



Benefits from Effective Energy Code Implementation in the City of Atlanta

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EXECUTIVE SUMMARY

Most people do not think of buildings as machines. But buildings are machines with structural, electrical, and mechanical systems that must work in concert to make them habitable. And like machines that we buy from stores, buildings must go through quality control checks before they “roll off the assembly line” to make sure they are fit for sale. Building codes are the quality control specifications adopted by governments to ensure that buildings within their jurisdiction meet standards for habitability, safety, and performance. Energy codes are the quality control specifications adopted by governments for energy efficiency.

Georgia adopted new residential and commercial energy codes that went into effect at the start of 2011 (the 2011 energy code).¹ The City of Atlanta Office of Buildings conducts quality control through their permitting and inspection process so that buildings and renovations in the City have additional review beyond the builder’s legal obligation to comply.

Benefits of Effective Energy Code Enforcement

Effective implementation of the 2011 energy code by the Office of Buildings will strengthen Atlanta’s economy, save water, improve public health, and enhance the comfort and long term energy performance of buildings.

Economic Development

Effective energy code implementation immediately saves residents and businesses money by reducing energy consumption, which lowers utility bills. Moreover, as energy prices increase, so do monetary savings from compliance with energy codes. Over a six and a half year period, electricity prices have increased almost 55 percent for residences and 39 percent for businesses in Atlanta.² Monetary savings increase consumer purchasing power and companies’ ability to invest in their businesses, ultimately aiding the City of Atlanta’s economy. This study estimates that full compliance with the 2011 energy code will save Atlanta residents and businesses approximately \$13.7 million over a five-year period. This money, saved by Atlanta residents, can then be spent within the local economy, boosting economic growth within the City.

Compliance with the 2011 energy code can also result in job growth within the building sector by boosting demand for skilled professionals whose products and services enable buildings to meet code (e.g., certified duct and envelope tightness verifiers and independent energy specialists). These positions

¹ Georgia’s new energy code became effective on January 1, 2011. For residential buildings, the 2009 IECC, along with the 2011 Georgia State Supplements and Amendments, make up the current energy code. For commercial buildings, builders may use one of two compliance pathways: either Chapter 5 of the 2009 IECC, along with the 2011 Georgia State Supplements and Amendments, or ASHRAE 90.1-2007.

² Between January 2005 and July 2011, average Georgia residential electricity rates increased 54.5 percent from 7.80¢ to 12.04¢ per kilowatt hour (kWh). During the same time, average Georgia commercial electricity rates increased 38.7 percent from 7.29¢ to 10.11¢ per kWh.

are the types of clean-tech jobs identified by the Sustainable Economic Growth Initiative taskforce led by the Metro Atlanta Chamber as important to the future growth of metro Atlanta.³

Some may argue the energy cost savings and increased number of jobs are not worth the added investment needed to achieve compliance from the building department or the construction industry. However, this investment is not only required to meet state law but several reports have shown that investments in improving the energy efficiency of buildings are more effective at job creation than investments in manufacturing.^{4,5}

Water Savings

Over 95 percent of the electricity consumed in Georgia is generated by thermoelectric power plants⁶ that burn fossil fuels or split atoms to produce heat. This heat boils water which creates steam that turns electricity-generating turbines. Therefore, these thermoelectric power plants require an enormous amount of water. While most of the water withdrawn for electricity production is ultimately discharged back into the environment, there is an amount lost through evaporation. In Georgia, approximately 0.57 gallons of fresh water is consumed by thermoelectric power plants for every kilowatt hour (kWh) of electricity that is produced.⁷ Improving energy code compliance in buildings reduces electricity consumption in Atlanta which in turn reduces the stress placed on Georgia's water supply. This study estimates that improved compliance with the 2011 energy code will save 131,741 megawatt hours (MWh) which would have consumed 75 million gallons of water over a five-year period.

Public Health

Inefficient buildings can contribute to serious health concerns, especially for children, the elderly, and those suffering from illness. Buildings that comply with the 2011 energy code can reduce health risks from, among other things, mold, dust and dust mites, rodents, insects, and combustion by-products.

Many people do not link buildings with air pollution but electricity used by Atlanta's buildings is largely generated by burning coal, which releases harmful pollutants such as sulfur oxides (SOx), nitrogen oxides (NOx), and particulate matter into the atmosphere. Inhaling these pollutants and their byproducts has adverse consequences for human health (e.g., respiratory disease, heart problems, and early mortality). A recent report estimates that emissions from coal-powered electricity plants kills over

³ Metro Atlanta Chamber. *Sustainable Economic Growth Initiative Final Report*. November 17, 2011. <http://www.metroatlantachamber.com/files/file/pub_pol/water_environment/20110920%20SEGI%20final%20report%20draft%202012.pdf>.

⁴ Oppenheim, Jerrold. *Energy Efficiency Equals Economic Development*. Tech. Entergy, June 2008. Web. <http://www.energy.com/global/our_community/advocate/Poverty_book.pdf>.

⁵ *How Does Energy Efficiency Create Jobs?* Issue brief. American Council for an Energy Efficient Economy. Web. <<http://www.aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf>>.

⁶ *Table 4. State Total Electric Power Industry Net Generation, by Energy Source, 2005 - 2009*. U.S. Energy Information Administration, 2011. Web. <http://www.eia.gov/cneaf/solar.renewables/page/state_profiles/excel/rspt04ga.xls>.

⁷ *Freshwater Use by U.S. Power Plants Electricity's Thirst for a Precious Resource*. Tech. Union of Concerned Scientists, Nov. 2011. Web. Jan. 2012. <http://www.ucsusa.org/assets/documents/clean_energy/ew3/ew3-freshwater-use-by-us-power-plants.pdf>.

24,000 people a year in the U.S. and results in over 38,000 non-fatal heart attacks annually.⁸ Achieving full compliance with the 2011 energy code in Atlanta will decrease electricity consumption per capita and therefore reduce these pollutants that harm human health. This study estimates that improved compliance with the 2011 energy code over a five-year period will prevent the release of over 600 tons of SOx and NOx into the atmosphere.

Comfort and Long Term Energy Performance

Buildings that are built to 2011 energy code standards also provide greater year round comfort (e.g., reduced outdoor noise, stuffy/muggy air, condensation, excessively dry air, and hot and cold areas) and improved long term energy performance of the heating and air conditioning system.

Georgia's Energy Code Compliance Goal

On March 29, 2009 Governor Sonny Perdue pledged that buildings in Georgia will achieve 90 percent compliance with Department of Energy (DOE) target energy codes (2009 IECC and ASHRAE 90.1-2007) by 2017.⁹ To fulfill that pledge, Georgia adopted the 2011 energy code. While it is the responsibility of each builder to meet the minimum requirements of the 2011 energy code, it is the decision of each city and county how to enforce the 2011 energy code.

Because there has been no large-scale study on enforcement of the residential energy code in Atlanta, the compliance rate with the residential energy code in Atlanta is unknown. However, other states report that commonly 40 – 50 percent of homes do not meet their residential energy code requirements.¹⁰ In 2010, the Georgia Department of Community Affairs (DCA) analyzed the rate of compliance with standards contained in the 2011 commercial energy code. DCA found that these commercial buildings complied with 80 percent of the requirements contained in the not-yet-enacted 2011 energy code.¹¹ Based on available information regarding current building practices, a substantial number of buildings will likely not meet 2011 energy code requirements. Therefore, the analysis contained in this study shows that improving compliance with the 2011 energy code in the City would yield a host of benefits for Atlanta's economy and public health. Appendix A discusses methods that the Office of Buildings can employ to reach this compliance goal.

⁸ Paul R. Epstein et al., *Full cost accounting for the life cycle of coal in "Ecological Economics Reviews."* (Annals of the New York Academy of Sciences, 2011), 85–86.

⁹ Perdue, Sonny. "Compliance with Section 410 of the American Recovery and Reinvestment Act." Letter. 25 Mar. 2009. <www.gefa.org/Modules/ShowDocument.aspx?documentid=953>Web. 31 Oct. 2011.

¹⁰ Yang, Brian. *Residential Energy Code Valuations: Review and Future Directions*. Tech. Building Codes Assistance Project, Alliance to Save Energy, Natural Resources Defense Council, June 2005. Web. 31 Oct. 2011. <http://www.energycodes.gov/publications/research/documents/codes/bcap_res_eval_2005.pdf>.

