EFFICIENCY AS PRODUCTIVITY

A conversation with Craig Schwitter

Actually, we have extra.

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The Un-expected_An architecture of Efficiency. Image courtesy of Estban de Backer.

This interview is the fourth in a series of interviews conducted by Esteban de Backer to question the status quo of efficiency in architecture. This interview was also conducted with Janette Kim, *ARPA Journal* editor.

With over 20 years of experience, Craig Schwitter is a leader in the engineering design of complex buildings and large scale developments that include educational, performing arts, cultural, civic, stadia, transportation, and master planning projects. Craig founded the first North American office of BuroHappold Engineers in 1999. Under Craig's leadership, the North America region offices expanded to offer a full suite of engineering arts including: structural, MEP, geotechnical and façade engineering, lighting design, fire and life safety, sustainability consulting, and sustainable master planning services.

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JANETTE KIM: The next issue of *ARPA Journal* is on performance. We're asking how architects and engineers evaluate the outcomes of their designs, and understand the relationship among diverse criteria. How do you, as somebody who works with energy efficiency, define the terms of performance relative to things like cost savings, carbon impact or client benefits?

CRAIG SCHWITTERS: I think there is a desire to work quantitatively today because of the nature of our generation. It's not just that people want to think in dollars and cents, or that everybody is an accountant all of a sudden. I think it's happening because we have become accustomed to quantitative reasoning. Today the economic driver of what we do is better understood...I love the show *Freakonomics Radio*, for example. It's amazing!

JK: It's a big part of our culture.

CS: It's one of the most popular podcasts on National Public Radio, and in many respects it's about the quantitative reasoning of our habits. The show cleverly explores how data can be better analyzed for patterns and show us what is more or less efficient in society —whether it is renting a house, using energy or even buying a cup of coffee.

JK: We are not the population we thought we were.

CS: Exactly. I'm not saying that everybody is an economist *per se*, but I think *economist* is at least a better term for this tendency than *accountant*. Economists search for some form of truth in numbers rather than simply count what the numbers are. If you think about building performance from that perspective, it starts to get interesting. As professional engineers, we can quantitatively assess the amount of energy or carbon coming out of a building, or the cost of the building, but I think we all know that those metrics are flawed because they often do not count externalities and don't tell the whole story. For example, the price of gasoline you pay to fill up your car is not really the true price of gasoline because it is subsidized in various ways—by military and other types of government spending. If we included the cost of the U.S. military in the cost of gasoline, it would surely be higher than the current cost at the pump!

And although we know that externalities are not necessarily priced, we also know that everybody is becoming a more educated economist. Systems like LEED, the Living Building Challenge or even ENERGY STAR are forming important benchmarks along the way. They're becoming more and more rigorous, but externalities still remain key to decision making. For instance, energy performance in a building obviously has a money-saving aspect to it, but the true economic value lies in completely other areas of design. For example, of the overall cost of an office building over a thirty-year period, capital costs amount to about 10 percent and energy might total 5 percent, but the salaries of the people within the structure will come to something like 85 percent. So, for a company that invests in a $50 million headquarters building, the costs of the human capital is going to be eight to nine times that over the course of thirty years—that's human capital thinking in a chair, having a cup of coffee in the atrium, collaborating with colleagues to invent a new product design or whatever the case may be. When you start to think of it this way, your whole idea of performance totally changes. If you ask, "How do I get fewer sick days out of people?" and "How can I get more productivity out of my talent?" a company owner just gets it. Now, is energy efficiency part of that puzzle? I think it absolutely is, because it's part of the culture of a high-performance workplace rather than a performance issue. In other kinds of buildings, too, you would probably have different metrics for other elements like health. The cost of indoor air quality affects a buyer's perception of a residential property, for example.

These ideas of productivity are out there; they're not formally qualified yet, but there is lots of activity in this space. It's coming, and it drives back to this idea that we are all, especially today's generation of architects, more educated economists today. This is, to me, a very important change in the marketplace.

JK: I love the *Freakonomics Radio* reference because it captures the way we think culturally. Not only does one manager, as a client representative, calculate the cost of construction through cost-benefit analysis, but we have also started to expect that the numbers will give us a counterintuitive sense of what's happening. This is fundamental to the *Freakonomics* logics.

