IMPACT OF CARBON ACCOUNTING ON GREEN BUILDING

Workshop Responding to Climate Change:

Wood's place in a global approach to green building

Organized by
UNECE/FAO Team of Specialists on Forest Products Markets and Marketing

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Palais des Nations, Geneva, Switzerland

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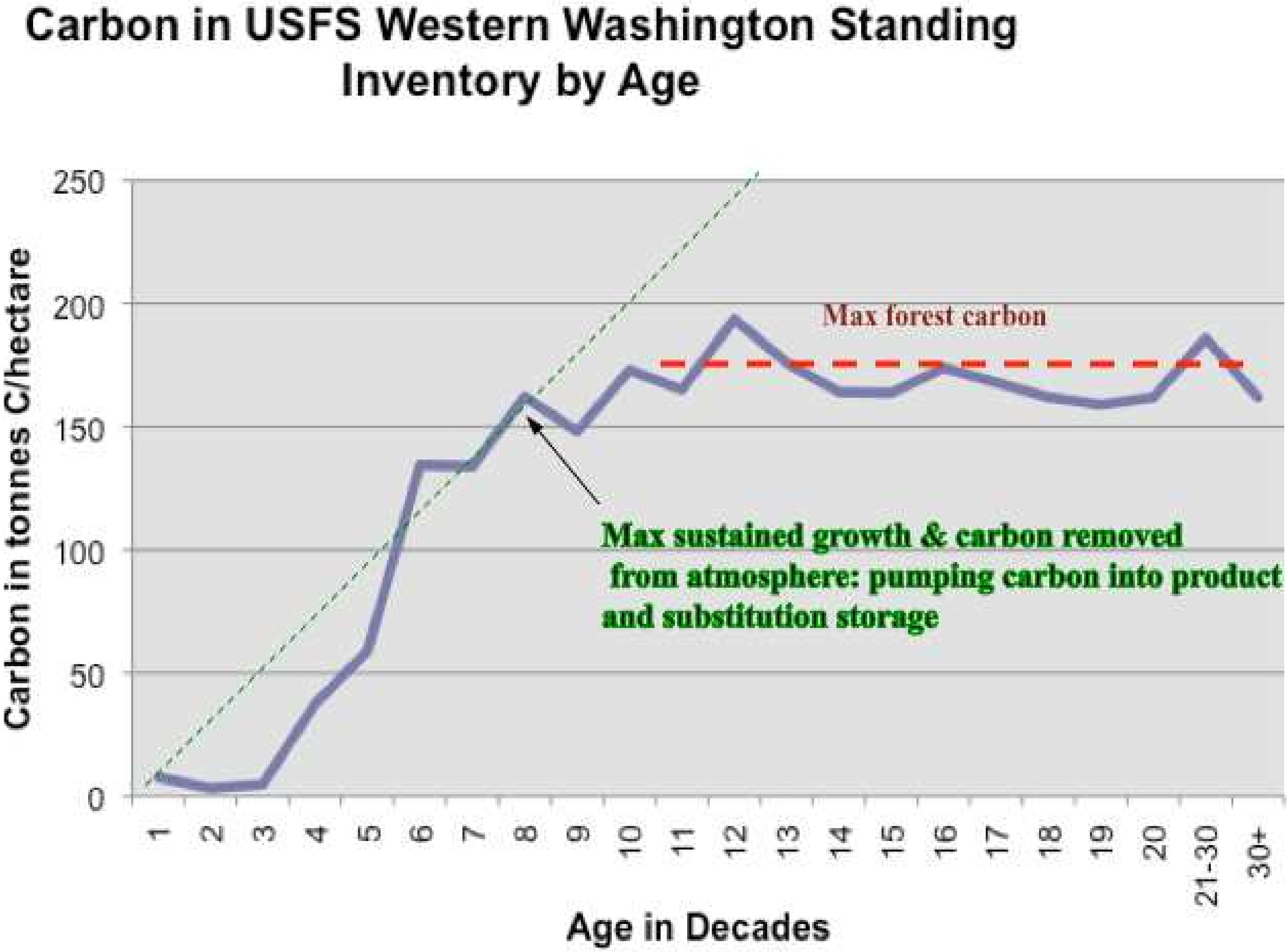
CORRIM

Consortium for Research on Renewable Industrial Materials

A non-profit corporation formed by 15 research institutions to conduct cradle to grave environmental studies of wood uses

Road Map for Main Points:

- Forests can store carbon or pump it into products
- To understand best options requires life cycle analysis across many carbon pools
- Each wood use has a different impact: displacing fossil intensive building products has the highest leverage
- The most obvious policy options are likely counterproductive – be smarter in what we ask for



Carbon in USFS Western Washington Standing Inventory by Age
Carbon in tonnes C/hectare
250
200
150
100
50
0
Max forest carbon
Max sustained growth & carbon removed from atmosphere: pumping carbon into product and substitution storage
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21-30
30+
Age in Decades

Need to track the carbon impact across every stage of processing and use:

LCI/LCA is the ~~accepted~~ method

- **ISO standards have been established**
- **Principles accepted by IPCC**
- **EPA is now *emphasizing* the importance of LCI**

- **US EISA 2007 sets GHG thresholds for biofuels requiring LCA**

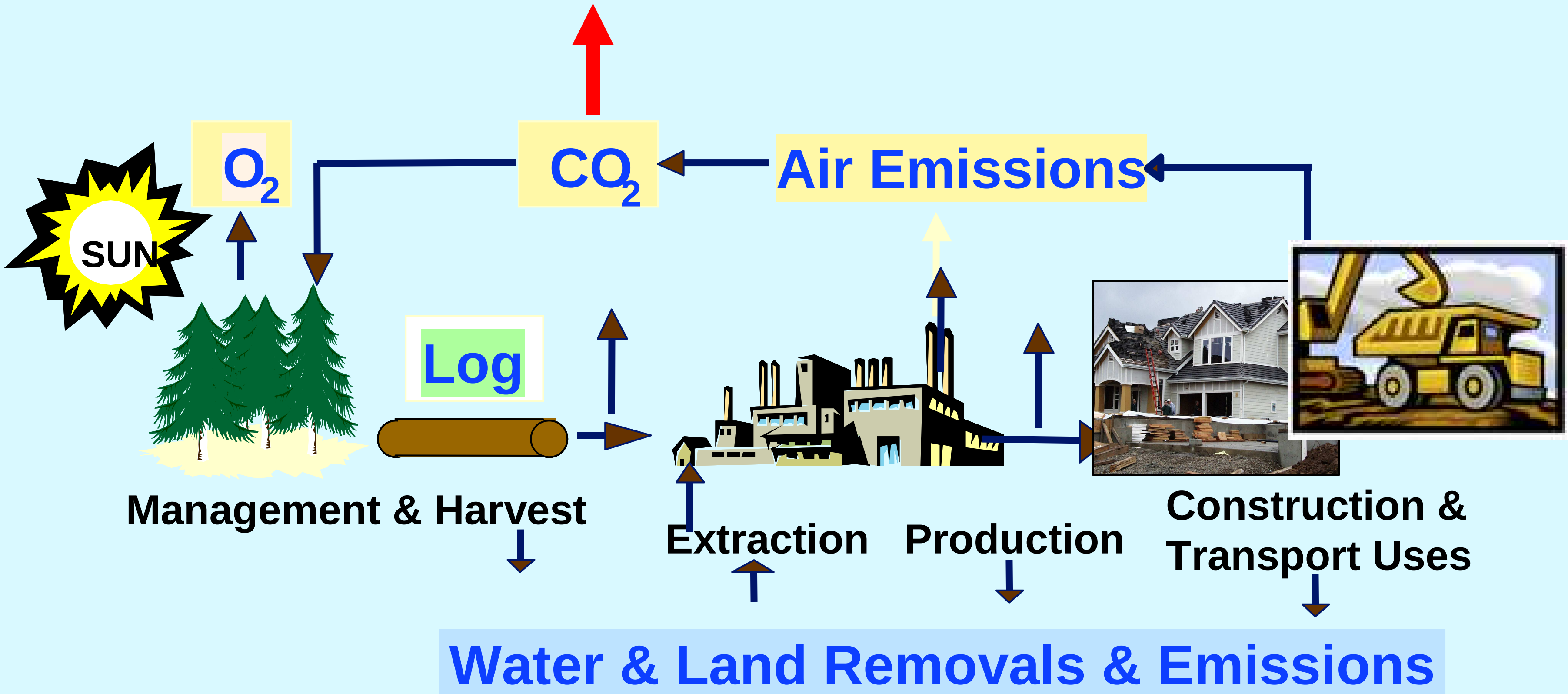
– a Congressional mandate

CORRIM:

Consortium for Research on Renewable Industrial Materials

- a 15 research institution non-profit corporation –

Measure environmental burdens for every stage of processing and product use.



