaces.
- **Ground Source Heat Pumps** – This technology has been around for 70 years, emits no CO_2, and produces fewer emissions than all other fossil fuels. Ground source heat pumps use the constant subsurface temperature to regulate building temperatures by passing air through the ground and then into the building. This type of system costs twice as much as a conventional system, but saves 50 to 75 percent in energy costs.

- **Energy Plus** – The Department of Energy developed this free software, which incorporates all the design features of a building into a model to simulate building energy use and outputs the results as a text file. It may be downloaded from http://www.eren.doe.gov/buildings/energy_tools/energyplus.
- **Energy Supply and Management** – The City of Chicago estimates that it will save more than $260 million by 2010 through the use of renewable energy, distributed energy sources, and better energy management (http://www.ci.chi.il.us/environment/).
- **Other Resources** – The web site for the Clean Air Campaign of the Pikes Peak Region lists many other resources (http://www.clnair.org/links.html).

New Construction

- **Innovative Building Materials** – The building industry and the building products manufacturing industry have aggressive research activities that are providing a host of environmentally friendly and sustainable products. These include soy-based adhesives and foam insulators, shellfish-derived coatings, gas-filled wall panels, and ceramic insulators. For additional information, go to http://www.nahbrc.org/ and click “Green Building” on the navigation bar.

- The Home Builders Association provides a “Built Green Checklist” on its web site at http://www.builtgreen.org/. While developed for single-family housing use, the checklist is
comprehensive and easy to understand, and may be used as a starting point for administrative
buildings and barracks.
- In collaboration with the General Services Administration, EPA successfully modernized a 1.2-
million square foot office complex in Washington, D.C. For details of this complex, see http://www.edcmag.com/edc/cda/articleinformation/features/bnp__features__item/0,4120,19197,
00.html. (Note, each “gap” in the URL represents two consecutive underscore characters.)
- The Assistant Chief of Staff for Installation Management requires Army activities to evaluate all
facility construction and repair projects using the Sustainable Project Rating Tool (SPiRiT),
which is the Army’s version of the Leadership in Energy and Environmental Design (LEED)
system developed by the U.S. Green Building Council.

- **Intelligent Buildings** – The intelligent building is the future of architecture. It looks like any other
building from the outside, but employs sophisticated control systems to make building systems (heating,
cooling, ventilation, lights, windows, and appliances) more convenient and efficient. Commercial office
buildings are being designed wherein lighting, temperature, and humidity in the space occupied by each
worker are regulated according to his/her preferences, and windows automatically darken to provide
appropriate ambient lighting for the task at hand. This technology is also appropriate for homes. In Bill
Gates’ private home, occupants wear an electronic pin that keeps track of them, so the house can adjust

lighting, temperature, music, and/or television shows as they move about. Investors are pumping vast
amounts of money into intelligent building research. Intelligent buildings make good financial sense.
For example, by turning off unnecessary lights and not heating unoccupied rooms, these buildings can
reduce utility bills by 20 to 30 percent.

Energy Independence

- **Photovoltaics** – Photovoltaics (PV) have the potential to provide a significant amount of the nation's electricity supply. *The theoretical potential of PV on rooftops alone could satisfy up to one-third of world electricity demand.* However, they are expensive to manufacture, have not yet realized their efficiency potential, and require lots of space. This situation is starting to change. Overall system efficiency is improving. New products that integrate photovoltaic cells into building materials are now coming on the market. Skylights, awnings, wall panels, and roof shingles now incorporate PV, generating electricity while serving a second structural function. This integrated approach obviates the need for additional land use, reduces total system costs, and makes available thermal energy dissipated by the PV panels for space heating and/or water preheating.
  - The total average power available from solar radiation exceeds current human consumption by 1500 times (Source: World Energy Assessment: Energy and the Challenge of Sustainability; United Nations Development Programme, UN Department of Economic and Social Affairs and World Energy Council: New York, 2001).
  - Fort Huachuca, Arizona, uses conventional solar hot water heaters, photovoltaics, day lighting systems, and solar walls on hangars. Fort Carson has applied some of these technologies; with an average of 247 days of sunshine per year (http://www.coloradosprings-travel.com/), solar technology may have many more uses at the Installation. The Million Solar Roofs program is working to enhance the use of solar hot water and photovoltaic systems through partnerships with the Department of Energy, communities, and other federal agencies.
  - Japan's National Space Development Agency commissioned construction of a space solar power satellite. This technology originated in 1899 with Nikola Tesla, who tried to light homes in Colorado Springs by beaming energy from a tower. The experiment was unsuccessful, but its principles led to the current attempts to capture solar energy. The advantage of a space-based solar array is that it would work even on overcast days.
- **Biofuels** – Biofuels are alcohols, ethers, and other chemicals made from renewable resources (e.g., fastgrowing trees, grasses, and algae) and waste products (e.g., agricultural and forestry residues, and

