

Chasing the Whale: USU's Quest for Carbon Neutrality

*Ryan M Yonk Ph.D
Department of Political Science
Southern Utah University*

*Kayla Dawn Harris
Department of Economics and Finance
Utah State University*

*R. Christopher Martin
Department of Economics and Finance
Utah State University*

Abstract: Utah State University has committed itself to achieving carbon neutrality by 2050 using a combination of conservation efforts and purchased carbon offsets. We evaluate the efforts taken on USU's campus to reduce energy consumption since 1998. We find that, despite the pledge, energy consumption per square foot has remained relatively constant over the past 15 years. Given the present realities of USU's growth and budget limitations, it seems that USU will be unable to reach its goal of on-campus carbon neutrality without purchasing costly carbon offsets.

"I don't really consider this a political issue, I consider it to be a moral issue. "

– Al Gore

Comments like these from former Vice President Al Gore typify the current debate over climate change. Indeed climate change is one of the most contentious areas of political debate, and one where few compromises are likely. Indeed because the issue has been framed as a question of morality what actions to take and how to take them have become near religious in their pitch and timbre. In particular there

has been vocal political pressure to reduce Greenhouse Gas (GHG) emissions, although there is little agreement about the best way to do so.

In particular public and private universities in the United States have faced increasingly vocal pressure to craft emission-reduction policies, to move to carbon neutrality and to do so with deliberate speed. In what follows we trace how those policies were implemented at Utah State University and analyze the effects of these policies and goals.

Our analysis relies on the now well demonstrated disconnect between politics and policy, between rhetoric and results. For instance the distorted incentives politicians face while in office. Politicians are pushed to “undertake socially desirable long-term projects” in order to satisfy their constituency and win votes (Gersbach, 2004, 157). However, politicians are not in office for the long run and have no incentive to do more than “opt for inefficient short-term projects or stick to the status quo.” (157).

A similar situation occurs in higher education. Current university leadership is under pressure to promote sustainability from future and current students, faculty, interest groups and donors. University leadership can set goals for sustainable projects with time horizons well beyond their tenure, and little is required on their part to complete these projects. The sum of our analysis suggests that Utah State University’s ambitious goals regarding carbon emissions are one such case of politically expedient statements translating into meaningless or detrimental policy.

59 **Understanding Energy Consumption and Carbon Production**

60 The term carbon footprint was born out of the phrase ecological footprint, an
 61 analytical and educational measurement of how energy and resources flow from
 62 areas in which they are supplied to where they are demanded and what constraints
 63 these place on nature (Wachernagal, 1962, 3; East, 2008, 2). In recent years the
 64 term carbon footprint has become the catchall phrase for politicians, producers,
 65 consumers and even investment companies (Hertwich 2009, 1). Unfortunately this
 66 usage has pushed the term into the public arena, allowing it to be exploited for
 67 public relations and financial purposes (Murray, 2009, 238). Additionally, the
 68 scientific community, up to this point, has not found a general definition or means of
 69 measurement, for a carbon footprint (Murray, 2009, 238; Wiedmann, 2007, 4).

70 When it comes to using a more generalized term for carbon footprint, there
 71 are two paths these definitions take. The first focuses on reducing green house gas
 72 emissions and marketing consumer goods that produce fewer emissions. The
 73 second is a “rigorous measurement of greenhouse gases for the purpose of
 74 calculating and reducing a company’s [or a country’s or university’s] greenhouse
 75 gases.” (Hertwich, 2009, 2). Wiedmann and Minx (2007) advocate the most general
 76 system that can be used to compare different carbon emission levels. They look at
 77 carbon as it is produced through all the levels of production of a good (4). Their
 78 approach includes bottom-up, or tracing carbon from the ‘cradle to the grave’ (4).
 79 The top-down method analyzes carbon’s life cycle while focusing mostly on the first

order impacts (5). Of course, there is a hybrid approach, which mixes these two methods in an attempt to reach the best of both.

Because no general scientific measurement or definition has been agreed upon, countries, companies and universities have had to develop their own methods for measurement, making it impossible to compare different institutions. These institutions are then forced to rely on emissions scopes, or as seen with universities, various programs are created without a standard by which we can compare different campuses (East, 2008, 7). Since there is no standard by which carbon emissions programs can be compared we decided to model on campus electricity consumption. Of all campus operations energy consumption has the most significant impact on the environment (Simpson, 2003, 151). When it comes to modeling energy consumption there is a general consensus on factors that need to be considered.