CORRIM's Research Protocol

- Developed a comprehensive Research Plan - 22 modules
- Research guidelines follow LCI and LCA international protocol of ISO 14040's Standards
- Reviewed by International LCI/LCA experts

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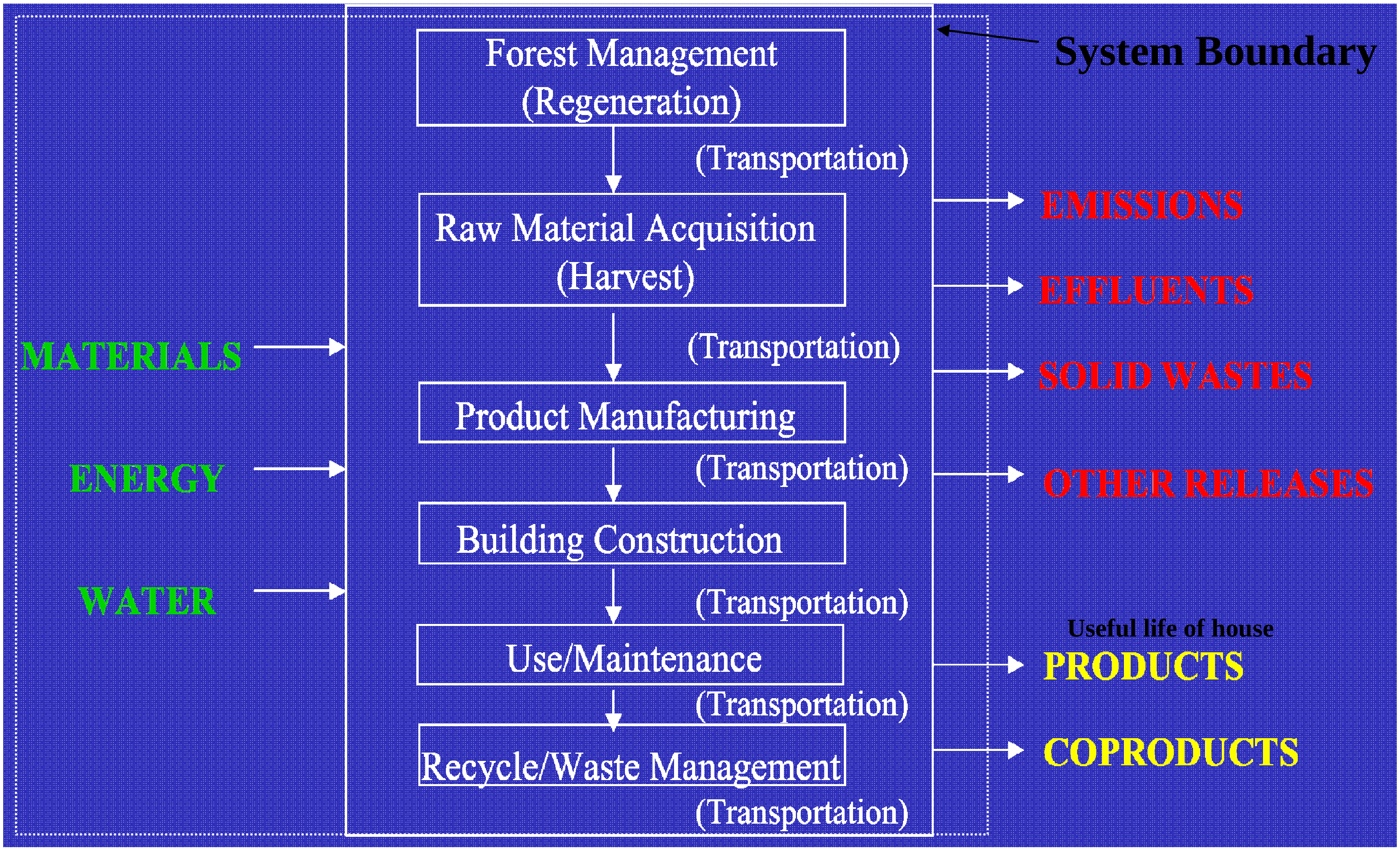
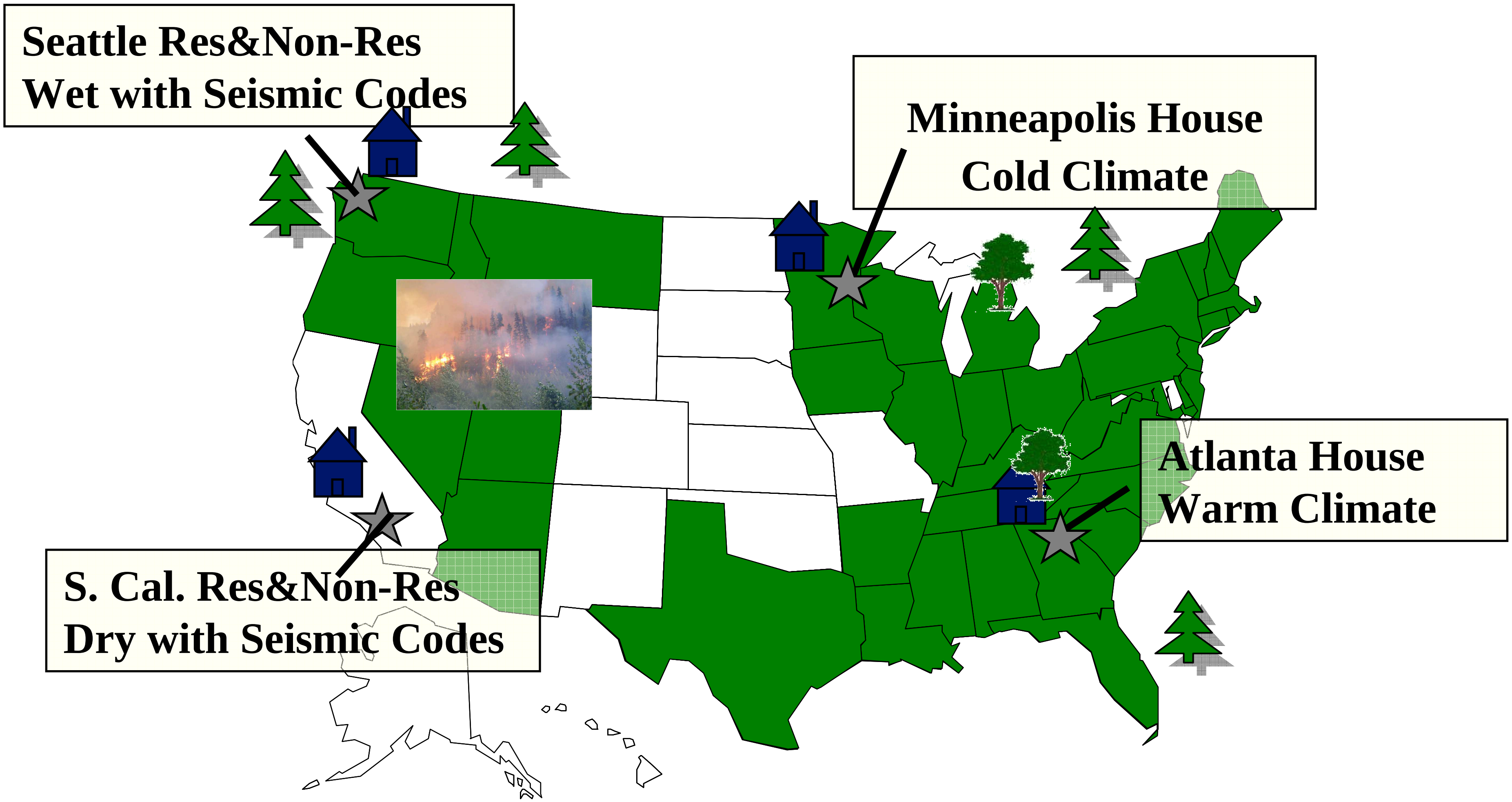
Life Cycle Inventory Analysis



