# Architects' Precipitate Claim of Emissions Influence

NATHAN RICHARDSON
Oklahoma State University

As the significance of energy and environmental issues are gaining prominence of an historic nature, it is no surprise that many actors in the economy are striving to define their spatial relationship to a potential solution. This is particularly evident as one considers the design and construction industry. A multiplicity of sources cite buildings and their associated energy consumption and greenhouse gas emissions as accounting for about half of the total anthropogenic factors of climate change. Accordingly, many in the design profession are presenting themselves as the central agents of change in order to avoid what some say is a "doomsday scenario" by the middle of the twenty-first century. While these impassioned efforts are admirable, this paper seeks to add gravity and specificity to just that portion of carbon-dioxide emissions and energy consumption that actually falls within the architect's sphere of action. What precisely is within the architectural profession's purview, and by extension, what is its' potential role in curbing energy consumption and greenhouse gas emissions? While the commercial sector is no small opportunity for impact, it is the residential sector that belies the claims made by many that architects should or even can be the central figures in addressing these complex issues. While one could argue that the residential building sector accounts for nearly 25% of emissions and by extension, architects have a commensurate opportunity to revise current trends, even a cursory look at the evidence exposes the sophism embedded in such a claim. This paper pegs the architects' influence over residential energy and emissions closer to 2.8%. This analysis presumes a fairly traditional conception of practice and is not intended to serve as an abdication of responsibility for those practicing architecture; more importantly, it aims to serve as a base from which to derive new models of practice that expand the profession's sphere of influence.

## INTRODUCTION

In the *Rough Guide to Sustainability*, Brian Edwards summarizes an increasingly familiar and ominous picture for anyone planning to live beyond the next thirty years. The "doomsday scenario" in 2050 is qualified by unbreathable air, exhausted fossil fuels, and an unlivable planet.[1] Lest this author relax, knowing they will have reached the ripe old age of seventy-two by that time, the World Health Organization has already attributed 150,000 deaths per year to global warming.[2] With such dire assessments abounding, it's no surprise that many are clamoring for solutions. Most industries are assessing their role in creating and solving these issues and some are making remarkably strident claims about their ability to confront this challenge. One such segment that has very substantive reasons to make such claims is that design profession often represented by the American Institute of Architects (AIA). Consider the following excerpts from "Architects and Climate Change".

> In our quest to dramatically cut greenhouse gas emissions and lessen our dependence on fossil fuels, we have overlooked the biggest source of emissions and energy consumption both in this country and around the globe: buildings and the energy they consume each year. *Buildings and their construction account for nearly half of all greenhouse gas emissions and energy consumed in this country each year…*

> Design and designers are at a unique position in the history within the United States and globally. Design can, within this next generation, illustrate that *architects and planners are not only agents of the change toward sustainability but quite possibly the most central and effective agents for making this change happen*.[3]

These pronouncements seem quite plausible on one hand and quite unbelievable on the other. To state that buildings account for 48% of greenhouse gas emissions and—by nature of their involvement in design and construction—that architects are in a position to lead is quite rational on a superficial level. And yes, relative to the opportunities of other professions to affect the emissions produced through the built environment, architects are in a unique position to initiate meaningful change. There are, however, other key factors to consider. The profession of architecture would do well to give them meaningful consideration before representing themselves as the saviors of the world in the face of the climate change threat. There are two primary conditions that comprise an alternate argument: first, the many drivers that shape the form and impact of our built environment on climate change are not entirely at the hand of architects; second, architects' simply don't act in a vacuum. Consider the following illustrations.

First, it is important to use more accurate language in the discussion of the profession's responsibility in the face of climate change. To focus on buildings specifically is only constructive to the extent that it identifies an opportunity for impact. While a significant portion of greenhouse gas emissions can be allocated to buildings, more fundamentally it is people and organizations that construct, inhabit, and operate these buildings. We quite simply shouldn't overlook the human condition on energy consumption and emissions. To draw a comparison, it is similar to stating that transportation represents 27% of greenhouse gas emissions and therefore car designers are uniquely positioned to lead the way in reducing those emissions. Even if the car designer has some control over the base efficiency of a given car model, they have less control over the method in which it is manufactured, and very little control over the extent and manner in which it is driven, maintained, and the length of its useful lifetime; all of these factors would have a considerable impact on the real efficiency of the automobile and by extension, its emissions. Furthermore, auto manufacturers often respond to regulatory policies that require certain environmental advancements. Obviously, auto designers aren't the sole initiators or authors of climate sensitive design.

