Building Sustainability into Codes: the Evolution of Building Regulation

Green Buildings and Green Growth: The Enabling Role of Standards and Trade

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The notes accompanying these slides were written in advance of making the presentation, so they are not an exact representation of what was actually presented. In addition, one slide has been added and a few slides have been modified. Also, I wish to acknowledge the fairly U.S.-centric nature of this presentation. While most of the points apply to building regulatory systems in general, they are mainly based on the experience of working to introduce a sustainable context to the building regulatory systems of the U.S. Hopefully this will not diminish the value of the content presented. - David Eisenberg February 18, 2011

*At One Time Codes **Were** Written In Stone*

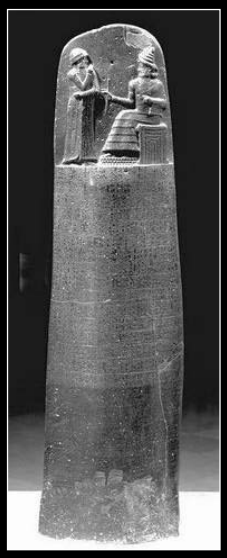
Some History…

1758 B.C. - Babylonian King Hammurabi enacts the first written building code.

Of its six provisions, the first designates what the owner must pay the builder.

The rest deal with building quality from a strictly performance basis…no technical details or guidance, no plan review, no engineering, no building science, no inspections…

Just performance and consequences…



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I want to start with a bit of history of codes. People talk about codes not being written in stone…well, the first one was! Dating back to more than 3700 years ago, this first code, from the Babylonian King Harmmurabi only had six provisions relating to buildings. Other than the first one, which covered what the owner needed to pay the builder, there are no technical details, nothing about plans, no science or engineering, or anything else like what we expect to see in modern building codes. This was really the first and simplest performance code - the building had better perform…or else! Pure performance and consequences for failure.

A Little Code History

Hammurabi's code…

229. If a builder builds a house and does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death.

230. If it kills the son of the owner the son of that builder shall be put to death.

231. If it kills a slave of the owner, then he shall pay, slave-for-slave, to the owner of the house.

232. If it ruins goods, he shall make compensation for all that has been ruined, and inasmuch as he did not properly construct it, he shall re-erect it from his own means.

233. If a builder builds a house for someone, even though he has not yet completed it; if the walls seem toppling, the builder must make the walls solid from his own means.

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This is the original eye-for-an-eye code - if the building fails and kills the owner, the builder is put to death. If it kills the son of the owner, the builder's son is put to death. If it kills a slave, the builder must pay for the slave, and if there are other costs and expenses, the builder is liable for them.

A Little Code History

The stringency of that first code may have impeded early innovation, but things progressed anyway.

Since the building codes that followed weren't written in stone, they've been evolving ever since.

Early codes were primarily responses to building failures and disasters, such as great fires and earthquakes.

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That code may have been an impediment to innovation with the kind of penalties for building failures it included, but fortunately, the codes that followed haven't been written in stone and innovation didn't stop.The next set of developments in codes resulted from massive disasters - mostly fires, sometimes earthquakes, or floods, or hurricanes. But mostly really big events which resulted in the outlawing of things like wooden chimneys and requirements intended to keep fires from spreading from one building to the next.

A Little Code History

However, over time they have come to address a much larger range of potential hazards created by buildings—added as those hazards became more widely recognized or the potential to address them became feasible.

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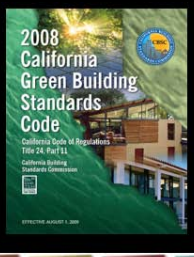
What has happened after that has been driven by many things. Some of the first model codes were actually written by insurance companies in order to try to minimize their losses. But over time, as various hazards were recognized and ways to address them were developed, the codes and building standards addressed more and more types of hazards or risks.

A Little Code History

Codes have continued to become more specialized, more detailed, and often more regionalized.



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That evolution has also meant that instead of having a single general building code book, we now have separate codes for specific things like fire, plumbing, mechanical systems, electrical systems, etc. And we also have, in the U.S., regional and state codes and some municipal codes as well. Uniformity has become an ongoing challenge, recognizing of course, that there are appropriate differences from place to place, different conditions and traditions and resources and so forth.

The Purpose of Building Codes

International Building Code (USA) - 2006 edition

101.3 The purpose of this code is to establish the minimum requirements to safeguard the public health, safety and general welfare through *structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards* attributed to the built environment and to *provide safety to fire fighters and emergency responders during emergency operations.*

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This is the purpose statement from the International Building Code (USA). The statement I've highlighted is the big picture - the central purpose of the code. The parts in italics are the specific areas of the focus - the details - admittedly very important details. However the central purpose is to safeguard the public from hazards attributable to the built environment.

Codes Do Well with the Risks they Address

Modern building codes enable us to design and build structures that are relatively safe for their occupants, making it seem that we've eliminated or greatly reduced the risks associated with buildings.

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Our modern building codes are extraordinarily good at enabling us to design and build buildings that rarely burn down, fall down, trap people in emergencies, expose them to raw sewage, electrocute them, let them fall from high places, or, as I like to say, suffocate them too quickly. Because they are quite effective at managing these types of risks, we tend to think we've eliminated or greatly reduced the risks associated with buildings.

But What About Systemic and Future Risks?

In reality, what we've done is to *move* many forms of risk in space and time:

- away from the building site, out into the natural systems that support us, and

- into the future.

However, the system we have created doesn't consider systemic risk, cumulative harm, or risks to future generations. As a result, what we're actually doing is just moving some types of risks in space and time. We're moving them away from the building site out into all the natural systems on the planet - our life support systems, and from the present to our children and grandchildren and all the future generations of all the other species on whose welfare our welfare also depends.

Our frame of reference determines what we see

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It's important to remember that when we focus on something, what we are actually doing is blocking out everything else. Our frame of reference absolutely determines what we are able to see. So we need to pay attention to whether we're working in the details or the big picture or some intermediate leve so we can understand the context in which we are working.

Our frame of reference determines what we see

To see things in context we have to constantly shift our focus between the *details* and *big picture* — that way we can see both the *things* and their *relationships*.

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We need to develop the habit of constantly shifting our focus and looking for the patterns and the spaces between things and their relationships, not just things themselves. This is how we learn to keep things in perspective and proportion. This is very important in the regulatory realm though awareness of it is often limited.