¹¹ The commercial buildings assessed were not required to meet the 2011 energy code but were assessed using the latest standards.

ANALYSIS

To quantify the benefits to the City of Atlanta of reaching full compliance with the energy code, this analysis first predicts the type and amount of future new construction and then models the energy savings associated with bringing that new construction in full compliance with the energy code. The first part of this section describes the construction forecast for the following types of construction:

- New residential;
- Residential additions;
- New multifamily;
- New commercial; and
- Commercial alterations.

The second part of this section describes the assumptions that were made to determine the energy savings of reaching full compliance for each construction type. Finally, a summary contains the results of the study in City-wide energy savings, cost savings, and emissions reductions, as well as a summary of recommendations for improving compliance with the energy code in the City.

Construction Forecast

Robin Camp with Office of Buildings provided the number of permits by building type between 2005 and 2011 for their fiscal year (July to June).¹² Table 1 contains an estimate of the calendar year (January to December) permits based on Atlanta's fiscal year permit data.¹³ Because the City did not provide information on the number of new multifamily units permitted,¹⁴ permits for multifamily units were based on information collected in the Census Bureau's Building Permits Survey for Atlanta, Georgia.¹⁵

¹² Camp, Robin, City of Atlanta, Department of Planning and Community Development, Office of Buildings. "Building Permit Data." E-mail interview. 2 Sept. 2011.

¹³ The City of Atlanta Office of Buildings provided raw data regarding the number of building permits issued for each fiscal year 2005 – 2011. For example, fiscal year 2005 data is from July 2004 to June 2005. In order to estimate the number of permits issued per calendar year, i.e., January to December, this analysis assumed that half the permits issued across two different fiscal years tally the permits issued in one calendar year. For example, half the permits issued in fiscal year 2005 and half the permits issued in fiscal year 2006 approximate the total permits issued in calendar year 2005. The raw data provided by the City also contained additional categories like residential alterations and commercial additions. This analysis does not count permits for such categories because construction numbers were too small or the type of construction was not deemed to trigger the requirements of the energy code.

¹⁴ The City of Atlanta Office of Buildings currently (though not historically) collects permit data of new multifamily buildings. Because the energy use and energy savings of a multifamily building is highly dependent on its size (number of units per building), this analysis uses information from the national Census Bureau's Building Permits Survey which collects information on the number of multifamily units permitted monthly and annually by jurisdiction.

¹⁵ *SOCDS Building Permits Database*. Census Bureau's Building Permits Survey. Web. <<http://socds.huduser.org/permits/>>.

Table 1: Permits Issued by the City of Atlanta Office of Buildings

Year	New Residential	Residential Additions	New Commercial	Commercial Alterations	New Multi-Family Units	Total
2005	1,699	1,129	339	1,176	6,410	10,481
2006	1,830	1,016	423	1,154	8,937	13,118
2007	1,233	937	376	1,066	8,050	11,414
2008	473	723	335	891	1,868	4,118
2009	200	579	243	843	750	2,511
2010	196	554	89	1,072	196	1,984
2011	196	532	28	1,256	510	2,364

As shown in Table 1, the total number of permits issued by the Atlanta Office of Buildings peaked in 2006 at the height of the housing bubble and then declined into 2011 with the recession. To forecast future construction in Atlanta into 2017, this study uses growth rates from a variety of data sources.¹⁶ According to forecasts from the National Association of Home Builders, Freddie Mac, Wells Fargo, Moody's, and Global Insight, new housing starts in 2012 will increase between 34 percent and 49 percent from the number of starts in 2011.¹⁷ This analysis relies on the more conservative growth rate of 34 percent for new residential and multifamily construction from 2012 to 2017. The growth rate for residential additions is based on the 2011 annual remodeling report from the Joint Center of Housing Studies of Harvard University which predicts a 3.5 percent growth in renovations from 2010 to 2015.¹⁸ The growth rate in new commercial construction and commercial alterations is based on a consensus forecast that predicts 6.4 percent growth in commercial construction from 2011 to 2012. The consensus report includes forecasts from McGraw-Hill Construction, IHS Global Insight, Moody's, FMI, Reeds Construction Data, and Associated Builders and Contractors.¹⁹ Figure 1 below shows both historical

¹⁶ This study uses a simple growth rate for each sector to promote simplicity and transparency of this study's assumptions while recognizing that actual building starts and renovations are subject to significant market cycles and other externalities.

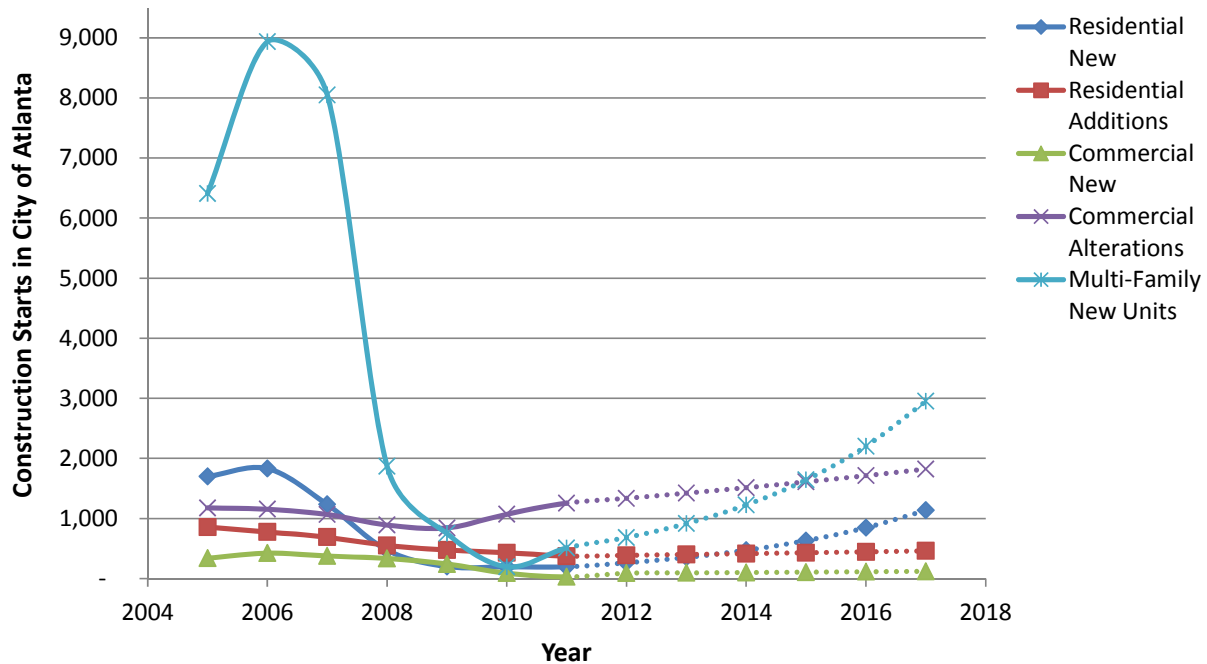
¹⁷ Thompson, Boyce. "Economists Trim 2011 Housing Forecasts, Call for Recovery in 2012." *Builder Online*. 14 June 2011. Web. 31 Oct. 2011. <<http://www.builderonline.com/economics/economists-trim-housing-forecasts-for-2011-call-for-recovery-in-2012.aspx>>.

¹⁸ This growth rate for City of Atlanta may also be conservative as demand for intown housing grows faster than suburban developments. *A New Decade of Growth for Remodeling: Improving America's Housing*. Rep. Joint Center for Housing Studies of Harvard University, 2011. Web. 31 Oct. 2011. <http://www.jchs.harvard.edu/publications/remodeling/remodeling2011/2011_remodeling_color.pdf>.