Second, it is important to note the critical role of the client in the process of realizing meaningful change in the building industry. In many respects the client represents a demand within the free-market economy for buildings that the architect is compelled to address. While today's architects have a significant opportunity to educate the market, the profession on the whole doesn't seem to have been effective in so doing. Although it's an increasingly worn critique, the position of the architect in the design and construction industry has seen meaningful erosion over the last few decades. The procedural imposition of construction managers, environmental consultants, and government regulation via land use and other policies can't be set aside. Fundamentally, architects are not independent authors acting in a vacuum and as a result it's critical that their responsibility in the realm of sustainability is measured with a critical awareness of context.

The third and primary illustration is more quantitative in nature and will be the focus of the remainder of this paper. There is a paradox within the claims cited in the AIA documentation above and it is as follows. Within the 48% greenhouse gas emissions assigned to buildings, roughly 21% can be assigned to commercial and 25% to residential.[4] Of the two, not only is the residential sector more significant, but it's precisely the arena in which architects currently play a relatively minor role. This is in part a function of the market and the legislative framework in which the market operates. Regulation in many states simply doesn't require the services of an architect in much of residential design, and if it does, profit margins are so thin as to place real limits on the extent to which sustainable technologies can be explored and implemented. As a result, it is essential for the profession to accurately quantify their current opportunity for impact within this 48% building emissions framework. In so doing, the profession has the opportunity to place their role as an agent of change in a more realistic light. Furthermore, this analysis will identify ways in which the profession can expand its ability to make positive changes in the built environment towards sustainability—particularly in the residential sector.

## QUANTIFYING ARCHITECTS' INFLUENCE

### Residential Sector Engagement

In an effort to more precisely establish that portion of greenhouse gas emissions that are within the architect's purview, this paper will focus on carbon dioxide ($CO_2$) and energy consumption. This is primarily due to the availability of data and the highly significant role $CO_2$ plays in the emissions picture. In 2007, the U.S. Environmental Protection Agency's Energy Information Administration estimated a total of 7,282 million metric tons (MMT) of anthropogenic greenhouse gas emissions. Of this total $CO_2$ was the most significant part, representing 5,917 MMT or 81.3%.[5] According to the same source, 1,261 MMT of $CO_2$ can be attributed to the residential sector. This represents about 21% which is noticeably less than the 25% figure noted above. This is due to the AIA's incorporation of additional factors such as embodied energy and transportation. In order to better understand the full range of components comprising the residential $CO_2$ emissions picture, the following insightful case study will first be addressed.

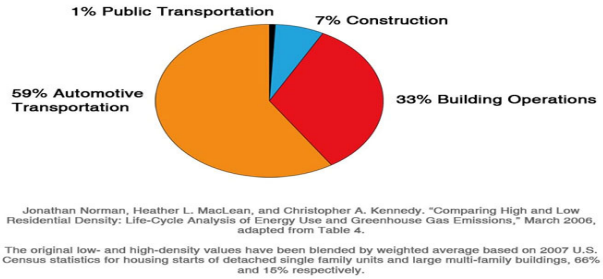


Figure 1: The life cycle components of energy use and emissions based on a 50-year life cycle for low and high density residential buildings.[7] (Illustration by author)

In a 2006 study[6] of low and high density housing in Toronto, by Jonathan Norman, et al., the following components of residential $CO_2$ emissions are demonstrated. Initial figures were based on annual GHG emissions over a 50 year life span.

These figures will serve as a basis for understanding the components of residential greenhouse gas emissions. If one considers the EPA figures noted above (1,250 MMT $CO_2$ represents building operations (consumption) and accounts for roughly 33% of emissions) and the 40% subtotal for building operations and construction cited in the figure above, it is clear that a reasonable argument can be made that 1,516 MMT of $CO_2$ emissions or 26% could be reasonably attributed to the residential sector of total U.S. emissions. This confirms, based on slightly different data sets, the general plausibility of the information presented by Mazria and the AIA. As such, one can move forward based on the understanding that residential emissions—including construction and operation—represent approximately 1,516 MMT of $CO_2$. Before one can dissect the construction and operations component of emissions however, this figure must be discounted based on the limitations in the practice of architecture within the residential sector.