There is wide agreement in the literature that climate is a large determinant of energy use (Geoffrey, 2007, 1786; Sailor, 1997, 992; Lam, 1998, 1). Geoffrey, Tso and Yau recommend controlling for temperature and wind velocity data (1768). Sailor and Munoz use “historical analysis of energy and climate data” to establish temperature at the determinate of energy consumption rates (992). They also find that wind speed is important in all states except Washington (997). As a proxy for climate they use heating and cooling days to indicate weather. Lam (1998) found that cooling-degree days significantly affect electricity usage in Hong Kong.

101 In an overview of the programs used by universities to measure
 102 sustainability measurements, including energy consumption, most institutions
 103 neglect to assess why their programs began and how they are being maintained.
 104 (Shriberg, 2002, 266). Currently several programs exist that measure carbon
 105 emissions, or a carbon footprint. These programs include: the National Wildlife
 106 Federation's State of the Campus Environment, Higher Education 21's Sustainability
 107 Indicators, the Clean Air Cool Planet Campus Carbon Calculator and a dozen others
 108 (261). The ACUPCC uses the Cool Planet Campus Carbon Calculator as their means
 109 to computing a carbon footprint.

110 The CPCCC consists of an Excel Inventory Calculator that measures "on-
 111 campus energy production, purchased electricity, transportation, waste, agriculture
 112 and refrigerants." (Step 1). The Excel file includes over 100 tabs and 50 different
 113 macros and requires a significant time investment to complete (Ben Berrett,
 114 personal communication, October 28, 2010). While this program offers a few
 115 outlines as to what cost and what speed it should be expected for these steps, no
 116 definitive advice is given about how best to achieve goals in these areas.

117 **Higher Education and environmental activism**

118 The launch of the first Earth Day in 1971 marked a significant shift in the
 119 perception of sustainable practices on university campuses. Congress embraced this
 120 movement in 2008 with the authorization of a 'University Sustainability Program',
 121 competitive grants offered to universities to "develop, implement and evaluate
 122 sustainability curricula, practices and academic programs." (Elder, 2008, 4).

123 Additionally, the Energy Independence and Security Act of 2007 provided one-time
124 funding for renewable energy projects at all levels of education (4). Currently, there
125 are over one dozen higher education associations working towards significant
126 advances in sustainable practices on campus (4).

127 The organized movement for Sustainability in Higher Education (SHE) began
128 in the 1980s with Anthony Cortese (Blum, 2008, 1). Cortese began pushing
129 sustainable practices at Tufts University by integrating environmental practices in
130 170 courses (Anthony Cortese 1). This translated into the collective push for
131 sustainable practices in higher education with the Talloires Declaration in 1990. The
132 Talloires Declaration was an agreement by university leaders meant to mobilize
133 resources, to promote sustainability and encourage other universities to join their
134 cause (Wright, 2002, 206). However, a lack of funding has lead most universities to
135 either ignore it, attempt to implement the principles, or to only incorporate
136 “umbrella principles” in their internal policies (206).

137 Growing form the logic of Talloires the American Colleges & University
138 Presidents’ Climate Commitment (ACUPCC) was created in 2006. The ACUPCC
139 provides a framework by which universities can build their sustainability plans. It
140 requires universities to: complete an emissions inventory, set a date by which to
141 become climate neutral, take immediate short-term actions and make sustainability
142 a part of their curriculum (Mission and History, 2011). Since its creation the
143 ACUPCC has received pledges from 468 schools, putting almost 25% of American
144 college students in the Presidents’ Climate Commitment (Blum, 2008, 2).

145 An extreme example of one institution of higher education's commitment to
 146 green energy is illustrated in the Los Angeles California Community College District.
 147 Larry Eisenberg was hired to oversee a \$5.7 billion dollar taxpayer-funded program
 148 designed to supply all nine colleges in the district with completely green energy,
 149 with a surplus that could be sold (Finnegan, 2011, 1). Unfortunately, Eisenberg's
 150 plan was based on technology that wasn't even available, the costs were too high to
 151 implement this plan, local weather didn't permit his designs and the proposed tax
 152 credits weren't available for these public institutions (2-6). Additionally, if the
 153 school were to run purely on green energy, windmills, solar panels and other
 154 sources would have to have been placed in every possible location (1). Once the
 155 community college board caught wind of Eisenberg's plan he had spent nearly 10
 156 million dollars in taxpayer money (1).