Many Huge Hazards Are Hidden in Plain View

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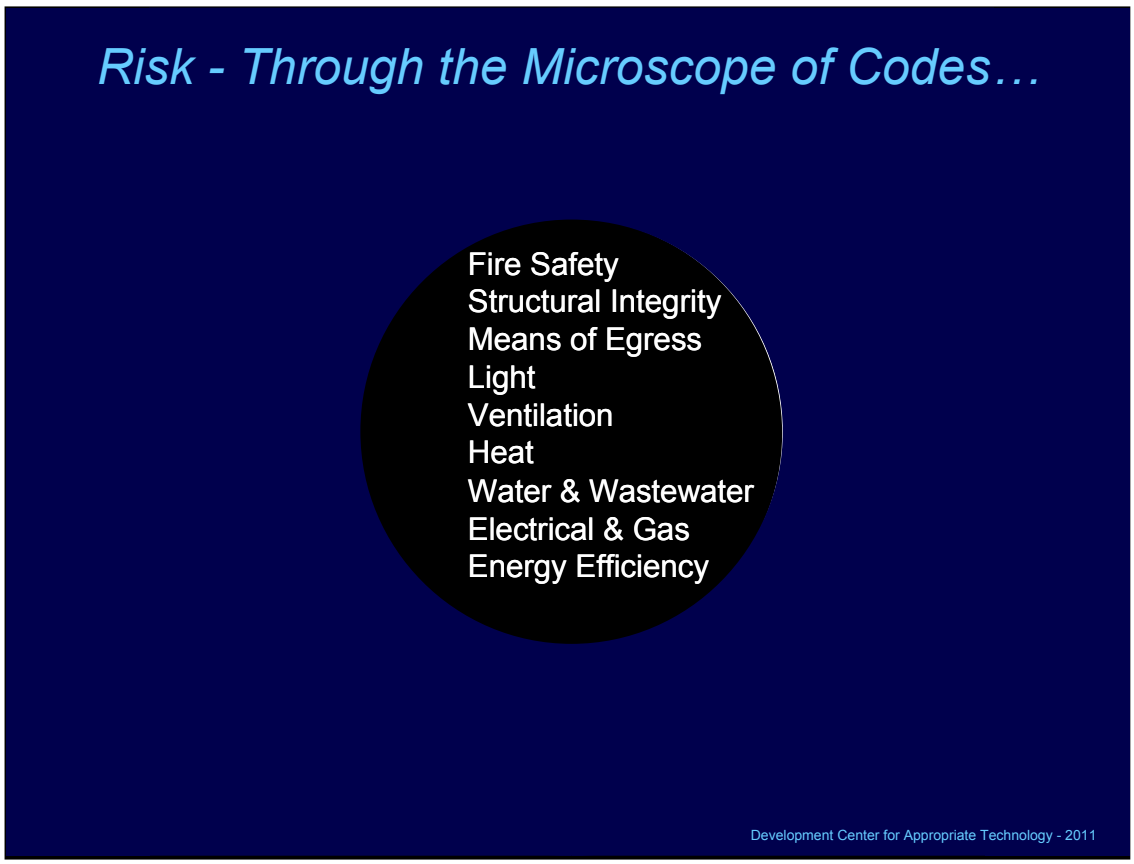
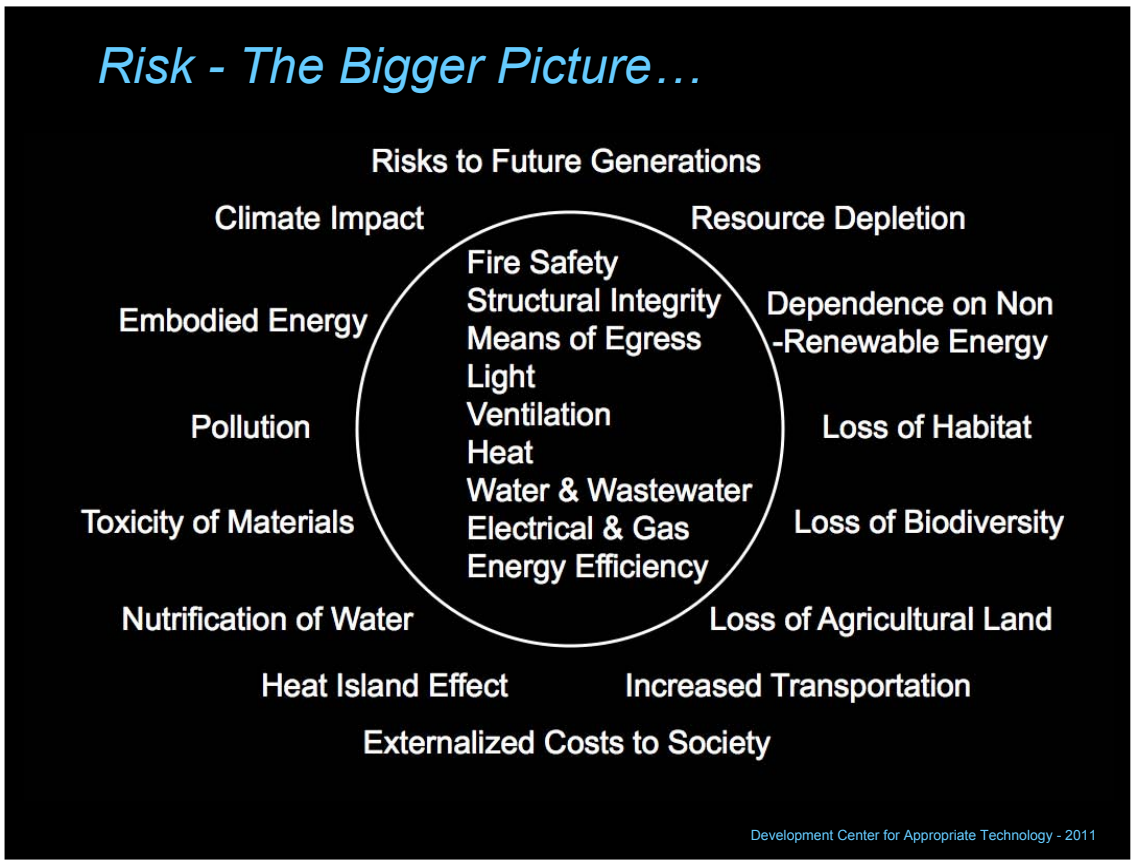
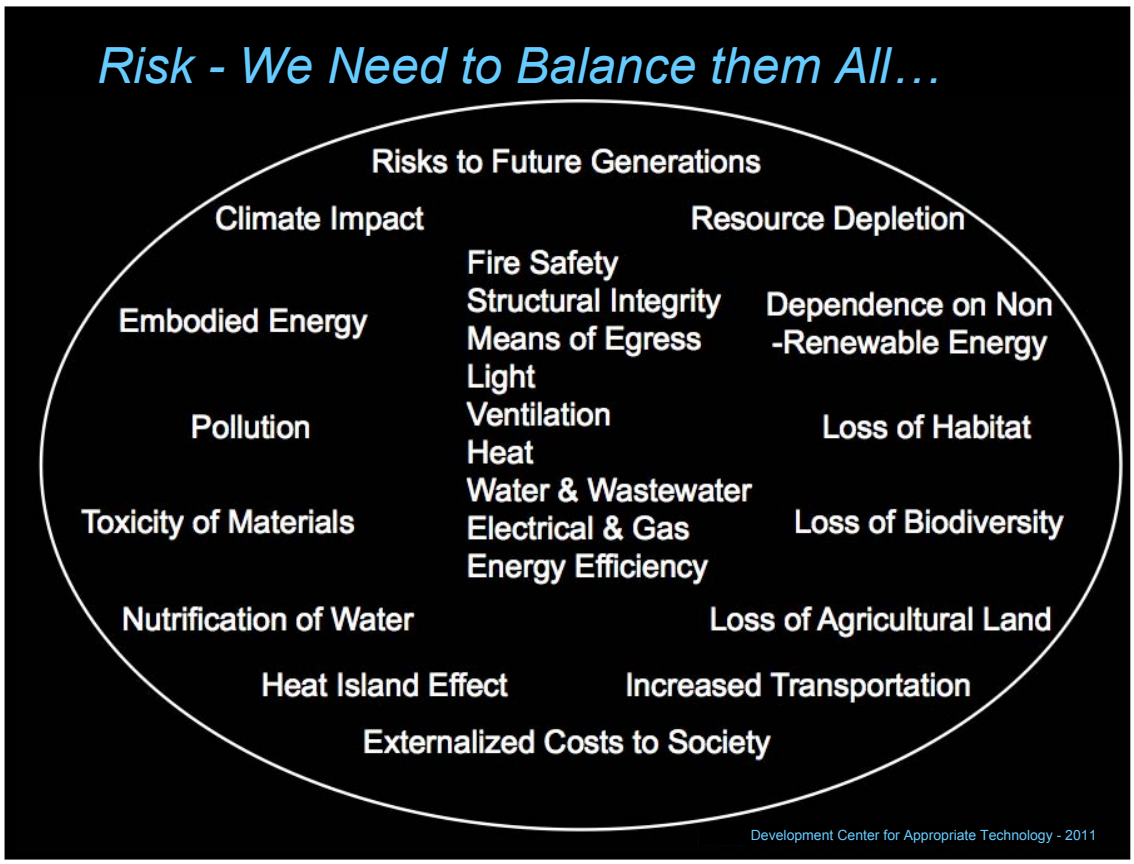
Regulatory thinking is often like looking through a microscope. We can see important risks to people in and around buildings. But important as they are, these building or project scale risks completely fill our field of view. They're very important because they are risks to real people. But outside the field of view are risks being created that are many orders of magnitude greater - generalized and distributed risks to billions of people that can't be seen through that lens.



