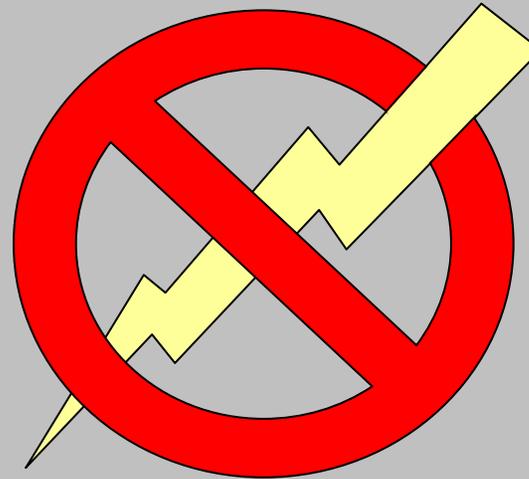


Tucson/Pima County



Net Zero Energy Code



**City of Tucson Office of
Conservation and Sustainable
Development
&
Pima County Development
Services,
Building Safety and
Sustainability**



If you can not measure it,
you can not improve it.
-- Lord Kelvin 1824-1907



If you can not measure it,
you can not improve it.

-- Lord Kelvin 1824-1907

Two new Concepts:

- **Energy Use Intensity**
- **Nega-watts**

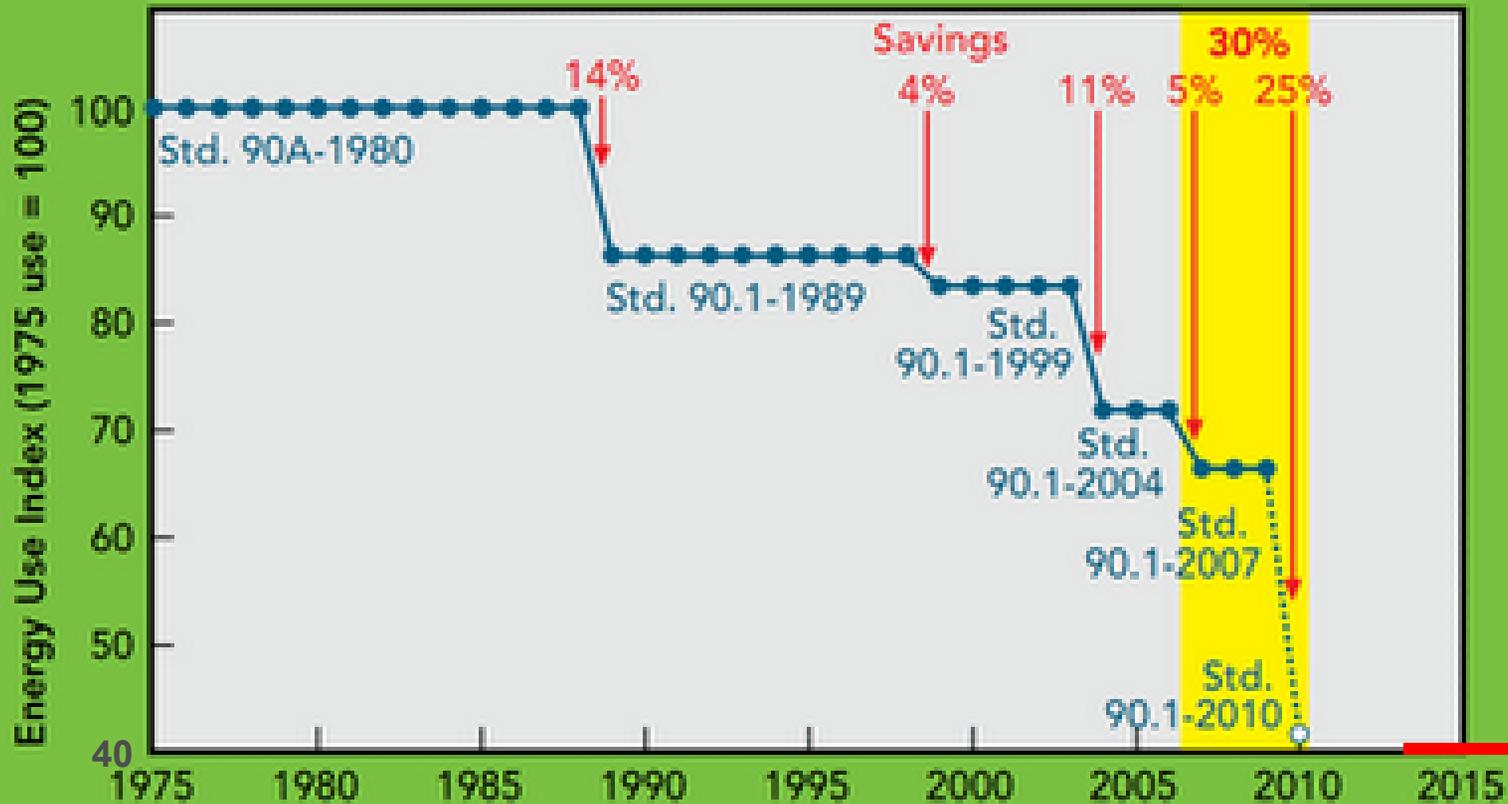


Agenda

- **Background**
- Development Process
- Economics



A Brief History of Commercial Codes



IgCC

ASHRAE Advanced Design Guides 50% “better” 20

Source: <http://usgbcblog.blogspot.com/2011/02/from-cutting-edge-to-common-practice.html>

Accessed 3/3/11



Posted originally, 4/28/11



Advanced Energy Design Guide for Small to Medium Office Buildings

**Achieving 50% Energy Savings
Toward a Net Zero Energy Building**

Developed by:
American Society of Heating, Refrigerating and Air-Conditioning Engineers
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy

<http://www.ashrae.org/publications/page/aedg50pct>



The % Better Problem

**% Better does not answer the question:
How much energy do I use, and therefore
need to produce to offset my use?**



1908 Model T



**How many gallons of
gas do I need to go
100 miles?**



1960 Ford Falcon: 20% “better”



2012 Ford Focus: 3% “better”



The % Better Problem

**% Better does not answer the question:
A Primary Metric is required**



1908 Model T: 25 mpg **4.0**



1960 Ford Falcon: 30 mpg **3.2**



2012 Ford Focus: 31 mpg **3.1**



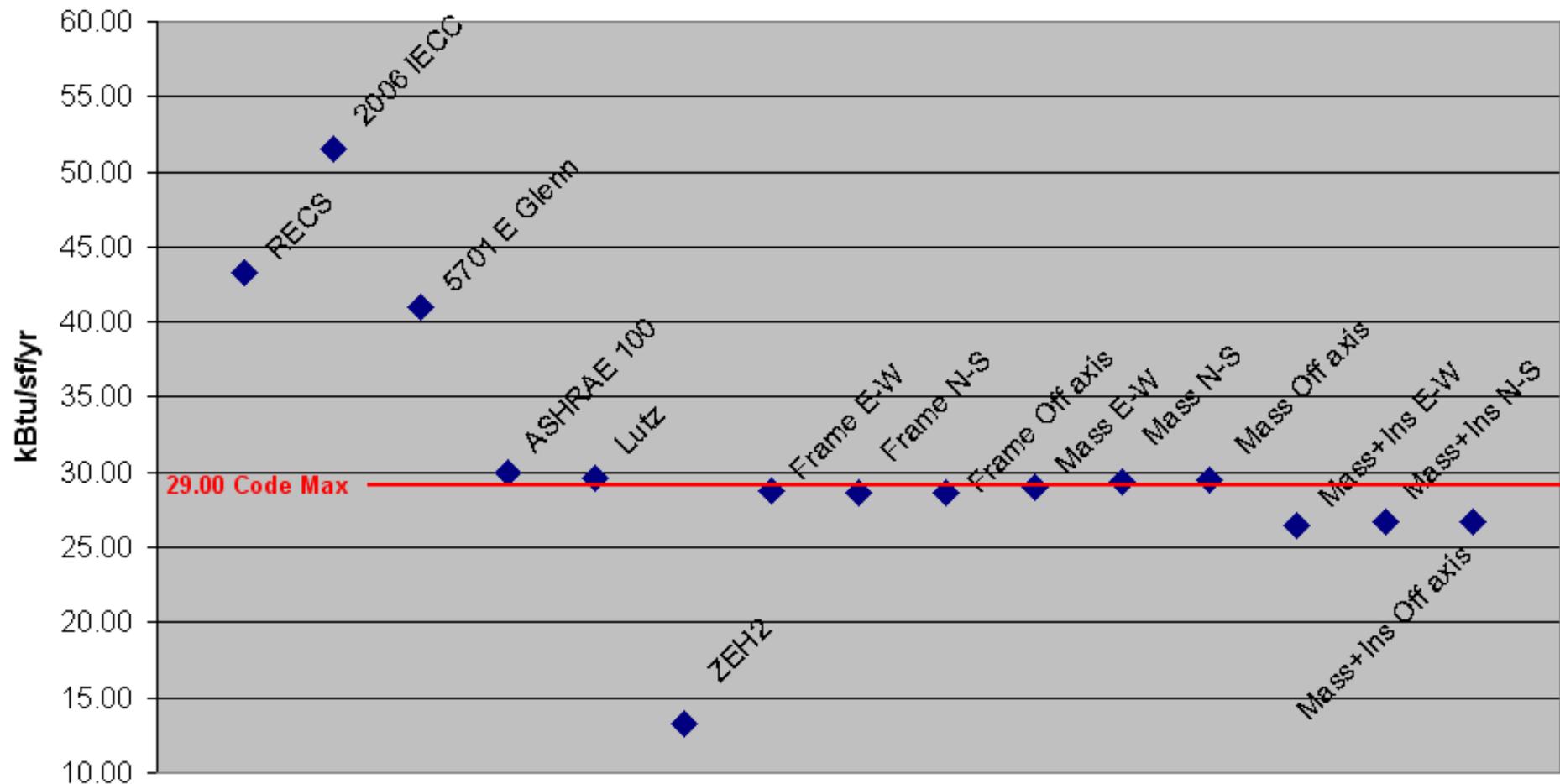
Energy Use Intensity

- A Primary Metric
- Total building site energy use divided by the building's gross floor area. The units of building energy use intensity are typically kBtu/SF/yr.
 - ASTM E2797-11 Building Energy Performance