¹⁹ "American Institute of Architects." *Consensus Construction Forecast*. American Institute of Architects. Web. 31 Oct. 2011. <<http://info.aia.org/aiarchitect/2011/charts/consensus-survey/july/july.html#>>.

permits (solid lines) and forecasted permits (dotted lines) in the City of Atlanta by building type. This analysis assumes that the number of permits issued between 2005 and 2011 was equal to the amount of construction.²⁰

Figure 1: Construction Forecast in City of Atlanta



Residential Models

To model the benefits of achieving full compliance with the energy code, this study analyzes the benefits of energy code enforcement for residential single-family new construction, residential single-family additions and residential multifamily new construction. Residential alterations were not analyzed as the majority of alterations do not trigger the requirements of the energy code. This study uses data from the Fulton County Tax Assessor Office to determine the basic characteristics of both residential new construction and an existing home with a new addition.²¹ The data from the Tax Assessor Office provides basic data of homes in Atlanta like the conditioned floor area, number of stories, number of bedrooms and type of foundation. The analysis uses this data and other assumptions described below as inputs in REM/Rate™, a Department of Energy approved software, to model energy savings resulting from improved energy code compliance for each type of residential construction.²²

²⁰ Permits do not always equal construction as a builder may apply for a permit but not follow through with construction. However, in 2011, nationally, the number of new residential starts were only 1% less than new residential permits according to a recent press release by the U.S. Census Bureau. See U.S. Census Bureau. *New Residential Construction in December 2011*. 19 Jan. 2012. Web. 23 Jan. 2011. <<http://www.census.gov/construction/nrc/pdf/newresconst.pdf>>.

²¹ Brigham, Henry. *2011 Tax Digest*. Atlanta, GA: Fulton County Tax Assessor, 6 Oct. 2011. Txt.

²² REM/Rate, produced by the Architectural Energy Program, is used to rate and certify ENERGY STAR homes. It has also passed DOE's BESTest, a test designed to evaluate building energy simulation programs.

New Residential Construction

This analysis uses the following specifications to model the baseline average new home in the City of Atlanta:

- 2-story, single-family home
- 4-bedrooms
- Conditioned floor area: 2,670 square feet
- Unconditioned basement on a slab
- Unconditioned attic
- 9-foot high ceilings 1st floor
- 8-foot high ceilings, 2nd floor
- Total ceiling area: 1,335 square feet
- Gross exterior wall area: 2,338 square feet
- Total window area: 350 square feet (15 percent of wall area, oriented equally to the north, south, east, and west)

The number of stories, bedrooms, conditioned floor area, and construction type (unconditioned basement/attic) is based on the specifications of the median City of Atlanta home built in 2010 according to the Fulton County Tax Assessor data.

To determine the differences between the baseline home and fully-code compliant home, this analysis relies on the historical experience gained by Southface over 32 years in the industry. Southface, based in Atlanta, has experience with the range of common construction practices, having certified thousands of EarthCraft homes across the Southeast and conducted field trainings to help improve the efficiency of low-income homes throughout Georgia. To further gain knowledge into common construction practices as it relates to the new energy code, Southface conducted seven assessments on single-family homes built in the City of Atlanta in the Fall of 2011.²³

To determine the savings from achieving full compliance with the energy code, this analysis determined what characteristics of homes are typically not compliant with the current energy code. This analysis assumes homes built in the Atlanta area are different than fully-code compliant homes in five main ways. These main characteristics are summarized in Table 2 below and described in the bulleted paragraphs following the table.

²³ Unfortunately, many of the assessed homes were not indicative of the majority of new residential construction built because the homes were either located in affluent Atlanta communities and/or built by certified green builders.

Table 2: Single-Family Residential New Construction Model Assumptions

Feature	Baseline	Fully-Code Compliant
Insulation	Poorly installed (Grade III) ²⁴	Adequately Installed (Grade II) ²⁴
Air Sealing	Adequate (7 ACH ₅₀)	More Extensive (5 ACH ₅₀)
Duct Sealing	Adequate (8%)	More Extensive (6%)
Equipment	Two 3 ton, 13 SEER Systems (Poor Load Calculation)	Two 2.5 ton, 13 SEER Systems (Improved Load Calculation)
Lighting	15% efficient	50% efficient

- Insulation.** This study assumes that the insulation in the baseline home is poorly installed. Typically insulation is compressed around electrical wires and boxes or is not appropriately cut to fit in the cavity. The energy code stipulates that insulation must be installed according to manufacturer instructions. Therefore, the fully-code compliant home has improved installation of insulation.
- Air Sealing.** This study assumes that the baseline home meets the testing requirement in the energy code (by meeting the testing threshold of 7 ACH₅₀). Typically homes do not meet all the air-sealing requirements in the energy code. The energy code stipulates that all joints, seams, and penetrations in the building envelope be sealed. If air-sealing is more strictly enforced, homes can easily achieve a testing threshold of 5 ACH₅₀.
- Duct Sealing.** This analysis assumes that the baseline home just meets the testing requirement in the energy code (8 percent leakage to outside). Although the testing requirement is generally met, this analysis assumes that duct sealing is typically not accomplished in accordance with the energy code. In general, mastic is not always used as a sealant as required by the energy code. In addition, building cavities (especially returns) are occasionally used as ducts. If the full requirements of the energy code (sealing on all ducts, air handlers, filter cavities) are enforced, duct leakages could easily meet a 6 percent testing threshold.
- Equipment.** Although many HVAC contractors in the City of Atlanta conduct a load calculation, that calculation typically does not include appropriate inputs. Studies have shown that this is a common issue in our region.²⁵ By improving the quality of the load calculations in the City, it is likely that installed air-conditioning systems will be smaller in size.

²⁴ Grade III insulation describes insulation with substantial gaps and voids with missing insulation amounting to greater than 2% (but less than 5%) of the surface area. Grade II insulation is insulation with moderate to frequent installation defects: gaps around wiring, electrical outlets, plumbing intrusions and rounded edges or “shoulders.”

²⁵ A study conducted in Florida indicates that the majority of HVAC systems are oversized by 20 percent because of incorrect inputs in the Manual J Load Calculation. See James, P. Florida Power and Light Company. The Effect of Residential Equipment Capacity on Energy Use, Demand and Run Time.

- **Lighting.** The new energy code requires that 50 percent of all light bulbs in permanent fixtures in the home be efficient. Based on the assessments of homes, many new homes do not meet this requirement. The analysis assumes 15 percent of bulbs are efficient in the baseline home and 50 percent are efficient in the code compliant home.

An analysis based on the above assumptions estimates that with a home fully compliant with the 2011 energy code, homeowners can save 574 kWh of electricity per year and 66 therms of natural gas per year. To estimate energy cost savings to the homeowner, this analysis uses 12.04 cents per kWh for residential customers²⁶ or \$1.556 per therm. These rates are the most recent average energy prices for residential customers available through the U.S. Energy Information Administration (EIA) State Energy Profile of Georgia.²⁷ Based on these rates, we estimate that the homeowner can save \$206/year in the first year occupying the home. As energy prices increase, so do monetary savings from compliance with the 2011 energy code. Moreover, as shown in Table 3 below, these individual home savings add up to a substantial amount of savings for City homeowners estimated at \$1.27 million over the next five years.

Table 3: Savings for Improved Compliance of Single-Family Residential New Construction

Year	Energy Savings		Energy Cost Savings
	Electricity (MWh)	Natural Gas (Therms)	
2012	332	17,358	\$66,962
2013	676	40,590	\$144,816
2014	1,032	71,742	\$235,004
2015	1,401	113,454	\$346,209
2016	1,783	169,356	\$480,763
5-Year Total	5,224	412,500	\$1,273,754

<<http://www.fsec.ucf.edu/en/publications/html/FSEC-PF-328-97>>. This analysis assumes the system in the baseline Atlanta area home is oversized by exactly 20 percent, i.e., a 3 ton system. In contrast, a fully-code compliant building would have a 2.5-ton system installed.

²⁶ *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State.* Energy Information Administration, July 2011. Web. <http://www.eia.gov/cneaf/electricity/epm/table5_6_a.htm>.

²⁷ This price per therm is higher than the per therm unit rate given by natural gas companies because it includes an amount for surcharges typically included in a natural gas bill. See *Average Retail Price of Natural Gas Sold to Residential Consumers, by State.* Energy Information Administration, 2010. Web. <http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html>.

