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Building Science

Wood Is Good

www.buildingscience.com
Energy Security
Climate Change

Hubbert’s Peak

- Shape of oil production in the US lower 48
- Predicting the peak made Hubbert famous

Ref: Hirsch 2005

Production vs Discovery

Ref: Uppsala Hydrocarbon Depletion Study Group

Where is the Oil?

Enhanced oil recovery

- Technology helps get oil out faster, and to get more (increases to 50%+ recovery)
- Increasing cost makes hard oil worth it
- The impact of enhanced oil recovery
  - Water and gas injection, heating, etc
- Delay peak followed by fast decay

So will we “run out”?  

- We will always have expensive oil
- “The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil.”
  - Zaki Yamani, Saudi Oil Minister 1962-1985
- As oil gets more expensive, we will develop substitutes
  - Natural Gas gets expensive too
  - coal, biofuel, wind, solar

Natural Gas

- Tight supply – likely past peak
Total Energy

Quadrillion Btu

Domestic Sources Supply 70% of Total Energy
40% of Total Supply is Petroleum
23% of Total Supply is Natural Gas
Buildings are #1 Use of Energy in the US (40%)

Petroleum Energy

2/3 of Oil is Imported
2/3 is Used in Transportation
Building Use is Very Small

Millions barrels per day

Electrical Energy

2/3 From Fossil Fuels
Oil Very Small
2/3 is Lost at Generating Plant
2/3 Used in Buildings

Quadrillion Btu
Transportation Sector Will Compete With The Building Sector For The Same Energy

- Fastest Growing Source of Energy
- America is the “Saudi Arabia of Coal”
- Carbon Dioxide Production Twice that of Natural gas (fundamental chemistry)

A half million years of data

- There is No Question that Climate Change is Happening
  - The Questions are When, How Bad, Did We do it and Can We Do Anything About it?
  - Looks Like Sooner Than Expected
  - Could be Pretty Bad, But then Again Maybe Not
  - Looks Like We Did Do it, But Not Completely Sure
  - We Can Fix It - But is it Worth it?
  - One Solution – Reduce CO2 Through Efficiency & Renewables

- Energy Security is a Decoupled Issue
  - Solution - Efficiency and New Energy Sources (coal?)
- Solving Energy Security the Wrong Way Will Worsen Climate Change
- Solving Climate Change also Solves Energy Security
Paths to Energy Security and Climate Change

Efficiency
Renewable Energy
Biofuel (ethanol)
Nuclear
Carbon Sequestration (clean coal)

Smart Path
Sustainable Technology Path

Dirty Coal
Oil Sands and Shale
Dirty Coal-to-Liquid Hydrogen

Dead End
Existing Technology Path

Typical Family Carbon Footprint
50% House
50% Transportation

Buildings Are The Key To Energy Security And Climate Change

It’s The Energy Stupid
Transition From A Hydrocarbon Based Economy to a Carbohydrate Based Economy

We Are The Saudia Arabia of Carbohydrates

It’s Never A Good Idea To Trade Food For Fuel

Celluloistic Ethanol
Wood Is A Battery For Energy From The Sun

Carbon + Water + Sunlight = Wood (photosynthesis)

The Ultimate Carbon Sequestration Is A Wood Building That Is Energy Efficient

Wood Is The Ultimate Building Material

When We Are Done It Turns Back To Carbon and Water and Releases The Energy
Plants Do A Better Job Of Converting Solar Energy Than Rocks

Let The Trees Do It

Keep The Money Here
Rain Control Layer
Air Control Layer
Vapor Control Layer
Thermal Control Layer
Advanced Framing
Use Less Stuff Better

Design Issues

- Design buildings that coordinate advanced framing practices with material availability and integrate with building envelope design and mechanical system layout

Advanced Framing System

- Stack Framing Concept
Design Issues

- Provide drawings that integrate advanced framing into complete building envelope design and mechanical system layout
Advanced Framing System

- 2 Stud Corners
  - Two stud corner
  - Connector plate
  - Single top plate
  - Top plate splice
  - Corner framing

Advanced Framing System

- Insulated headers
- No header necessary at non-bearing walls

Advanced Framing System

- Drywall clips allow for better installation with less drywall cracking

Advanced Framing System

- Drywall clips at corner and intersecting wall
**CASE STUDY**

- **2x4 16” oc WALL**

<table>
<thead>
<tr>
<th>8’Studs</th>
<th>Bd Ft</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Ext Wall</td>
<td>467</td>
<td>1634 bd ft</td>
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<tr>
<td>Ext Plate</td>
<td>95</td>
<td>331 bd ft</td>
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<tr>
<td>Int Wall</td>
<td>715</td>
<td>2502 bd ft</td>
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<tr>
<td>Int Plate</td>
<td>126</td>
<td>446 bd ft</td>
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<tr>
<td>Header</td>
<td>273</td>
<td>273 bd ft</td>
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<tr>
<td><strong>TOTAL WALL FRAME COST</strong></td>
<td><strong>$2749</strong></td>
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- **2x6 24” oc ADVANCED FRAME WALL**

<table>
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<tr>
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<td>Ext Plate</td>
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<td>347 bd ft</td>
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<td>148 bd ft</td>
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<td><strong>TOTAL WALL FRAME COST</strong></td>
<td><strong>$1632</strong></td>
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### CASE STUDY

#### WOOD FRAME WALL SUMMARY

<table>
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<tr>
<th></th>
<th>2x4</th>
<th>2x6</th>
<th>REDUCED BY</th>
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</thead>
<tbody>
<tr>
<td>8’ Studs</td>
<td>1403</td>
<td>665</td>
<td>(-738 / -52%)</td>
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<tr>
<td>Bd Ft</td>
<td>5186</td>
<td>3082</td>
<td>(-2104 / -40%)</td>
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<tr>
<td>COST</td>
<td>$2749</td>
<td>$1632</td>
<td>(-$1117 / -40%)</td>
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Seismic Testing

- Work with CERL (the US Army research laboratory), and BSC to facilitating code approval of advanced framing techniques by the Division of the State Architect in California, and other earthquake and high wind loading locations.

- Full scale assemblies have been tested under the new dynamic seismic loading protocols developed after the Northridge earthquake. New non-proprietary shear panels are now available for use that allow for advanced envelope design.

2 Story Aligned
Standard Plywood Panel

2x4 panel with plywood to establish baselines

Standard Plywood Panel Performance

Standard OSB Panel

Standard OSB Panel Performance
Diagonal Strap Shear Panel CURe1

Diagonal Strap Shear Panel CURe1
50% Total Energy Reduction  
(1,500 ft² house over basement)

Advanced Framing - less $1000
Insulating Sheathing - wash
95% Furnace - add $200
Simplified Ductwork - less $500
Basement Insulation - add $1000
Cavity and Roof Insulation - add $250
Heat Exchanger - add $1000
Air Sealing - add $250
16 SEER a/c - add $450
Tankless DHW - add $575
Compact Fluorescent Lighting - add $250
Energy Star Appliances - add $750

Approximately $3,500 more
50% Total Energy Reduction
(1,500 ft² house over basement)

Costs Approximately $3,500 more
Financed For Approximately $25/month
Saves $75/month in Utilities
Cash Flow is $50/month positive

We Don’t Have An Energy Problem
We Have A Stupid Problem

We’re Stupid

Don’t Do Stupid Things