These are the categories of risk and responsibility laid out in the codes. This is the view through that microscope…



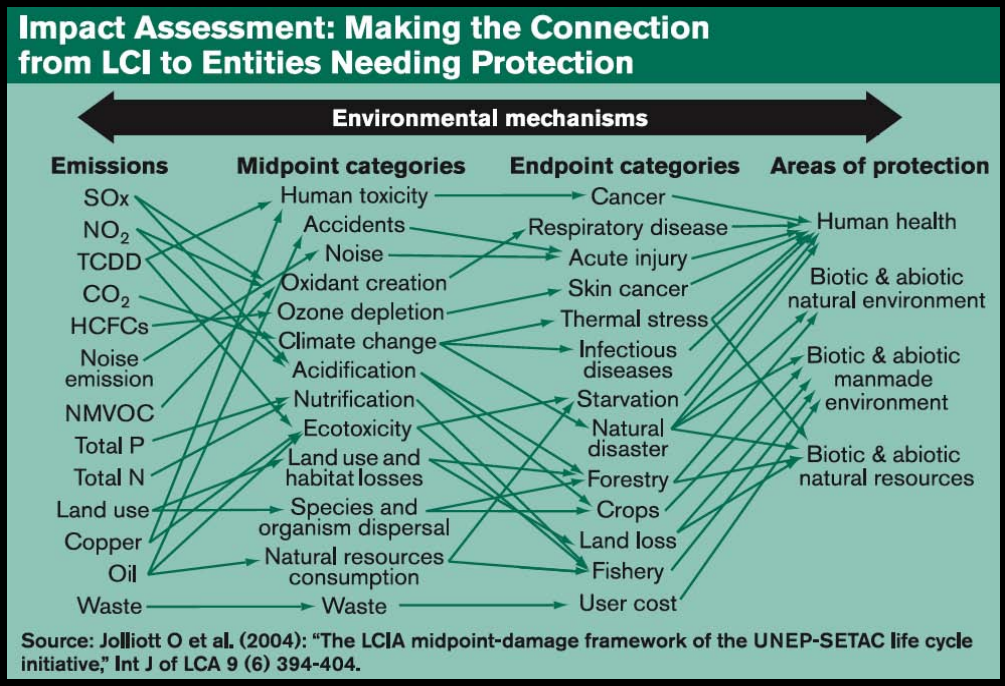
Here are some of the larger risks which are also attributable to the built environment and therefore part of the responsibility for safeguarding the public. However, most of these types of hazard are not currently addressed in building codes, and many not addressed in any current regulatory system.



It isn't either-or… we have to learn to address all these risks at the same time. What is needed is a more complete and balanced regulatory response to address and balance all these risks together. The real breakthrough in my thinking and my work came when I realized that I wanted everything that building officials wanted and more, not less. None of us want unsafe buildings, but these larger risks need to be addressed as well. If the purpose of regulations for the built environment is to safeguard the public, that has to include all this and our children and their children as well. We're not doing that now.

Risks and hazards occur throughout the entire lifecycle of built projects. The recognition of this larger set of hazards has been a key driver for the development of the green design and building and sustainable development movements around the world. With code and other public officials, I find it useful to explain what we're thinking about in speaking about the lifecycle of a building. Until you see buildings in this more fully integrated way, it's hard to see why many of us have the concerns we have about the built environment. The impacts of a building project begin with the acquisition of resources and their transportation and processing, and extend to the impacts on the land at the building site and the infrastructure it requires. They include all the impacts of the construction process itself, the wastes generated, toxic chemicals used, and then the flow of resources through the building over its lifetime for repair, maintenance and refurbishing and all the services we demand of our buildings. And then there are the impacts at the end of the life of the building and beyond, relating to whether the materials are reusable, recyclable, toxic, or will just end up in the landfill.

Built Environment Lifecycle Impact Assessment



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This is chart of some of the lifecycle impacts, risks and relationships that those of us concerned with sustainable building are trying to pay attention to and address. I don't expect you to be able to read all this or to understand all the relationships that are shown here. I don't claim to. But what is clear is that very few of these things are regulated by building codes and standards. These are real and many are huge risks. A challenge for those who are trying to design and build to minimize all these kinds of impacts while also dealing with the risks that the codes address - thereby taking on more responsibility not less - is that they often have a much harder time getting their projects approved than those projects contributing the most to these other hazards.

Drivers for Green Building & Green Regulations

Critical (and increasingly risky) Assumptions:

A stable and predictable climate.

Adequate and affordable supplies of energy, water, food and other critical resources.

The natural systems on Earth are robust enough to withstand whatever humans may choose to do.

Current regulatory systems are capable of dealing adequately with emerging risks.

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An area of conflict that often develops is a result of differing assessments of emerging risk. The basic assumptions on which so many of our decisions and public policies are increasingly questionable and continuing to rely on past assumptions is inherently risky in and of itself. Questionable assumptions include that we will have a stable and predictable climate, that we will continue to have sufficient and affordable supplies of energy, water and other vital resources that we need, not just for building but for everything we do. We continue to act as though the natural systems on the planet, our life support systems, are robust enough to withstand whatever 7 or 8 or 9 billion human beings might choose to do. And in the building regulatory realm, we act as though the current systems we have in place to regulate what gets built are adequate to deal with these larger, emerging problems.

