

The Colorado College  
Facilities Services

PRELIMINARY Report: Carbon Dioxide from Campus-related Sources and CCX

Introduction

Chicago Climate Exchange (CCX) allows organizations to create internal incentives to reduce greenhouse gas emissions by trading emission credits on an exchange. The exchange operates by taking a base year (average of 1998-2001 emissions), cutting that emission level by 4% (target for 2006), and then trading allowances and offsets to balance the carbon dioxide ledger. Currently, credits trade for \$1.32 per metric ton of carbon dioxide equivalent (CO<sub>2</sub>e); futures currently trade for \$1.50 per metric ton. The operating principle is that organizations must buy any CO<sub>2</sub>e emissions capacity in excess of 96% of the base year. CCX uses the World Resources Institute (WRI) Greenhouse Gas Protocol method to account for carbon emissions.

Colorado College operations require three major sources of energy that produce carbon dioxide emissions – electricity, natural gas, and liquid fuel. Other, smaller sources of greenhouse gasses exist – nitrogen oxides at the central heating plant and specialty gas use in the sciences, for instance. Based on general analysis, Colorado College has increased carbon dioxide emissions 9.22% over the base year, from 23,395 metric tons to 25,551 tons, a difference of 2,157 tons. Factoring in the target emission cut of 4% over base year, Colorado College exceeds target CO<sub>2</sub> emissions by 13.77% or 3,092 tons.

Summary

**CO<sub>2</sub> Emissions, Base Year (average of 1998-2000, see disclosure 8):**

	Consumption	Carbon Dioxide emitted (metric tons)
Electric (KWh)	15,618,610	15,728
Gas (MCF)	146,364	6,969
Liquid Fuel (gal)	54,200	511
Allowance		250
Subtotal		23,458
Green Power		(63)
Net		23,395

**CO<sub>2</sub> Emissions, Comparison Year (2004):**

	Consumption	Carbon Dioxide emitted (metric tons)
Electric (KWh)	17,127,594	17,248
Gas (MCF)	164,574	7,835
Liquid fuel (gal)	40,300	468
Allowance		250
Subtotal		25,801
Green Power		(250)
Net		25,551

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Disclosures

Under the WRI GHG Protocol, organizations must declare which method they use to account for greenhouse gas emissions, and must make any applicable disclosures for transparency.

- 1) Except as noted, this preliminary report includes on-site emissions of carbon dioxide from combustion, and off-site emissions from production of purchased utilities and combustion of liquid fuel supporting transportation.
- 2) This is a preliminary report. It applies the accounting principles of transparency and materiality.
- 3) This report **does not** adjust baseline for acquisition or disposal of facilities; CCX allows this kind of baseline adjustment.
- 4) This report presumes that there is no credit for carbon sequestration – trees and grass at Colorado College do not factor into greenhouse gas emissions.
- 5) Food and its effects (exhalation of carbon dioxide from cellular respiration by campus students, staff, faculty and visitors) are not factors in this report.
- 6) All greenhouse gas units in this report are metric tons of carbon dioxide equivalent.
- 7) This analysis includes an allowance of 250 tons of CO<sub>2</sub>e to cover emissions from utilities purchased to support the Gilmore-Stabler Cabin and the Baca Campus, fleet diesel purchased on Procurement Cards by CC Transportation drivers during field trips, and non-carbon dioxide greenhouse gasses (nitrogen oxides, unburned fuel, e.g.) from college-related combustion, primarily heating and transportation
- 8) This report sets a baseline year using data from calendar years 1998-2000. Fuel purchases from 2001 included an operating decision to switch to liquid fuel for 45 days in the winter, purchasing records for which are not immediately available. Future evaluations of the business case to enter CCX will require infilling this data and resetting baseline to average of 1998-2001.
- 9) This analysis includes renewable energy sources (wind power credits, hydroelectric power) and presumes that power purchased from the electrical grid (i.e. not produced at Colorado Springs Utilities plants) derives completely from coal combustion.
- 10) Master utility meters account for the majority of utility consumption. Two representative months in the baseline window (February and August, 1999) indicate that 92-95% of electric use comes from the master electric meter. These same months indicate that 85-87% of campus gas use comes from the master gas meter. The same representative months in 2004 corroborated these findings. This report presumes that house meters (any meter that is not the master meter) represent 6.5% and 14% of electric and gas use, respectively.
- 11) Replacement of the master electric meter in June of 1998 reduced verifiable energy purchase.
- 12) This analysis accounts for one year of Tutt Science Center wind credits in 2004.
- 13) CCX pro forma requires an increasing CO<sub>2</sub> emissions reduction by year. 2003 target emissions are 1% below base year, 2004 target reduction is 2%, 2005 target reduction is 4%, and 2006 target reduction is 4%. This report considers the 4% target as the comparison.