157 Other colleges and universities agree that there is a need to pursue more
 158 environmentally friendly and sustainable practices, but are not willing to risk large
 159 scale embarrassment or failure like that in Los Angeles. Despite these concerns
 160 there are schools that understand that this switch comes as a cost and thus they
 161 must choose between sustainability and growth. For example, the Ivy Plus
 162 Sustainability Working Group was formed in 2007 in order to reduce greenhouse
 163 gas emissions on campus (Ivy plus sustainability working group, 2010). All of these
 164 schools have set reasonable emission reduction goals and only two have gone as far
 165 as to promise the currently unattainable goal of zero emissions by 2050. For
 166 example, Yale University has chosen instead to cut their emissions by 43 percent by

2020, levels that exceed those prescribed by the Kyoto protocol. Harvard University has chosen to cut Green House Gas Emissions by 30 percent by 2016.

Utah State University

Utah State University is a large public research institution located in Logan Utah with a total enrollment of 25,767 and a just under 2000 employees. Created in 1888 as Utah's land grant institution questions of public interest have long been central to the institution's mission and focus and in recent years exploration of alternative energy generation have become increasingly important.

As an institution Utah State University has had a long tradition of managing and conserving energy resources. Since its founding in 1888 they have devoted at least one engineer in their Facilities Department to overseeing issues relating to energy consumption (Blue Goes Green, 2008). However It wasn't until the energy crisis of the 1970s that significant energy reduction efforts were made (Ben Berrett, personal communication, October 28, 2010). During the crisis the Department of Energy issued grants to help cover the cost of rising energy prices. Then, in 1995 funding increased and USU Facilities shifted their excess funds towards reinvestment. After the dot-com bubble ruptured, state revenues decreased, and the excess funding awarded during the 1970 energy crisis was transferred elsewhere, leaving Facilities with utility bills they didn't have the budget to pay. Since that time USU's Facilities Department has carried a deficit on their energy bills and have been looking towards energy loans and stimulus money to cover the costs (Ben Berrett).

Figure 1 Here

189 Since that time Facilities has tackled much of the ‘low hanging fruit’ when it
 190 comes to reducing energy consumption. Beginning in 1999 USU Parking began
 191 exchanging their buses, the Aggie Shuttles, for ones that run on natural gas. Across
 192 campus water has been saved through a centralized, regulated sprinkler system
 193 (Blue Goes Green, 2008). According to the director over Facilities, Ben Berrett, more
 194 has been done with decreasing water consumption than reducing energy
 195 consumption (personal communication, October 28, 2010). Utah State was also
 196 home to the first Platinum LEED certified building in the state (Climate Action Plan,
 197 2010, 10).

198 USU’s major projects aimed at decreasing energy use include: a chilled water
 199 plant, a natural gas co-generation plant, and a campus wide conversion to energy
 200 efficient light bulbs and light sensors (Blue Goes Green, 2008). Installed in 2003, the
 201 chilled water plant cools air with generators, which is then pumped into buildings
 202 across campus to control the temperature more efficiently. Then, in 2004 Facilities
 203 installed the co-generation unit, which burns ‘cleaner’ natural gas and turns it into
 204 electricity; energy that would normally be considered excess and wasted is used to
 205 heat or cool buildings (Blue Goes Green).

206 Apart from these two sources, USU’s remaining electricity needs are supplied
 207 by Logan city. Currently, Logan city has no plans to ‘green’ their energy portfolio
 208 (Emily Malik, personal communication, December 20, 2010). USU’s Climate Action
 209 Plans notes the necessity of Logan city shifting their portfolio and they ‘expect’ solar
 210 and wind energy to increase in popularity in Logan, in order for them to reach their

211 goal (Climate Action Plan, 2010, 10). When it comes to choosing which green
212 projects are implemented the state often picks the projects with the shortest
213 payback period. Additionally, projects are only initiated as funds become available
214 (Ben Berrett, personal communication, October, 28, 2010).

215 Commitment from the University's leadership began when President
216 Stanford Cazier signed the Talloires Declaration in 1991 and President George
217 Emert renewed this commitment in 1993 (Climate Action Plan, 2010, 6). As of 2003
218 USU had "made only what could be termed as sluggish progress of implementing in
219 theory or practice the tenets of the Talloires Declaration." (AggieEcology, 2003, 8).
220 Many peer institutions had surpassed Utah State as "models of campus greening for
221 the higher education community." (9). AggieEcology pushed for significant changes
222 to USU's Sustainability Projects, but little was done until the Presidency of Stan
223 Albrecht.

