Overview of the International Green Construction Code (IgCC)

Green Building Forum
College of Technological Studies
Kuwait, March 26-27, 2012

Eng. C.P. (Chuck) Ramani, P.E.
International Accreditation Service
Overview of the development and schedule of the International Green Construction Code (IgCC)

Highlights of the Code provisions

Where the IgCC has been adopted
References


- *IgCC* Final version, published March 2012


An Introduction to Green Building

Figure 1-1
United States CO₂ emissions by sector.

- **Buildings** 46.9%
  (2580 MMT CO₂e)
- **Industry** 19.6%
  (1082 MMT CO₂e)
- **Transportation** 33.5%
  (1845 MMT CO₂e)
An Introduction to Green Building cont’d

Figure 1-2
United States energy consumption by sector.

- Buildings: 49%
- Transportation: 28.2%
- Industry: 22.7%
Human Evolution and the Thirst for Energy

- Ability of the earth to support a wide variety of life is in question.

- Unprecedented and rapid increase in population over the last 250 years. The total number of people in the world first reached 1 billion in about 1800, and it had taken about 2 million years to reach this level.

- The next billion was added in about 130 years. A further billion took about 30 years from 1930 to 1960. The next billion was added in only 14 years (by 1974), and the next billion took about 13 years (until 1987).

- Nearly every household in the industrialized world is now connected to the electric utility grid.

- Increased consumption of the earth’s resources have led to increased pollution and ecosystem disruption around the world.
Human Evolution and the Thirst for Energy cont’d

---

Potential Energy
Total = 94.820 Quadrillion Btu

- Petroleum 37%
- Natural gas 25%
- Coal 21%
- Nuclear electric power 9%
- Renewable 8%

Alternative Energy
Total = 7.745 Quadrillion Btu

- Solar 1%
- Hydroelectric 35%
- Geothermal 5%
- Biomass 50%
- Wind 9%

---

Green building and sustainable construction is rapidly on its way towards being the norm.

**Figure 2-3**
Annual oil production.
The Green Building Landscape and the Road Ahead

- Energy Star program established by the U.S. EPA and Department of Energy (DOE in 1995) employs a proven energy management strategy to measure current energy performance, setting goals, tracking savings and rewarding improvements.

- The WaterSense program established in 2007 by the U.S. EPA, seeks to protect the nation’s water supply by promoting water conservation and enhancing the market for water-efficient products.

- U.S. DOE created the Lighting Facts program to assure decision makers that the performance of LED-based products is represented accurately (2010).
The 2030 Challenge

- The 2030 Challenge is an industry initiative that recognizes that buildings are the major source of global demand for energy and materials that produce by-product greenhouse gases (GHG).

- Slowing the growth rate of GHG emissions and then reversing it is the key to addressing climate change and keeping global average temperature less than 2°C above pre-industrial levels.

- The 2030 Challenge calls upon the global design and construction community to reduce fossil fuel energy consumption in all new buildings by 60% immediately for each building type, with the ultimate goal of achieving carbon-neutral buildings by 2030 (using no fossil fuel GHG-emitting energy to operate).
The 2030 Challenge cont’d

- Currently only a small percentage of the world’s new buildings are actually built green (only 3% were in the United States in 2007), and many “green” buildings were not any more efficient than required by local codes. Even LEED did not require higher energy efficiency than base codes until 2008.

- In light of these facts, we appear to be short of meeting the goals of the 2030 Challenge, though we are only in the first phase.
The 2030 Challenge also demands that industry address existing buildings.

By 2035 approximately 75% of the built environment will be either new or renovated.

As existing buildings make up 90% of the built environment in any given year, this segment of the market cannot be overlooked if 2030 Challenge goals are to be met.
The Green Building Landscape and the Road Ahead cont’d

Figure 3-2
The 2030 Challenge to reduce fossil-fuel energy consumption.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fossil fuel energy consumption</th>
<th>Renewable</th>
<th>Fossil fuel energy reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today</td>
<td>60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>Carbon neutral*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Using no fossil fuel GHG-emitting energy to operate.

Figure 3-3
The expanding scope of codes and standards push voluntary green building rating programs while simultaneously being pulled by voluntary green building rating programs resulting in a trend towards zero impact buildings.
Sustainable Communities

Figure 4-4
Public transportation.

Figure 4-5
Dedicated bicycle path.