9 Product LCIs in 4 Supply Regions; LCAs for 4 Construction Sites (with different materials)



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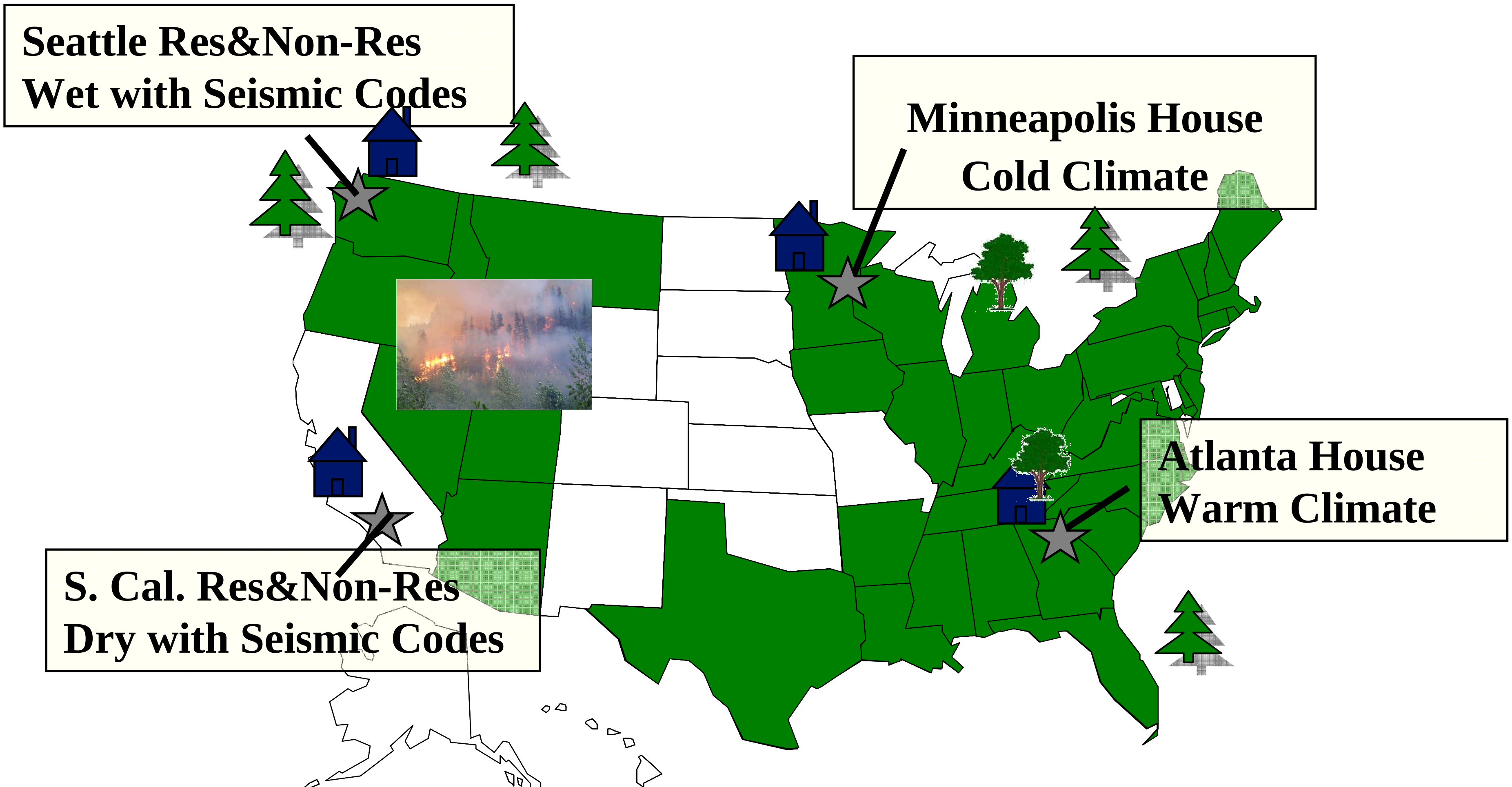


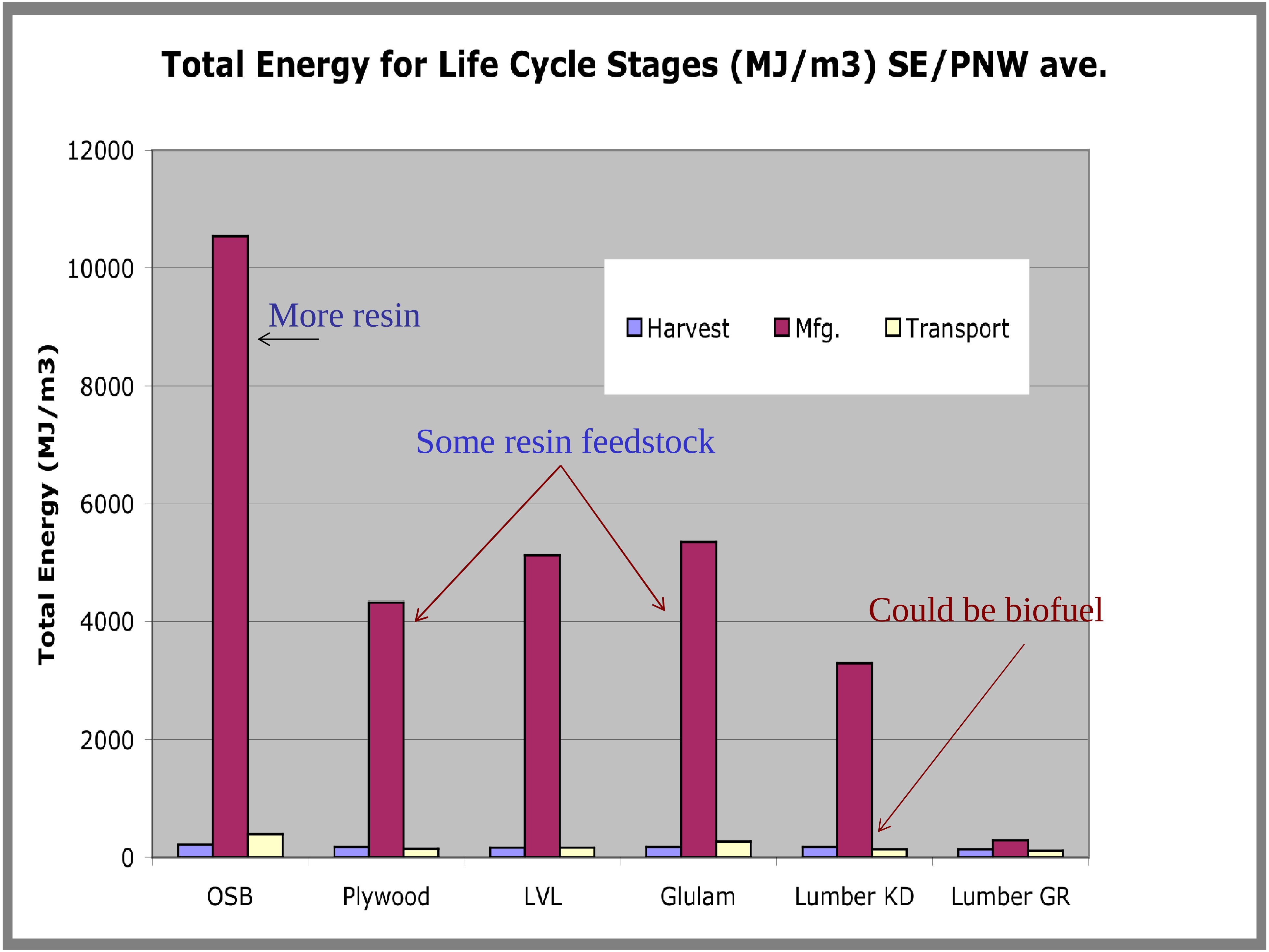
In process: Biofuel LCIs (from 3 feedstock sources) for 3 Virtual Bioprocessing Plants