It's clear that the residential sector is a significant component of the U.S. $CO_2$ emissions picture, and yet, the relatively minor role architects play in this segment of design has been a point of longstanding awareness. According to the 2006 AIA Firm Survey, residential design billings only accounted for 18% of total billings in 2005, which was up from only 12% in 2002 and 9% in 1999.[8] While this billings information portrays the minimal fee architects receive through residential design and construction, it isn't the entire picture. One must also consider the scope of architects' involvement in the design of the residential sector. Admittedly, the number of homes designed by architects is a difficult number to pin down.

> "The problem-and I hate to be Bill Clinton here-is the term design a home," says Kermit Baker, chief economist of the American Institute of Architects. "Theoretically, an architect could say, 'I designed a model home for a builder, and they made 5,000 of them. So did I design 5,000 homes or not?' There is a huge continuum, and that's why it's so difficult to put a figure on it. To some extent, it's one hundred percent; to another extent it's as low as two percent." The most accurate number, if we're talking about new single-family houses that have "significant architect involvement," is 28 percent, according to Baker's 2001 AIA report based on the institute's survey of firms and U.S. Census data.[9]

Clearly there is a broad range in the extent to which architects are involved in residential design. If 28% is the most accurate number to consider with respect to single family residences only, then this would most reasonably represent the lowest figure in the residential sector as a whole—due to the more common regulatory requirements for architect's involvement in multi-family design. Ac-

cording to the U.S. Census, from 2001 to 2007, detached single family construction accounted for no less than 66% of the unit housing starts.[10] Therefore, even if architects are directly involved in the design of the other 34% (being multi-family) which seems unlikely but plausible, architects' involvement in the entire residential sector wouldn't amount to more than 53%.

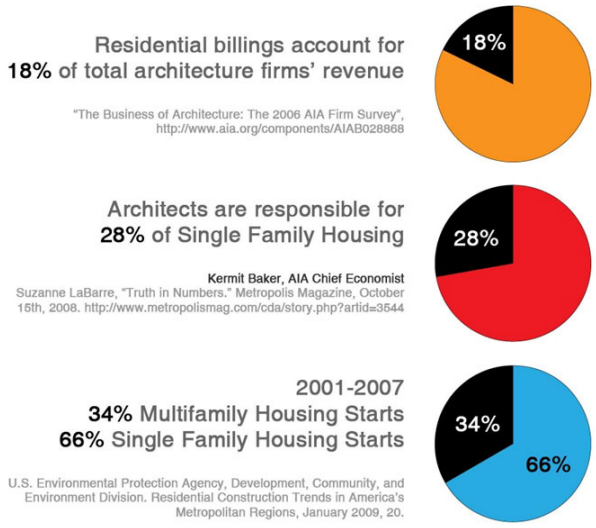


Figure 2: Architects' involvement in the design of residential building and construction.[8,9,10] (Illustration by author)

So, in spite of the fact that the residential sector is a key component in addressing the $CO_2$ emissions picture, that portion within the purview of architects would likely not amount to more than 803 of the roughly 1,516 MMT $CO_2$ previously identified as residential sector specific. Of that figure, just what impact can architects most reasonably expect to make?

**Transportation**

In many cases, when an architect becomes involved in a project, a site has been selected and a rough program is taking shape. In reality, many clients know what they plan to build and where they intend to build before they consult a design professional. As a result, those emissions that would be the result of transportation to and from a given residence are generally foregone conclusions. Even if an architect has some input in locating a structure with favorable connections to mass transit and employment opportunities, they simply have too little control over the real transportation decisions of the eventual end-user. As a result, the substantial 42% of residential sector emissions that result from the inclusion of the transportation component simply isn't based in reality. Therefore, this analysis has not included the additional 2,240 MMT $CO_2$ that could be attributed to residential development based on transportation. As such, we remain at the 803 MMT $CO_2$ previously discounted to account for architect's involvement in only 53% of residential design and construction.