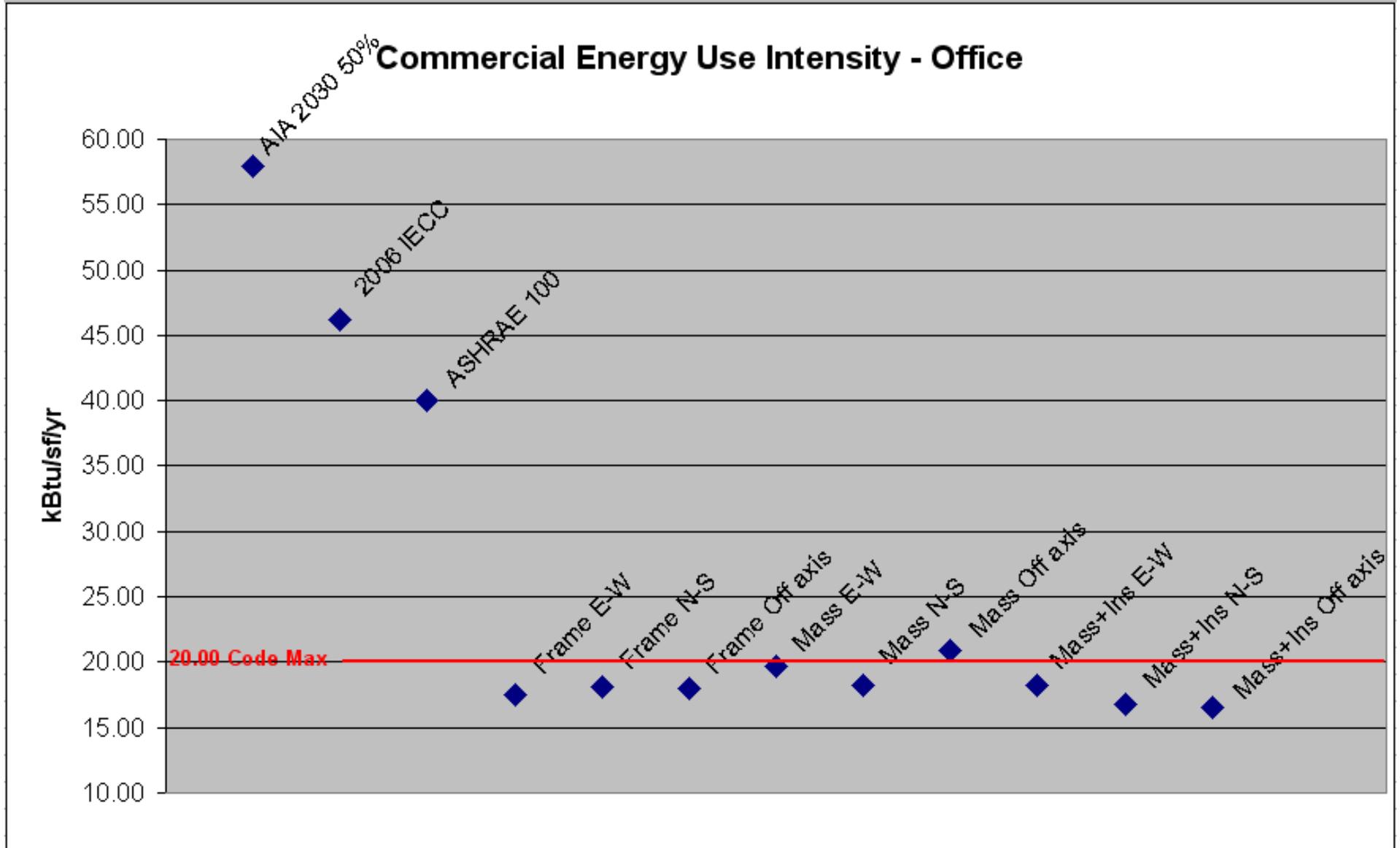


Energy Use Intensity = MPG

Residential Energy Use Intensity



Energy Use Intensity = MPG



Energy Use Intensity

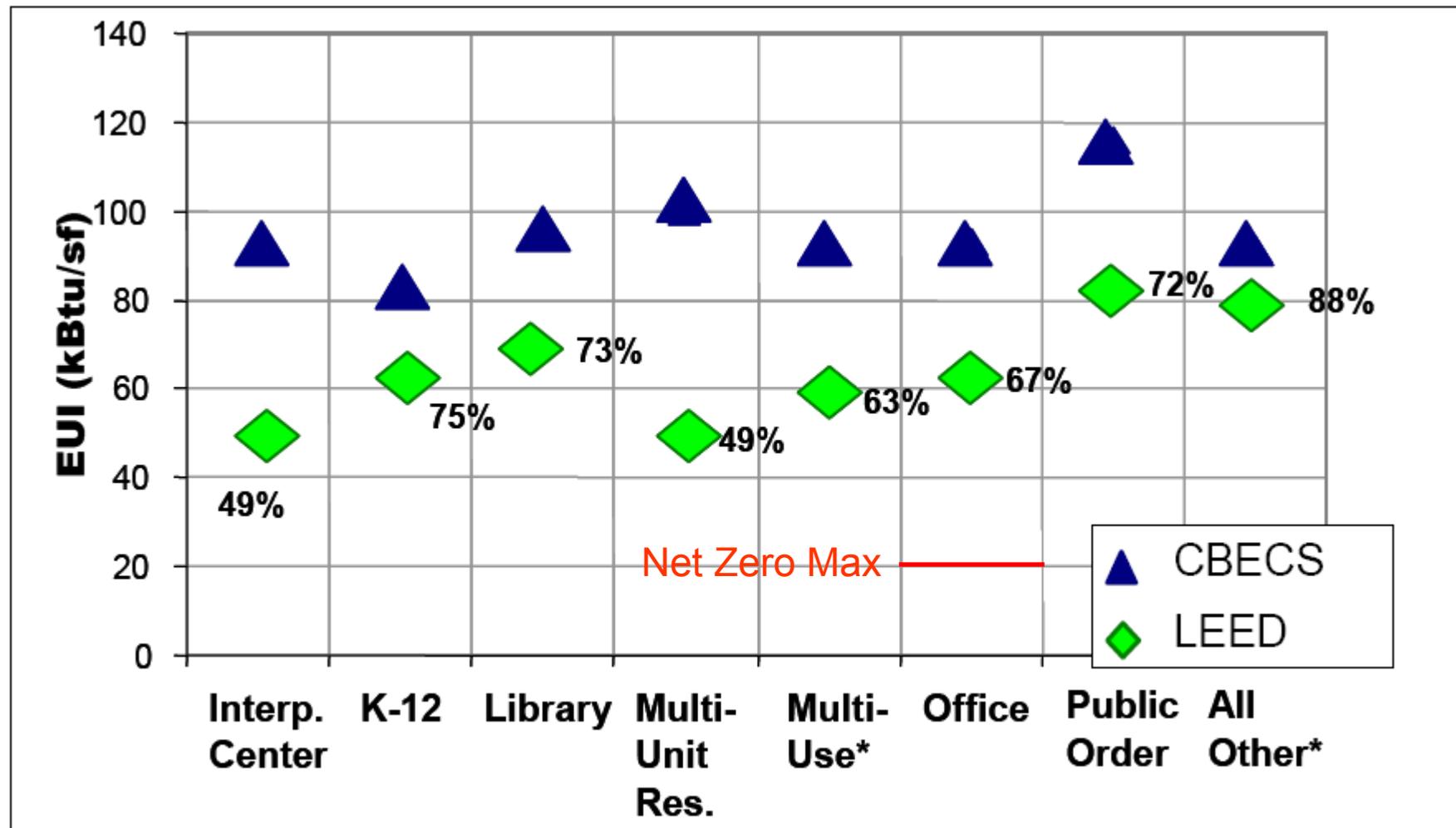


Figure 10: LEED-NC and CBECS EUIs (kBtu/sf) by Type



Agenda

- Background
- **Development Process**
- Economics



Research Design