224 On January 22, 2007 President Albrecht signed the American College and
225 University Presidents' Climate Commitment. The ACUPCC has set the goals of carbon
226 neutrality and increased student education. As part of this pledge President
227 Albrecht has set the goal of a carbon neutral campus by 2050. Utah State is also a
228 member of the Association for the Advancement of Sustainability in Higher
229 Education. Since the signing of the ACUPCC there has been a push to change
230 University curriculum to include sustainable education, although it has been met
231 with some resistance. In 2010 Utah State produced the Climate Action Plan, an
232 illustration of where Utah State is on their path to a sustainable campus. Since 1990

233 USU has seen a 20% increase in student population, with only a 1% increase in
234 energy growth, demonstrating how continuing efforts on behalf of Facilities have
235 been beneficial. (Climate Action Plan, 2010, 9)

236 Directly after President Albrecht signed the ACUPCC the Sustainability
237 Council (SC) was formed. The Sustainability Council focuses on “outreach, education,
238 research, and conservation/sustainability efforts.” (Climate Action Plan, 2010, 6).
239 Their projects include: Aggie Recyclers, a recycling program, Aggie Blue Bikes, a bike
240 loaner program, Earth Day, Sustainability Week, and exhibits at freshman
241 orientation (7). USU’s recycling program began in 1990 and has expanded to the
242 point where in 2009 it recycled over 664 tons of material (12). Because
243 transportation accounts for almost half of carbon emissions, Aggie Blue Bikes and
244 the previously mentioned Aggie Shuttle system are heavily promoted. Efforts have
245 also been made to switch current University fleet vehicles to hybrid or “right sized”
246 vehicles. (11).

247 Earth Day celebrations and Sustainability Week activities (starting in 2009)
248 have increased awareness of sustainability issues through the Blue Goes Green
249 marketing campaign. A major piece of this PR campaign is the pledge program “Take
250 the Challenge”, a voluntary declaration by students, faculty and staff to lower their
251 carbon footprints (13). Currently this program has over 500 pledges (3% of the
252 student population). In February 2011 a ‘Blue Goes Green’ student fee was passed,
253 giving BGG its only financial support since 2007 (Jordy Guth, personal
254 communication, September 14, 2010). While there was no plan put forward

255 describing how this funding would be used the SC has several goals including:
256 joining Earth Hour and the Graduation Pledge Alliance. Additionally they want to
257 create a campus sustainability map, 'green' USU conferences, increase awareness in
258 on-campus housing, and develop a sustainability intern to coordinate efforts and
259 projects. (14).

260 Despite the claims of proponents of these policies on USU's campus almost
261 no serious evaluation of the effectiveness of these policies on actual GHG emissions
262 or carbon footprints has been conducted. We undertake to provide such an test
263 using data from the facilities department.

264

265

266 **Evaluating Sustainability Programs**

267 A series of gases classified as Greenhouse Gases (GHG) are understood to
268 contribute to global warming. These anthropogenic contributions to climate change
269 vary in degree due to the amount of gases being released and their current
270 concentrations in the atmosphere (Rodhe, 1990, p. 1217). Policy goals are geared
271 towards reducing the emissions of these gases.

272 The crux of climate change policy is that GHG emissions are largely a result
273 from human action. As such, policy attempts to change the underlying behaviors
274 that lead to what may be an irresponsible and unsustainable level of emissions. The
275 goal of the sustainability movement at USU is to change behavior in such a way that
276 it will reduce emissions related to the University's operations.

277 When Utah State University conducted its GHG emissions inventory in 2008,
278 it identified various sources of GHG emissions from the operation of the University
279 and calculated each source's level of emissions. When calculated, sources both
280 directly and indirectly related to the University's operation were included. The two
281 largest sources were purchased electricity and natural gas, which are both functions
282 of on-campus energy consumption.

283 The next major sources were all related to travel, with student commuters,
284 air travel, and faculty/staff commuters as the 3rd, 4th, and 5th largest sources of
285 GHG emissions respectively. Since this travel is directly related to University
286 business, these sources were included in the emissions inventory. An alternative
287 would be to only include emissions from University's fleet of motor pool vehicles.
288 This category represents only 3% of emissions in the 2008 inventory.

289 **Modeling On-Campus Energy Consumption**

290 As shown in Table 1, on-campus energy consumption, (consisting of
291 purchased electricity and natural gas) represents the largest source of GHG
292 emissions at USU. This is consistent with Wackernagel et al.'s (2005) experience. We
293 limit the scope of our research to only modeling on-campus energy consumption for
294 the following reasons: 1) Data for on-campus energy consumption is more reliable
295 than data modeling student and faculty commutes; and 2) We assert that USU will
296 be able to exert more control over on-campus energy use than it will over student
297 and faculty commutes. Therefore, as USU attempts to reduce its GHG emissions, we
298 expect that the most encouraging progress will take place on-campus.