Figure 4-6
Hybrid-only parking.
Becoming Knowledgeable About Sustainability Can Be Challenging

- Cost of purchasing multiple, green building rating systems and codes
- Studying and understanding the differences between them
- Keeping abreast of changes
- Developing documentation that supports product acceptance
- Training personnel & customers
Sustainability Builds Upon Life Safety
Sustainability Builds Upon Life Safety
Code Concepts

- Written in mandatory language that provides a new regulatory framework
- Provides both performance & prescriptive options
- Code can be modified to account for local conditions
- Addresses the 2030 Challenge
- Designed with local, state & federal laws in mind
Green Codes Have a Different Objective Than Traditional Codes

Traditional model codes focus on the negative impact that the environment has on the longevity and safety of buildings.

The IgCC (and other green rating systems/codes) focus on reducing the negative impacts of buildings on the environment.
Flexibility to Adjust the IgCC Requirements

The IgCC also provides jurisdictions with the ability to adapt the code to address regional environmental goals and concerns, including the ability to encourage and recognize higher building performance through project electives in an Appendix.
What is the IgCC?

- The 2030 Challenge initiated a series of events that led to the development of a more sustainable and comprehensive code that can be an overlay to the building code.

- Building departments don’t have the capability to enforce green building standards by themselves because building codes don’t address toxicity, zoning issues, etc.

- An Adoptable, Useable and Enforceable code

- Intended to reduce the negative impacts of the built environment on the natural environment
What is the IgCC? cont’d

- Addresses
  - Conservation of:
    - Natural resources
    - Materials
    - Energy
    - Water
  - Air & indoor environmental quality
- Owner education
IgCC Context

- The IgCC is *not* a rating system, nor is it intended to replace them.

- The IgCC is code which is intended to be adopted on a mandatory basis.

- Unlike most rating systems, the IgCC primarily consists of minimum mandatory requirements, just as other I-Codes.
Scope and Intent

- Consistent and coordinated with the ICC family of Codes & Standards

- Applicable to the construction of
  - New and existing buildings
  - All buildings, excluding
    - residential buildings under the scope of the IRC
    - R-3 occupancies
    - R-2 & R-4: 4 stories in height or less
    - Temporary Structures

- Intended to be enforced primarily by building officials – a system already in place nationwide

- Intended to drive green building into everyday practice
Our Partners

SAFE & SUSTAINABLE BY THE BOOK
<table>
<thead>
<tr>
<th>Event</th>
<th>Date Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGCC PV 1.0 posted for public comment</td>
<td>March 15 to May 14, 2010</td>
</tr>
<tr>
<td>Public comments posted</td>
<td>July 2, 2010</td>
</tr>
<tr>
<td>Public hearings to review public comments to PV 1.0</td>
<td>August 14 to 22, 2010</td>
</tr>
<tr>
<td>PV 2.0 posted for public comments</td>
<td>November 3, 2010, with comments due by January 3, 2011</td>
</tr>
<tr>
<td>IGCC Code Development Hearing</td>
<td>May 16 through 22, 2011, Dallas, Texas</td>
</tr>
<tr>
<td>A Final Action Hearing</td>
<td>November 3 through 6, 2011, Phoenix, Arizona, in conjunction with the 2011 ICC Annual Conference</td>
</tr>
<tr>
<td>The first edition of the IGCC is scheduled to be published</td>
<td>in early 2012.</td>
</tr>
</tbody>
</table>
Concepts

- Uses “model” code approach that provides communities the ability to modify.

- Minimum & advanced levels of performance (green & high-performance buildings).

- Works as an overlay to the ICC Family of Codes. References other I-Codes
  - IBC, IFGC, IMC, IPC, IPMC, IFC, IWUIC, ICCPC, IEBC, IZC, IECC.
Concepts

- Written in mandatory language that provides a new regulatory framework.
- Provides both performance & prescriptive options.
- Code can be modified to account for local conditions.
- Addresses the 2030 Challenge.
- Designed with local, state & federal law in mind.
Concepts

- ANSI/ASHRAE/USGBC/IES Standard 189.1 also is offered as a compliance option.