The only remaining segments of emissions are construction and operation. According to the case study cited above, operation accounts for roughly 80% of this subset (construction being the other 20%). These two components are clearly within the architect's sphere of influence, but to what degree? Certainly the architect makes many important decisions regarding the materials used in construction, but doesn't have quite as much control over how materials are produced and the manner in which a building is erected. And of course, the architect makes many decisions that will have some impact on how efficiently a building can operate, but less impact on how efficiently a home is actually operated.

**Construction**

First, consider construction. It is estimated that only 3% of total energy use occurs during construction. Compare this to 50% of energy used to operate buildings.[11] As such, the construction segment of the energy and emissions picture appears relatively insignificant. This is also illustrated as one considers the life-cycle costs associated with construction and operation. It is similarly estimated that the cost of construction represents only 17% of the total cost including operation over a fifty year period.[12] Furthermore, the comparative study of low and high density residential construction identified only 7% of $CO_2$ over the life of a structure as a function of construction. Therefore, the bulk of the emissions picture resides in operation, not construction of facilities. While these sources confirm the relatively minor role construction plays in the larger emissions and energy picture, in reality an architect's ability to reduce $CO_2$ emissions is even smaller.

The biggest factor in an architect's ability to make a dent in construction energy and emissions is not represented by construction itself, but in the abil-

ity to choose between certain segments of the construction industry. In a study synthesizing research into primarily wood, concrete, and steel houses, embodied energy estimates were found to range from 325 GJ for wood, to 375 GJ for concrete, and 525 GJ for steel.[13] If one considers a choice between houses which are predominately constructed of these materials, it is evident that one can influence energy consumption within a range of approximately 38%. While the precise number may be disputed, the fact remains that architects are rarely in the position to choose materials "xyz" over none, but instead choose materials "xyz" over "abc", for instance.

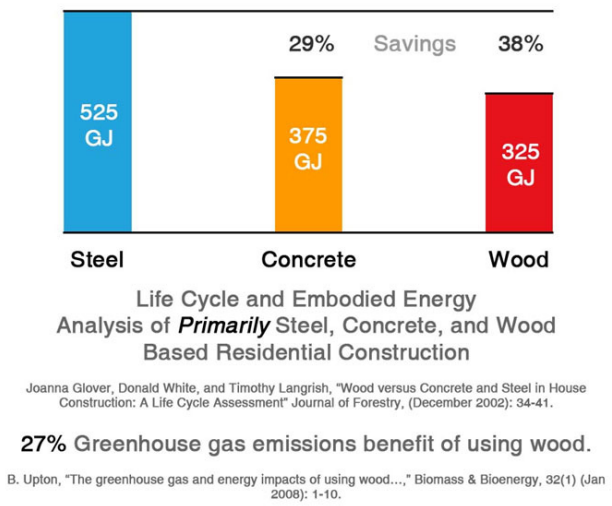


Figure 3: Life cycle and embodied energy analysis of alternative systems and materials in residential construction.[13,14] (Illustration by author)

As a result, it's quite plausible that within the construction subset of emissions, architects may have as little opportunity for impact as 38%. According to another study it is estimated that the potential benefits of using wood based building materials could account for 22% of embodied energy and 27% of embodied greenhouse gas emissions.[14] So, it appears likely that no more than 20-40% of embodied energy and $CO_2$ emissions are within the architect's "construction" sphere of influence. Of the 161 MMT $CO_2$ represented by residential construction in which architects are involved, only **32-64 MMT $CO_2$** would represent their real impact for change. And one could contend that this figure is optimistic, given the extent to which building codes in the United States determine methods and materials in construction and the extent to which wood—as an economically and environmentally favorable material—is already in use.