CS: Maybe we look for some form of truth in those projections because there's so much spin; so many opinions. I see the younger generation of architects today, such as SHoP and BIG, for instance. Their pitches are all about economic drivers for design: the perception of economics, the strategy of development and the sites at which value can be

unlocked. Did the previous generation of architects pitch that way in the 70s and 80s? I wasn't around professionally at that point, but it doesn't seem the focus was the same.

In the context of what we can do as engineers, we are dragged along by the marketplace and see where we can maybe make a difference.

ESTEBAN DE BACKER: I think the two offices you mention, SHoP and BIG, promote pragmatic thinking in terms of the market economy, but in a way that requires immediacy, like a value you rapidly assess. It's as though when you invest, you want your money back as quickly as possible. In contrast, the way you talk about efficiency and performance is more deferred in time. What would this mean for an investor? If the program of a building or its ownership changes, how does the immediacy that the market requires address a long-term way of thinking? How can we, as cultural thinkers rather than as investors, address these different interests?

CS: I don't think these firms necessarily promote short-term thinking on the part of value. I think they look at quite long-term thinking, or locked-in value, whether a property is held for a long time or sold off immediately. We have seen owners develop a headquarters building under the guise of, say, LEED, to attract a company. Then once the company moves in, they sell the building to them for the next twenty-five years and cash out. There is absolute value there. Is it the type of value that you can track in dollars per square foot per LEED points? I don't know yet.

A lot of economic data is starting to be culled right now. But you have to recognize that the first time somebody collected a broad swath of U.S. city energy data was just a few years ago, in New York City. You can't find reliable information on total building energy consumption in most U.S. cities. And what data is available has typically only just become available. The U.S. Green Buildings Council (USGBC) has a database of all LEED-rated buildings. I don't know if this data is fully available yet, but with it you could start to see these benchmarks of what's LEED and what's not around your neighborhood.

JK: That helps long-term thinking?

CS: Absolutely. If the *Freakonomics* guys were here, they'd ask what datasets I can use to find a trend. Right now, it's hard for me to say you should move into a LEED building because it's better for you.

JK: *That's* interesting.

CS: It's not easy to understand correlations of data in the energy world. *Freakonomics* had an interesting podcast a couple of weeks ago[1] on energy standards implemented by the Californian Energy Commission in the 80s. The prediction was that homes would use 80 percent less energy, but an environmental economist found in the data that it absolutely doesn't work. Maybe it went a bit far—and was contrarian—to say the energy code is not effective. They say in the podcast, "It's going to get really complicated for a bit," but overall the point is, "you can't track this." You can say, "We're saving 80 percent," but nobody actually knows whether that's true. It's very, very difficult to track some of these effects, because of the nature of the users and the changing dynamics of the economics around it. We're seeing that across a swath of our projects. It's very easy for us to say, "This is productive energy use," but energy use is very different in play.

JK: Are there any surprises coming out as the data has started to show trends? Or is it too early to tell?

CS: We saw a trend in our preliminary analysis, particularly on the renovation of buildings. If you take an older building that does not have great energy performance characteristics, you LEED-ify it, snazz it up and truly improve energy and workplace performance, two years later you'll find it uses more energy! But mainly because the office now has more workers, more density of computers and plug loads and ultimately more productivity than before. But it can be frustrating that the *total* amount of energy has increased even though the renovation sought to make the building *more* energy efficient.