- ICC 700 is offered as a compliance option
  - For low-rise residential, including R-3 occupancies and R-2/R-4 occupancies that are four stories and less in height

- Residential occupancies of five stories and above have three paths – comply with the IgCC base requirements, comply with ASHRAE 189.1, or comply with ICC 700.
Chapter Topics

- Energy use conservation/efficiency (IECC baseline).
- Water use conservation/efficiency.
- Indoor environmental quality.
- Materials and resource conservation.
- Jurisdictional Requirements -- customization options beyond base (22 choices); includes ANSI/ASHRAE/USGBC/IES Standard 189.1.
- Project Electives (52 project electives) – designer choice (Appendix A)
- Site development & land use.
- Existing buildings & sites.
- Commissioning, Operation & Maintenance.
- Administration, Definitions, Referenced Standards.
Framework

New Regulatory Framework

Administration & Enforcement

- The IGCC is an “overlay” code
- Its administrative requirements work in tandem with the administrative requirements of other I-Codes

Baseline Requirements

- The IGCC is an effective tool which has the potential to significantly reduce the negative impact of buildings on the environment.
- Energy performance must be 30% better than the minimum requirements of the 2006 IECC
- Plumbing fixture and fitting flow rates are reduced by 20% compared to the IPC
- The code contains a plethora of other minimum mandatory requirements
- The IGCC can be applied to private sector buildings with confidence; it will not overburden that sector
- In this form it is similar in administration and enforcement applications to all other I-Codes

Jurisdictional Requirements

Using Table 302.1, jurisdictions can ramp up or require enhanced performance in many areas, and at multiple levels, as required to suit their own environmental goals and geographic conditions, including:

- More stringent site, land use, material resource and indoor environmental quality provisions
- Enhanced energy and water performance

Project Electives

- The jurisdiction indicates a number between zero and 14 as the minimum number of project electives that must be complied with for all projects built in the jurisdiction.
- The owner and designer select specific project electives from the list of 60 electives in Table 303.1. The total number of project electives selected and implemented must be at least the number that the jurisdiction has indicated in Table 302.1.
Chapter 3

- Chapter 3/Appendix A is unique in that it allows the jurisdiction to customize the document to a limited degree.

- Focus is on adoptability through flexibility of the document to coordinate with the local jurisdictions environmental goals and specific regional geography.

- Four (4) major components of Ch 3/Appendix A:
  1. Jurisdictional Requirements.
  2. Option to adopt ASHRAE Standard 189.1 (Replaces IgCC Except Chapter 1)
  3. Project Electives
IgCC Table 302.1 allows regional choices, similar in concept to Table R302.1(1) in the IRC.

- Allows jurisdictions to make choices for higher levels of stringency by:
  - Determining whether certain provisions will be enforced in the jurisdiction. (Typically yes or no answers.)

- Decisions made in the Table apply to all buildings constructed in the jurisdiction.

- Many of the choices in Table 302.1 may pose risks for certain jurisdictions. (Thus they may pose a barrier to adoption in some regions and are not mandatory for all jurisdictions.)
Project Electives

- Allows owners and design professionals to make choices which:
  - Encourage and drive the construction of buildings which exceed the already stringent minimum requirements of the code.
  - Encourage practices which are difficult to mandate.
  - Adds a degree of flexibility to the code.
  - Jurisdiction determines minimum number that must be satisfied in Table 302.1.
  - Owner chooses which electives will be complied with on a project by project basis.
Even where adopted in its baseline/minimum form (where no project electives are selected and only “No” boxes checked), the IgCC is poised to produce significant environmental benefits.

✓ No longer must mandatory green building requirements be limited to government buildings.
IgCC Chapter 4: Site Development and Land Use
Preservation of Natural Resources

Protection by area: e.g. floodplains, conservation areas, park lands, agricultural lands, greenfields.

Site design and development requirements:
- Pre-design site inventory and assessment
- Stormwater management,
- Landscape irrigation systems,
- Management of vegetation and soils
- Erosion control

Site waste management plan.
Transportation impact.
- Walkways and bicycle paths
- Changing and shower facilities
- Bicycle parking and storage
- Vehicle parking

Heat island mitigation.
- Site hardscape
- Roof coverings

Light pollution mitigation.

Detailed site development requirements.
- Subsurface graywater irrigation systems
- Vegetation and soil protection
- Soil reuse and restoration
- Landscape, soil and water quality protection plan
- Vegetative roofs

Site & land use project electives.
IgCC Chapter 5:  
Material Resource Conservation and Efficiency
Material Resource Conservation and Efficiency

- Material and Waste Management
  - Waste management plan for construction phase
  - Post occupancy recycling areas must be shown on plans.