## Operations

Naturally the operational component is more difficult to establish. But similar logic follows. Let's take lighting for instance. The architect can choose to incorporate energy conserving fixtures and sufficient natural light in an effort to minimize energy consumption, but one can't control the real extent to which they are in operation, much less omit them altogether (except in rare circumstances). Similarly, the architect can with the consulting engineer specify energy efficient mechanical systems and, for a given level of consumption, reduce energy use and greenhouse gas emissions. But most commonly, local weather and climate makes the systems' inclusion a practical prerequisite to design regardless of other efforts to control heat gain, heat loss, etc. Of the emissions attributed to operations, to what extent can architects' expect to make a significant impact? According to the Energy Information Administration, residential space heating and cooling accounted for a combined 492 MMT $CO_2$. This represents about 32% of the 1,538 MMT $CO_2$, being that portion of emissions that are due to residential projects. If we also add in lighting which some sources say is approximately 25%[15] of energy consumption and clearly within the realm of an architect's authorship, we reach 57%—say 60% of the operational emissions. As in the case

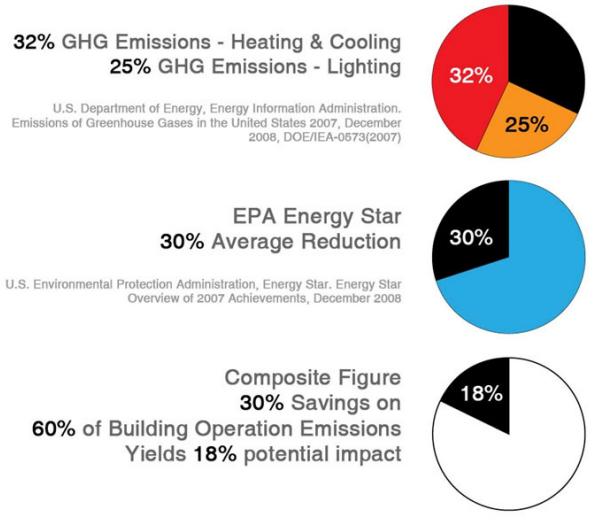


Figure 4: Operational components of influence.[15,16] (Illustration by author)

of building materials and construction, a designer is once again choosing efficient systems over relatively inefficient systems, not omitting the energy consumption altogether. To what extent could these emissions reasonably be reduced? Consider EPA's Energy Star which began rating homes in 2000; by 2007 approximately 840,000 homes were registered under their rating system. Under the residential system, Energy Star claims homes can reduce their energy use by 30%.[16]

Certainly there may be more aggressive strategies to reduce emissions that are and should be explored, but in the residential sector where economic limitations are a fundamental reality, it appears that a 30% increase in efficiency is reasonably accessible. As a result, one could claim that an architect might have the ability to impact 30% of the operating emissions through efficient strategies in lighting, space heating, and space cooling. Since these elements amount to approximately 60% of operations (642 MMT $CO_2$) or 385 MMT $CO_2$, it is reasonable to conclude that an architect's opportunity for impact, through increased efficiency might be **116 MMT $CO_2$**.

## CONCLUSION

In conclusion, one might appropriately argue that architects (and their consultants) based on the residential component of the energy and emissions data, can't realistically claim to be at the forefront of solving the climate change crisis. Even though the profession can highlight the 48% of greenhouse gas emissions (of which residential represents 25%) accounted to buildings, it severely over-represents their ability to shape change. While this figure would place 1,479 of the 5,917 MMT $CO_2$ U.S. emissions at the hand of architects, it simply isn't the case. In an admittedly cursory fashion, this analysis illustrates the limitations on architects' ability to initiate that change, and more realistically quantifies the profession's ability to impact emissions in the residential sector at **148-180 MMT $CO_2$**. This figure represents 2.8% of greenhouse gas emissions which, though statistically significant, is much less substantial than the 25% figure commonly cited. And it's certainly in the profession's best interest to acknowledge the distinction.

The point here is not to relegate responsibility. Clearly there are areas in which architects in the residential realm can have a substantial impact. But it would be a fundamental mistake to claim responsibility, leadership and control where relatively little actually exists. By honestly acknowledging the exiting limitations on an architect's ability to impact energy emissions in the U.S. residential sector, one can more effectively find new frontiers to creatively implement solutions to the problems our societies face. Underpinning this entire analysis is a fairly narrow, however common view of architectural practice and industry engagement. As such, the discussion inversely illustrates latent opportunities for architects to influence the trajectory of the built environment. There are a growing number of architects who recognize the inherent limitations in the traditional conceptualization of their professional role. These professionals have expanded their scope of services in order to become more effective agents in creatively implementing their ideas with respect to design and the environment.