299 Using OLS regression, we model USU's energy consumption from October
 300 1998 to September 2010. We control for the University's growth in terms of student
 301 body and building space, as well as seasonal variations in temperature.

302 **Table 1**
 303 Energy Consumption in MMBTUs
 304 (Testing our Model of Energy Consumption)
 305 Observations: 146
 306 Groups: 13

Variable	Coefficient	p-value
Energy Use Days	23.12	.000**
Student Count	.550	.000**
Square Foot	.017	.018**
Constant	-31261.82	.285
R Square	0.76	

307

308 Hypothesis

309 Based on the claims in both the literature and those promoting sustainable
 310 policies we hypothesize that USU's on-campus energy consumption will decrease
 311 over the time period after controlling for increases in population and square
 312 footage. Such a decrease would be evidence that USU's program of sustainability and
 313 carbon neutrality has resulted in meaningful reductions in emissions. neutrality.

314 Methods

315 To test our hypothesis we used cross-sectional time series and included the
 316 squares of each of the variables confirmed in our model. This approach tests for
 317 changes in effects of each of the variables over time. The expectation is that if energy
 318 efficiency policies have had a significant effect we would see a sign change for each
 319 of our variables and those variables would remain statistically significant.

320 Results

We find that despite the allocation of additional resources to energy conservation, the effect of increases in square footage, student population and energy use days does not decrease as additional emphasis is placed on conservation. In short the energy cost of each additional student or square foot has remained constant over the time period.

Table 2
Energy Consumption in MMBTUs
(Testing for Effects of Energy Efficiency Policy)
Observations: 146
Groups: 13

Variable	Coef	P Value
Energy Use Days	14.41	.029**
Energy Use Days Squared	.005	.164
Student Count	.34	.665
Student Count Squared	.000	.745
Square Footage	-.502	.202
Square Footage Squared	6.44 e-08	.185
Constant	1016649	.201
R Square	0.77	

Our results suggest that energy consumption remains primarily a function of exogenous variables outside the control of those who increase energy efficiency. Simply put, increasing student populations, additional buildings and the realities of climate largely dictate energy consumption. Further we find that the cost of those increases are not mitigated by energy conservation measures. We find no evidence that supports the hypothesis that changes in policy at Utah State University have to any degree, significantly mitigated consumption.

Discussion

While there are varied methods for computing a carbon footprint, energy consumption is always a factor. USU's main sources of energy are natural gas and energy purchased from Logan City. Although natural gas is considered an alternative energy source, it is not carbon neutral. As demonstrated in **Figure 2**, Logan City's energy portfolio consists mostly of coal-powered plants. Unless on-campus energy consumption is dramatically reduced, carbon neutrality will be unfeasible without offsetting that consumption.

Figure 2 Here

Figure 3 here

Assuming no significant shifts in technology occur the ultimate promise of reaching carbon neutrality by 2050 will only happen if carbon offsets are purchased. Since Utah State University is a public institution it is likely that the funding for this project will come from taxpayer dollars. Currently, the carbon-offset market is riddled with problems. Many of the companies offering carbon offsets are using current purchases to fund the start-up of projects, meaning many dollars going to offset carbon emissions do nothing of the sort. Additionally, USU has pledged to buy a good from a market, with no knowledge of how that market will function, or what costs will be in 2050. Utah State is in the position that many universities are in where "The biggest steps are still to come, particularly as universities entertain the idea of being fully carbon neutral—which no amount of light bulb ex-change programs will achieve." (Blum, 2008, 2).

361 Our analysis shows that this pledge is an example of the distorted incentives
 362 associated with higher education policy goals. The leaders making policy and
 363 signing pledges at colleges and universities will not be around long enough to make
 364 sure those policies are implemented. Due to their desires to keep spending low,
 365 there is no incentive to cover the initial costs of capital. However, making policy is
 366 cheap and it quickly adds to a university's PR campaign. To achieve these goals
 367 major shifts in student, faculty and staff behavior must occur. There is little
 368 incentive for these groups to pay more in terms of travel time, or comfort, to achieve
 369 a goal in the distance future.