Some Perspective…

Take the habitable part of our planet - from 200 feet down into the ocean to 16,000 feet above sea level, convert that volume into a sphere: this is the size of the *Livable Planet Earth:*

diameter 1041 mi / 1675 km

The Moon

Diameter = 2160 mi / 3476 km

The Earth

Thanks to Paul Eisenberg for the calculations and image.

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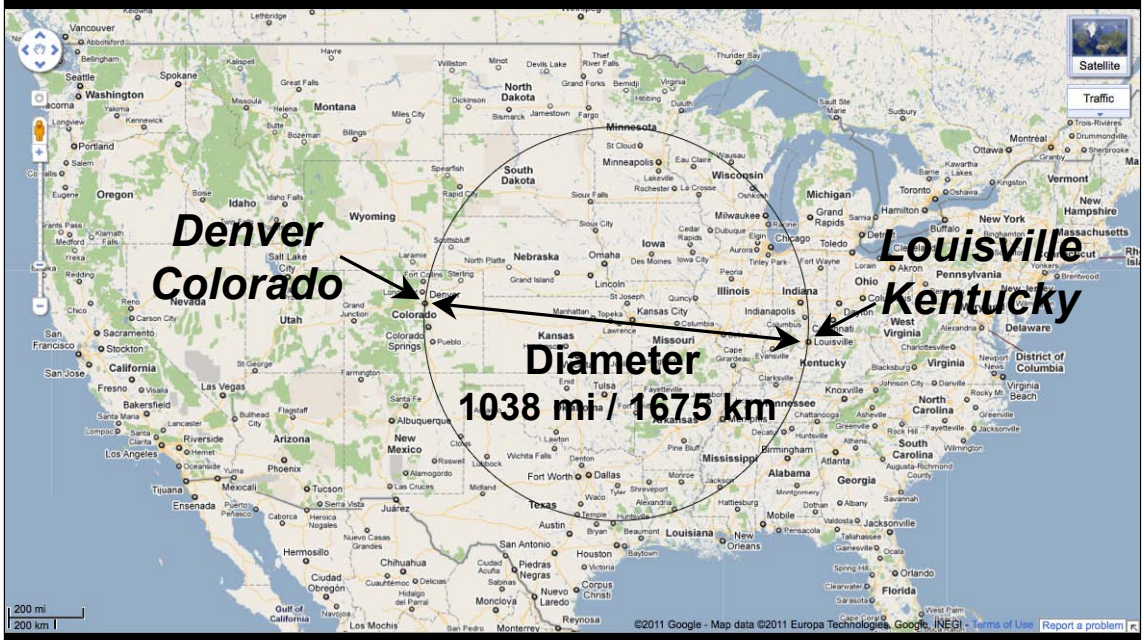
If you have ever wondered just how big the eco-sphere is - the habitable part of the planet including at least some of what is below sea level and going up to the highest altitudes that generally support human populations, here is the answer: TINY. The Canadian scientist, biologist, ecologist and educator, David Suzuki, has said that if the Earth was the size of a basketball, this layer would be the thickness of plastic food wrap. Imagine taking that plastic wrap off and rolling it into a ball. My brother Paul and I discussed this a few months ago and he did the research and calculations — and the actual size of the livable part of our planet would be less than half the diameter of the moon if you converted that volume into a sphere. 1041 miles in diameter. All of human history has taken place in that space and today nearly 7 billion of us are living in this space…on this tiny planet.

Some Perspective…



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If you wonder how far that is, it's about the distance from Denver Colorado to Louisville, Kentucky.

Some Perspective…

Take ALL the WATER on the planet or ALL the ATMOSPHERE and convert their volume into spheres: *this is what we have to work with*…

Images: http://www.sciencephoto.com/images/imagePopUpDetails.html?id=690550330

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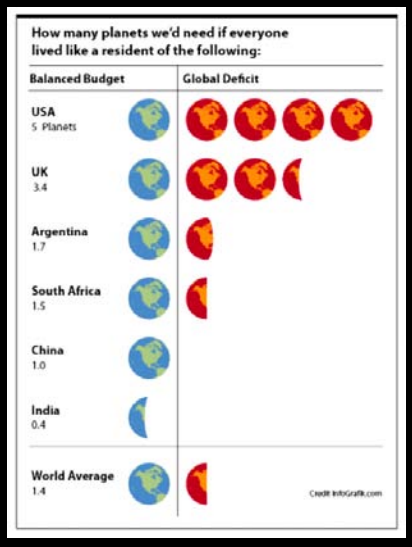
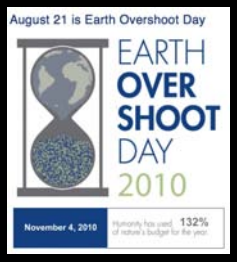
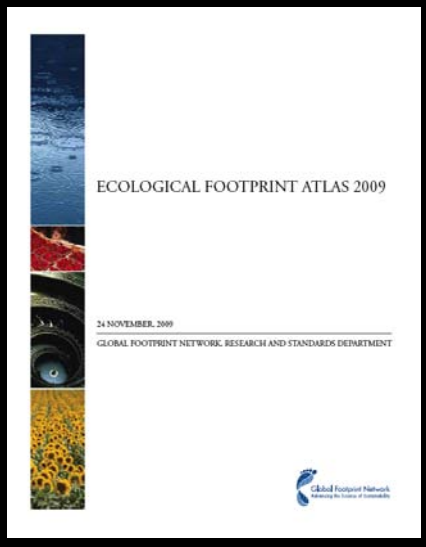
And following on that, we were doing further research and came across these images and their calculations, which match up quite well with the previous calculations and images. That sphere of water on the left is all the water on Earth, fresh and sea water - that's it. And on the right, that sphere is all the Earth's atmosphere calculated at the atmospheric pressure at sea level. Does that make it more plausible that we might be able to alter the atmosphere or oceans?

Drivers for Green Building & Green Regulations

Ecological Footprint is Driving Recognition of Limits.







www.footprintnetwork.org

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There is also ample evidence that if everyone on the planet was consuming resources and producing waste and pollution at the rate of the average American citizen we would need several more planets to support them. This graphic shows that we are already in planetary overshoot - in fact, the Footprint Network also has a project about global overshoot, and this year, we hit that day on August 19th - the day they estimate this year that humans had usurped 100% of the earth's biological capacity meaning that we are now using up and degrading the earth's ability to support us. You can see here the relative per-capita footprint in different countries - China is at about the ecological budget of the planet, whereas India is still within their ecological means.