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Electricity

Colorado College buys most of its electricity from Colorado Springs Utilities (CSU), which generates power by burning coal or oil at any of three local energy plants and at three hydroelectric plants. CSU also buys power from the Western grid.

According to Colorado Springs Utilities, 82% of power demand in Colorado Springs comes from local plants. Local plants have 633 megawatts of generation capacity, 33 megawatts of that coming from hydroelectric sources. Based on these numbers, 95.7% of the power consumed by Colorado Springs Utilities customers derives from coal (see Disclosure 9).

Colorado College also buys 50 “green-power” blocks per month – equivalent to a monthly 5,000 kilowatt-hour (KWh) wind power offset, at a \$0.03 per kilowatt-hour premium (approximate). This wind power offset has been in place since 1998. Colorado College purchased 355,554 KWh worth of wind power credits for Tutt Science Center, based on one half of predicted electrical consumption for two years (see disclosure 12). The Tutt Science Center wind power comes at a \$0.019 per KWh premium.

Colorado College electric use occurs principally at buildings served by the campus master electric meter. All major campus buildings receive electricity from this meter, and it accounts for 92-95% of the campus electric use (see Disclosure 10). The balance of electrical consumption comes from meters associated with individual properties, or “house meters.”

Annual average electric consumption at the master meter for the baseline window (see disclosure 8) was 14,603,400 KWh, of which 60,000 KWh come from wind power. Calculated annual average electric consumption at house meters (see disclosure 10) for the baseline window was 1,015,210 KWh, of which none was wind power. Total annual average electric consumption for the baseline window is 15,618,610 KWh.

The United States Department of Energy provides an energy balance method for determining heat required for sub-bituminous coal-fired steam turbine generation. This method presumes 33% efficiency and indicates 2.21 pounds of CO<sub>2</sub> per KWh of power generation. CC student Emily Wright, in her 2002 study of the campus ecological footprint, assigns 31.4% as the heat efficiency of Colorado Springs Utilities coal plants. Using the Department of Energy method and Ms. Wright’s efficiency value, each KWh of electricity creates 2.32 pounds of carbon dioxide.

Colorado Springs Utilities has not responded to inquiries about CO<sub>2</sub> emissions resulting from generation or consumption, the latter value incorporating lost and unaccounted use. This report presumes that the 31.4% efficiency value is more valid than an arbitrary 33% efficiency, and therefore applies that figure to CO<sub>2</sub> emissions calculations from Colorado College electrical consumption derived from coal.

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**Electrical Consumption and Associated CO2 Emissions:  
Base Year (average of 1998-2000, see disclosure 8)**

	Consumption (KWh)	Carbon Dioxide emitted (metric tons)
Master Electric	14,603,400	14,706
House Electric	1,015,210	1,022
Subtotal	15,618,610	15,728
Green Power	60,000*	(63)
Net		15,625

\* Green Power credits since 1998, \$0.03/KWh premium

**Electrical Consumption and Associated CO2 Emissions:  
Comparison Year (2004)**

	Consumption (KWh)	Carbon Dioxide emitted (metric tons)
Master Electric	16,010,400	16,123
House Electric	1,117,194	1,125
Subtotal	17,127,594	17,248
Green Power	237,777**	(250)
Net		16,998

\*\* Green Power credits since 1998 plus 1 year of Tutt Science Center wind power allocation (see disclosure 12), \$0.019/KWh premium

By this analysis, base year electricity consumption accounted for 66.96% of total CO2 emissions (see disclosures 3, 4, 5, 7, 8, 9 and 10). Comparison year electricity consumption accounted for 66.52% of total CO2 emissions. Comparison year CO2 emissions exceed base year emissions by 1,333 tons, or 8.51%. Comparison year CO2 emissions exceed base year target (4% reduction, see disclosure 13) by 13.77%.