370 Although politically expedient, the Climate Action Plan's goal of carbon
 371 neutrality in 2050 is not based on the realities of energy consumption at USU. The
 372 CAP lists its strategies as "(1) reducing campus energy consumption, (2) obtaining
 373 energy from renewable and sustainable sources, (3) institutionalizing a sustainable
 374 culture among students, faculty, and staff, and as a last resort (4) purchasing carbon
 375 offsets." (Climate Action Plan, 2010, 3). Strategies (1) and (2) are meaningful on a
 376 limited scale; however, these two strategies alone will not be enough to even
 377 approach carbon neutrality. Strategy (3) is, by nature, difficult to measure. The
 378 cross-sectional time series analysis allows us to track changes in consumption
 379 patterns due to strategies (1) and (3). We find no evidence that reductions are
 380 taking place over time. Even with generous assumptions, it is a leap to claim that
 381 potential reductions through these strategies could outweigh the effects of growth
 382 in student body and campus square footage at Utah State.

383 USU is in the same situation as many higher education institutions, including
 384 Cornell. According to Cornell’s Dean Koryanagi ““The rate of change has been so
 385 quick that we were pushing for low-hanging fruit for years and years, and now we’re
 386 talking about major initiatives that cost tens of millions of dollars.” (Blum, 2008, 2).
 387 According to strategy (4) in the CAP, the approach to any residual GHG emissions
 388 after implementing strategies 1-3 is to purchase carbon offsets. If the pledge is
 389 honored, USU’s commitment to carbon neutrality represents a sizable unfunded
 390 financial liability for the University.

391

392

393

394

395

396

397

398

399

400

401

Sources:

- AggiEcology: USU thinks green! (2003). Utah State University Criteria for Best Practices in Campus Sustainability. p. 1-74.
- "Anthony Cortese." (2010.) Second Nature. Second Nature. Retrieved from: <http://www.secondnature.org/about/team/cortese.html>.
- Blue Goes Green. (n.d.). Utah State University Greats. Retrieved October 23, 2010, from <http://www.usu.edu/greats/location/index.cfm?article=31962>
- Blum, Andrew. (2008). Carbon Neutral U. Metropolis Mag. p. 1-3. Retrieved from: <http://haldanestudy.alittlefarmer.com/pdf/CarbonNeutralUMetMag022008.pdf>.
- Bonoli, Giuliano (2000). *The Politics of Pension Reform*. Cambridge: Cambridge University Press.
- Climate Action Plan. (2010). Utah State University. Logan, Utah, p. 1-32.
- East, Andrew John. (2008). What is a Carbon Footprint? In *Vegetable Industry Carbon Footprint Scoping Study: An Overview of definitions and methodologies* (1-10). Retrieved from: http://www.vegiecarbontool.com.au/uploads/Discussion%20Paper%201_What%20is%20a%20carbon%20footprint.pdf
- Elder, James L. and Jean MacGregor. (2008). The Sustainability Movement in Higher Education: An Overview. *Mobilizing STEM Education for a Sustainable Future*. p. 1-12. Retrieved from: <http://mobilizingstem.wceruw.org/documents/The%20Sustainaiblity%20Movement%20and%20Appendices.pdf>.
- Finnegan, Michael and Gale Holland. "Grand Dream Loses Sheen in Glare of Daylight." LA Times. March 6, 2011. p. 1-7.
- Geoffrey K.F., Kelvin Tso and K.W. Yau. (2007). Predicting electricity energy consumption: A comparison of regression analysis, decision tree and neural networks. *Energy* 32(9). p. 1761-1768. Retrieved from http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V2S-4MR1P3S1&_user=464852&_coverDate=09%2F30%2F2007&_rdoc=1&_fmt=high&_orig=gateway&_origin=gateway&_sort=d&_docanchor=&view=c&_searchStrId=1709809869&_rerunOrigin=google&_acct=C000022310&_version=1&_urlVersion=0&_userid=464852&md5=1ab296ca341e9f6921ba25010d02f35b&searchtype=a.
- Gersbach, Hans. (2004). Competition of politicians for incentive contracts and elections. *Public Choice*. 121 p. 157-177. Retrieved from <http://www.jstor.org/stable/30026516>.