Crucial to Recognize System Limits

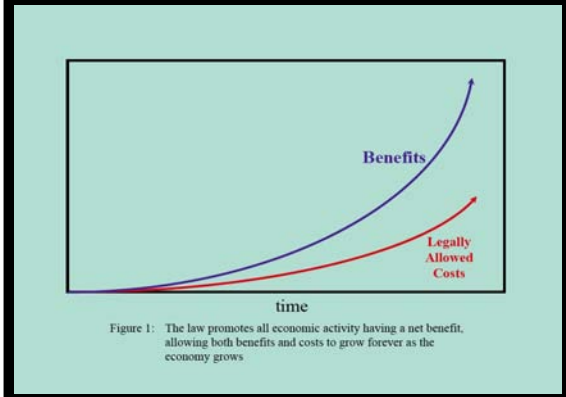

Figure 1: The law promotes all economic activity having a net benefit, allowing both benefits and costs to grow forever as the economy grows

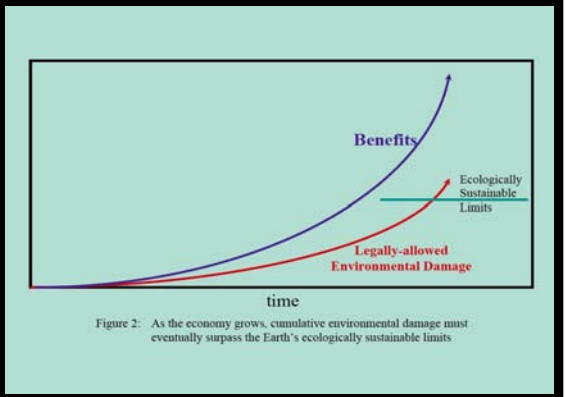

Figure 2: As the economy grows, cumulative environmental damage must eventually surpass the Earth's ecologically sustainable limits

Minimum standards typically set *acceptable levels of risk* using individual, incremental cost-benefit analyses, disregarding the existence of upper limits: unlimited increments of risk = unlimited risk.

Graphics & concept: Joe Guth, Science & Environmental Health Network www.sehn.org

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There is another issue that needs to be addressed in our regulatory systems and that is the reality that there is such a thing as cumulative harm and that there are, in fact, system limits. The current legal framework for most regulations is based on establishing acceptable levels of risk by doing cost-benefit analyses. As long as the potential economic benefit of each individual increment of activity is greater than the potential economic harm, the activity is permitted. Since we allow infinite economic activity and growth, we have legalized infinite harm. There are in fact system limits and cumulative harm happens all the time. The regulatory system has yet to accept this scientific reality. This has contributed greatly to the challenges we are facing in adequately safeguarding the public from hazards attributable to the built environment.

A Constant Challenge

We don't get regulations until problems are large, serious, and persistent enough to demand an official response. So the main navigational tool in the regulatory realm is…

And because we don’t get regulations until problems are large, serious and persistent, the main navigational tool in the regulatory realm is…

… the rear-view mirror. And since we rarely have preventive or precautionary regulatory structures with anticipatory capabilities built into them, we lose the chance to deal with new risks when they're small and manageable – or better yet – avoidable. Worse, emergent risks or new kinds of risk tend to be problematic for the regulators and so they are often reluctant to acknowledge them or respond to the need for change. The regulatory realm tends to be a powerful agent in reinforcing the status quo.

That describes some of the historic and general background for the changes that are now taking place. Since 1995, my organization has been working with the various building codes and standards organizations in the U.S. to introduce the concepts we just looked at and to create a sustainable context for building codes and standards. These are some of the things we wrote or facilitated in the publications of the code organizations over the years. In 2007, as Chair of the US Green Building Council Code Committee I had the honor of signing a memorandum of understanding between USGBC and the International Code Council (ICC) - the U.S. national organization of building officials, to work together in support of green building and a more sustainable built environment.

Codes, Standards, Rating Systems, more…

There has been a proliferation of green building programs, rating systems, standards, and now green codes. However, there is not yet national or international consensus about all these things.