Natural Gas

Colorado College uses natural gas as a heat source for the campus high temperature hot water distribution system, which provides domestic hot water and building heat to the majority of campus facilities. Colorado College buys natural gas from Colorado Springs Utilities. Historically, gas consumption at the master meter accounts for 85-87% of total campus use (see disclosure 10). The balance of gas consumption occurs at house meters.

Annual average consumption of natural gas at the master meter during the baseline window was 125,873 million cubic feet (MCF). Calculated annual average natural gas consumption at house meters was 20,491 MCF. The annual average of natural gas consumption during the baseline window was 146,364 MCF.

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The United States Department of Energy provides direct conversion methods for natural gas based on volume and heat content. At elevation, gas line pressure is lower than at sea level, so heat content per unit volume is lower. This analysis uses the heat content calculation method to determine CO<sub>2</sub> emissions from natural gas. Colorado Springs Utilities indicated that the average heat content of natural gas at 6,000 feet is 827 British Thermal Units (BTU) per cubic foot (CF). The Department of Energy conversion factor for CO<sub>2</sub> emissions based on heat content is 117.080 pounds of CO<sub>2</sub> per million BTU. This conversion method indicates 105.02 pounds of CO<sub>2</sub> per MCF of gas at altitude, or 0.04761 metric tons of CO<sub>2</sub> per MCF.

**Natural Gas Consumption and Associated CO<sub>2</sub> Emissions:  
Base Year (average of 1998-2000, see disclosure 8)**

	Consumption (MCF)	Carbon Dioxide emitted (metric tons)
Master Gas	125,873	5,993
House Gas	20,491	976
Total	146,364	6,969

**Natural Gas Consumption and Associated CO<sub>2</sub> Emissions:  
Comparison Year (2004)**

	Consumption (MCF)	Carbon Dioxide emitted (metric tons)
Master Gas	141,543	6,738
House Gas	23,040	1,097
Total	164,574	7,835

By this analysis, base year natural gas consumption accounted for 29.79% of total CO<sub>2</sub> emissions (see disclosures 3, 4, 5, 7, 8, 9 and 10). Comparison year natural gas consumption accounted for 30.67% of total CO<sub>2</sub> emissions. Comparison year CO<sub>2</sub> emissions exceed base year emissions by 867 tons, or 12.44%. Comparison year CO<sub>2</sub> emissions exceed base year target (4% reduction, see disclosure 13) by 12.96%.

Liquid Fuel

Colorado College purchases liquid fuel for combustion in transportation fleet vehicles and as redundant fuel for the campus high temperature hot water system. Liquid fuel purchase records for the baseline window do not exist; this report uses the 2001 data for gasoline and diesel from the CC Ecological Footprint. Liquid fuel consumption data for the comparison year comes directly from fiscal year 2003-04 fuel purchase records, and assume a steady state. These records do not include purchase of diesel fuel by CC Transportation drivers while supporting field trips, because drivers use procurement cards. See disclosure 7.

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The CC Ecological Footprint reports that liquid fuel purchases were 30,500 gallons of gasoline and 23,700 gallons of diesel fuel. Liquid fuel purchases during FY 2003-04 amounted to 33,300 gallons of gasoline and 17,000 gallons of diesel fuel.

The United States Department of Energy provides direct conversion methods for gasoline and diesel fuel based on volume. These ratios are 0.00887 tons of CO<sub>2</sub> per gallon of gasoline and 0.01015 tons of CO<sub>2</sub> per gallon of diesel fuel.