- Hertwich, Edgar G. and Glen P. Peters. (2009). Carbon Footprint Nations: A Global, Trade-Linked Analysis. *Environmental Science and Technology*. p. 1-8.
- Ivy Plus Sustainability Working Group. Ivy Plus Sustainability. Yale University. Retrieved December 13, 2010, from <http://sustainability.yale.edu/ivy-plus>.
- Lam, J.C. (1998). Climate and Economic Influence on Residential Electricity Consumption. City University Hong Kong. Retrieved from http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V2P-3SYVDSR-7&_user=464852&_coverDate=05%2F31%2F1998&_rdoc=1&_fmt=high&_orig=gateway&_origin=gateway&_sort=d&_docanchor=&view=c&_searchStrId=1709814380&_rerunOrigin=scholar.google&_acct=C000022310&_version=1&_urlVersion=0&_userid=464852&md5=04329bdf742dafb5733e0b06eb3744d7&searchtype=a.
- Paldam, Martin (2007). Political Business Cycles. In Mueller, C. (ed.) *Perspectives on Public Choice*. p. 342-370. Cambridge: Cambridge University Press.
- Mission and History. (n.d.). America's College and University President's Climate Commitment . Retrieved August 10, 2010, from <http://www.presidentsclimatecommitment.org/about/mission-history>.
- Murray, Joy and Christopher Dey. (2009). The carbon neutral free for all. *International Journal of Greenhouse Gas Emissions* 3 (2009.) p. 237-248. Retrieved from [http://2554224636599807885-a-1802744773732722657-ssites.googlegroups.com/site/gicacidea/Thecarbonneutralfreeforall.pdf?attachauth=ANoY7cqgInT3BOuzJypAEycsq4osm6S8YxjaLqzlAcMt5F2UZXdOifRwc-uUsqozMga4QAHadg0CSpE5fKSfbleXwPfayBYAXRHsd_wq4x8vP-zBEvqURmc73vyvp_TvmdPhZS7oOKNtzKNc1yVZc4xaodk\]pyYa_uy4oq-y_RGzmPFmoNlq8FkskSQNM4RLK91bezE2Myp_1gSt1RInKcqDKnu7Gizv7w%3D%3D&attredirects=1](http://2554224636599807885-a-1802744773732722657-ssites.googlegroups.com/site/gicacidea/Thecarbonneutralfreeforall.pdf?attachauth=ANoY7cqgInT3BOuzJypAEycsq4osm6S8YxjaLqzlAcMt5F2UZXdOifRwc-uUsqozMga4QAHadg0CSpE5fKSfbleXwPfayBYAXRHsd_wq4x8vP-zBEvqURmc73vyvp_TvmdPhZS7oOKNtzKNc1yVZc4xaodk]pyYa_uy4oq-y_RGzmPFmoNlq8FkskSQNM4RLK91bezE2Myp_1gSt1RInKcqDKnu7Gizv7w%3D%3D&attredirects=1).
- Rodhe, Henning A Comparison of the Contribution of Various Gases to the Greenhouse Effect. *Science*. New Series, Vol. 248, No. 4960 (Jun. 8, 1990), pp. 1217-1219
- Sailor, David J. and J. Ricardo Munoz. (1997). Sensitivity of electricity and natural gas consumption to climate in the U.S.A. Methodology and results for eight states. *Energy*, 22(10). p. 987-998. Retrieved from <http://goo.gl/6sYcl>.
- Step 1: Conduct an Emissions Inventory. (2010). Climate Action Toolkit. Clean Air-Cool Planet. Retrieved from <http://www.cleanair-coolplanet.org/toolkit/inv-home.php>.

- Simpson, Walter. (2003). Energy Sustainability and the Green Campus. Planning for Higher Education. p.150-158.
- Wackernagel, Mathis and William E. Rees. (1962). *Our Ecological Footprint, reducing human impact on the earth*. New Society Publishers. B.C. Canada. p. 1-3.
- Wackernagel, M., Monfreda, C., Moran, D., Wermer, P., Goldfinger, S., et al., (2005). National footprint and biocapacity accounts 2005: The underlying calculation method. Global Footprint Network.
- Wiedmann, T. and Minx, J. (2008). A Definition of 'Carbon Footprint'. In: C. C. Pertsova, Ecological Economics Research Trends: Chapter 1, pp. 1-11, Nova Science Publishers, Hauppauge NY, USA. https://www.novapublishers.com/catalog/product_info.php?products_id=5999.
- Wright, Tarah S.A. (2002). Definitions and Frameworks for Environmental Sustainability in Higher Education. Journal of Sustainability in Higher Education. 3(3): 203-220.