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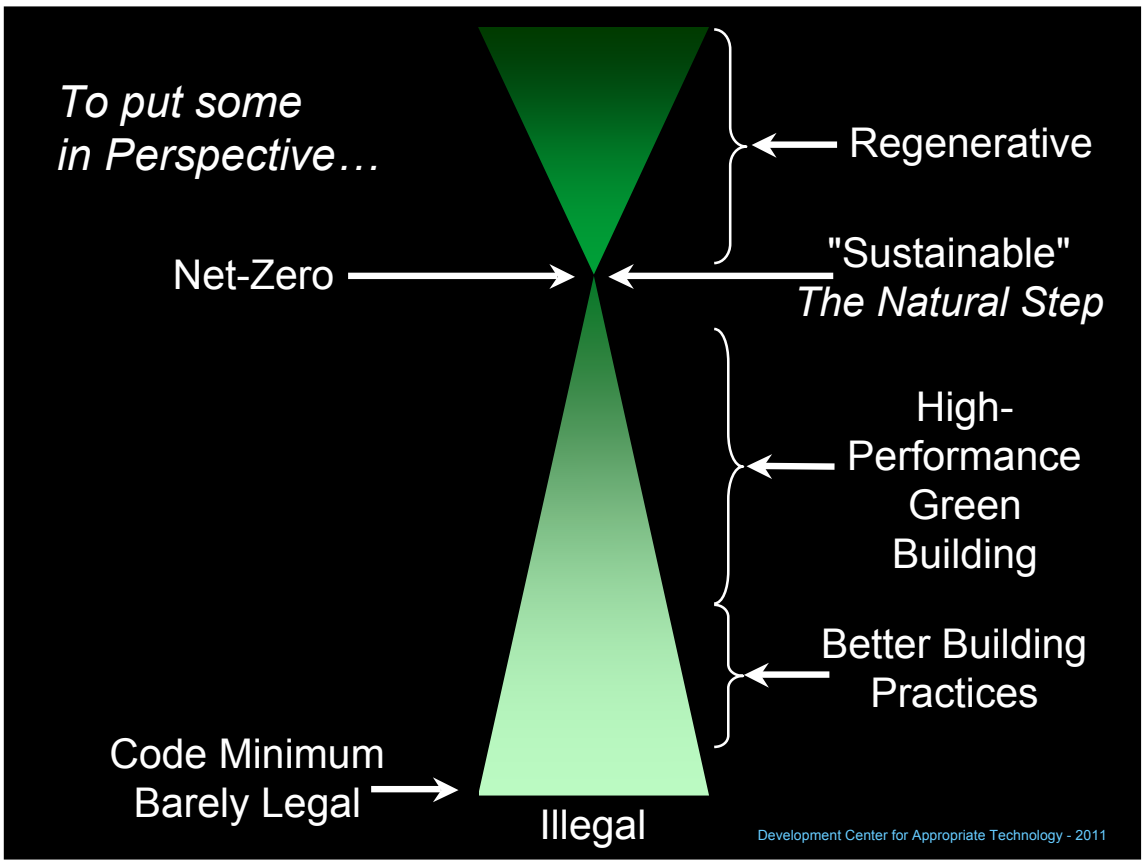
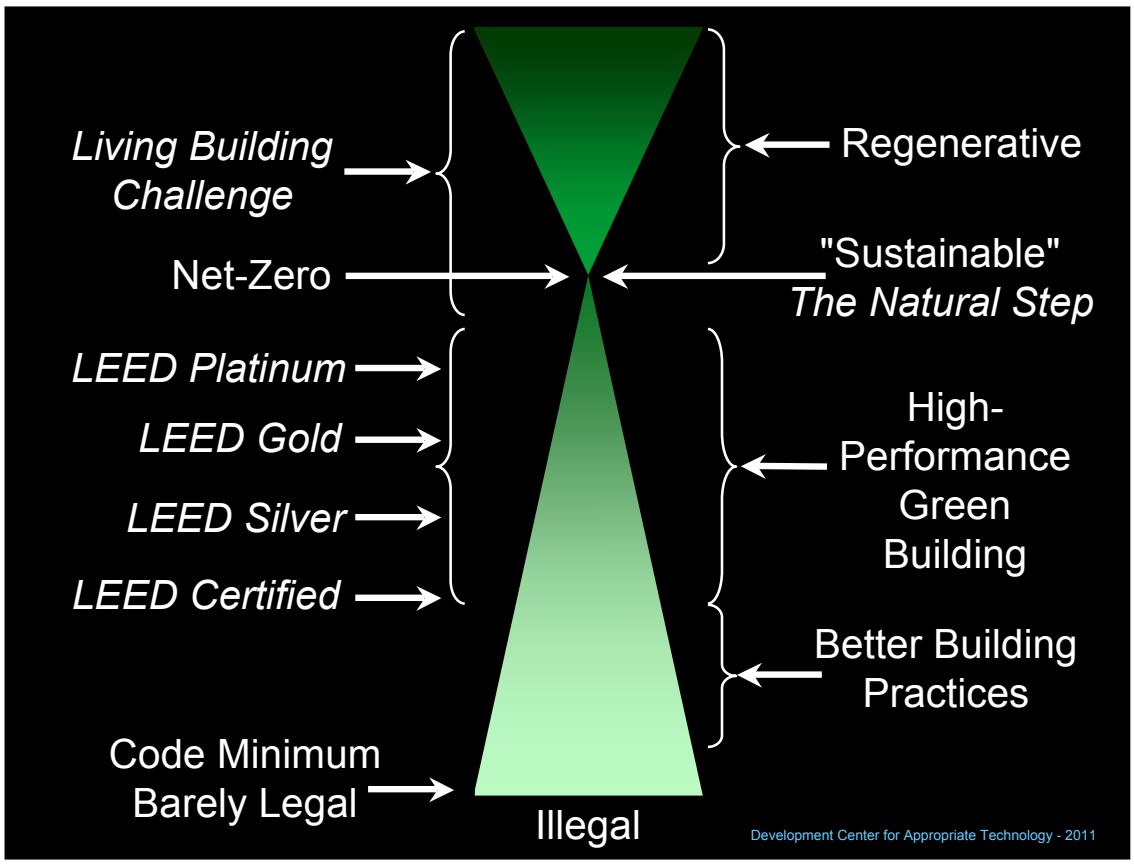
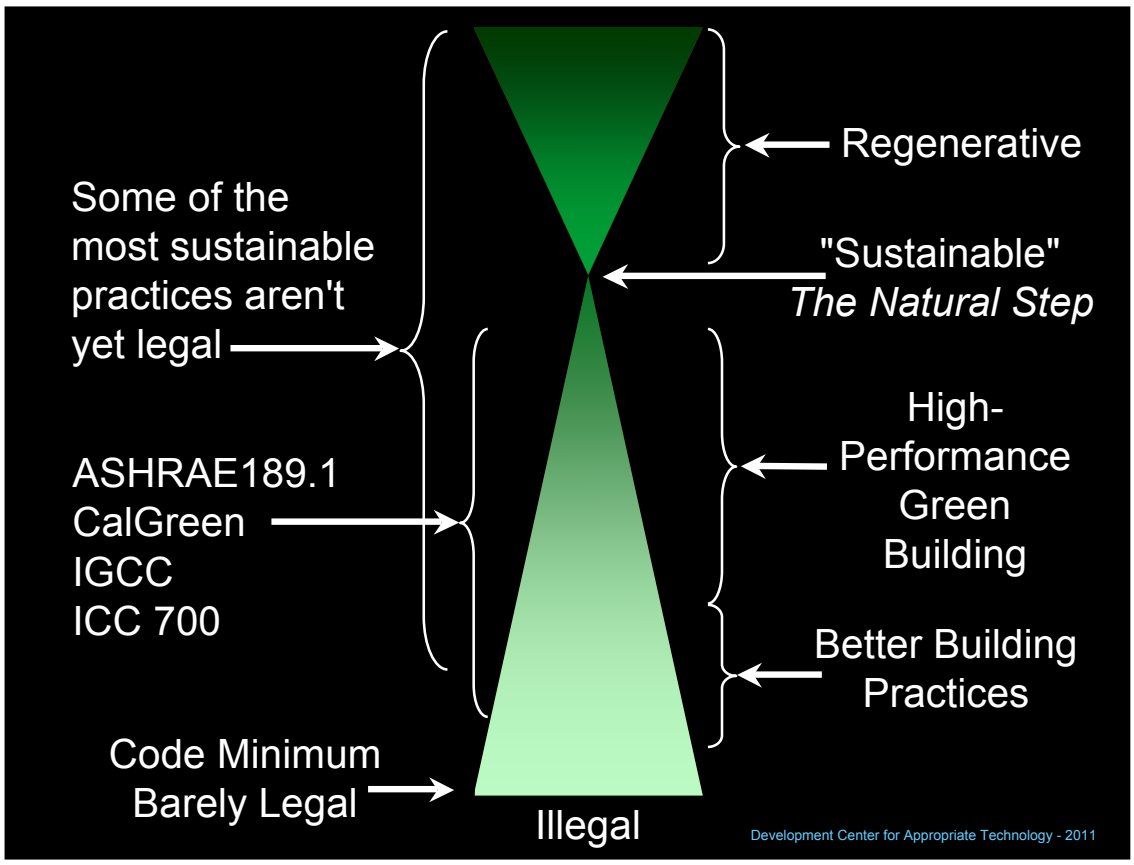
In the past few years there has been a proliferation in the U.S., like in other countries, of green building programs, rating systems, standards, and codes. There are other systems and processes and organizations emerging like the Natural Step Framework, Lifecycle Analysis and Assessment databases and systems, and more.



This graphic may help put some of this into perspective. We can think about the level of sustainability or greenness as a range extending from not meeting the minimum requirements established by codes and thus being illegal (since codes are minimum standards, if anything is done to a lower standard it's a violation of the law) to better and higher performance/green buildings, to a place of net-zero or "sustainable." What Bill McDonough says is 100 percent less bad and Paul Hawken has defined as the midpoint between destruction and restoration. There are a variety of systems or tools you can look at or use - The Natural Step is a good one - www.thenaturalstep.org or www.thenaturalstep.org/en/canada - to get a sense of how we can think about and work with the system limits and conditions of natural systems. The goal is to get to a place where we're creating regenerative projects and systems - the way nature and natural systems work - creating more benefit than harm across the range of impacts over the life of a project.



Here we can see where the various levels of LEED (or it could be other green building rating systems) might fit into this framework. And we can also see the Living Building Challenge, which I will discuss in a bit more detail in a few moments.