**Liquid Fuel Consumption and Associated CO<sub>2</sub> Emissions:  
Base Year (average of 1998-2000, see disclosure 8)**

	Consumption (Gal)	Carbon Dioxide emitted (metric tons)
Gasoline	30,500	271
Diesel	23,700	240
Total	54,200	511

**Liquid Fuel Consumption and Associated CO<sub>2</sub> Emissions:  
Comparison Year (2004)**

	Consumption (Gal)	Carbon Dioxide emitted (metric tons)
Gasoline	33,300	295
Diesel	17,000	173
Total	40,300	468

By this analysis, base year liquid fuel consumption accounted for 2.18% of total CO<sub>2</sub> emissions (see disclosures 3, 4, 5, 7, 8, 9 and 10). Comparison year natural gas consumption accounted for 1.83% of total CO<sub>2</sub> emissions. Base year CO<sub>2</sub> emissions exceed comparison year emissions by 43 tons, or 8.41%. Base year target CO<sub>2</sub> emissions (4% reduction, see disclosure 13) exceed comparison year by 8.77%.

Allowance

This study includes an allowance for other CO<sub>2</sub> sources, including purchased utilities for the Baca and Gilmore-Stabler properties, diesel fuel purchased by fleet drivers on Procurement Cards. Minor contributions to greenhouse gas emissions include nitrogen oxides, both from the central plant and all other combustion sources, and use of specialty gasses in the sciences. The size of the allowance (250 metric tons) is completely arbitrary.

Chicago Climate Exchange (CCX)

The Chicago Climate Exchange is a legally binding and voluntary emissions trading network that seeks to internalize the greenhouse gas externality. A similar exchange operates in Europe, where nations trade carbon dioxide emission credits in support of compliance with the Kyoto

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Treaty. CCX requires participants to determine baseline emissions, set reduction goals, then meet those goals or purchase credits to make up the difference.

CCX credits have a nominal price of \$1.50 per metric ton of CO<sub>2</sub>, and the annual fee to participate in the exchange is \$1,000. The exchange expects an emission reduction of 4% under baseline. Using this analysis (see disclosures), Colorado College is currently “short” in carbon emissions capacity, meaning that Colorado College would have to reduce greenhouse gas emissions by approximately 14% or purchase carbon financial instruments (CFI) to offset any use in excess of the base year. Under this analysis, balancing the carbon account without conserving energy requires purchase of 2,939 CFI. At nominal prices of \$1.50 per CFI, this is an investment of \$4,408.50. At the May 2, 2005 CFI trading price of \$1.14, the carbon account balance costs \$3,350.46.

Considering the participation fee, the total direct cost of participating in CCX in the near term seems to hover between \$4,500 and \$6,000. However, the trading price for CFI on the European exchange – where emissions have been capped by government fiat – is €16.50, or \$21.22. In the event that Colorado College participates in the CCX and legislation caps carbon emissions, the exchange market will do its job and raise prices. At \$20 per CFI, Colorado College would have to pay almost \$60,000 to balance the carbon account with emission credits.

Currently, Colorado College can balance the carbon account with emission credits at substantially less expense. If and when the market begins to allocate resources to highest use, and should prices rise above \$10/ton, there will exist incentives to reduce emissions through alternative power sources or actual conservation. These incentives do not yet exist.

#### Reducing Colorado College Carbon Dioxide Emissions

Electricity is the most significant source of Colorado College carbon dioxide emissions. Colorado College can purchase wind power credits for a premium of approximately \$0.01 per KWh. This option allows Colorado College to reduce its carbon dioxide emissions while continuing to expand energy use. Purchasing \$10,000 worth of wind power credits – 1,000,000 KWh – reduces carbon dioxide emissions by 1,052 pounds. Wind credits cost \$9.50 per ton of CO<sub>2</sub> emission avoided, over 6 times the cost to buy credits on the exchange.