Residential Addition

This analysis uses the following specifications to model the baseline average existing home undergoing an addition in the City of Atlanta:

- 1-story, single-family home
- 3-bedrooms
- Conditioned floor area: 1,400 square feet
- Unconditioned, enclosed crawlspace
- Unconditioned attic
- 8-foot high ceilings
- Total ceiling area: 1,400 square feet
- Gross exterior wall area: 1,197 square feet
- Total window area: 180 square feet (15 percent of wall area, oriented equally to the north, south, east, and west)
- Built in 1950's: No wall insulation, R-19 in attic
- Pre-addition air-leakage: 19 ACH₅₀
- Pre-addition duct leakage: 25%
- 400 square feet addition on side of building

The number of stories, bedrooms, conditioned floor area and construction type (unconditioned crawlspace/attic) is based on the specifications of the median City of Atlanta home built before 1990 according to the Fulton County Tax Assessor data. This analysis assumes homes built after 1990 are of sufficient size to not undergo an addition. The pre-addition air-leakage and duct-leakage characteristics are based on Home Performance with ENERGY STAR assessments of over 300 homes with crawlspaces in Georgia.

Based on information from interviews with those in the renovation industry in Atlanta, this analysis estimates that the typical addition in the City of Atlanta is 400 square feet outside the existing building volume.²⁸

To determine the savings from achieving full compliance with the energy code, this analysis determined what characteristics of the addition are typically not compliant with the current energy code. This analysis assumes additions in the Atlanta area are different than fully-code compliant additions in four main ways summarized in Table 4 below and described in the bulleted paragraphs following the table.

²⁸ Seville, Carl. "Size of Residential Addition in Atlanta." E-mail. 30 Dec. 2011.

Soens, Robert. "Size of Residential Addition in Atlanta." Telephone interview. 20 Jan. 2012.

Table 4: Single-Family Residential Addition Model Assumptions

Feature	Baseline	Fully-Code Compliant
Insulation	Poorly Installed (Grade III)	Adequately Installed (Grade II)
Air Sealing	Poor (18.4 ACH ₅₀ for full home)	Addition Sealed (15.7 ACH ₅₀ for full home)
Duct Sealing	Poor (25%)	Addition Ducts Sealed (21%)
Lighting	5% efficient	15% efficient

- **Insulation.** As with new residential construction, this study assumes that the insulation in renovations is not installed in accordance with manufacturer instructions as required by code.
- **Air Sealing.** Although an envelope leakage test is not required by the energy code for residential additions, air-sealing is required. This analysis assumes the envelope leakage ratio²⁹ in the addition is equivalent to that in the remainder of the house for the baseline home. For the fully-code compliant home, this analysis assumes the addition to have an envelope leakage ratio equivalent to the code compliant home in new construction.
- **Duct Sealing.** Although a duct leakage test is not required for an addition in Georgia, duct sealing is required. This analysis assumes the duct sealing for the addition is equivalent to the rest of the house for the baseline home (25 percent duct leakage). For the fully-code compliant home, this analysis assumes duct leakage is 6 percent for the portion of ducts in the addition.³⁰
- **Lighting.** The new energy code requires that 50 percent of all light bulbs in permanently installed fixtures be high efficiency. This analysis assumes lighting is inefficient in the addition for the baseline home and that for the fully-code compliant home, efficient lighting is installed.

An analysis based on the above assumptions estimates that a homeowner of an addition fully compliant with 2011 energy code can save 305 kWh/year and 41 therms/year or the equivalent of \$100/year.³¹ As energy prices increase, so do monetary savings from compliance with the 2011 energy code. Moreover, as shown in Table 5 below, these individual home savings add up to a substantial amount of savings for City homeowners estimated at more than \$612,000 over the next five years.

²⁹ Envelope leakage ratio is a metric that determines how many leaks there are in the building thermal envelope. It is the amount of air leaving the blower door when the house is depressurized to 50 pascals (CFM₅₀) divided by the square footage of the building envelope. After the addition, the baseline home will have 18.4 ACH₅₀ while the full code compliant home will have a leakage rate of 15.7 ACH₅₀.

³⁰ Based on these assumptions, the baseline home will have a duct leakage of 25 percent while the full code compliant home will have duct leakage 20.8 percent.

³¹ *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State.* Energy Information Administration, July 2011. Web. <http://www.eia.gov/cneaf/electricity/epm/table5_6_a.htm>.

Average Retail Price of Natural Gas Sold to Residential Consumers, by State. Energy Information Administration, 2010. Web. <http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html>.

Table 5: Savings for Improved Compliance of Single-Family Residential Additions

Year	Energy Savings		Energy Cost Savings
	Electricity (MWh)	Natural Gas (Therms)	
2012	118	15,867	\$38,783
2013	240	32,308	\$79,122
2014	367	49,323	\$120,131
2015	498	66,953	\$164,494
2016	634	85,198	\$210,073
5-Year Total	1,857	249,649	\$612,603

New Multifamily

This analysis uses the following specifications to model the baseline average new multifamily unit being built in the City of Atlanta:

- 3-story building
- Unit size: 989 square feet
- Breezeway entrance
- 8-foot high ceilings
- Gross exterior wall area: 1,008 square feet
- Gross wall area adjacent to conditioned space: 504 square feet
- Total window area: 38 square feet (15 percent of wall area, oriented to the south)

The size of each unit is based on data given during a telephone call with Sean McKenzie at Dale Hensen Associates, Inc., a real estate advisory firm in Atlanta.³² Typical code issues and many building attributes were based on Southface’s experience with EarthCraft Multifamily projects in the Atlanta area.

To determine the savings from achieving full compliance with the energy code, this analysis determined what characteristics of multifamily buildings are typically not compliant with the current energy code. This analysis assumes multifamily buildings in the Atlanta area are different than fully-code compliant additions in four main ways that are summarized in Table 6 below and described in the bulleted paragraphs following the table.

³² McKenzie, Sean, Dale Hensen Associates, Inc. "New Multifamily Construction in Atlanta." Telephone interview. 30 Sept. 2011.

Table 6: Multifamily New Construction Model Assumptions

Feature	Baseline	Fully-Code Compliant
Insulation	Poorly Installed (Grade III)	Adequately Installed (Grade II)
Air Sealing	Adequate (7 ACH ₅₀)	Extensive (6 ACH ₅₀)
Duct Sealing	Adequate (8%)	Extensive (6%)
Lighting	15% efficient	50% efficient

- Insulation.** As with new residential construction, this study assumes that the insulation in new multifamily construction is not installed in accordance with manufacturer instructions as required by code. This analysis assumes that the insulation in the baseline multifamily building is poorly installed and that the insulation in the fully-code compliant multifamily building is installed well.
- Air Sealing.** Although an envelope leakage test is not required by the energy code for multifamily construction, air-sealing is required. Because of the fire code, the majority of multifamily buildings already exhibit adequate air-sealing to meet the testing threshold of 7ACH₅₀. However, there is additional air-sealing that could occur and would likely be missed by an inspector. This analysis assumes that the fully-code compliant unit meets a testing threshold of 6 ACH₅₀.
- Duct Sealing.** This analysis assumes that most multifamily buildings barely meet the testing requirement in the energy code (8 percent leakage to outside) for ducts outside the building envelope. However, if the full requirements of the energy code (sealing on all ducts, air handlers, filter cavities) are enforced, duct leakage could easily meet a 6 percent testing threshold. Because the same subcontractor also installs the ducts inside the building envelope, this analysis assumes that leakage rates of ductwork located within the building are consistent with leakage rates of ductwork located outside of the building.
- Lighting.** The new energy code requires that 50 percent of all light bulbs in permanently installed fixtures be high efficiency. This analysis assumes this requirement is overlooked for new multifamily construction as it is difficult to enforce. Therefore, for the baseline new multifamily building, this analysis assumes that 15 percent of fixtures are efficient. For the fully-compliant building, this analysis assumes efficient lighting is installed in 50 percent of fixtures.

An analysis based on the above assumptions estimates that the individual leasing an apartment that is fully compliant with 2011 energy code can save on average 325 kWh/year or the equivalent of

\$53/year.^{33,34} Moreover, as shown in Table 5 below, these individual savings add up to a substantial amount of savings for City apartment dwellers estimated at over \$872,000 over the next five years.