- Internet Research
 - Build America Program
 - ASHRAE Advanced Energy Design Guides
- 2012 and 2015 IECC
- Energy Modeling
 - by Dr. Nader Chalfoun and Virginia Cardona, University of Arizona
- Water use statistics from Tucson Water

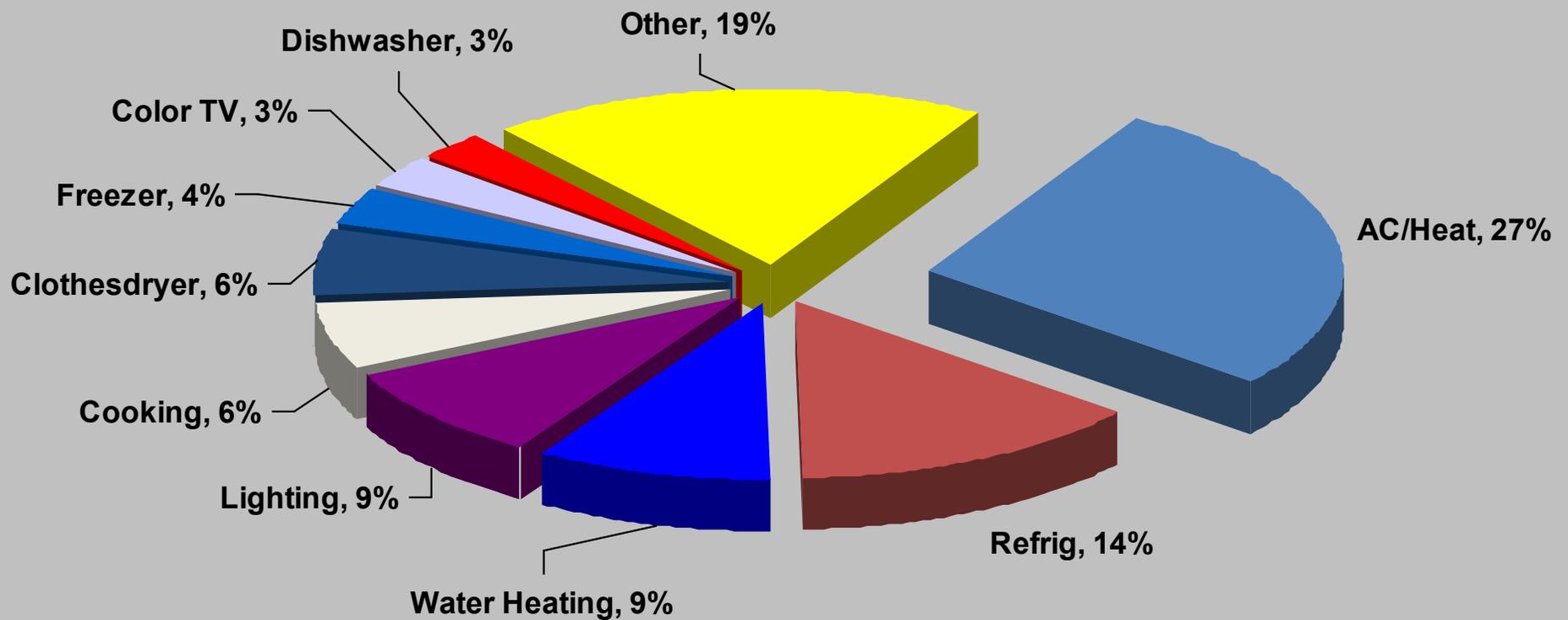


Key Concepts:

1. Energy Use Intensity is the metric



Energy – Where's it Going



Energy IN Water

- **Energy** = **Water**

4,800 kwh of **electricity** to pump
1 acre foot of **water** to our homes

Typical Tucson home with four people will use **.51** acre
feet/year

4,800 kwh/acre foot x **.51** acre feet = **2,472** kwh/year



Water is the fourth largest user of
Electricity in the home after water
heating!