Primary data manufacturing survey's

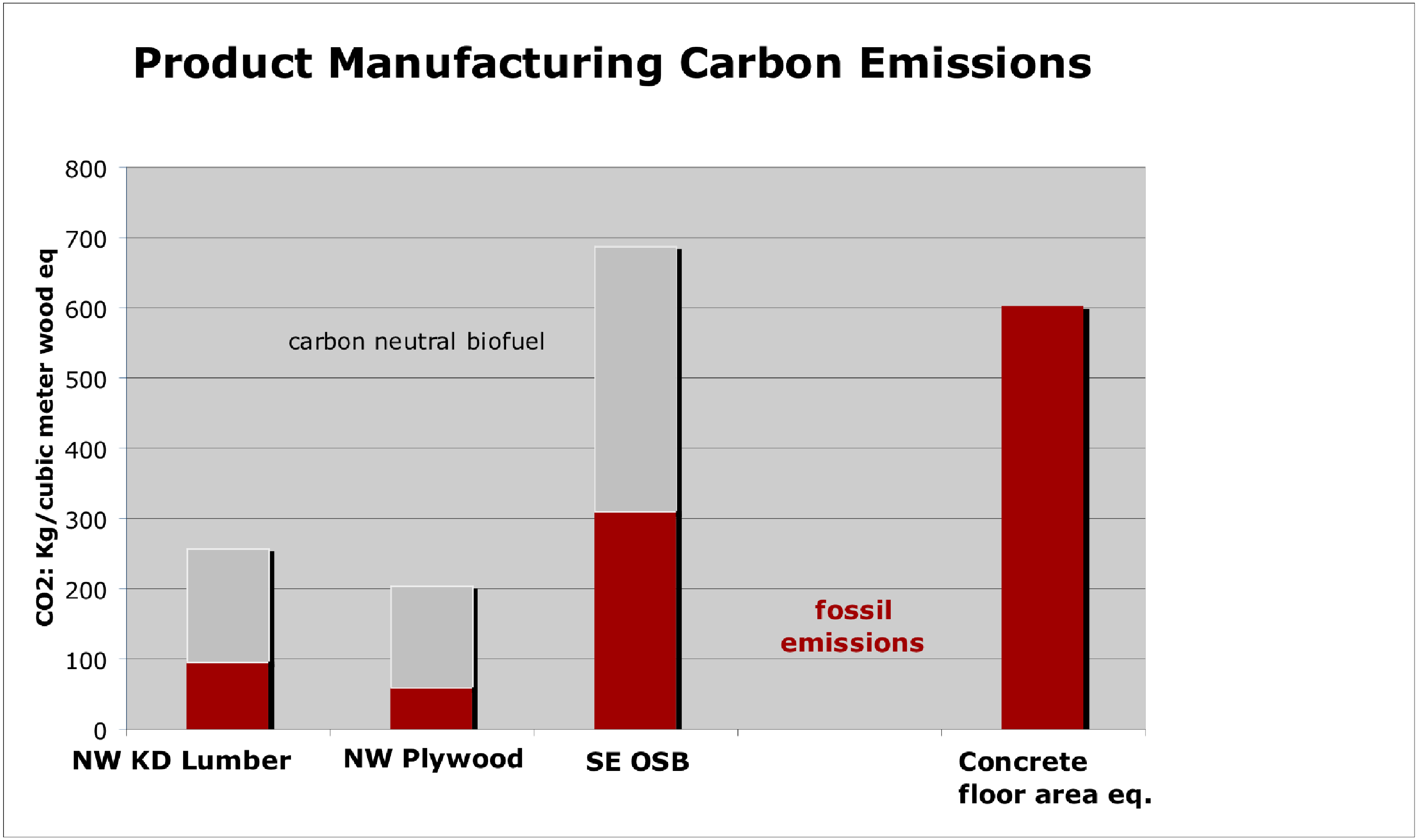
of 9 wood products covering 4 regions:

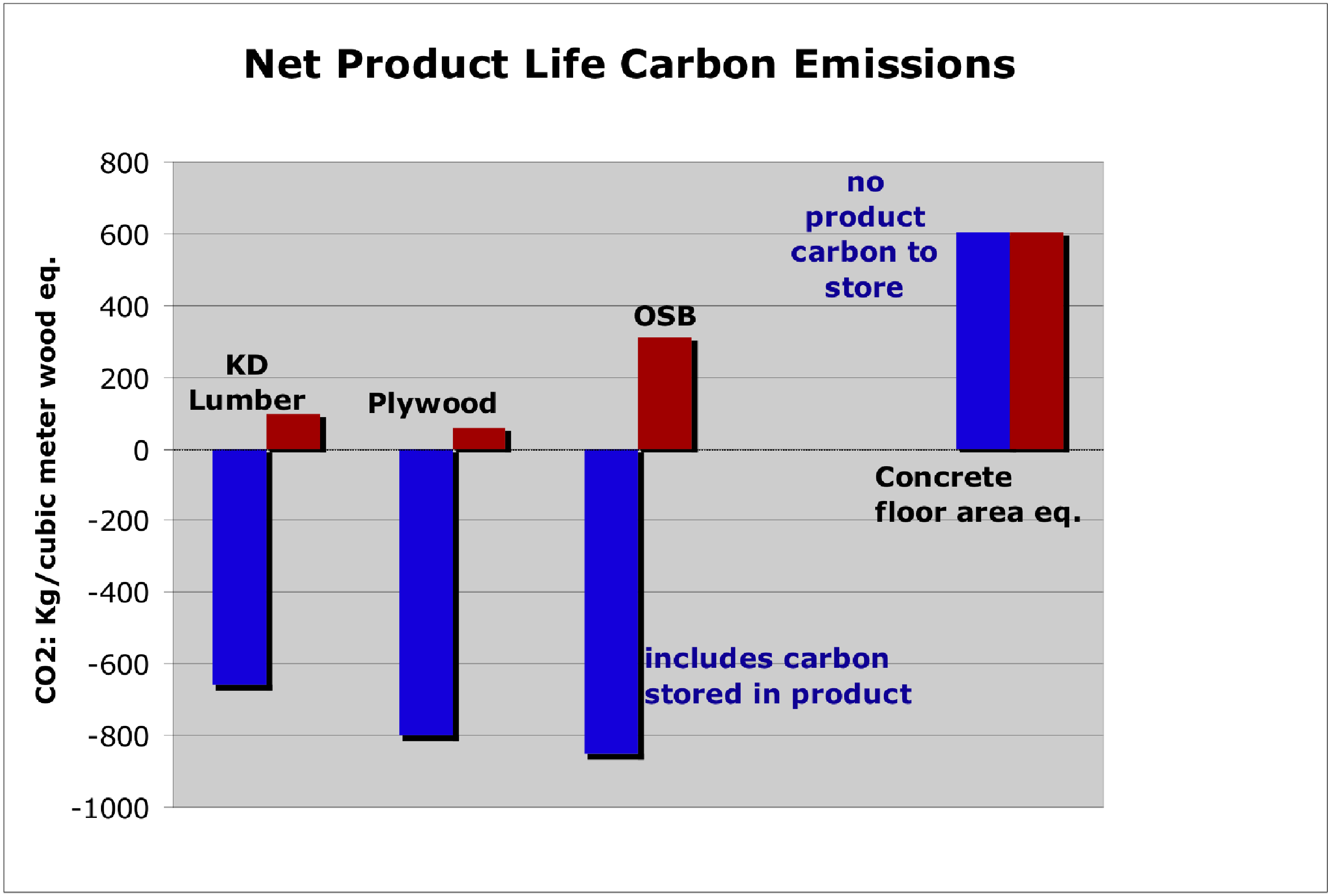
- Mill surveys at **<u>unit process level</u>** (saw, dry, plane, energy, etc.)
- Non-wood inputs (energy by source, raw materials)
- Emissions and solid waste outputs

- Yields, flows (co-products) and mass balances
- *Calculate unit factor estimates (raw materials, air, water, and solid emissions, energy, carbon)*



Total Energy for Life Cycle Stages (MJ/m3) SE/PNW ave.
Total Energy (MJ/m3)
12000
10000
8000
6000
4000
2000
0
More resin
Harvest
Mfg.
Transport
Some resin feedstock
Could be biofuel
OSB
Plywood
LVL
Glulam
Lumber KD
Lumber GR


Product Manufacturing Carbon Emissions
CO2: Kg/cubic meter wood eq
800
700
600
500
400
300
200
100
0
carbon neutral biofuel
fossil emissions
NW KD Lumber
NW Plywood
SE OSB
Concrete floor area eq.