municipal and industrial wastes). It is estimated that domestically produced biomass resources could
eventually provide at least half of the light duty vehicle (LDV) fuel requirement in the United States.
Biodiesel fuels are available today. In the not-too-distant future, biomass will be consumed in fuel cells
in vehicles and stationary equipment to produce heat and electricity very efficiently, with virtually no

pollution and no net increase in carbon emissions. Eventually, high-efficiency biomass power plants will
allow any facility to generate its electricity on site.

- The use of methane power will be increased in Georgia and other states. Several Electrical
Membership Corporations in Georgia plan to generate power using methane from four landfills in
the state. Nebraska has a 3.2-megawatt landfill methane power plant.
- Agriculture and wood waste, called biomass when used for electricity generation, is used by the
Community Power Corporation of Colorado to generate electricity for single dwellings. For more
information, go to http://www.gocpc.com/.

- **Hydrogen** – Hydrogen is not a viable direct energy source since very little free hydrogen is available.
Instead, many view hydrogen as the ultimate energy storage and transmission medium. In this context,
hydrogen will be extracted from hydrocarbons, biofuels, and water and shipped/piped to another location
where it will be burned or consumed in a fuel cell, producing only energy and water vapor. Iceland,
which has rich geothermal and hydrologic resources that can be employed to extract hydrogen from
seawater, has the goal to become the first hydrogen economy. Iceland New Energy, a consortium that
includes Daimler Chrysler AG, Norsk Hydro AS of Norway, Royal Dutch Shell Group, and a Reykjavikbased
venture capital fund, has launched projects aimed at promoting the hydrogen economy in Iceland.
Three buses powered by hydrogen fuel cells will be introduced into Reykjavik's city transport fleet by
the end of 2002. A second project will begin replacing conventional chemical batteries

with fuel cells in
stationary power structures that are not currently on the regular electric grid.

- **Alternative Fuel Vehicles (AFVs) –** Alternative fuel vehicles (AFVs) are available on a limited basis
now, but it will be a few more years before they begin to capture an appreciable market share in the
public and private sectors. Honda is working on a zero-emission vehicle that uses fuel cells for power.
The state of California will give up to $9,000 in rebates to people who buy super-low-emission vehicles
(SuLEVs). Because lower costs per mile are associated with fueling large fleets, buses and other fleet
vehicles are prime candidates for alternative fuels such as compressed natural gas (http://www.afdc.doe.gov/afvehicles.html).
- **Wind Power** – Through the 1990s, wind was the fastest growing source of electricity generation in the
world. However, the majority of this growth occurred in Europe, where conventional energy costs are
higher than those in the United States. With large, untapped, wind energy resources throughout the
country and declining wind energy costs, the United States is now moving forward with an aggressive
initiative to accelerate the progress of wind technology and further reduce its costs, to create new jobs,
and to improve environmental quality. Wind Powering America, an initiative led by the Department of
Energy to increase the use of wind power, will expedite the movement of wind technology into the
mainstream of the U.S. electricity supply sector. For more information on how to establish a wind farm
at your installation, go to http://www.nrel.gov/wind.
  - Wind technology is available from Colorado Springs Utilities. Developments in wind technology
include larger, more controllable and grid-compatible turbines; hybrid systems; and stand-alone
systems for small, localized uses.
  - Colorado Springs Utilities offers power generated from wind and hydropower; currently, these
alternatives cost more than power from coal.

Fort Carson 25-Year Goals for Energy

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory
communities, at the Installation Sustainability Workshop on 4-6 September 2002.