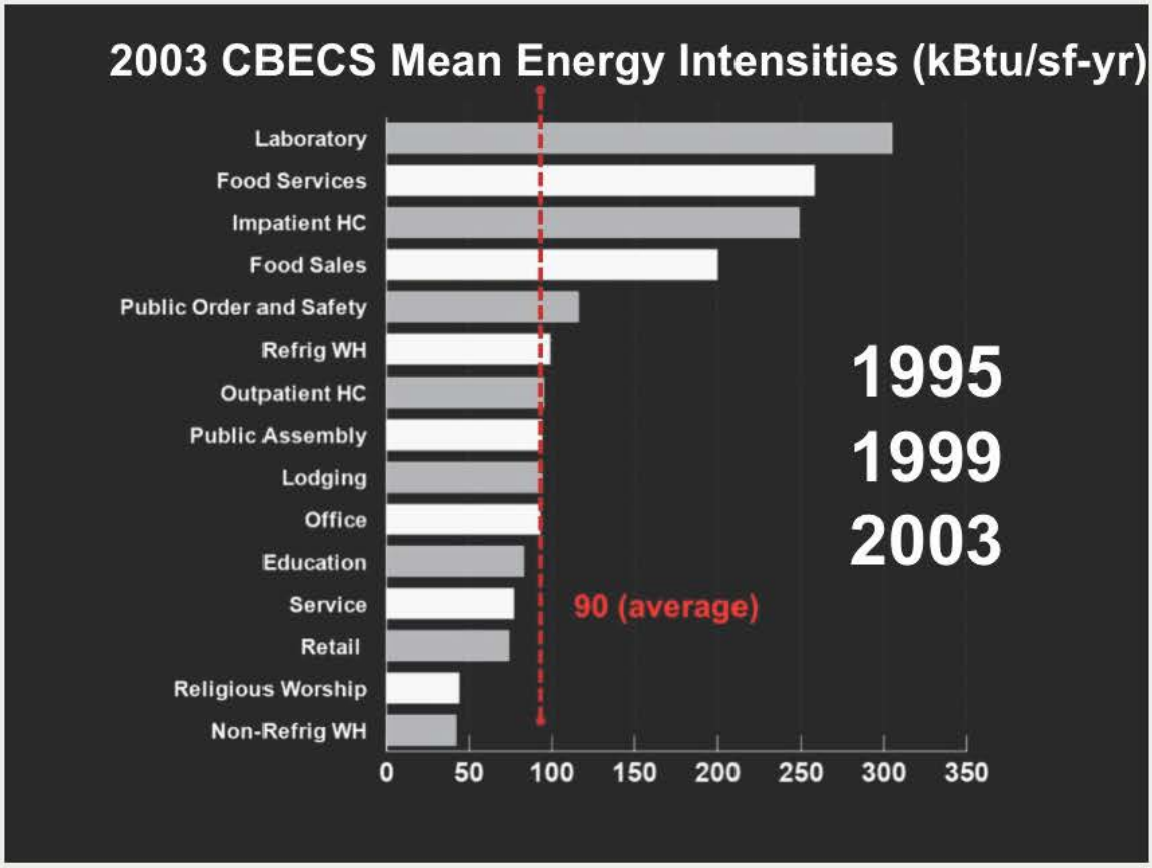

Image courtesy of Buro Happold.

Is this a bad thing or a good thing? Some clients might reflect that we did all of these cool energy-saving things, and we didn't save energy in the long run. We actually encouraged *more* energy use. It's the opposite of something a developer once said to me: "I can't believe the pressure of these government regulations these days. Some systems tell me the most energy-efficient building I have is the one that is an empty one because it has the lowest energy use." You know, I always think about that comment. They are right! It is frustrating.

The question for us—and this is something we don't have any answers to—is not the amount of energy you're using but the efficiency of how you're using it. What matters is how productive you are with energy. We started a study about a year and a half ago that compared productivity in New York buildings to their energy use. We started mapping and correlating these two things together, and it was very interesting, because some buildings that are energy hogs create enormous productivity. Many buildings are truly energy hogs, from large banks with their data centers to hospitals to research centers, and so on. But pound for pound, person for person, according to the tax base or however you want to measure it, these buildings use a lot of energy but they are incredibly productive at the same time. And then there are other buildings that are very inefficient with their energy use that might not have such significant productivity, which perform very poorly. You need to look at the two variables to understand what is going on. What you really want is an efficient building that has high productivity.

But these two elements are not always correlated.

$$\text{EFFICIENCY} = \frac{\text{USEFUL WORK}}{\text{ENERGY EXPENDED}}$$

$$\text{EFFICIENCY}_{\text{BEEC}} = \frac{\text{ECONOMY}_{\text{BEII}}}{\text{ENERGY}_{\text{EUI}}}$$

(Weather-Normalized Source)

Image courtesy of Buro Happold.