Net Product Life Carbon Emissions
CO2: Kg/cubic meter wood eq.
800
600
400
200
0
-200
-400
-600
-800
-1000
KD
Lumber
Plywood
OSB
no
product
carbon to
store
Concrete
floor area eq.
includes carbon
stored in product

Life Cycle Assessment of Buildings

Performance Indices:

- **Embodied & Fossil Energy**
- **Global Warming Potential (GWP/GHG)**
- **Air Pollution**
- **Water Pollution**
- **Solid Waste**
- **Ecosystem Health**

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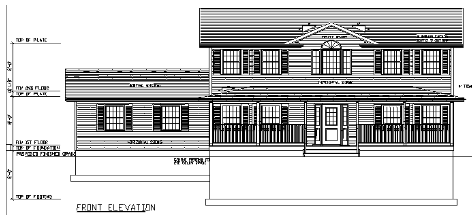
Representative Houses Designed to Local Code

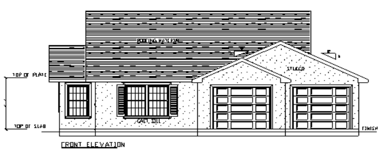
Minneapolis House
Cold Climate



<u>Wood vs. steel framed</u>
designed to same R code

Concrete basement, sheetrock, insulation, wood trusses, vinyl windows, vinyl siding and asphalt roofing.

Atlanta House
Warm Climate



<u>Wood framed vs. concrete block exterior walls</u> designed to same R code.

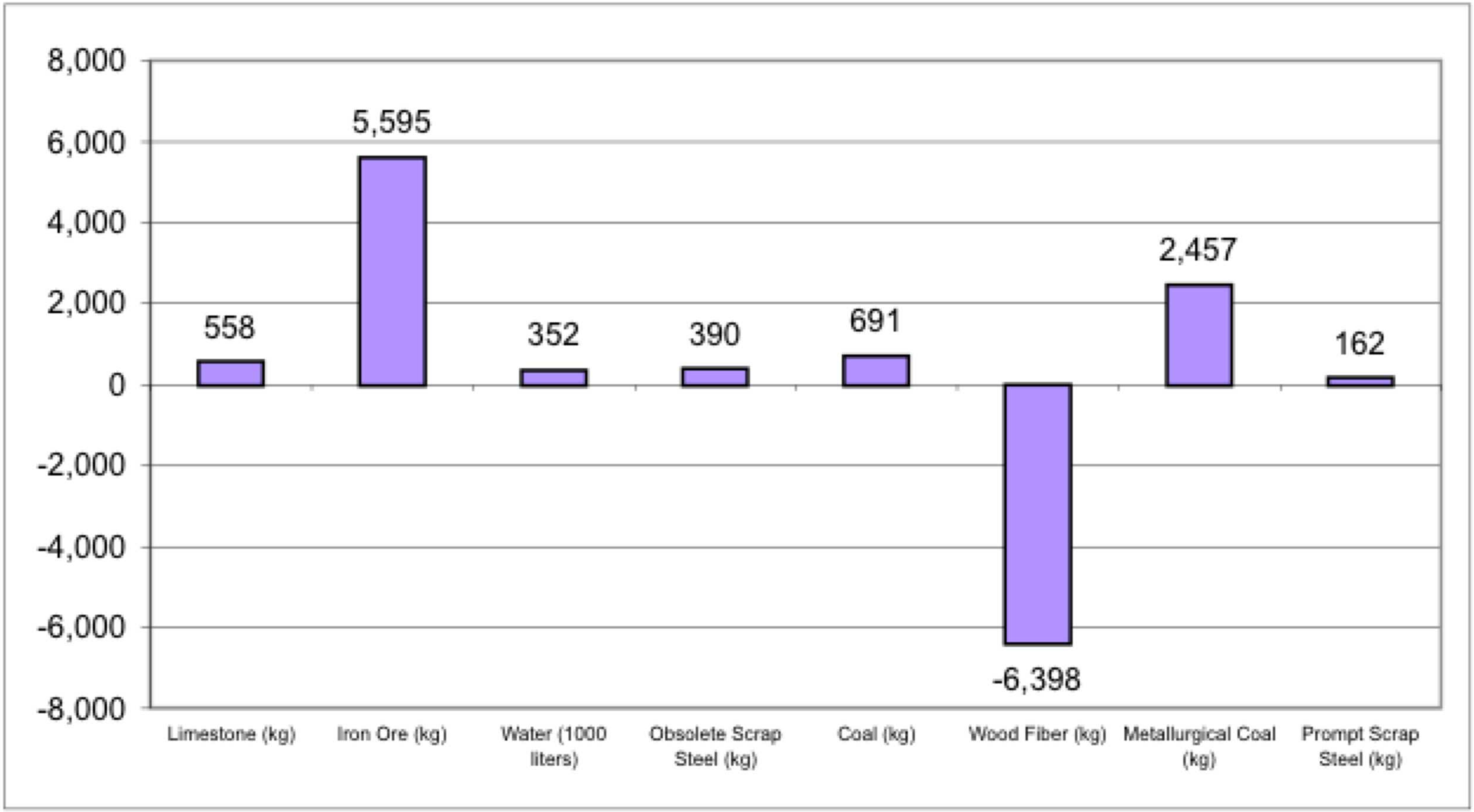
Slab on grade, sheetrock, insulation, wood trusses, vinyl windows, stucco/vinyl siding and asphalt roofing.

Material Design Differences:

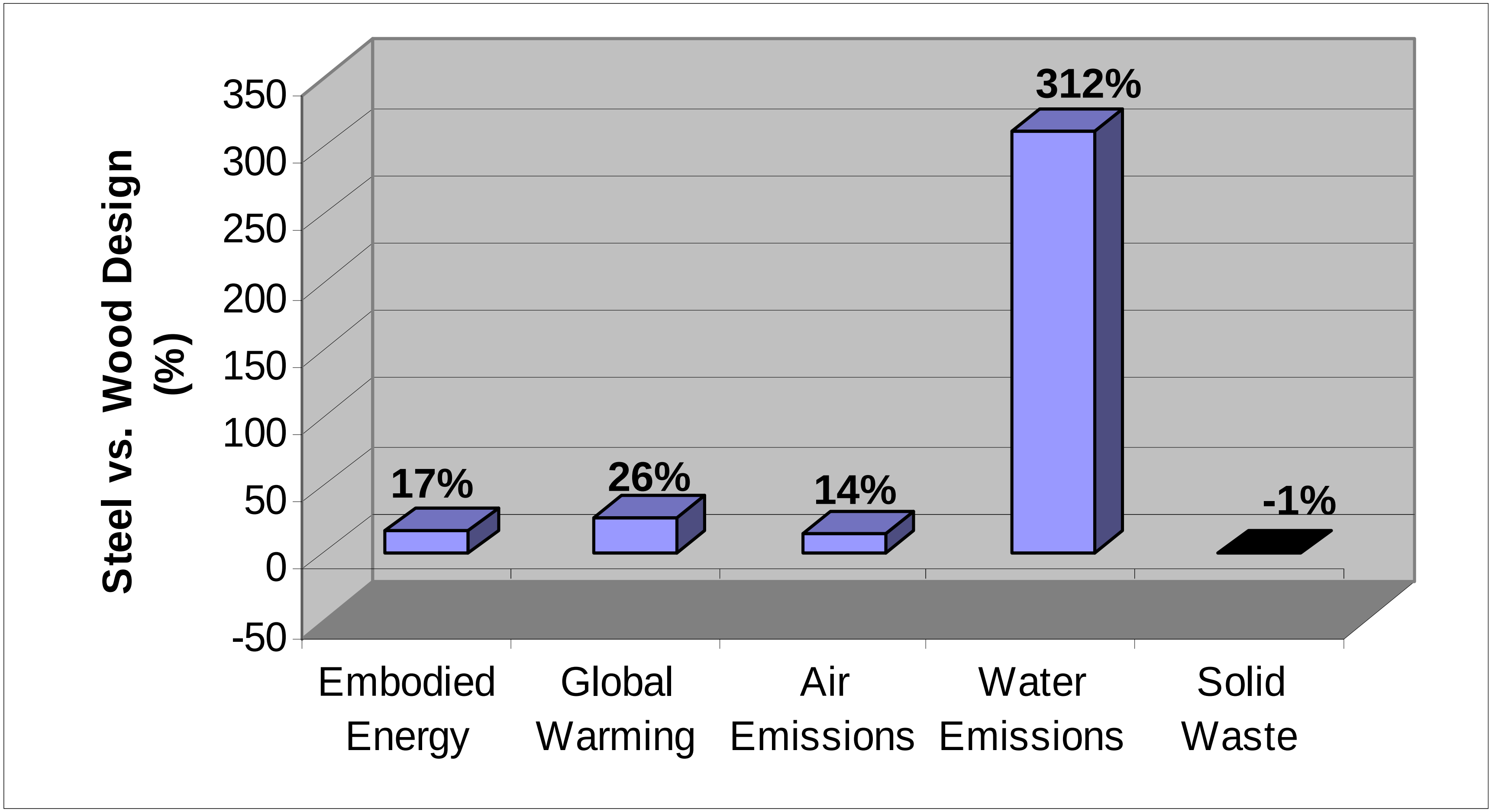
Minneapolis Steel Frame minus Wood Frame Extraction

(materials in kg)