- Materials and their properties.
  - 55% of materials used in every project must be any combination of the following
    - Used,
    - Recycled,
    - Recyclable,
    - Bio-based or Indigenous.
Material Resource Conservation and Efficiency

- **Lamps**: Limits mercury content in lamps
- **Now moved to Project Electives Appendix – no longer a requirement.** *Service Life*: Building service life plan to be included in construction documents. Not less than 25 years.
- **Storage and handling of materials.**
- **Moisture Control**: Requires specific inspection of foundation drainage systems, damproofing and waterproofing, flashings and roof coverings.
- **Material related project electives.**
ICC-ES Environmental Programs Evaluates to All of the Green Building Codes, Rating Systems

We study the “rules”

And “translate” them into Environmental Criteria
IgCC Chapter 6:
Energy Conservation, Efficiency & Atmospheric Quality
Buildings may use either of the following compliance paths:

- Performance based path
- Prescriptive based path
Energy Efficiency and Atmospheric Quality

Figure 8.14
Wall Assembly with Mass: Wall assembly in hot-dry climate with mass exposed to the interior conditioned space. Insulation is placed on the exterior.
Figure 8-15
Window Performance:
A low solar heat gain coefficient (SHGC) value generally means a spectrally selective low-e coating protects the window from infrared radiation (heat transmittance).

Glazing responds differently to visible and infrared wavelengths.

IR heat is reflected by coating.

Near infrared (heat only) transmission is limited.

Visible

Infared

Spectrally selective low-E coating

Light and heat transmitted
Energy

Major section topics:

- Energy performance and peak power.
- Atmospheric impacts – reduced CO2e emissions.
- Metering, monitoring and reporting.
- Auto-Demand/Response strategies.
- Building envelope systems.
Energy

Major section topics (cont.):

- Mechanical and Svc Water Heating systems
- Electrical power and lighting
- Appliances and equipment
- Renewable energy.
- Commissioning and maintenance.
- Energy related project electives.
Ch 7 major section topics:

- Plumbing systems and conservation measures.
- Landscaping and irrigation – addressed in Chapter 4.
- Specific water savings measures.
- Use of graywater, rain collection and storage.
Chapter 7

Water Resource Conservation & Efficiency

Ch 7 major section topics (cont.):

- Fixtures, fittings, equipment & appliances
- HVAC systems and equipment efficiency
- Water treatment system efficiency
- Specific topics (e.g. Submetering, fountains)
- Nonpotable water use
- Alternative water sources
Non-Potable Water Use

- The IgCC contains detailed provisions for the design, construction and installation of graywater, rainwater catchment and reclaimed water systems.

- Effective use of non-potable water where it is appropriate and is permitted by codes within the jurisdiction is very important.

- Non-potable water is generally considered to be water that is not suitable for drinking purposes and includes the reuse of water within buildings, as facilitated by graywater, rainwater catchment and reclaimed water systems.

- Many green codes, standards and rating systems discourage or prohibit the use of potable water, for toilet and urinal flushing, etc.

- The International Plumbing Code (IPC) contains an appendix that addresses the design, construction and installation of graywater systems.
Water Efficiency

**Figure 6-7**
Graywater system schematic.
IgCC Chapter 8: Interior Environmental Quality and Comfort
Chapter 8 major section topics:

- Building construction features, operations & maintenance
- HVAC system requirements
- Construction phase emissions and pollution control, HVAC flush out
- Asbestos use prevention
- Material emissions & pollutant control
- IAQ measures
- Views to exterior and day-lighting
### Indoor Environmental Quality, Health and Well-Being

#### Table 9-3
**Oil-Based Chemicals with High Environmental Risk**

<table>
<thead>
<tr>
<th>Oil based chemical</th>
<th>Areas of Use</th>
<th>Environmental Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>Glue in OSB and plywood</td>
<td>Carcinogenic; allergenic; irritates air inhalation routes; poisonous to water organisms</td>
</tr>
<tr>
<td>Phenol</td>
<td>Glue in laminated lumber</td>
<td>Carcinogenic; mutagenic; poisonous to water organisms</td>
</tr>
<tr>
<td>Chloroprene</td>
<td>Synthetic rubber, glue</td>
<td>Carcinogenic; damages liver and kidneys; irritates inhalation routes</td>
</tr>
<tr>
<td>Butadiene</td>
<td>Synthetic rubber (SBR)</td>
<td>Probably carcinogenic</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>Polyvinyl chloride (PVC)</td>
<td>Persistent carcinogenic; can cause damage to liver, lungs, skin and joints; irritates inhalation routes; poisonous to water organisms</td>
</tr>
<tr>
<td>Ethylene (ethene)</td>
<td>Polyethylene</td>
<td>Probably carcinogenic</td>
</tr>
<tr>
<td>Propylene (propene)</td>
<td>Polyethylene</td>
<td>Probably carcinogenic</td>
</tr>
<tr>
<td>Phthalates</td>
<td>Softeners in plastics</td>
<td>Persistent; irritates the mucous membranes; allergenic; probably carcinogenic; environmental oestrogen; damages reproductive organs</td>
</tr>
<tr>
<td>Amines</td>
<td>Silicone, polyurethane, epoxy</td>
<td>Irritate inhalation routes; allergenic; possibly mutagenic; very acidifying in water</td>
</tr>
<tr>
<td>Epichlorohydrin</td>
<td>Epoxy</td>
<td>Carcinogenic; highly poisonous to water organisms</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Synthetic rubber</td>
<td>Carcinogenic; highly poisonous to water organisms</td>
</tr>
<tr>
<td>Acrylic acid</td>
<td>Acrylic plastics and paints</td>
<td>Poisonous to water organisms</td>
</tr>
<tr>
<td>Styrene</td>
<td>Polystyrene, polyester, synthetic rubber (SBR)</td>
<td>Irritates air inhalation routes; damages the reproductive organs</td>
</tr>
<tr>
<td>Isocyanate (TDI, MDI, etc.)</td>
<td>Polyurethane, glue</td>
<td>Strongly allergenic; difficult to break down; irritates skin and mucous membranes</td>
</tr>
<tr>
<td>Alkyl phenol toxilates</td>
<td>Pigment paste, alkyd varnish</td>
<td>Environmental oestrogen; damages reproductive organs</td>
</tr>
</tbody>
</table>
Indoor Environmental Quality, Health and Well-Being cont’d