Table 7: Savings for Improved Compliance of Multi-Family New Construction

Year	Electricity Savings (MWh)	Energy Cost Savings
2012	303	\$36,665
2013	710	\$86,115
2014	1,254	\$151,598
2015	1,983	\$240,183
2016	2,961	\$357,660
5-Year Total	7,211	\$872,220

Commercial Models

To model the benefits of achieving full compliance with the energy code, this study analyzed the benefits of energy code enforcement for commercial new construction and commercial alterations. Commercial additions were not modeled because so few commercial additions occurred in the City as compared to commercial alterations. This study used data from the Fulton County Tax Assessor Office to determine the basic characteristics of both commercial new construction and an existing commercial building undergoing an alteration.³⁵ This data provided the floor area of the commercial building, the type of building, and the year the building was built in the City of Atlanta. This data and other assumptions described below were used as inputs in the eQUEST software, a free simulation tool developed by Lawrence Berkeley National Labs and funded by DOE, to model energy savings resulting from improved energy code compliance for commercial buildings.

New Commercial Construction

According to data from the Fulton County Tax Assessor, the types of new commercial buildings built in 2009 and 2010 varied widely (e.g., retail, fast food restaurant, office, warehouse, etc.). This analysis assumes that the typical new commercial building constructed in the City is a commercial office space because the commercial office space generally has lower energy use intensity than many other

³³ Because a majority of the units in a multifamily building face the interior, this analysis modeled for an interior unit for the multifamily building. Energy savings are averaged from a bottom, middle, and top level interior unit. *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State*. Energy Information Administration, July 2011. Web. <http://www.eia.gov/cneaf/electricity/epm/table5_6_a.htm>.

Average Retail Price of Natural Gas Sold to Residential Consumers, by State. Energy Information Administration, 2010. Web. <http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html>.

³⁴ Because this analysis did not model exterior units, building-wide savings will likely be greater than estimated. Natural gas savings are not present as the majority of new multifamily units do not include natural equipment or appliances.

³⁵ Brigham, Henry. *2011 Tax Digest*. Atlanta, GA: Fulton County Tax Assessor, 6 Oct. 2011. Txt.

commercial spaces. Because of this assumption, the estimate of energy savings from the analysis will be conservative.

This analysis uses the following specifications to model the baseline average new commercial office building in the City of Atlanta:

- Single-story office building
- Conditioned floor area: 10,000 square feet
- Steel-stud wall construction
- Flat roof
- 13 feet floor to structure height with acoustical tile ceiling at 9 feet
- Total ceiling area: 10,000 square feet
- Gross exterior wall area: 5,200 square feet
- Total window area: 1,040 square feet (20 percent of wall area, oriented equally to the north, south, east, and west)

To determine the savings from achieving full compliance with the energy code, this analysis determined the discrepancies between common construction standards and those mandated by the energy code. Several assessments were conducted on commercial buildings in the City of Atlanta in the Fall of 2011 to determine such discrepancies. Because the commercial assessments were not comprehensive of all commercial construction in Atlanta, energy model assumptions used in this study also relied on the experience gained by Southface through 32 years of experience in the Atlanta area.

This analysis assumes new commercial buildings in the Atlanta area are different than fully-code compliant additions in five main ways. These main characteristics are summarized in Table 8 below and described in the bulleted paragraphs following the table.

Table 8: New Commercial Building Model Assumptions

Feature	Baseline	Fully-Code Compliant
Roof Insulation	R-15	R-20
Windows	0.35 SHGC	0.25 SHGC
Air Sealing	Poor (0.8 ELR)	More Extensive (0.5 ELR)
Lighting	Inadequate Controls	Code Compliant Controls
Water Heating	No timer on circulation pump	Timer on circulation Pump

- **Insulation.** Based on an assessment of compliance with the energy code within the City, roof insulation did not always meet code. This analysis assumes R-15 continuous roof insulation on a new building, whereas R-20 is required to meet the energy code.
- **Windows.** Based on the statewide compliance survey conducted by the Georgia DCA in the Spring of 2011, the majority of commercial buildings throughout the state do not meet the window requirements in the energy code. Product labels with performance specifications are rarely affixed to commercial windows and therefore energy code compliance cannot be

verified.³⁶ This is in large part because commercial windows are typically site-built. This analysis assumes the baseline window has a 0.35 SHGC and the fully code-compliant window meets code with a 0.25 SHGC.

- **Air Sealing.** The commercial code requires that each commercial building be sealed to prevent air infiltration. Because this is often an overlooked requirement in the commercial code, it is rarely complied with and enforced. This analysis assumes that the baseline building has poor air-sealing or a higher envelope leakage ratio (ELR) and that the code-compliant building has improved air-sealing or a lower ELR.
- **Lighting.** Based on an assessment of compliance with energy code within the City, the majority of buildings meet the lighting density requirements in the code. However, many buildings lack the required controls, especially occupancy controls.
- **Water Heating.** The assessments revealed that mechanical systems in the City typically meet energy code. However, our experience indicates that the majority of new buildings that have a water circulation system do not have the required timer on the circulation pump.

Because the average floor area of a new commercial building built in the City during 2009 and 2010 was around 18,000 square feet (instead of 10,000 square feet as assumed in the model), to estimate average energy savings, this analysis multiplied the savings in \$/s.f. by the square foot size of the building.³⁷

An analysis based on the above assumptions estimates that the average new commercial building that is fully compliant with the 2011 energy code can save on average 14,800 kWh/year and 240 therms/year. To estimate energy costs to the building owner, this analysis uses the most recent average energy prices for commercial customers available through the EIA State Energy Profile of Georgia, 10.11 cents per kWh³⁸ and \$1.082 per therm.³⁹ Based on these energy prices, the average building owner can save \$1,760 per year. As energy prices increase, so do monetary savings from compliance with the 2011 energy code. Moreover, as shown in Table 9 below, these individual building savings add up to a substantial amount of savings for City building owners estimated at \$2.5 million over the next five years.

³⁶ Bill Towson. Georgia Department of Community Affairs. Final Report: State Energy Code Compliance Evaluation Pilot Study for Commercial New Buildings and Additions. June 30, 2011.

³⁷ Because the energy-use of commercial buildings is not dominated by loads from the building envelope, i.e., skin loads, estimating the energy savings per square foot is a reasonable method of extrapolating energy savings between two similarly sized buildings.

³⁸ *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State*. Energy Information Administration, July 2011. Web. <http://www.eia.gov/cneaf/electricity/epm/table5_6_a.htm>.

³⁹ This price per therm is higher than the per therm unit rate given by natural gas companies because it includes an amount for surcharges typically included in a natural gas bill. See *Average Retail Price of Natural Gas Sold to Residential Consumers, by State*. Energy Information Administration, 2010. Web. <http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html>.

Table 9: Savings for Improved Compliance of Commercial New Construction

Year	Energy Savings		Energy Cost Savings
	Electricity (MWh)	Natural Gas (Therms)	
2012	1,318	21,275	\$154,907
2013	2,726	43,983	\$316,595
2014	4,222	68,126	\$484,035
2015	5,807	93,704	\$667,927
2016	7,496	120,954	\$861,780
5-Year Total	21,569	348,042	\$2,485,244

Commercial Alteration

Office buildings were by far the most common commercial space existing in the City, followed by retail and warehouses. Therefore, this analysis assumed the alteration was to a commercial office space. The most common alteration of a commercial office space occurs when tenants of a commercial building change. When this happens, the building owner typically does not need to comply with the majority of items required by the energy code (e.g., insulation, windows, air-sealing, HVAC) because they are not replacing the existing systems. However, the majority of owners do change the lighting in the office space.

As in previous models, to determine energy savings from improved compliance with alterations, the analysis assumed what is not code-compliant in baseline buildings. This analysis assumes commercial alterations in the Atlanta area are different than fully-code compliant alteration in one way as shown in Table 10.

Table 10: Commercial Alteration Model Assumptions

Feature	Baseline	Fully-Code Compliant
Lighting	Inadequate Controls	Code Compliant Controls

- Lighting.** As with new commercial construction, the majority of commercial lighting power densities in the assessments met the energy code. However, the controls did not. Therefore, for this model, inadequate controls were assumed in the baseline building and code compliant controls were assumed in the fully-code compliant building.