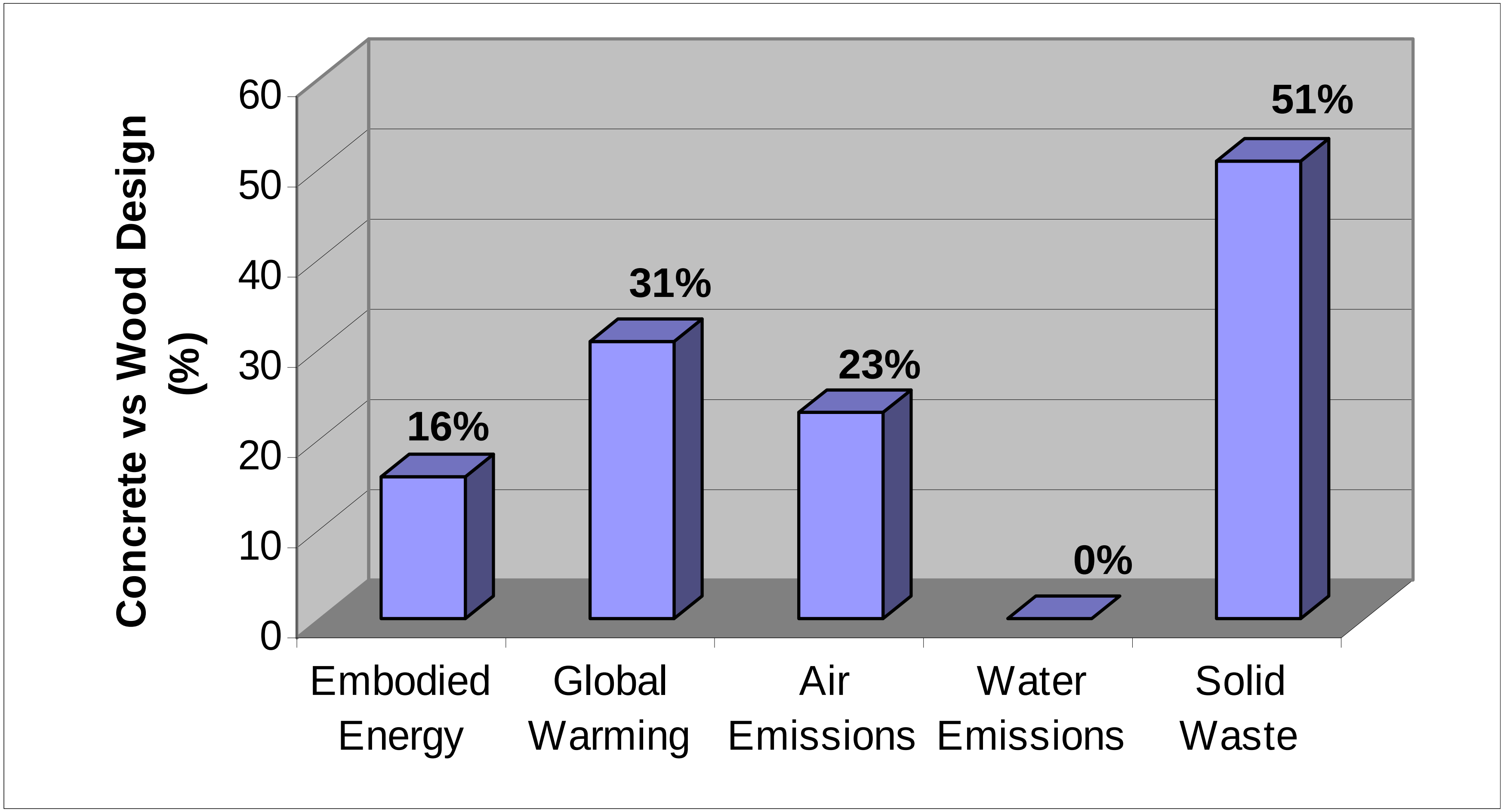
6-8% of house mass



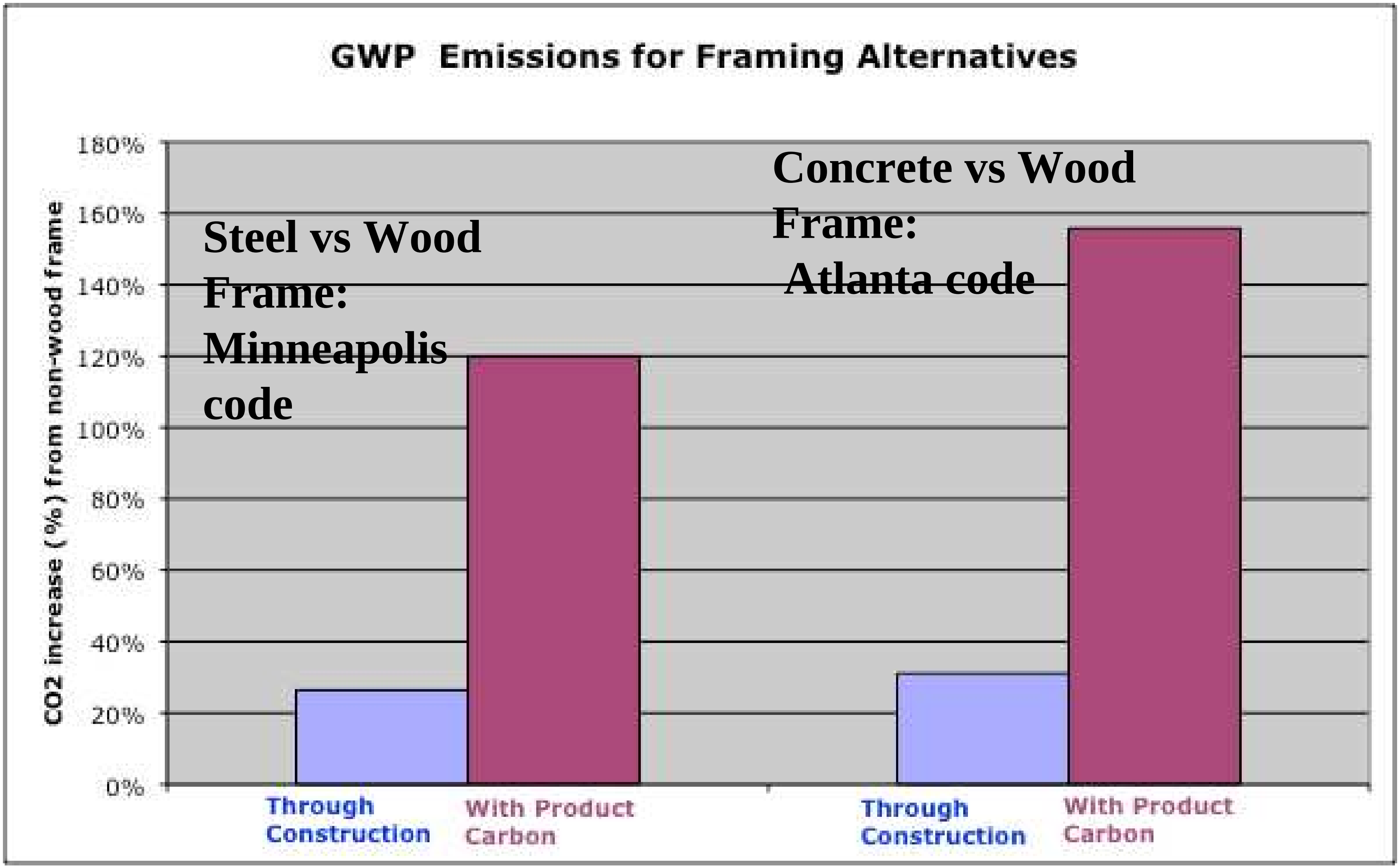
Summary Performance Indices
Minneapolis House