Figure 9-5
Light shelves increase the depth of the daylighting zone while providing shade and reducing glare.

Figure 9-6
Daylight penetration and footcandle level increases with window height. Daylight glazing is most effective above 7–8'.

Figure 9-7
Exterior louvers can reduce heat gain and glare.
Indoor Environmental Quality, Health and Well-Being cont’d

**Figure 9-8**
Daylighting and daylight sensor controls for electric lighting.
IgCC Chapter 9: Commissioning, Operation & Maintenance
Chapter 9 major topics:

- Commissioning (inspections and testing) required as listed in Table 903.1.

- Post occupancy reporting required where selected by the jurisdiction in Table 302.1. (904.1.1.1)
Building Commissioning

- Assures the owner that the building will function as designed (reliability and reduced operating costs).
- Integrated project deliver (IPD) is an effective contract tool and an indispensable component of engineering success of green construction.
- The “MacLeamy Curve” developed in 2004 by Patrick MacLeamy shows how integrated project delivery (IPD) moves design and construction decisions to earlier in a project.
- Commissioning usually involves a qualified third-party.
- Table 903.1 of the IgCC gives an example of areas that commissioning can address.
Modeled after

- Special inspections criteria in Chapter 17 of the IBC and
- Commissioning criteria found in the IECC

Table 903.1 – Commissioning Plan

- List of items for which commissioning is required
- Contains columns which distinguish between pre-occupancy and post-occupancy commissioning
- Commissioning requirements extend well beyond the energy realm, including site, materials, water, etc.
IgCC Chapter 10: Existing Buildings
Loosely based on the provisions of the IBC for existing buildings:

- For alterations/renovations: whatever is changed must meet current IgCC requirements.
- Unaltered components can remain as they are.
- Additions are treated much like new construction: applicable requirements of the IgCC must be satisfied.

Section 1002.1: Prohibits the construction of additions to buildings in flood hazard areas.

- Exception: where all habitable space is located at least 1 foot above flood elevation.
Existing Buildings

Alterations to Existing Buildings:

- Basic prescriptive requirements addressing:
  - Leaks
  - Defective equipment and systems
- Extensive prescriptive list limited to 10% of the cost of alterations.
- Triggered by a change of occupancy or alteration.
IgCC Chapter 11: Existing Building Site Development
Applies to additions to and alteration, repair, maintenance and operation of the sites.

Similar to Chapter 34 of the IBC for existing buildings.

Applies only where buildings are altered or added to.

Section 1105 of the IgCC covers historic buildings.
IgCC Chapter 12: Referenced Standards and Appendices
Reference Standards

Compliance with the referenced standards is necessary for compliances with the code.

The list contains the title of the standard, the edition (date) and addenda, if any.

Appendices

Provide optional or supplemental criteria.
Where has the IgCC been adopted?
State of Rhode Island
State of Maryland
State of Oregon
City of Richland, WA
City of Keene, NH
City of Ft. Collins, CO
Kayenta Township, AZ
City of Boynton Beach, FL
City of Phoenix, AZ
City of Scottsdale, AZ
For more information and updates check the ICC website

www.iccsafe.org/igcc
Thank you!

For additional information contact Chuck Ramani, P.E., C.B.O. at cramani@iasonline.org (866) 427-4422