5 BUILDINGS

	Source EUI [ENERGY]	Bldg Econ. Intensity Index [ECONOMY]	EFFICIENCY (BEEC) [ECONOMY] / [ENERGY]
5 Times Sq.	313.7	618.5	1.97
One Bryant Park	362.6	950.3	2.62
1 Penn Plaza	304.4	489.2	1.61
Empire State	198.2	464.1	2.34
Met Life	344.8	651.0	1.89
Averages:	396	213	2.2

Image courtesy of Buro Happold.

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JK: Where is the waste in this system? I can't help thinking about the current trend to build luxury condos with eight-bedroom apartments. There's a different kind of density there than you describe in an office.

CS: That is a different kind of problem, I think. That's more about global investment politics than anything else. But clearly, the trend of building larger-scale spaces that are not part of a sharing economy is a problem. We are very interested in sharing-economy problems and solutions.

The densification of offices, or the flexible workspace, is really a sharing economy issue. Approaches like hot-desking can pack people into a space because not everybody needs a dedicated office that's left empty three days a week. Things are changing—not as quickly as Uber or Airbnb are—but the sharing economy can have a big impact on efficiency.

EDB: I think this is happening a lot at a smaller scale. People are sharing offices, and sharing costs...

CS: But, ironically, you'd use more energy, because offices are now...

EDB: Twenty-four/seven.

CS: But that is not a problem. In my opinion, the idea of sustainability is shifting. It is not about using *less* but about using what we have *better*.

I sometimes show my students slides comparing Europe to the United States. The European Union has more GDP per carbon use than we do, so they're more efficient, because of the density of their cities, their energy regulations and their sources of nuclear power and so on. They are head and shoulders more efficient than the United States. When I look at that, I think this is an opportunity, ironically, for the United States to get more efficient.

JK: That's kind of easy!

CS: Yes! We can use *what we have* better. If we think about it this way, we can grow the productivity of a dense urban city like New York City by 30 percent using the same amount of energy that we're using today. Rather than curbing its emissions by 30 percent, New York City can grow by 30 percent without any additional inputs. Per capita, per GDP, per dollar of economic output, per CFM [cubic feet per minute] and per pound of reinforcement in buildings, we'd use less energy.

EDB: Is it a question of changing our mentality? I'm thinking about suburban sprawl in the United States.

CS: The book *SuperFreaknomics* has an example which I think is super-fascinating. It's about horse manure, basically. In the beginning of the twentiethcentury—at least in American cities or global cities—the problem of horses and carriages was a big deal. The city couldn't get more dense because of the sanitary problems associated with horse shit. You just couldn't get away from it, and it was the biggest planning issue of the day. But the technology shift around the internal combustion engine basically blew the issue away within a twenty-year period, and allowed densification that previously stymied the planners. This might be a gross simplification of the situation, but the thought that there could be some major technology shift—and that we just can't foresee future constraints—is a cool idea. You know, I'm a technologist, so I'm an optimist.

JK: Esteban and I were talking about this question just now in the lobby. When you design a building in one moment in time, how do you anticipate changes down the road? How do you deal with the idea that an entire air-handling system, natural gas prices or fuel sources for a building might shift?

CS: One major concept in building design and community design is the question of centralization versus decentralization. Centralized systems are centrally controlled and

price-regulated—they're utilities essentially—and are also relatively old and ossified. And then there are local systems. We like to develop building designs that are more adaptable, and separate from centralized dependency. If you're getting energy from a steam plant it may go up in price...

JK: And that makes you vulnerable to things you can't control?

CS: Yes, like a blackout.

There's a pure efficiency play here, too. In a centralized system, by the time a kilowatt travels from a power plant to a lightbulb, it loses at least 60 percent of its energy. If I can produce it locally in a co-generation plant, we lose only a very small fraction of the energy in distribution. I don't have to produce what is called a "negawatt" at the power plant—the energy you produced but that simply got lost in the distribution inefficiencies. This is why people want smart grids. If you can deal with inefficiency through the smart grid, you can triple the amount of energy that's available for buildings. You can save energy and significantly increase the amount of energy available in the United States without any additional carbon generation.

EDB: The strategy of decentralization might work for private companies, but what about infrastructures that are the government's responsibility? Beyond private resilience for a business, what about the public sphere? The idea that you are responsible for your own in a market economy doesn't work within other realms. It's a question of equity!