Here I've added a few of the newer standards and codes here in the U.S. as well as an indication that there are still many of the most sustainable practices that are not yet approved or allowed - in other words, some of the lowest impact, most viable and beneficial building materials, systems and practices are not currently allowed in many places. That is an area needing investment for research, development and deployment.

One of the real leading edge programs is the Living Building Challenge, a program designed to help define something beyond all the other green building rating systems and program goals I'm aware of. The Living Building Challenge 2.0 is a set of 20 imperatives - requirements - aimed at moving us toward crating projects that meet or exceed net-zero impact performance across the spectrum of impacts of built projects.

The Living Building Challenge

The LBC aims to inspire the shift toward truly regenerative projects. To be certified, projects must meet 20 Imperatives and have been in operation for a year. They must:

- harvest all of their own energy and water
- offset their land use and carbon impacts
- be adapted to their site and climate
- be free of toxics and operate pollution free
- provide healthy and humane indoor environments
- and be beautiful, inspirational and educational

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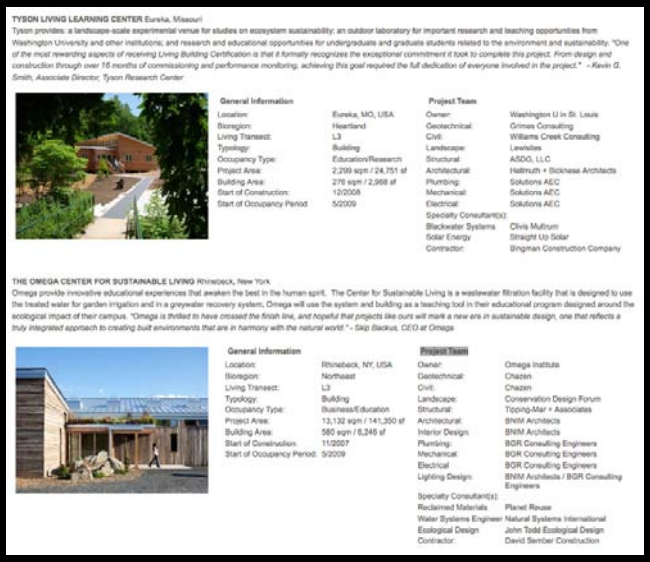
The Living Building Challenge 2.0 is a set of 20 imperatives - requirements - aimed at encouraging the creation of projects that go beyond net-zero in all areas. It includes site, energy, water, materials, and also beauty and inspiration and education. These are there because many of us believe that people don't take care of things they don't care about - they don't care for what they don't love - and people love beautiful buildings and so they last longer - which is much more sustainable.

The Living Building Challenge

The International Living Building Institute recently certified the first two Living Building Projects: the *Tyson Living Learning Center* in Missouri and the *Omega Center for Sustainable Living* in New York.

More info at: http://ilbi.org



TYSON LIVING LEARNING CENTER Eureka, Missouri

Tyson provides a landscape-scale experimental venue for studies on ecosystem sustainability; an outdoor laboratory for important research and teaching opportunities from Washington University and other institutions; and research and educational opportunities for undergraduate and graduate students related to the environment and sustainability. *"One of the most rewarding aspects of receiving Living Building Certification is that it formally recognizes the exceptional commitment it took to complete this project. From design and construction through over 16 months of commissioning and performance monitoring, achieving this goal required the full dedication of everyone involved in the project." - Kevin G. Smith, Associate Director, Tyson Research Center*

General Information

Location:	Eureka, MO, USA
Bioregion:	Heartland
Living Transect:	L3
Typology:	Building
Occupancy Type:	Education/Research
Project Area:	2,299 sqm / 24,751 sf
Building Area:	276 sqm / 2,958 sf
Start of Construction:	12/2008
Start of Occupancy Period:	5/2009

Project Team

Owner:	Washington U in St. Louis
Geotechnical:	Grimes Consulting
Civil:	Williams Creek Consulting
Landscape:	Lewitales
Structural:	ASDG, LLC
Architectural:	Hellmuth + Sickness Architects
Plumbing:	Solutions AEC
Mechanical:	Solutions AEC
Electrical:	Solutions AEC
Specialty Consultant(s):	
Blackwater Systems:	Clivis Multrum
Solar Energy:	Straight Up Solar
Contractor:	Bingman Construction Company

THE OMEGA CENTER FOR SUSTAINABLE LIVING Rhinebeck, New York

Omega provide innovative educational experiences that awaken the best in the human spirit. The Center for Sustainable Living is a wastewater filtration facility that is designed to use the treated water for garden irrigation and in a greywater recovery system. Omega will use the system and building as a teaching tool in their educational program designed around the ecological impact of their campus. *"Omega is thrilled to have crossed the finish line, and hopeful that projects like ours will mark a new era in sustainable design, one that reflects a truly integrated approach to creating built environments that are in harmony with the natural world." - Skip Backus, CEO at Omega*

General Information

Location:	Rhinebeck, NY, USA
Bioregion:	Northeast
Living Transect:	L3
Typology:	Building
Occupancy Type:	Business/Education
Project Area:	13,132 sqm / 141,350 sf
Building Area:	580 sqm / 6,246 sf
Start of Construction:	11/2007
Start of Occupancy Period:	5/2009

Project Team

Owner:	Omega Institute
Geotechnical:	Chazen
Civil:	Chazen
Landscape:	Conservation Design Forum
Structural:	Tipping-Mar + Associates
Architectural:	BNIM Architects
Interior Design:	BNIM Architects
Plumbing:	BGR Consulting Engineers
Mechanical:	BGR Consulting Engineers
Electrical:	BGR Consulting Engineers
Lighting Design:	BNIM Architects / BGR Consulting Engineers
Specialty Consultant(s):	
Reclaimed Materials:	Planet Reuse
Water Systems Engineer:	Natural Systems International
Ecological Design:	John Todd Ecological Design
Contractor:	David Sember Construction

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Just within the past couple of weeks the first Living Building projects have been certified including these two in Missouri and New York. These two projects met the full certification which includes having been monitored for their full operation for a year before they could be certified.

City of Seattle LBC Pilot Program

The Pilot Program allows additional flexibility in the application of development standards in the Land Use Code through the design review process in order to accommodate innovative technologies or design approaches that might otherwise be discouraged or prohibited. The Pilot Program will accept up to 12 projects over a 3-year period.

www.seattle.gov/dpd/Permits/GreenPermitting/LivingBuildingPilot/default.asp

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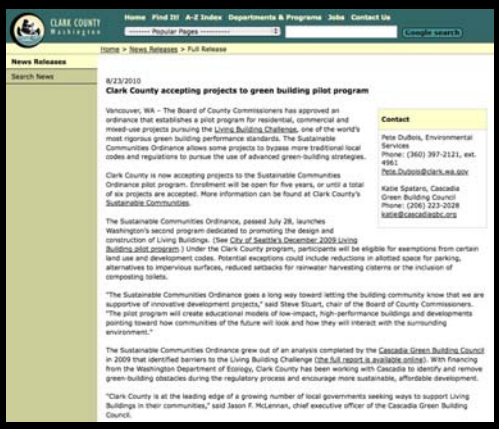
A fantastic example of political leadership occurred recently in Seattle, where the city leaders voted to create a pilot program allowing increased flexibility in the building and land use codes to allow Living Building Projects to be built in the city so that the city could understand more fully what would need to change in order for such projects to become as easy to build as mainstream projects are now.