Because only one change in energy code compliance was found for commercial alterations, this analysis estimated energy savings by comparing the new commercial office building model with a model of the same office building without controls. The average floor area of all commercial building alterations in the City was around 14,300 square feet (instead of 10,000 square feet as assumed in the model). To

estimate average energy savings, this analysis multiplied the savings in \$/s.f. by the square foot size of the average commercial building existing in the City.⁴⁰

An analysis based on the above assumptions estimates that the average commercial alteration that is fully compliant with 2011 energy code can save on average 4,400 kWh/year and would use an extra 45 therms/year. The reason the full-code compliant commercial alteration uses more natural gas than the baseline building is reducing electricity consumption for lighting also decreases the heat given off by lighting. Reducing heat generated by lighting lowers the amount of cooling required during the cooling season but increases the amount of heating required during the heating season. Hence, natural gas consumption will increase. However, overall energy use is reduced by introducing controls.

To estimate energy costs to the building owner, this analysis uses the most recent average energy prices available through the EIA State Energy Profile of Georgia, 10.11 cents per kWh for commercial customers⁴¹ or \$1.082 per therm⁴² or the equivalent of \$394/year. As energy prices increase, so do monetary savings from compliance with the 2011 energy code. Moreover, as shown in Table 11 below, these individual building savings add up to a substantial amount of savings for City building owners estimated at \$8.4 million over the next five years.

Table 11: Savings for Improved Compliance of Commercial Alterations

Year	Energy Savings		Energy Cost Savings
	Electricity (MWh)	Natural Gas (Therms)	
2012	5,865	-60,944	\$524,458
2013	12,108	-125,812	\$1,072,706
2014	18,750	-194,830	\$1,645,318
2015	25,818	-268,274	\$2,267,405
2016	33,338	-346,415	\$2,920,632
5-Year Total	95,880	-996,275	\$8,430,520

⁴⁰ Because the energy-use of commercial buildings is not dominated by loads from the building envelope, i.e. skin loads, estimating the energy savings per square foot is a reasonable method of extrapolating energy savings between two similarly sized buildings.

⁴¹ *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State*. Energy Information Administration, July 2011. Web. <http://www.eia.gov/cneaf/electricity/epm/table5_6_a.htm>.

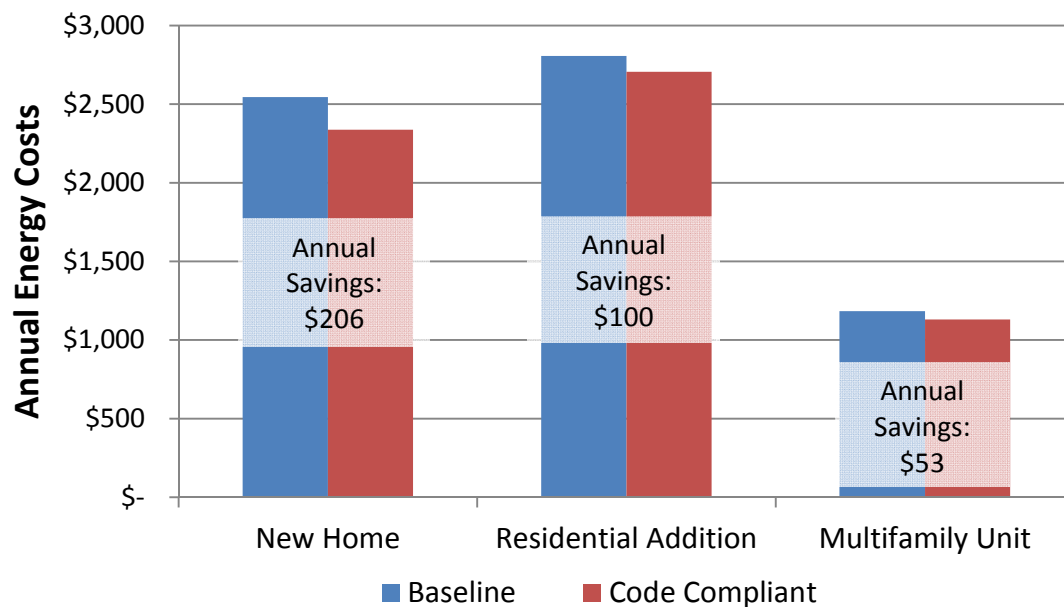
⁴² This price per therm is higher than the per therm unit rate given by natural gas companies because it includes an amount for surcharges typically included in a natural gas bill. Energy Information Administration. See *Average Retail Price of Natural Gas Sold to Residential Consumers, by State*. Energy Information Administration, 2010. Web. <http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html>.

SUMMARY OF ANALYSIS

Economic Development

Achieving full compliance with 2011 energy code will immediately save residents and businesses money by reducing energy consumption, which lowers utility bills. Energy savings increase consumer purchasing power and companies' ability to invest in their businesses, ultimately aiding the City of Atlanta's economy. As shown in Figure 2 below, a homeowner in the residential sector can save \$206/year if their home fully complies with the 2011 residential energy code. A homeowner with an addition can save \$100/year and an individual living in an apartment can save \$53/year. The majority of these savings stem from enforcing quality insulation installation, air-sealing, duct-sealing, and the lighting requirements in the energy code.

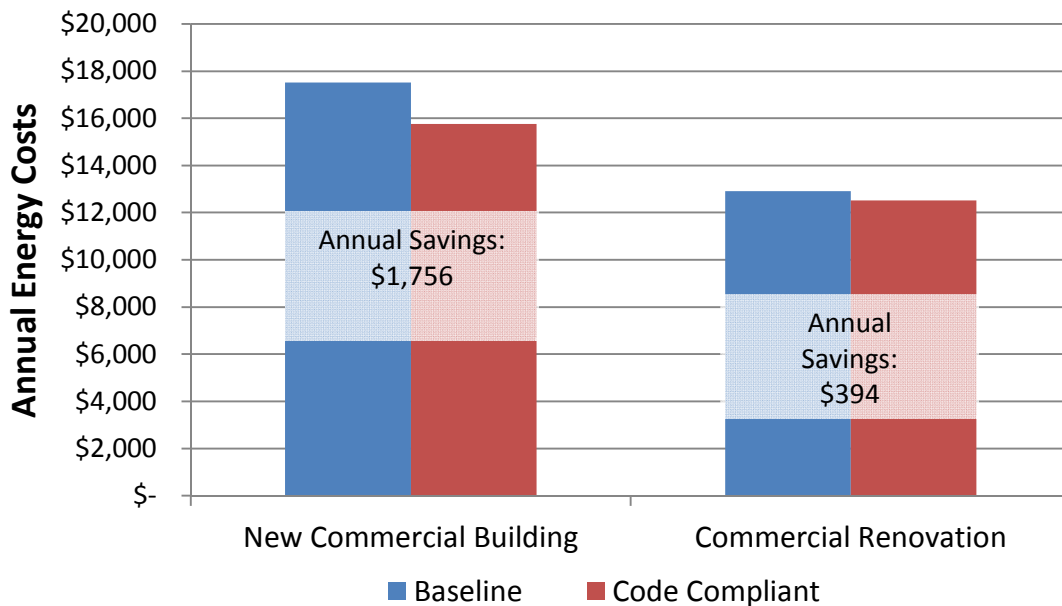
Figure 2: Annual Energy Costs for Baseline and Code Compliant Residential Buildings



In the aggregate, individual savings in residential buildings results in dramatic savings for the community. Over the course of five-years, savings from full 2011 energy code compliance in residential buildings can exceed \$2.7 million for the City of Atlanta.

The owner or operator of a commercial building can also save energy through improved enforcement with the 2011 commercial energy code. The average owner/operator can save \$0.10/ square foot in a new building, with an average savings of \$1,756/year, and \$0.03/ square foot for a building alteration, with an average savings of \$394/year.

Figure 3: Annual Energy Costs for Baseline and Code Compliant Commercial Buildings⁴³



In the aggregate, individual savings in commercial buildings can also result in dramatic savings for the community. Over the course of five-years, savings from full 2011 energy code compliance in commercial buildings can exceed \$11 million for the City of Atlanta.