CS: Do you mean an American "live free or die" attitude?

EDB: Yeah, something like that.

CS: "Don't tread on my energy production"? I think that's a more cultural issue in the United States but I do think that decentralization is a key concept here, particularly about resiliency but also around efficiency.

JK: To push the point further, though, we might look at water as a parallel infrastructure. The fact that governments produce robust water systems has been critical for the public, and has enabled access to safe drinking water. At the same time, in India, for example, big companies and big developers are creating small enclaves of energy production, leaving a lot of people without access to an energy system. Is there sometimes a tendency for decentralization to leave out common good?

CS: Probably. The market doesn't really like the weak. So, yes, probably. But maybe it's not "either/or." Maybe it's an "and" situation.

JK: Did these issues arise when you worked for New York State on the Five Cities Energy Master Plan? Is there a difference in the way you talk about benefits when you work with a private client as opposed to the state? Are there a different set of priorities?

CS: Absolutely. You know, the state is first and foremost an economic development engine, rather than an energy supplier. They think of themselves that way. They want to encourage economic growth in the state, and they don't want to have to build more power plants to do it. It's pretty simple. Building new power plants is difficult and time-consuming, and not just because it's a regulatory issue or a NIMBY issue, but because they know it's inefficient in the long run. They clearly understand the negawatt issue.

The *last thing* I want to do is add to a *more* centralized system. Right now, I have a centralized system that works, and some of that power, like hydroelectric power, is very efficient and inexpensive and the real question at hand is how I can get more from that system. I think public sector entities think like this. The goal is not just for price regulations to keep things cheap for people, but to encourage more economic productivity with the same amount of energy consumption.

Maybe it's defeatist to think we can do better with what we have, but with clients it's difficult to convince them to go backwards. We don't use the term sustainability anymore. I try to banish it from all of our lingo because it's a fairly outdated term, *already*. Instead of going backwards in history, the idea that we have to go forward is important. While we

because we've created a problem that is going to last for generations, if not forever.

I found the change in Bill McDonough's book *Cradle to Cradle*'s focus on upcycling interesting. We are starting to use the word *surplus* a lot more. We all must understand that energy ultimately is a fixed sum. You don't use less or more. It's there. You either create it or destroy it. That's just the law of thermodynamics.

JK: It just changes states.

CS: Exactly, and that's *super*-important to understand in terms of the efficiency equation. I don't see surplus as a bad thing. Could it be a wolf in sheep's clothing, as though "it's great; everything's fine again because oil is cheap"? Maybe, but I really don't believe we're sliding back into the 80s again. And regulatory market constraints have developed over time—at governmental and consumer levels—and these will ultimately limit using surplus inefficiently. In the long run I am fascinated by the idea of surplus because it speaks to the idea that we *have* a lot of energy, but use it with remarkable inefficiency.

JK: Sometimes we have extra.

CS: Actually, we have extra. If you think about it in terms of the oil price shock we're going through right now, that becomes clear. If anything, the price of oil is going down because there is too much energy.

JK: That's amazing.

CS: I never thought about this before, but you know, surplus is showing up because we can now be more efficient in our conservation. The supply pressures are coming down.

JK: It's not worth it to pay for more efficiency anymore.

CS: Exactly. The Saudis want us to pay more for oil eventually, as do the Texans. Maybe they are in cahoots with each other!

JK: What are the implications of building codes for this conversation? If codes tend to work along a logic of minimums and maximums, does this idea of surplus and a more productive use of energy escape the logic of code?

CS: No, I think codes are very important because they form a benchmark that goes beyond other forms of motivation. The "I want to do better than your neighbor" tendency is formidable, and I think the market will drive that, but at some point you have to say that your neighbor just can't have a car that spills oil and tracks it around the neighborhood. So you have to put a benchmark in. Thinking macro-economically, oil prices are coming down right now (there is a glut, or surplus, of energy either because the global economy is slow or because we're more efficient), but if you ratchet up regulation you can force efficiency back into the system when oil prices swing back the other way. That's when regulation is critical, because without it you'd have no safeguards.