Production efficiency is not within Colorado College’s sphere of influence, but would result in substantial impact. If CSU were able to implement 33% production efficiency instead of 31.4%, for instance, carbon dioxide emissions resulting from campus electrical consumption would drop by 860 tons. It is reasonable to assume that Colorado Springs Utilities would pass costs associated with increasing plant efficiency on to customers.

Should Colorado Springs Utilities choose to participate in the exchange, it may seek credit for improvements to its system. This raises a structural question about where the market should aggregate carbon dioxide emissions and reductions – at the point of generation or at the point of consumption. The WRI greenhouse gas protocol allows either. If CSU participates in the

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exchange on behalf of all its customers, Colorado College would no longer claim either the emissions or the savings from electricity consumption. This would adjust the baseline and emissions targets substantially, and make natural gas the primary campus concern.

Natural gas consumption is seasonal, and depends largely on temperature, square footage served, and intensity of use. Long, cold winters require more heating than short, warm winters. Providing heating and hot water to a kitchen or residential facility requires more energy than heating and supporting a library, for instance. Normalizing factors for natural gas consumption are not part of this analysis, and should be part of any efficiency discussion. Increase central plant efficiency by 5% after normalization could result in cutting 337 metric tons of carbon dioxide.

Liquid fuel purchase contributes a modest amount to carbon dioxide emissions. Because the data available for study does not include diesel purchased on the road by CC Transportation drivers, this portion of Colorado College's CO2 emissions is incomplete. Liquid fuel purchases do not currently differentiate between transportation-related diesel and diesel used for heating at the central plant. There are no national standards on fleet efficiency for combined fleets of passenger cars, light or combined trucks, 15-passenger vans, and diesel-powered vehicles. This study cannot determine whether Colorado College can achieve increased fleet fuel efficiency. Even so, a 5% increased overall liquid fuel efficiency (including diesel burned for heat at the Central Plant) would avoid 24 tons of CO2 emissions.

With the exception of wind power purchase, this report does not provide cost estimates for any of these emission control efforts.

	CO2 emissions savings	Percentage of current excess	Cost (\$/ton CO2)
+1M KWh wind power purchase	1,052	35.79%	9.50
+2.6% Electric production efficiency	860	29.26%	Unknown
+5% Central Plant efficiency	337	11.47%	Unknown
+5% fleet efficiency	24	0.82%	Unknown
Total	2,273	77.34%	

These changes, though significant, are not sufficient to meet the CCX goal. Electric consumption on the campus shows a clear increasing trend. Purchase of wind power is an expense to reduce CO2 emissions, not an investment in reduced emissions. Moreover, if CSU participates in the exchange, and seeks to aggregate carbon dioxide emissions at the point of generation on behalf of its customers, wind power purchase does nothing to help Colorado College's carbon balance. On the other hand, taking advantage of the ability of CCX to broker a bilateral trade, say with a farmer in Easter Colorado who cannot yet afford to make his practices less carbon intensive, Colorado College could create a carbon balancing partnership.

Investing in energy conservation allows Colorado College to see the benefit of the investment continue to accumulate long after it recoups the initial cost. Conservation investment requires careful study – making lighting more efficient may not be the most effective conservation, but it

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is easy to quantify, easy to price, and easy to implement. Increasing energy efficiency of network equipment, on the other hand, is more difficult to quantify and more difficult to implement, even though it might result in more carbon dioxide emissions reduction.

At the price range for CFI, exercising the CCX option is more symbolic than substantial. Conservation is more substantial than symbolic.

