



# Colorado Capitol Complex Phase I and II

Denver, Colorado  
Energy Performance Contract



**Project Size:** 19 buildings, 1,784,261 sq ft  
**Project Value:** \$13,564,460  
**Source of Funds:** CitiCapital  
**Contract Terms:** 19-years

**Project Schedule:**

Project Phase	Project Dates	
	Started	Completed
Comprehensive Energy Analysis	January 2003	August 2003
Phase I - Design/Implementation	January 2004	May 2005
Phase II – Design/Implementation	January 2005	December 2006
Monitoring	January 2007	January 2026

**Guaranteed Annual Energy Savings:** \$608,733

**Annual Non-Energy Savings:** \$316,252

**Achieved Summarized Savings:** N/A

**List of Improvements:**

- Many modifications to the chilled water system:
  - Eliminate unnecessary bridle loops
  - Eliminate unnecessary bypasses
  - Eliminate tertiary pumps
  - Correct piping design errors
  - Install variable-speed drives on secondary pumps
  - Convert 3-way valves to 2-way operation
  - Modify chiller sequencing
  - Correct neutral bridge installation
  - Relocate static pressure sensor
  - Rebalance primary pumps
- Install water side economizers
- Install new energy-efficient chillers
- Replace cooling tower
- Install new central boiler plant to eliminate purchase of costly utility steam

(see other side for more)

Baselines	kWh	kW	CCF	Water (gal)	Steam (lbs)	Energy \$	Non-Energy \$	Total Dollars*
	33,250,509	7,044	123,127	32,604,000	38,492			\$2,589,970
ANNUAL SAVINGS								
Year	kWh	kW	CCF	Water (gal)	Steam (lbs)	Energy \$	Non-Energy \$	Total Dollars*
Construction	9,432,206	15,789	-115,153		38,903	\$1,555,372		\$1,555,372
1	787,147	15,038	-26,808	1,387,000	3,042	\$128,005	\$79,063	\$207,068

\* Energy Savings + Non-Energy Savings = Total Annual Dollars Saved

\* Although Non-Energy Savings occurred during construction, they were not calculated for the construction period

**Measurement and Verification:** IPMVP, 1997, Option A (short-term/periodic measurement after retrofit compared to base conditions). IPMVP, 1997, Option C (entire facility-level comparison before and after retrofit, typically with utility bills).

**Comments:** The project started in May of 2002 with a goal of identifying potential energy conservation measures, with an assumed project value of approximately \$4,000,000. The audit phase identified 35 energy conservation measures (ECMs). Thirteen of those met the maintenance and financial goals of DPA/Central Services. The audit was conducted in 19 state buildings located in Denver and Grand Junction with a total area of 1,784,261 square feet.

The energy conservation being implemented include lighting improvements in 18 buildings, water conservation improvements in 13 buildings, upgrade / expansion to DDC controls in 14 buildings, chilled water system improvements at ten downtown buildings and at 690 Kipling, optimization of chiller controls at the Governors Residence, installation of water side economizers at Colorado History

**Reference:**

Lance Shepherd, Architect  
Colorado Capitol Complex  
1313 Sherman Street, Suite 319  
Denver, CO 80203  
Tel 303 866 3450  
Fax 303 894 7478  
lance.shepherd@state.co.us  
or  
Rod Vanderwall, State Buildings  
Tel 303 866 6110  
Fax 303 894 7478  
rod.vanderwall@state.co.us





## Colorado Capitol Complex, continued

Museum and 690 Kipling, replacement of chillers, pumps and towers at 1881 Pierce Street, replacement of district steam with gas-fired boiler plant for the ten downtown buildings, adding insulation to the North Campus West Building, deleting unused water meters at 1881 Pierce Street, implementing oversight of an Energy Resource Conservation Manager in 19 buildings, and direct purchase natural gas for 8 buildings.

Many of these projects had been identified and listed as Control Maintenance Projects but have not been funded for many years due to higher priority projects and shortfalls in state revenue.

Shortly after implementation of Phase I began, the steam utility company expressed a desire to build, own and operate the plant. The State, with assistance of CES, negotiated a deal with the utility where the utility would pay for the cost of building and operating the boiler plant. As a part of this arrangement, the State is receiving energy cost reductions as if they had built their own plant. The benefits to the State for this arrangement are huge; the State's energy costs are the same as if they owned their own boiler plant, yet the utility in fact owns and operates the plant; over \$1.5 million of project funds were freed up for the State to spend on other capital needs.



Further energy savings opportunities were uncovered during the initial implementation of Phase I. These measures, coupled with savings from the steam utility deal, enabled implementation of the following scope: Water side economizers were installed in four additional buildings; variable-speed drives were installed on pumps in two buildings; uninsulated heat exchangers were insulated in one building; domestic hot water/steam system improvements were implemented in six buildings; EMS controls were expanded / upgraded in six buildings; variable frequency drives were installed on air handlers in three buildings; a city water cooled compressor in the Capitol building was placed on the chilled water system; a city water pumping system in the Annex was replaced, automatic lighting controls were upgraded in the Centennial Building; new boiler plants were installed in the Labor Building and Museum; constant volume reheat air handlers in the Museum were converted to variable volume; faulty condenser water pumps in the Museum were repaired; new rooftop units and an entire new chilled water system was installed at the Kipling street complex; a new chiller, backup chilled water pump, cooling tower and water side economizer were installed in the power plant; existing chillers were repaired in two buildings; the pneumatic air compressor system in the power plant was upgraded; a new pump room ventilation system was installed in the power plant; and water meters to avoid sewer charges, double-pane windows, and an 80-kW microturbine were installed at the Labor Building.

**For more information, contact:** Steve Spurgeon, 800 475 3500 x3609  
[www.chevronenergy.com](http://www.chevronenergy.com)

### List of Improvements, cont'd.:

- Replace steam traps
- Upgrade and expand energy management system
- Unoccupied hours setback temperature
- Eliminate unnecessary equipment operation
- Outside air temperature lockouts
- Add baseboard heat control
- Chilled water reset
- Condenser water reset
- Hot water reset
- Improve air side economizer control
- Reset air handler discharge temperatures
- Comprehensive lighting retrofit
- Convert all fluorescent fixtures to T8 lamps and electronic ballasts
- Replace incandescent fixtures with fluorescent fixtures
- Replace exit fixtures with LED exit fixtures
- Install reflectors to reduce lamp quantities
- Lamp and ballast disposal
- Replace mercury vapor fixtures with metal halide fixtures
- Replace toilets with low-flow toilets
- Insulation and air sealing
- Energy training program
- Insulate heat exchangers
- Repair condenser pumps
- Modify domestic hot water systems to permit shutting of steam during the summer
- Install variable frequency drives on pumps and air handlers
- Place city-water cooled equipment on chilled water loop
- Replace domestic water pumping station
- Automatic lighting controls
- Convert instant volume reheat air handlers to variable volume
- Replace old DX rooftop units with new chilled water units
- Retro commissioning
- Replace chillers in three separate plants
- Upgrade pneumatic air compressor system
- Improve pump room ventilation
- Repair existing chillers
- Install water meters to avoid sewer charges
- Replace steam boiler with hot water boilers
- Replace windows
- Install microturbine