Based on the construction projection in the City, full compliance with the 2011 energy code can save Atlanta residents and businesses a total of \$13.7 million over only a five-year period. These savings can be applied towards residents’ retirement, expenses, and discretionary spending, as well as businesses’ capital improvements and bottom line. To reap these savings, obviously the citizens of Atlanta must invest in their building department and the construction in their homes to improve compliance with the energy code. Some may say these investments are not worth the savings. However, it has been shown that investments in improving the energy efficiency of buildings are more effective at job creation than investments in manufacturing.^{44, 45} This is because investment in energy efficiency both saves homeowners money overtime and creates jobs within the building sector by boosting demand for skilled professionals whose products and services enable buildings to meet code. Both the jobs and savings have a multiplier effect in the economy. The wages from increased jobs and savings from energy efficiency work are spent in the local economy, thus creating more jobs,⁴⁶ the wages from which are

⁴³ The total annual energy costs for a renovated building may not accurately describe a typical commercial building in the City as it is based on a commercial office building. However, the total annual savings should represent the benefit of installing a light fixture.

⁴⁴ Oppenheim, Jerrold. *Energy Efficiency Equals Economic Development*. Tech. Entergy, June 2008. Web. <http://www.energy.com/global/our_community/advocate/Poverty_book.pdf>.

⁴⁵ *How Does Energy Efficiency Create Jobs?* Issue brief. American Council for an Energy Efficient Economy. Web. <<http://www.aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf>>.

⁴⁶ One could argue that electricity savings take jobs away from the energy production industry. However, it has been shown that energy production employs 10 jobs per \$1 million investment as opposed to the construction or retail which employ between 17 and 20 jobs per \$1 million invested. Therefore money spent to improve the

spent again in the local economy creating more jobs and thus multiplying its effect throughout the economy. For example, if the City improves enforcement of the testing requirement in the energy code, DET verifiers, certified to conduct this testing, will earn wages which they will then spend in Atlanta and homeowners will save money from improved building performance, allowing them to spend in Atlanta.

Error! Reference source not found. details the energy savings by type in both sectors as well as total cost savings. Because this study calculates cost savings using the EIA’s national forecast of electricity and natural gas rates over the five-year period,⁴⁷ actual cost savings experienced by Atlanta residents and businesses could be higher given that Georgia’s electricity rates have increased at a higher percentage than the national average since 2005.

Table 12: Energy Savings and Cost Savings for Improving Energy Code Compliance in City of Atlanta

Year	Residential Energy Savings		Commercial Energy Savings		Total Energy Savings		Total Energy Cost Savings
	Electricity (MWh)	Natural Gas (Therms)	Electricity (MWh)	Natural Gas (Therms)	Electricity (MWh)	Natural Gas (Therms)	
2012	753	33,225	7,184	-39,670	7,937	-6,445	\$821,774
2013	1,626	72,898	14,834	-81,828	16,460	-8,930	\$1,699,353
2014	2,653	121,065	22,972	-126,704	25,625	-5,639	\$2,636,086
2015	3,883	180,407	31,625	-174,570	35,508	5,837	\$3,686,219
2016	5,378	254,554	40,834	-225,461	46,212	29,093	\$4,830,908
5-Year Total	14,293	662,149	117,449	-648,233	131,741	13,916	\$13,674,340

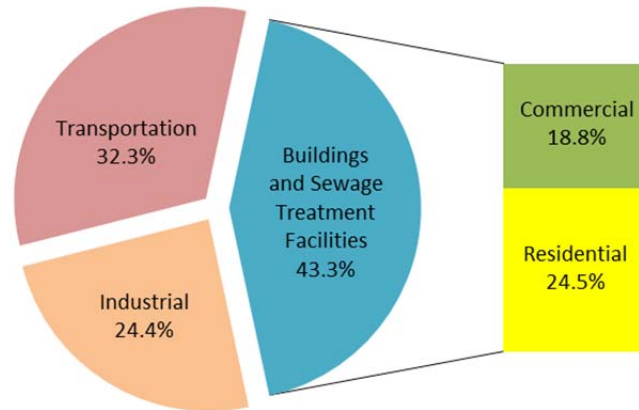
energy efficiency of homes has a net positive effect on the number of jobs. See *How Does Energy Efficiency Create Jobs?* Issue brief. American Council for an Energy Efficient Economy. Web. <<http://www.aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf>>.

⁴⁷ *Annual Energy Outlook 2011: Table 3.5: Energy Prices by Sector and Source – South Atlantic*. Energy Information Administration. Web. <<http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=0-AEO2011&table=3-AEO2011&ion=1-5&cases=ref2011-d020911a>>.

Water Savings

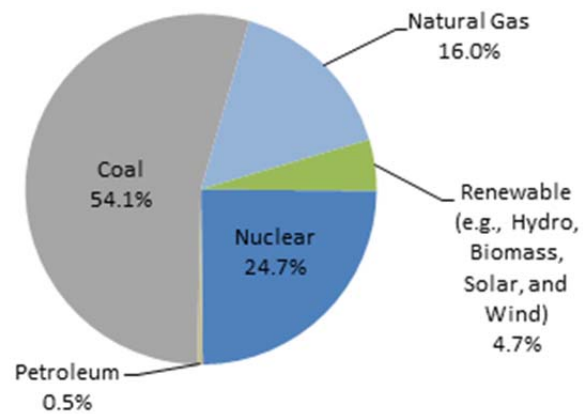
Georgia commercial and residential buildings account for 43 percent of total energy consumption in Georgia as shown below in Figure 4.⁴⁸

Figure 4: Energy Consumption by Sector in Georgia, 2009



Therefore, the building sector is the single largest consumer of energy in the state, and most of this energy is in the form of electricity. Improving energy code compliance in buildings will reduce the amount of electricity consumed. It will also help Georgia better manage its water resources because Georgia's thermoelectric power plants require an enormous amount of water. As shown in **Error! Reference source not found.**, over 95 percent of the electricity consumed in Georgia is generated by thermoelectric power plants that burn fossil fuels or split atoms to produce

Figure 5: Electric Power Generation in Georgia, 2009



⁴⁸ Table C10. *Energy Consumption by End-Use Sector, Ranked by State, 2009*. U.S. Energy Information Administration, 2011. Web. 24 Jan. 2012.

<http://www.eia.gov/state/seds/hf.jsp?incfile=sep_sum/html/rank_use.html>.

The commercial end-use sector, which consists of office, government, educational, religious, and civic buildings, institutional living quarters, and sewage treatment facilities, accounted for 18.8 percent of Georgia's energy consumption. The residential end-use sector, which consists of living quarters for private households, accounted for 24.5 percent of Georgia's energy consumption. For sector definitions, see:

Glossary C. U.S. Energy Information Administration, 2011. Web. 24 Jan. 2012.

<<http://www.eia.doe.gov/tools/glossary/index.cfm?id=C>>.

Glossary R. U.S. Energy Information Administration, 2011. Web. 24 Jan. 2012.

<<http://www.eia.doe.gov/tools/glossary/index.cfm?id=R>>.

heat.⁴⁹ This heat boils water which creates steam that turns electricity-generating turbines. While most of the water withdrawn for electricity production is ultimately discharged back into the environment, there is an amount lost through evaporation. A report by the Union of Concerned Scientists calculates that in Georgia, 0.57 gallons of fresh water is consumed by power plants for every kWh of electricity that is produced.⁵⁰ Improving energy code compliance in buildings reduces electricity consumption in Atlanta which in turn reduces the stress placed on Georgia’s water supply. This study estimates that improved compliance with the 2011 energy code will save 131,741 MWh which would have consumed 75 million gallons of water over a five-year period.

Public Health

A breakdown of Georgia’s electric profile, shown above in **Error! Reference source not found.**, illustrates that the electricity used by Atlanta’s buildings is largely generated by burning coal, which releases harmful pollutants such SO_x, NO_x, and particulate matter into the atmosphere.

Complying with the 2011 energy code can improve public health by reducing the consumption of electricity generated by coal-fired power plants.⁵¹

Table 13 below summarizes the type and amount of emissions that could be avoided by improving compliance with the 2011 energy code.