Key Concepts:

1. Energy Use Intensity is the metric
2. Include the embedded energy in water in the Energy Use Intensity



Why Build More Efficient?



Design a rule system that does not require more footprint than is already used by the building.

Design a rule system that reduces the standby power requirements of the grid, thereby reducing capital expenditure for traditional power generation.

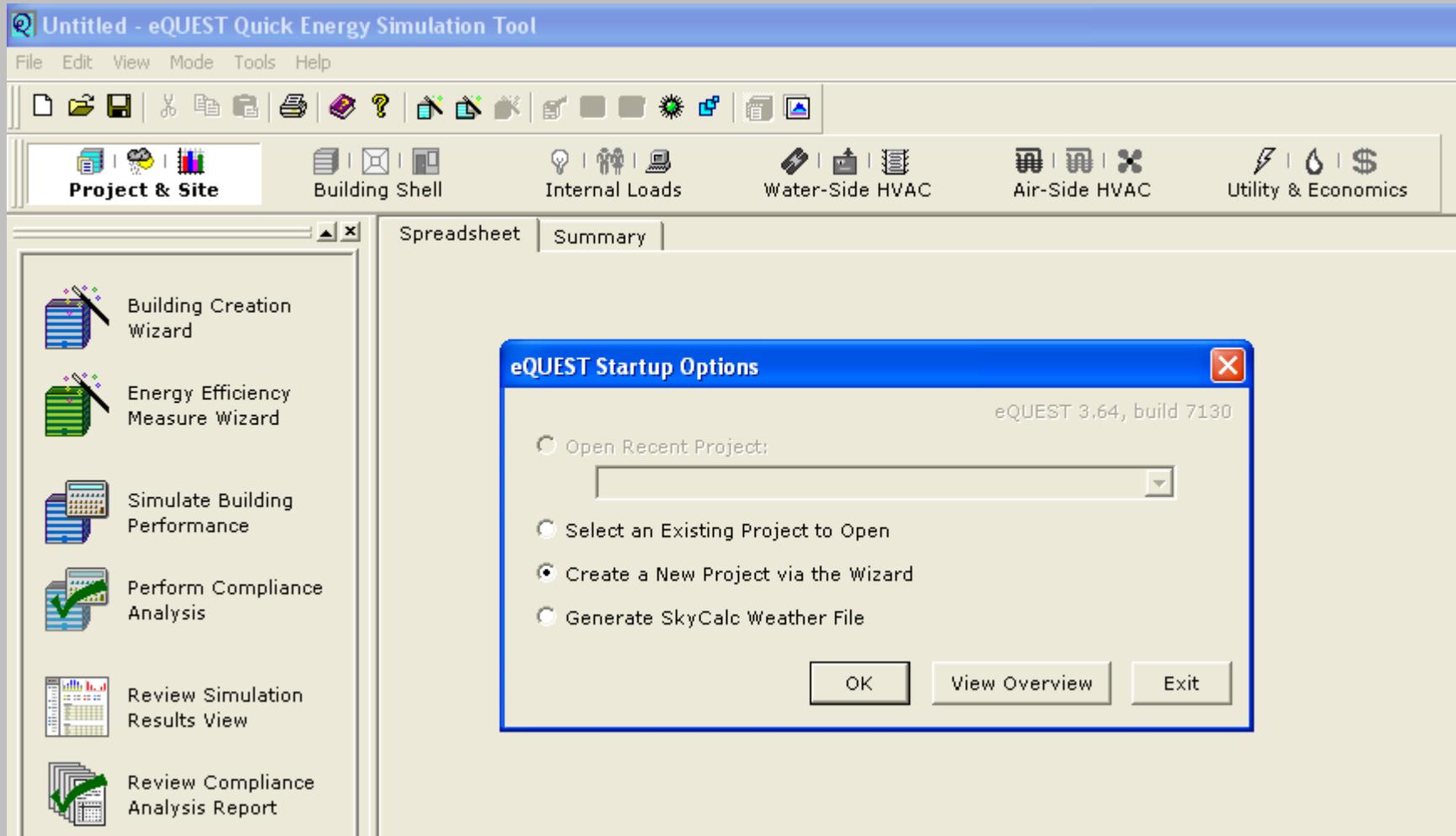


Key Concepts:

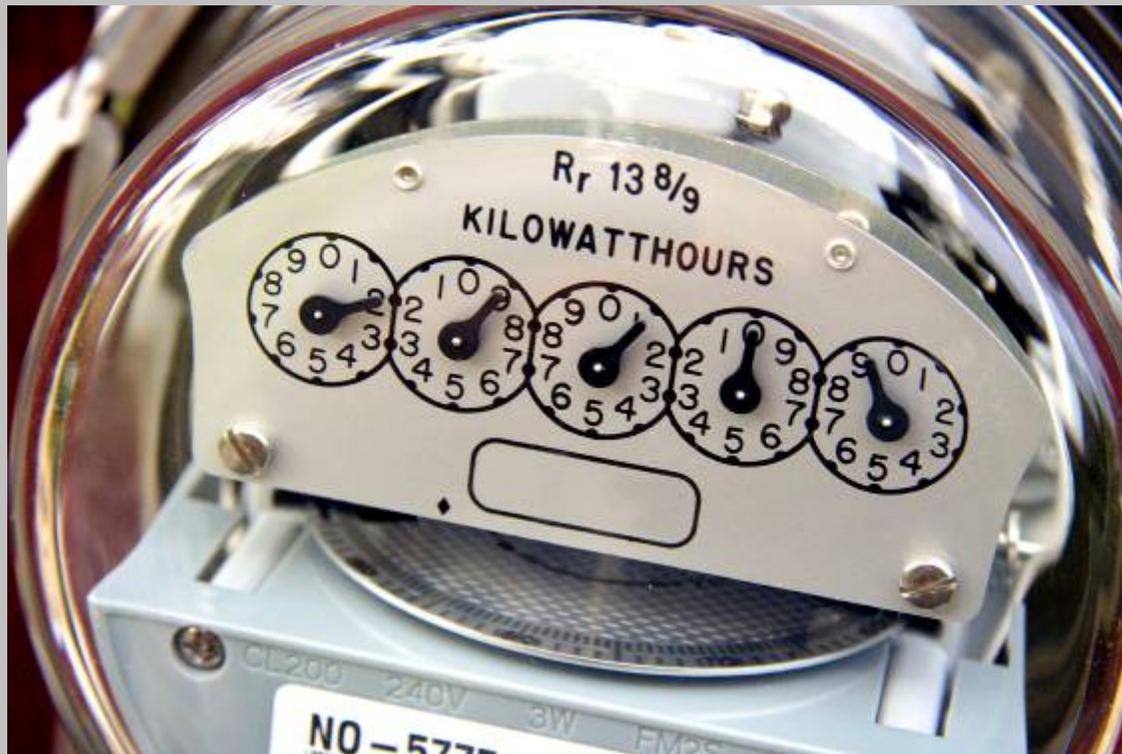
1. Energy Use Intensity is the metric
2. Include the embedded energy in water in the Energy Use Intensity
3. Limit the area of PV production to the roof of the building (and potentially covered parking for commercial buildings)



Energy Modeling is Cool...



Proof is in the Use



Key Concepts:

1. Energy Use Intensity is the metric
2. Include the embedded energy in water in the Energy Use Intensity
3. Limit the area of PV production to the roof of the home (and potentially covered parking for commercial buildings)
4. Net-zero must be proven with 12 months continuous use prior to issuing certificate



Agenda

- Background
- Development Process
- **Economics**



Economics

- What do energy efficiency improvements cost?
- **Nega-watt** = the energy saved over the life of an energy efficiency improvement
- The Nega-watt Tipping point:
 - when the cost of a nega-watt costs more than a PV watt



Fun Stuff

- [Nega-watt calculator](#)