Figure 1
Campus Energy Consumption Over Time

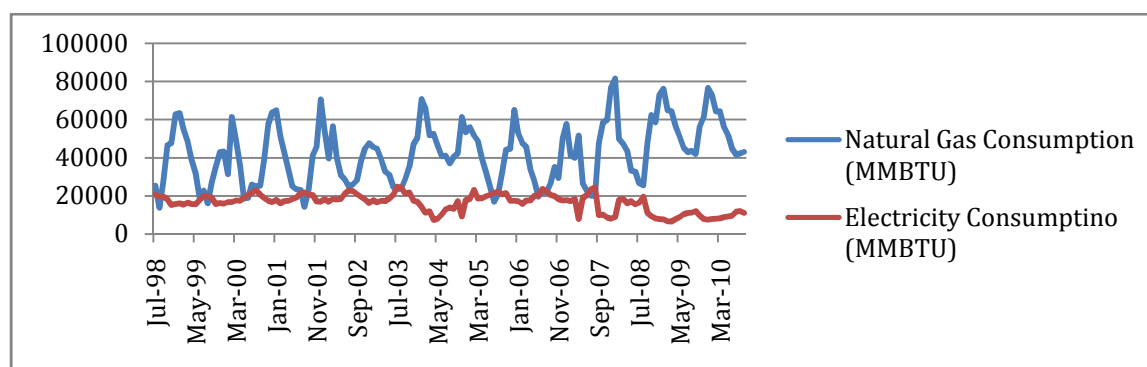
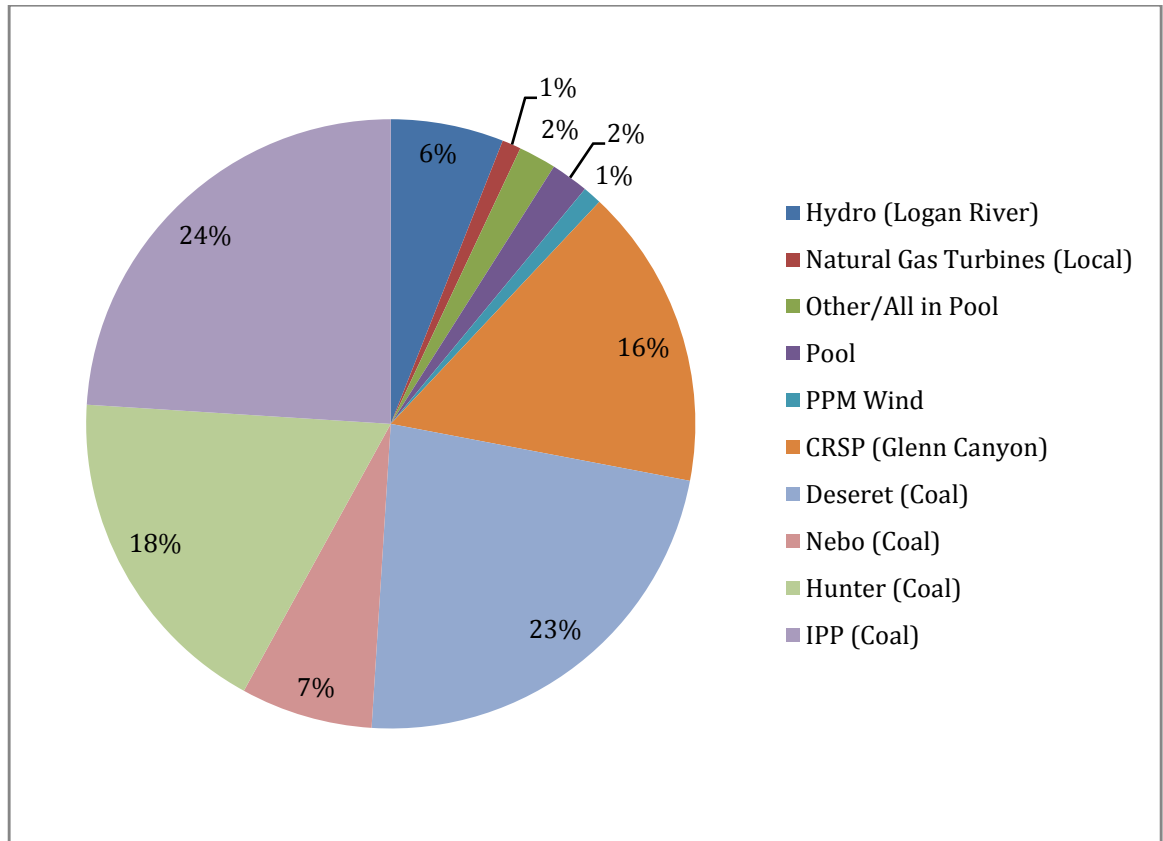


Figure 2
Electric Resources 2009-2010



520
521
522
523
524
525
526

Figure 3
Total USU GHG Emissions by Source