Recommendations for refinement and future study

- Understand 2001 liquid fuel use; create a full four-year baseline.
- Study campus square footage dynamic from 1998-present; create a space-adjusted baseline
- Illuminate campus building electric consumption, by studying electrical sub-meters
- Identify electric consumption dynamics of major building systems (lighting, ventilation, heating/cooling, IT equipment, etc).
- Quantify diesel purchases by drivers on field trips

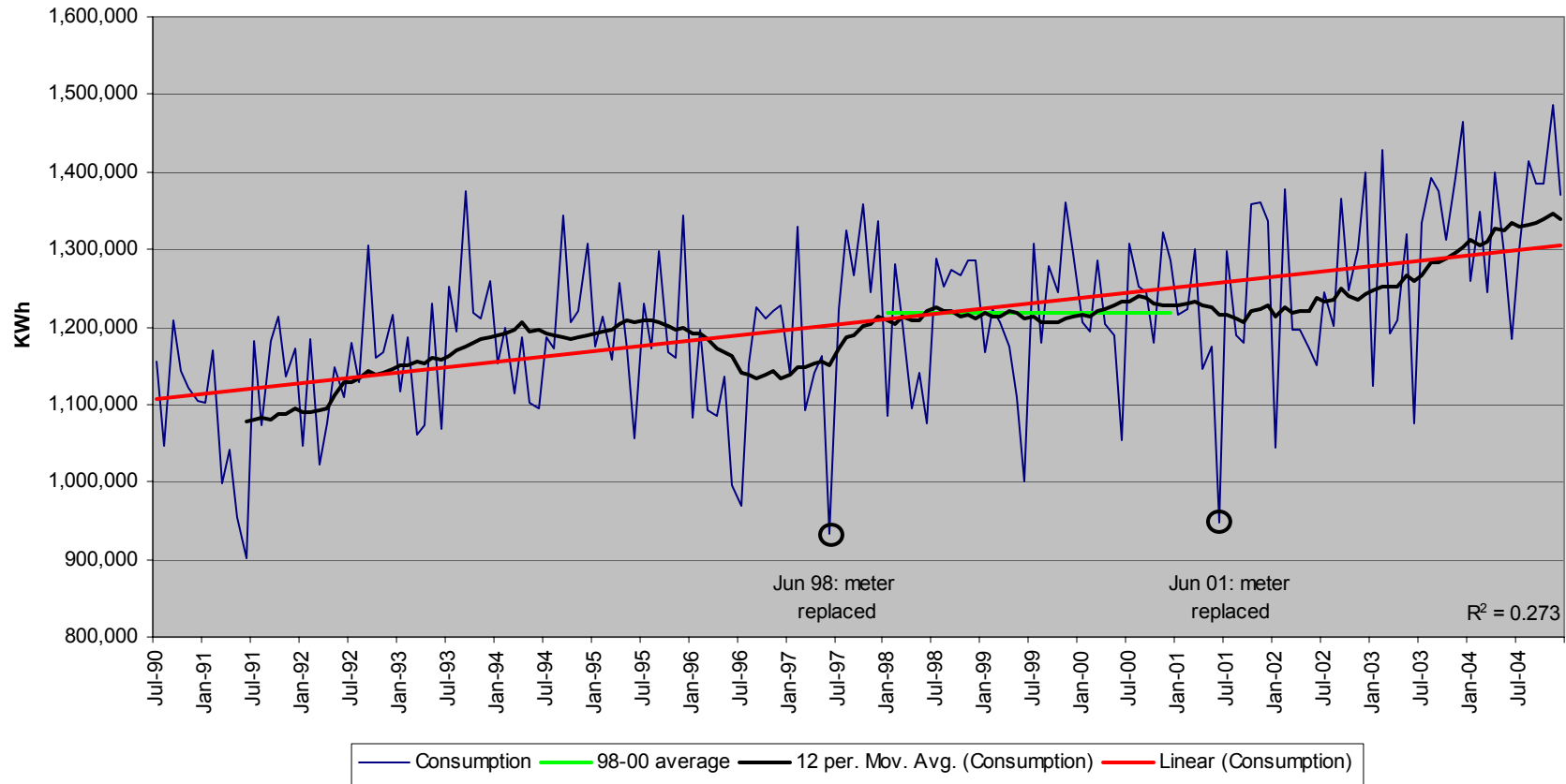
Attachments

- Master Electric Monthly Consumption
- Master Gas Monthly Consumption
- Carbon Dioxide from Master Meters, Monthly

