Better Buildings:
The Demand for Necessary Change

R. Christopher Mathis
President
Mathis Consulting Company
2014-15 BETEC Chairman
The End in Mind

- Buildings Matter!
  - We have to value them and their LIFETIME performance MORE!

- Trends...

- The necessity of change...
  - The role of BETEC, NIBS and everyone here
Building Science Challenges...

- Energy?
- Water management?
- Pests?
- Indoor air quality?
- Air leakage?
- Durability?
- Safety?
- Longevity...
1974 40 years 2014 40 Years 2054
World Population 1800 - 2050
Population Doubles in 30 Years
Population Doubles in 40 Years
Population Doubled in 50 Years
We Are Here
U.S. Energy Consumption

![Energy Consumption Graph](image)

Source: USEIA - 2012
U.S. Energy Production - 2011

- Coal: 46%
- Renewable: 12%
- Nuclear: 21%
- Oil: 20%
- Natural Gas: 1%

Source: USEIA - 2012
U.S. Energy Production

2/3 = 2/3 = Fossil Fuels

- Fossil Fuels: 67%
- Other: 21%
- Renewables: 12%

Source: USEIA - 2012
Projections on the Future?

electricity net generation
trillion kilowatthours per year

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% Share of Electricity Generation:
- **Coal**: 45%
- **Natural gas**: 23%
- **Renewable**: 10%
- **Nuclear**: 20%
- **Oil and other**: 1%

Source: EIA, Annual Energy Outlook 2011
World Energy Consumption by Fuel

1990 – 2035

Source: USEIA – 2012
Climate Change? Buildings Matter!

Responsible for over HALF of the carbon emissions...

Our buildings pollute almost twice as much as our cars...

Source: USEIA
“The Size of Things...”
120 million homes in US
Half with crappy windows...

60 million homes

Over 1.4 billion windows
What If We Replaced Windows?
Heat Loss (winter)  Heat Gain (summer)

U-factor

Existing: 1.20
New: 0.30

Solar Heat Gain

Existing: 0.90
New: 0.30

Use the “Worst” Code-Compliant Window
Homes with AC - 1973 vs. 2012

- Northeast: 14% (1973) vs. 82% (2012)
- Midwest: 35% (1973) vs. 93% (2012)
- South: 69% (1973) vs. 99% (2012)
- West: 41% (1973) vs. 66% (2012)
- US Total: 49% (1973) vs. 89% (2012)
What Would We Save?

- 1 to 3 Tons of Air Conditioning per house
  - Depending on size, location, leakiness, etc.

- 1 ton = 12,000 Btu/hr

- 13 SEER = 13,000 Btu/kWh

- ~1 kW of peak power savings per house

- ~120 million existing homes
  - About half have lousy windows

- ~60 million * 1 ton * 1 kW/ton = 60 million kW
60 Million kW?

Over 300 coal-fired power plants....
Million kW?

Over 300 coal-fired power plants...
What would be the impact of reducing their air leakage?
Age of US Homes...

- 25% Built BEFORE 1990
- 75% Built 1990-2009
Experimental Design: Air Sealing

➢ Construction Demographics
  ➢ House age
  ➢ House size
  ➢ Climate zone

➢ Other key assumptions
  ➢ Envelope characteristics
    ➢ Insulation, window area
  ➢ Leakage assumptions
  ➢ Assumptions about renovations made over time
  ➢ Thermostat settings/Occupant comfort
  ➢ HVAC and duct performance
    ➢ System types, efficiency, delivery efficiency, etc.

How sensitive are the models?
Annual Energy Bills - KC, MO
2006 Code Baseline

What’s wrong with these assumptions? Does it matter?
Simple Math...

- 120,000,000 homes
- $2,000 annual energy bill
- 5% due to unwanted air leakage
  - Yes, probably more like 20%...

What would we save?
- 5% saves $12 billion annually
- 10% save $24 billion annually
- Etc.

Annually...
About the cost of a small nuclear plant...

...every year
Efficiency vs. Power Plants?