Clark County, Washington LBC Pilot



Clark County Washington's Pilot Program authorizes increased flexibility in code enforcement for up to six Living Building projects over a five year period.

These pilot programs represent a shift in communities, recognizing that in order to prevent the worst outcomes today we must enable the best outcomes.

www.co.clark.wa.us/news/news-release.asp?pkNewsSeq=2108

And recently, Clark County, Washington followed with a similar ordinance of their own. These are hugely encouraging signs, when jurisdictions recognize that their regulatory structures are inhibiting the best and most sustainable projects while allowing projects with much larger negative impacts to be approved much more easily. This is an important shift, the recognition that the solutions to the impending challenges we are facing require us to make the most rapid and fundamental shift toward enabling the best in order to prevent the worst outcomes. Other communities and states are developing stretch or reach codes to go along with the development of aspirational instead of just minimum standards.

The Shift to Performance-Based Codes

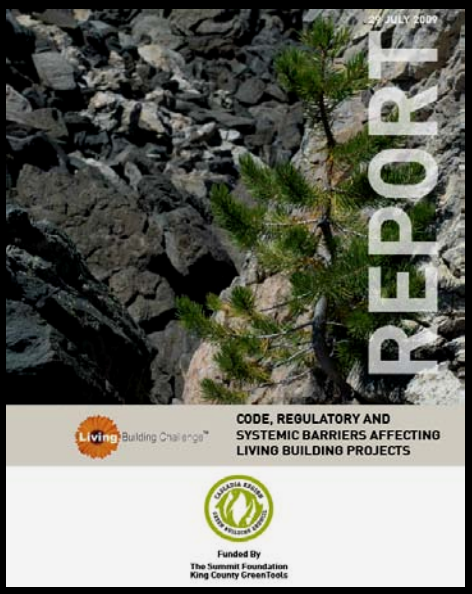
The IRCC, supporter of the international shift to performance-based building regulations, held a Global Policy Summit on Sustainability in 2005.

http://www.irccbuildingregulations.org

Development Center for Appropriate Technology - 2011

There has also been an increasing shift toward performance based codes, in part because they enable more rapid change and innovation and in part because they allow clearer definition of the goals and objectives rather than focusing exclusively on what we are trying to avoid or prevent. There is an international organization, the Inter-Jurisdictional Regulatory Collaboration Committee (IRCC) which is made up of national building code organizational representatives from countries developing or using performance-based building code systems. I have had the pleasure of presenting at four of their international conferences and meetings, including in 2005, their Global Policy Summit on Sustainability. There are excellent resources on their website and they are working to appropriately incorporate sustainability into performance based systems.

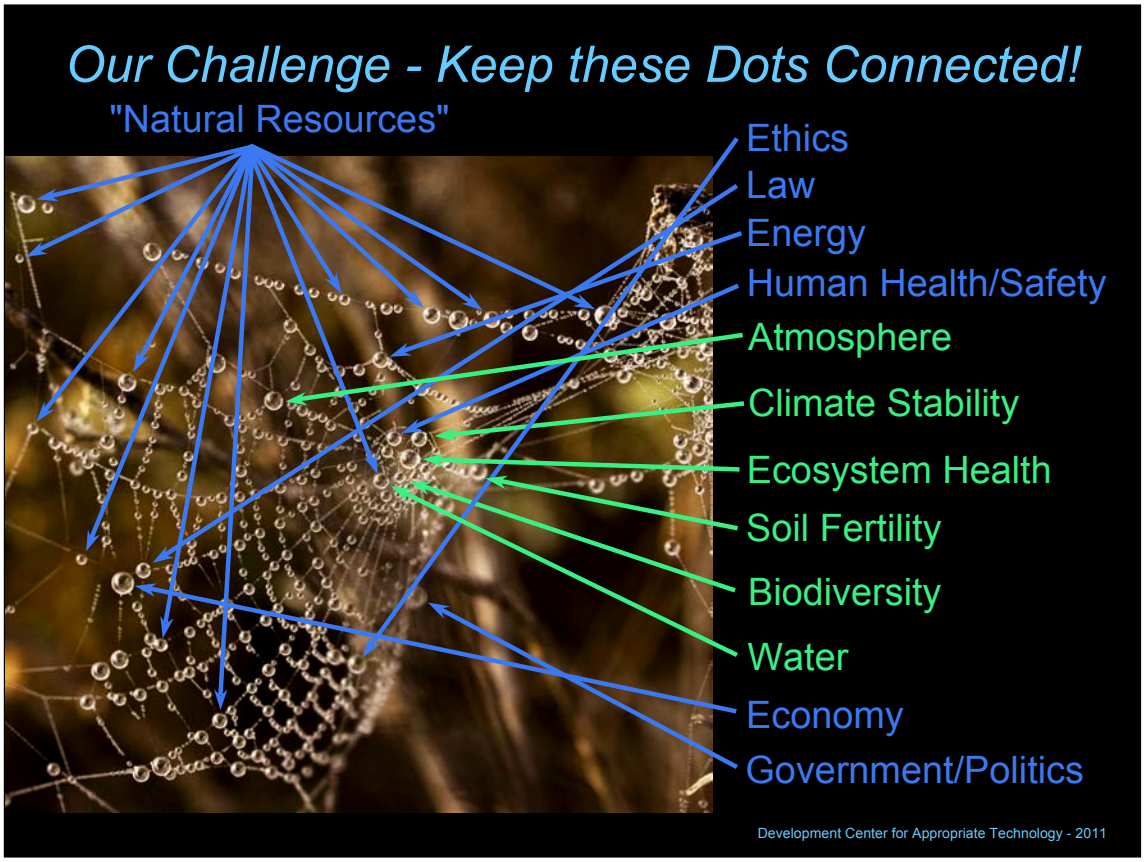
The Living Building Challenge



This is a 2009 report from the Cascadia Region Green Building Council on the spectrum of building regulatory issues related to Living Building and other deep green projects.

www.dcat.net/resources/index.php

DCAT, my organization was hired by the Cascadia Region Green Building Council to produce a report on the code and regulatory barriers to Living Building Challenge projects. This report, which was published in the summer of 2009, covers a wide range of regulatory issues in depth, and offers many recommendations.



Finally, I just want to make the point that in all of our work in creating codes and standards for the built environment, that everything we do is connected to the web of life and our relationship to and place in it. As long as we keep looking at risk in fragmented and isolated ways, seeing ourselves as being independent instead interdependent with living and natural systems, we will continue to undermine our own well-being and future prospects. I put "Natural Resources" in quotes here because some of my Native American friends see everything as relations - part of their family. They've asked me if we would think of mining our children or grandmothers or using up our cousins or sisters? They've pointed out the near total lack of respect in our modern cultures for what is not manmade. We have the very real responsibility of maintaining the health of those connections and relationships in what we are doing, especially given that the built environment has among the largest of all impacts of human activities on this little planet.


Thank you!
www.dcat.net/resources/index.php
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Thank you!