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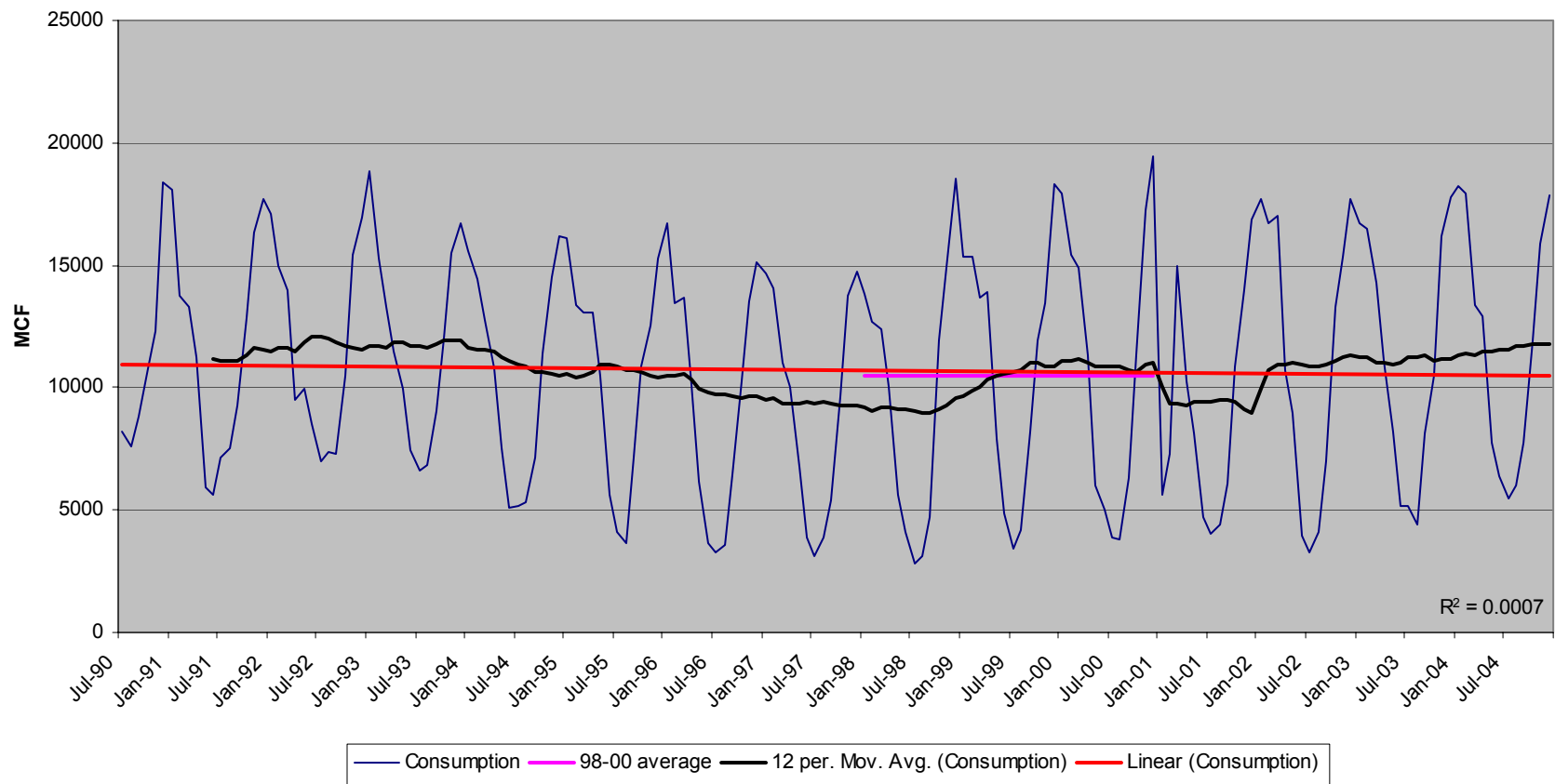
Master Electric, Monthly Consumption



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Master Gas, Monthly Consumption



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Monthly CO2 Emissions