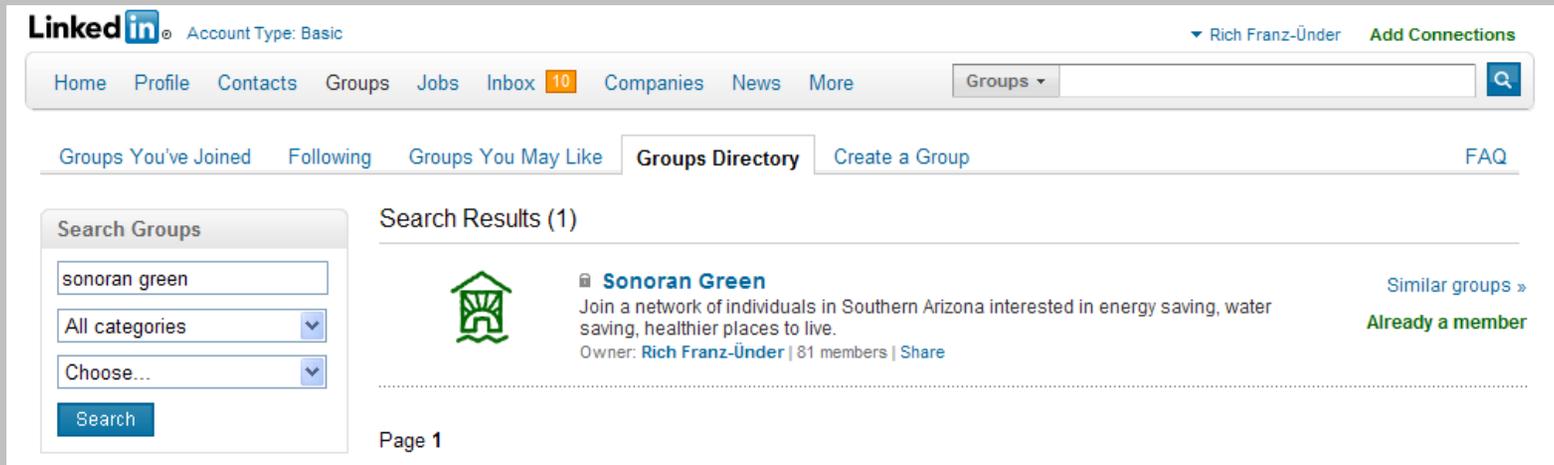
Fun Stuff

- [Nega-watt calculator](#)
- Nega-watt = 10.5 cents
- PV watt = 7.3 cents with incentives
(16.7 cents without incentives)
- Solar Hot water = 3.2 cents with incentives
- TEP watt = 12.4 cents (GS 10)



How to Keep Informed

- Join the linked in group Sonoran Green:



The screenshot shows the LinkedIn interface for a user named Rich Franz-Ünder. The top navigation bar includes links for Home, Profile, Contacts, Groups, Jobs, Inbox (with a notification badge of 10), Companies, News, and More. A search bar is present with a dropdown menu set to 'Groups'. Below the navigation bar, there are tabs for 'Groups You've Joined', 'Following', 'Groups You May Like', 'Groups Directory' (which is selected), 'Create a Group', and 'FAQ'. On the left side, there is a 'Search Groups' sidebar with a search input field containing 'sonoran green', two dropdown menus for 'All categories' and 'Choose...', and a 'Search' button. The main content area displays 'Search Results (1)' for the group 'Sonoran Green'. The group's profile picture is a green house icon. The group description reads: 'Join a network of individuals in Southern Arizona interested in energy saving, water saving, healthier places to live.' The owner is listed as 'Rich Franz-Ünder' with 81 members and a 'Share' link. To the right of the group name, there are links for 'Similar groups »' and 'Already a member'. At the bottom left of the search results, it says 'Page 1'.



www.pimaxpress.com/Green

[Home](#)



Google™ Custom Search

- [Home](#)
- [Building Permitting](#)
- [Code Enforcement](#)
- [Green Building](#)
- [Land Planning & Regulation](#)
- [Subdivision & Development Review](#)

Contact

Rich Franz-Ünder,
RA/LEED AP
Green Building Program
Manager
Email

Yves Khawam, PhD
Chief Building Official
Email

Phone: 520-740-6490
Fax: 520-740-6888



Betty Stamper
Regional Solar
Coordinator
520-740-6463
Email

- [Click here Solar Farm Site Development Plan and Permitting Requirements](#)
- [Click here for residential scale solar and wind installation requirements](#)

Organizations

- US Green Building Council
- Arizona Chapter US Green Building Council
- ICC Green Building



LEED
FOR HOMES

LEED for Homes Program

Providing services to builders and home owners in Arizona, New Mexico and Southern California

- [Getting Started with LEED](#)
- [LEED Rating System](#)
- [Fees](#)
- [Related Information](#)



Regional Residential Green Building Program For Use in Pima County and City of Tucson

- [Getting Started](#)
- [New Construction](#)
- [Remodeling](#)
- [Calculators and Guidance](#)
- [Related Publications](#)



Tucson/Pima County Net-Zero Energy Code

- [Net Zero Energy Code](#)
- [Energy Budget Calculator](#)
- [Economic Benefits Report](#)
- [Nega-watt Tipping Point Calculator](#)
- [Related Publications](#)



[What is Green and which program is best for me?](#)



[Resources and Tools](#)

[Seminars and Presentations](#)

[HVAC and Manual J](#)



[Case Studies](#)



News

[First LEED Platinum in Tucson](#)
[Silverbell Gold gets national attention in USA today](#)
[Silverbell Gold featured in Builder Magazine](#)
[First LEED Gold in Southern Arizona](#)

[News Archives](#)