100 Years versus 30 Years?

Life Expectancy

Homes
Power Plants
Residential Buildings

1% New
99% Existing

1/9/2014
Mathis Consulting Company
Commercial Buildings

74% was built before 1989!!!

93% of our commercial building stock was built before 2003!

Before 1989
1990 to 1999
2000 to 2003
U.S. Commercial Construction

Over 50% new since 2010

Source: USEIA, 2013
The Road to “Net Zero”

- 50% Better than Code?
- 40% Better than Code?
- 30% Better than Code?

Minimum Energy Code

2013
Improvements in EUI: 1975 to Present

Code minimum is still a long way from “Net Zero”

"Net Zero"

Target: 30% better vs. 2004

Target: 50% Better vs. 2004
Commercial Building Trends

- **85%**
  - ≤ 25,000 square feet
  - Use 40% of the energy of the commercial buildings sector

- **15%**
  - Over 25,000 square feet
  - Use 60% of the energy of the commercial buildings Sector
Everybody Wants to be Green...

- “It ain’t easy...”
- What’s “Green” Standards?
- Ratings, Metrics?
- What Boundary Conditions?
- For how long?
- Same everywhere?
Other Forces of Influence...
Katrina...
“SuperStorm Sandy

110 mph wind gusts (Category 1)
Estimated $20-$30 billion damage
>6 million people without power
40 minutes... 12,000 homes destroyed
For How Long?
We Know What to Do...

- Insulation
- Caulk, Weatherstripping
- Better Windows
- Duct Sealing
- Duct Insulation
- More Efficient Heating
- More Efficient Cooling
- More Efficient Lighting

Fix Existing Buildings!
Market Transformation

Regulations, Laws, Codes

PUSH

Education, Marketing, Incentives, etc.

PULL

Note: The primary “friction” in this system is our resistance to change...
Built Environment Trends

- More severe climate events
  - “Superstorms”, Extreme cold, Extreme heat, etc.

- Increased expectations for building performance
  - Energy, Durability, Health, IAQ, Resilience, etc.
  - What is “sustainable”?
  - For how long?

- Is the “code” going to address these?
Market Transformation Takes Time

We must support more aggressive Market Transformation in the building industry:

- Building Science
- Energy Performance
- Sustainability
- Durability and Resilience
- Appraisals & Valuation
- Utility Valuation
- Lending Practices
- Basic Building Techniques
Challenges and Opportunities - 2

- We must VALUE:
  - Our strong and capable building industry
  - A desire for “different and better”
  - Homes, Offices, Schools, etc.
  - Durability
  - Resilience
  - Longevity
  - Safety
  - Etc.
Challenges and Opportunities - 3

- Expanding our messages beyond the basics:
  - Energy Efficiency
    - Reliable, accurate, certified
  - Durability
    - For how long?
  - “Green”
    - All green is LOCAL!
      - Water, Site, IEQ, Material
  - Resilience
    - Stuff happens...
  - Existing buildings

Delivering Greater VALUE!
We must expand our messages to ever-broader audiences

- Practitioners
  - Architects, engineers, manufacturers

- Valuation Professionals
  - Lenders, Appraisers, Realtors, Insurance Industry

- Other Valued Decision Partners
  - Utilities, Policy Makers
We Know What to Do…

- Better New Construction
- Better building science application
- Better water management
- Better air sealing
- Better envelopes
- Better human comfort and productivity
- Value efficiency, durability, resiliency
- Shape the valuation equation

Build Better Buildings!
The Life Cycle of Our Decisions

- One year?
- 11 years?
- 30 years?
- 100 years?
- 1000 years?
BETEC, NIBS and You

- Collaboration is key
  - Leverage our building science knowledge to ever greater impact

- Demonstrate the value of greater investment in our existing buildings
  - Homes, offices, schools, etc.

- Demand better buildings
  - Teach the value propositions better
  - Teach the value propositions to a much wider audience
Expand Our Outreach!

“Preaching to the Converted” limits the size of the congregation...
Thank you!

Chris@MathisConsulting.com