Table 13: Emission Savings for Improving Energy Code Compliance in City of Atlanta

Year	SO _x (metric tons)	NO _x (metric tons)	CO ₂ (metric tons)
2012	30.8	6.9	5,352
2013	63.9	14.3	11,120
2014	99.4	22.2	17,354
2015	137.8	30.8	24,115
2016	179.3	40.1	31,493
5-Year Total	511.2	114.3	89,434

Nitrogen oxide (NO_x) creates ground-level ozone or smog, which cause respiratory illnesses. Sulfur oxide (SO_x) can also cause respiratory problems and both NO_x and SO_x contribute to acid rain and reduced

⁴⁹ Table 4. State Total Electric Power Industry Net Generation, by Energy Source, 2005 - 2009. U.S. Energy Information Administration, 2011. Web. <http://www.eia.gov/cneaf/solar.renewables/page/state_profiles/excel/rspt04ga.xls>.

⁵⁰ Freshwater Use by U.S. Power Plants Electricity’s Thirst for a Precious Resource. Tech. Union of Concerned Scientists, Nov. 2011. Web. Jan. 2012. <http://www.ucsusa.org/assets/documents/clean_energy/ew3/ew3-freshwater-use-by-us-power-plants.pdf>.

⁵¹ Emissions from coal-powered electricity plants kills over 24,000 people a year and results in over 38,000 non-fatal heart attacks annually. See Paul R. Epstein et al., Full cost accounting for the life cycle of coal in “Ecological Economics Reviews.” (Annals of the New York Academy of Sciences, 2011), 85–86.

water quality.⁵² This study estimates that full compliance with the 2011 energy code can result in avoiding 114 metric tons of NOx emissions and 511 metric tons of SOx emissions, or a total of more than 600 metric tons of NOx and SOx emissions.

Energy code enforcement can also mitigate the emission of 89,434 metric tons of CO₂, a major greenhouse gas. By volume, averted CO₂ emissions are the largest environmental impact of full compliance with the 2011 energy code adoption. Five-year avoided emissions of CO₂ are the equivalent to:⁵³

- Annual emissions from 17,536 passenger vehicles;
- Carbon sequestered from 19,000 acres of pine forest annually;
- Emissions from burning 208,000 barrels of oil; or
- Emissions from burning almost 500 railcars of coal.

Not only can full compliance with the 2011 energy code help the outdoor air quality in the City of Atlanta, it can also improve the air quality inside compliant buildings. This is in large part because holes exist between our living spaces and other unhealthy and/or humid locations like attics, crawlspaces, or the garage. Improving energy code compliance can improve indoor air quality by sealing these holes, which reduces air infiltration from unhealthy and humid areas. The resultant improved air quality reduces health risks for children, the elderly, and those with respiratory illnesses like asthma by reducing dust and dust mites, mold spores, radon, rodents, insects, and combustion by-products.

Comfort and Future Energy Performance

More than half of all homeowners are dissatisfied with the comfort in their home. In addition, comfort is becoming more of a priority as individuals stay in their home for a longer time.⁵⁴ Fortunately, homes that comply with the 2011 energy code requirements and related requirements in the international residential code (IRC) provide much greater year round comfort. These homes have reduced outdoor noise, stuffy/muggy air, condensation, excessively dry air, and hot and cold areas.

Ensuring full compliance with the 2011 energy code not only improves the comfort of a home, but it also ensures its long term energy performance. For example, the IRC requires that duct systems in homes meet certain performance standards. This is an important feature in energy code-compliant homes because poor duct design can negate the performance of energy efficient HVAC systems, which are designed to work optimally with proper duct systems.⁵⁵ In fact, new energy efficient equipment, specifically equipment with a variable speed motor, installed in ductwork that does not meet code requirements may use more energy than the old inefficient equipment it replaces. Ductwork that does not meet code requirements has more restrictions to air flow. Unlike older systems, efficient HVAC systems with variable speed equipment have the capacity to overcome these restrictions so that they

⁵²Noonan, D. and Chiroco, J. Air Today, Gone Tomorrow: Atlanta's Air Quality Past and Future. <<http://www.prism.gatech.edu/~dn56/AirToday.GSU.pdf>>.

⁵³ This equivalency was estimated using the U.S. EPA's Greenhouse Gas Equivalencies Calculator.

⁵⁴ Upton, G. *What Your Customers Want?* Decision Analyst. Web. <http://www.decisionanalyst.com/publ_art/cuswant.dai>.

⁵⁵ Ueno, K. "ECM Motors Better (Or Worse) Than You Think." *Home Energy*. May/June (2010): 34-38.

can deliver adequate air flow to each room to ensure occupant comfort. However, overcoming these restrictions also means that these efficient HVAC systems use more power to push air through the system. Therefore, the new energy efficient HVAC systems typically use more power when installed on a poorly designed duct system. Because this new energy efficient equipment will become the norm and because duct systems are rarely replaced, it is important that ducts be designed well from the start.

APPENDIX A: RECOMMENDATIONS FOR EFFECTIVE ENERGY CODE IMPLEMENTATION

At a time of increasing uncertainty, full compliance with the 2011 energy code presents the City of Atlanta with a win-win opportunity. First, full compliance can save City residents and businesses \$13.7 million over a five-year period. Aside from these direct monetary savings, which can be spent on consumer items or capital improvements, full compliance with the 2011 energy code can only occur through the employment of qualified building professionals. So, full compliance with the 2011 energy code has a multiplier effect resulting in both monetary savings *and* increased employment.

To further the win-win proposition, energy savings also improve the quality of life for Atlanta residents. Energy code compliance will improve the air quality in Atlanta by consuming less electricity (as compared to the baseline scenario) that is generated by coal-fired power plants. This can reduce the number of hospital visits from respiratory, heart, and related illnesses. Other benefits of improved compliance include better indoor air quality, a more comfortable home, and improved long term energy performance.

To improve the enforcement of the 2011 energy code, technical advisors from industry stakeholders formed a taskforce with the City of Atlanta Office of Buildings. After seven meetings in 2011, this taskforce developed a list of key recommendations, including:

- Inspector cross-training and inspector consolidation;
- Use of checklists and field guides;
- Required submittal of the energy code compliance certificate;
- Careful review and required submittal of load calculations and duct designs; and,
- Required submittal of COMcheck⁵⁶ report for commercial projects.

These recommendations summarized below, are discussed more detail in a separate document titled: Removing Barriers to Compliance: Energy Code Compliance Taskforce.

Residential Recommendations

Inspector cross-training and inspector consolidation will improve compliance with the 2011 energy code as inspectors will see the building as a system instead of as separate parts. This systems view of a building is important in making sure the air-sealing and insulation requirements in the code are met. In addition, as building inspectors receive more training (DET Verifier, BPI Building Analyst, etc.), they will better understand how to inspect for the air-sealing and insulation requirements in the code.

The use of checklists and the field guides will also help code officials improve compliance with the air-sealing, duct-sealing, and lighting requirements in the 2011 residential energy code. Checklists are used in every industry where complexity is inherent. They have enabled pilots to fly aircraft more safely and

⁵⁶ COMcheck is an energy simulation tool developed by DOE that can show whether a building's design is in compliance with the commercial energy code. This tool can also be used to conduct simple trade-offs within the building envelope or lighting system.

reduced the rate of fatalities from surgery by a third.⁵⁷ Buildings are complex systems and energy codes are ever changing. A checklist in concert with the residential field guide, which has key insulation and air-sealing diagrams, will help inspectors check whether every single item in the 2011 residential energy code is met in every building.

So that the mechanical requirements in the 2011 energy code are met, the taskforce recommends that the City require load calculation and that duct designs should eventually be submitted to the City. The taskforce recommends that a trained professional review these submittals so that the industry becomes adept at accurately performing these calculations. In addition, the taskforce recommends that the City require the submittal of the compliance certificate that summarizes the load calculation results and testing results, further aiding in compliance of these requirements.

Commercial Recommendations

For commercial projects, the submittal of COMcheck will make sure the insulation, lighting, and window requirements in the 2011 energy code are met for two reasons. One, the individual providing specification for the projects will be able to see whether their project meets energy code through COMcheck. Second, the plans reviewer can use the report to review plans and the field inspector can use the inspection checklist provided by COMcheck to field verify that requirements are met.

⁵⁷ Gawande, Atul. *The Checklist Manifesto: How to Get Things Right*. New York: Metropolitan, 2010. Print.