I will give you an example of how regulation can work. I worked on a large-scale master-plan project in the Middle East a few years back, with a series of three blocks on a massive site. Our engineering team produced a master plan about the project's energy usage and building orientation not aligned to the existing street grid, but to a better orientation for energy use. The local planners wanted to shift the building orientations back to the existing street grids. When we reviewed the two options with our client the question came up, "Which option uses more energy?" Because of the local energy regulations and requirements in this county, I said a potentially controversial answer: "*Both* options use the same amount." They resisted, saying, "No, no, no. You told us this one is more efficient." Our response was that although one was more efficient than the other in using energy, ultimately both were controlled by the amount of energy to be used by local codes. Simply put, both schemes use the same amount of kilowatt hours, but that the one that is efficient is the one cheaper to operate in the long term. The planners, without hesitation I might add, picked the energy-efficient scheme.

EDB: I have a question about the Adaptive Building Initiative (ABI) you started with Chuck Hoberman in 2008. I'm interested in the role that creativity plays in efficiency. Perhaps we need to think in a more creative way to be more efficient. Hoberman describes himself as

an inventor. What is the role of creativity at ABI, especially between engineering and architecture?

CS: The adaptation of building skins is pretty fundamental to the energy performance of a building. From a perspective of innovation, an adaptable façade system is probably the most efficient way to have both a transparent façade and an energy-efficient façade simultaneously. But the *continual* adaptation of that skin is, shall I say, a little ahead of its time. We have done successful projects through ABI, but it hasn't moved to the mainstream at this stage. One challenge that we see before continual adaptation strategies start becoming more commonplace, is that even static façade systems need to be more energy responsive. Think about it: How often do we see building skins similar on all sides of a building? It can be very frustrating to see this. We know where the sun is, correct? Even in a static sense there are huge efficiencies that can be wrung out of building design at this stage over the business-as-usual approach we often see today. And we should probably think about *that* problem before building skins start to adapt and change. I love the concept of it—don't get me wrong—because we partially invented it. But the first thing to do is convince a developer who thinks it's cheaper to make building façades the same on all sides that it might be cheaper not to because of some energy requirements.

Over the last ten years, we have become more savvy about the idea that envelopes are important as a building system, not just a series of components. In other words, you used to think of façades as though they were trim for a car. When you buy a car, you buy the chassis and the engine, and then you choose either leather seats or cloth seats—that was your façade. But today, people are beginning to realize it's as important as the transmission. It's a system because it drives so much of the energy efficiency of a building.

EDB: There is actually much more attention to retrofitting existing buildings than constructing new buildings. The issue of intervening on the efficiency of façades is huge.

CS: Yes. Nico Keinzl is teaching a course on the sustainability in existing buildings at Columbia GSAPP. I think these are important issues to be exploring. It's a huge issue for a place like New York City.

Looking at the existing building fabric is incredibly important, but then you run into the problem that a building's energy production goes up after renovation. It's hard and a very difficult problem to solve. So, you have to ask yourself whether you are solving the right problems. Maybe that's what I'll conclude with today: If using less energy solves the problem, I don't think we've identified the right problem. I think the problem has to do with the productivity of energy.

JK: Along that note, do you have other concluding thoughts on the topic of efficiency?

CS: Climate change is the major issue of the day. We're in the middle of it. How we deal with it is very important. The question "Should we be saving more, or should we be more productive with what we have?" might just sidestep the ultimate need to use less. But it does come into play by jumping scale. In a dense urban environment, using more energy but doing so more productively can actually solve the climate change problem because ultimately we'll use less energy somewhere else. I work with projects that have a tight boundary around them, but I see solutions from those boundaries that can solve the broader issue. Going back to the observation that a "productive" building in terms of energy is one that is empty, is not the solution. I want to do more, something better, with that building—and not punish or penalize it for using energy in the first place.

If the question is whether we should use less, it's probably the wrong question. The question should be how productively can we use energy. If it is linked to larger solutions like the densification of cities, more efficient transportation networks, or more efficient energy distribution systems, then it's a real part of the solution. If not, then you're just using the word *energy* in an inefficient context. That could be the true wolf in sheep's clothing.

1. "How Efficient Is Energy Efficiency? A New Freakonomics Radio Podcast" Freakonomics.com (February 2015). Accessed July 1, 2015. link. ^