On a broad scope, this paper inversely illustrates proximate arenas in which emissions and climate change could be addressed, but aren't currently engaged by the profession to any large degree. Among these opportunities are the following. Engage in public service to aid in shaping public policy, building codes, transportation plans, and infrastructure investment. Collaborate more critically with the manufacturing and construction industries, thereby shaping products and practices in an environmentally sensitive way. Participate as an equity stakeholder in development driven models of built enterprise, while leveraging market-driven opportunities for reshaping patterns of development, return, and property management, for instance. Some firms have begun to make similar shifts in a tangible and profitable fashion. Through an expanded role in the design and construction industry, they have managed to implement ideas that would have most certainly been outside their natural control as architects burdened by more common models of professional practice. Among the most recent successful examples of this expanded practice are Jonathan Segal in San Diego[17], KRDB in Austin[18], and Randy Brown in Omaha.[19] For those that grow impatient with the superficial claiming of responsibility and leadership on climate change found among the majority professional class and are alternatively motivated to find real opportunities to bring change, this emerging view of practice may indicate enhanced opportunities for impact, not simply claim them when they don't yet exist.

## ENDNOTES

1 Brian Edwards, *Rough Guide to Sustainability,* 2nd ed. (London: RIBA Enterprises, 2005), 5.
2 Ibid., 3.
3 Edward Mazria and the American Institute of Architects, "Architects and Climate Change", quoted in, Daniel E. Williams, *Sustainable design: ecology architecture, and planning*, (Hoboken, New Jersey: John Wiley & Sons, 2007), xvi-xvii. *Emphasis added*.
4 The additional 2% is attributable to the industrial buildings sector. These percentages are based on the EPA Energy Information Administration statistics presented by Edward Mazria AIA, of Architecture 2030 in "The Building Sector: A Hidden Culprit", http:/www.architecture2030.org/current_situation/building_sector.html
5 U.S. Department of Energy, Energy Information Administration. *Emissions of Greenhouse Gases in the United States 2007*, December 2008, DOE/IEA-0573(2007), 1.
6 Jonathan Norman, Heather L. MacLean, and Christopher A. Kennedy. "Comparing High and Low Residential Density: Life-Cycle Analysis of Energy Use and Greenhouse Gas Emissions," March 2006, adapted from Table 4. Please note, the original low- and high-density values have been blended by weighted average based on 2007 U.S. Census statistics for housing starts of detached single family units and large multi-family buildings, 66% and 15% respectively. See also note 9.
7 Ibid.
8 "The Business of Architecture: The 2006 AIA Firm Survey", http://www.aia.org/components/AIAB028868
9 Suzanne LaBarre, "Truth in Numbers." *Metropolis Magazine*, October 15th, 2008. http://www.metropolismag.com/cda/story.php?artid=3544
10 U.S. Environmental Protection Agency, Development, Community, and Environment Division. *Residential Construction Trends in America's Metropolitan Regions*, January 2009, 20.
11 Brian Edwards, *Rough Guide to Sustainability*, 22-23.
12 Ibid., 23.
13 Joanna Glover, Donald White, and Timothy Langrish, "Wood versus Concrete and Steel in House Construction: A Life Cycle Assessment" *Journal of Forestry,* (December 2002): 34-41.
14 B. Upton, "The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States," *Biomass & Bioenergy,* 32(1) (Jan 2008): 1-10.
15 Brian Edwards, *Rough Guide to Sustainability*, 192.
16 U.S. Environmental Protection Administration, Energy Star. *Energy Star Overview of 2007 Achievements*, December 2008, http://www.energystar.gov/ia/partners/publications/pubdocs/2007%20CPPD%204pg.pdf
17 Fred A. Bernstein, "Doing it all (and raking it in)," *Architect*, 96 no. 10 (September 2007): 63-66; http://www.jonathansegalarchitect.com, http://www.architectasdeveloper.com
18 Murrye Bernard, "KRDB: The art of the deal" *Architectural Record*, (December 2007): 43; http://www.krdb.com/
19 Anita Moryadas, "Developing Savvy" *Architecture*, (February 2006): 24-25; http://www.randybrownarchitects.com, http://www.moderneco-homes.com