Summary Performance Indices
Atlanta House

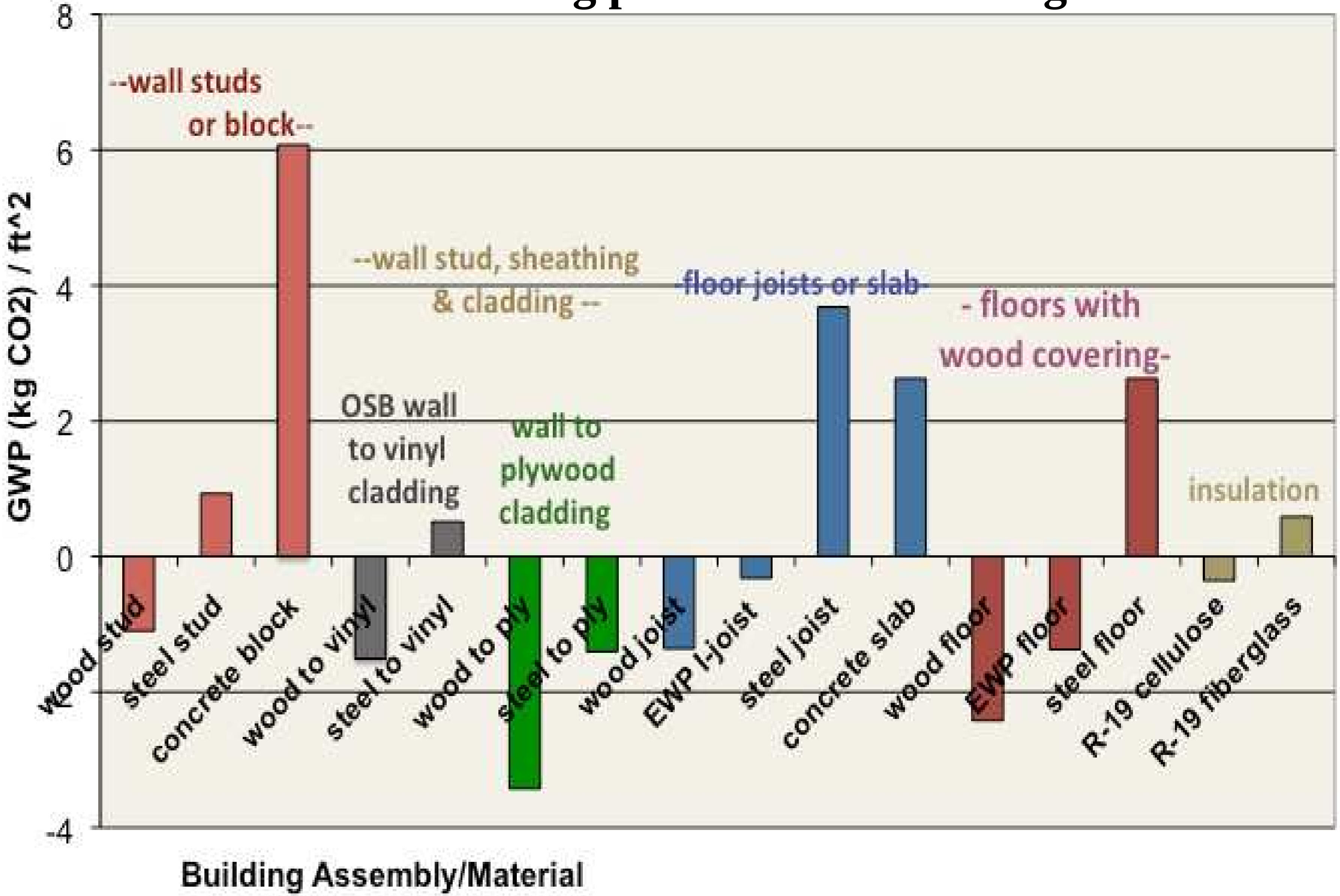


With Carbon in Products



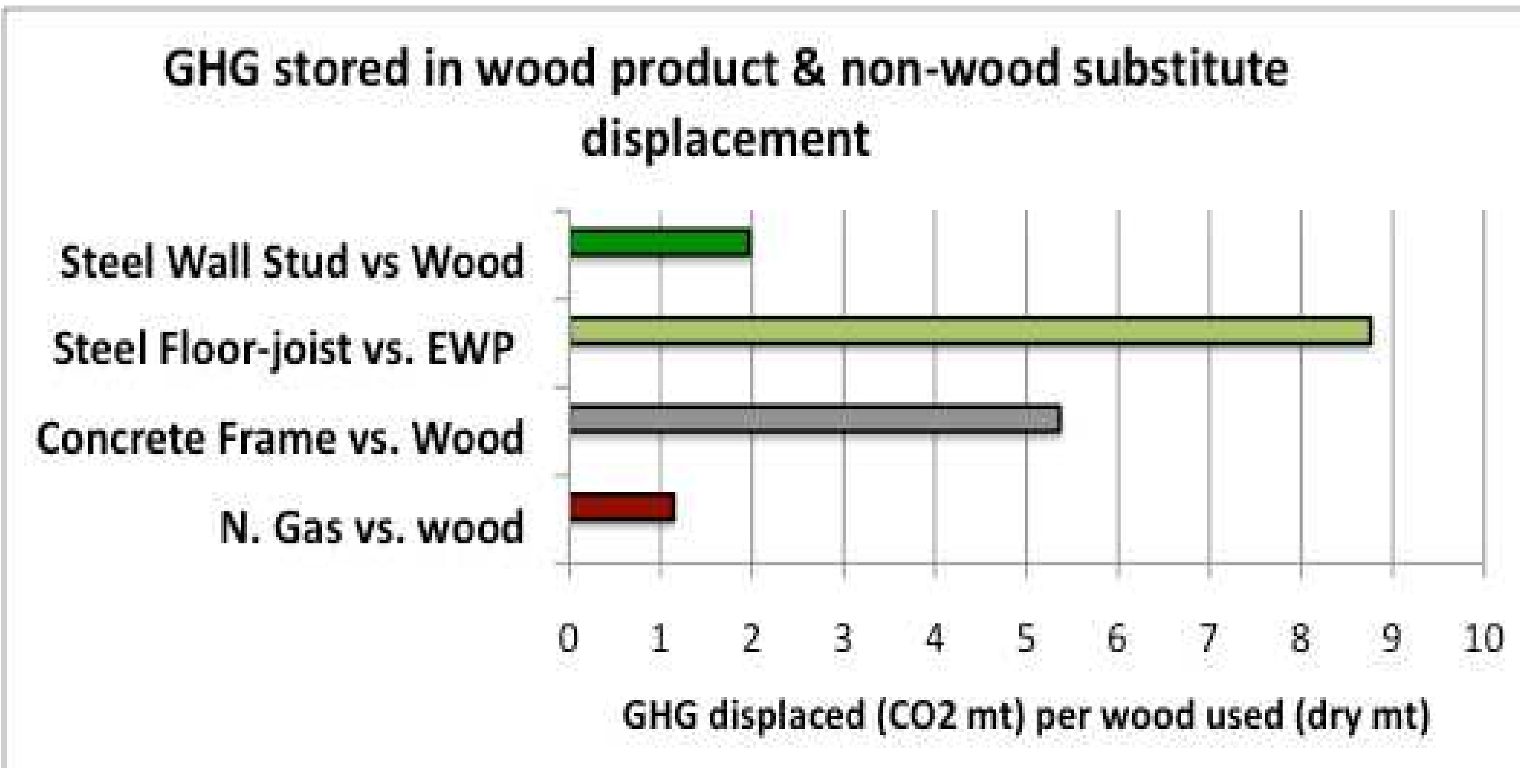
GWP per Building Assembly

including product carbon storage



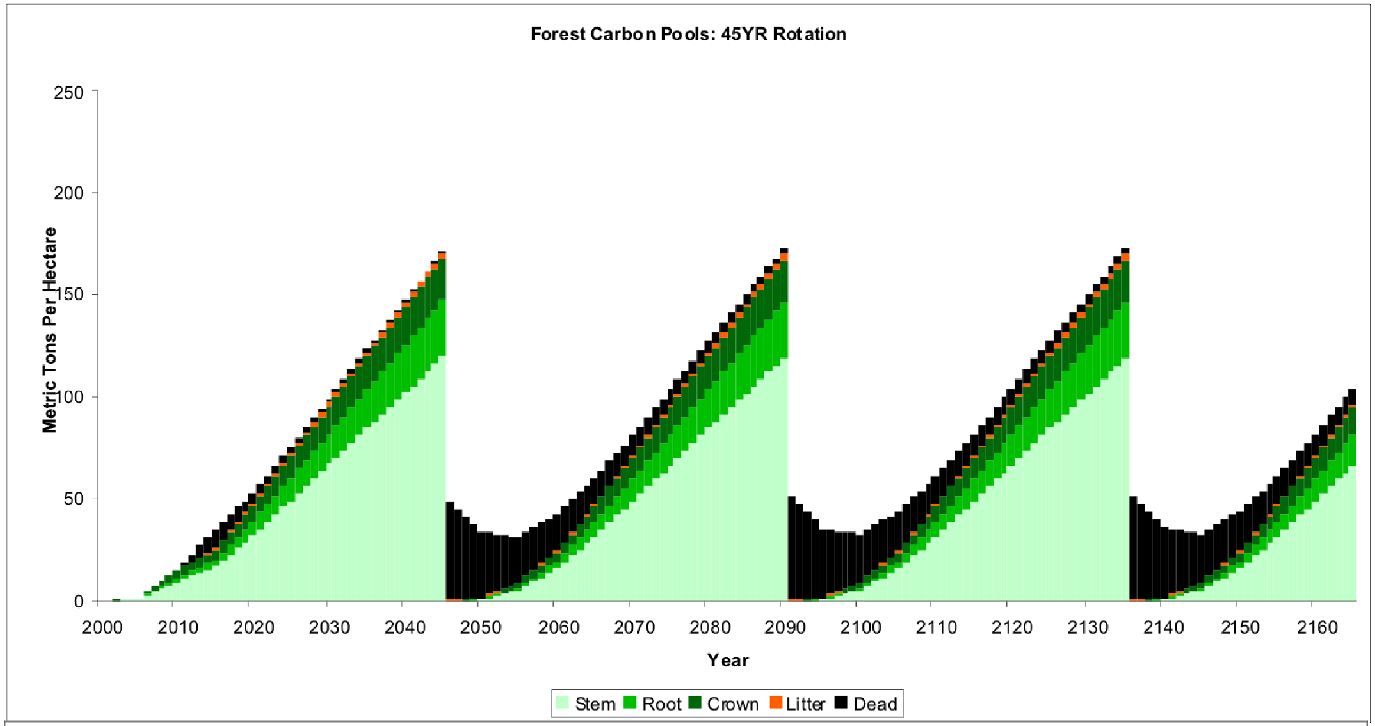
Displacing Carbon Emissions

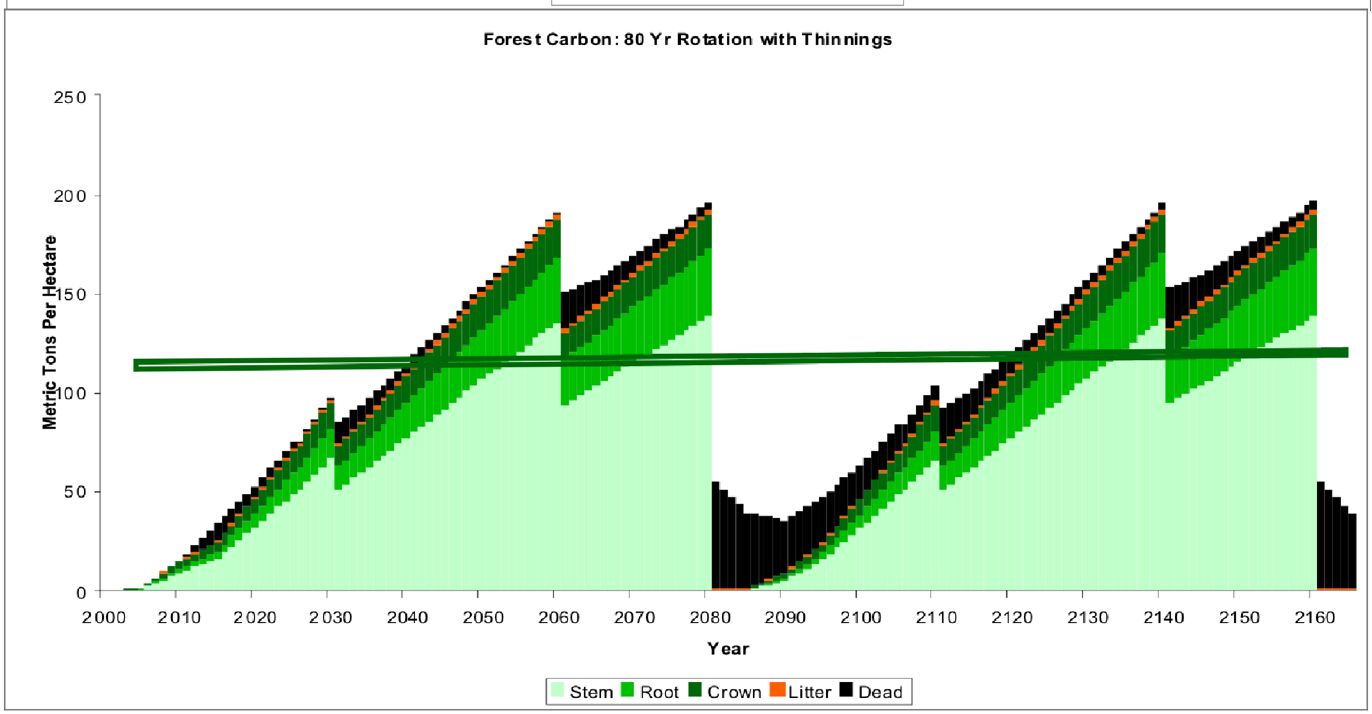
Substituting wood for energy intensive materials can be more effective




More Direct Substitution

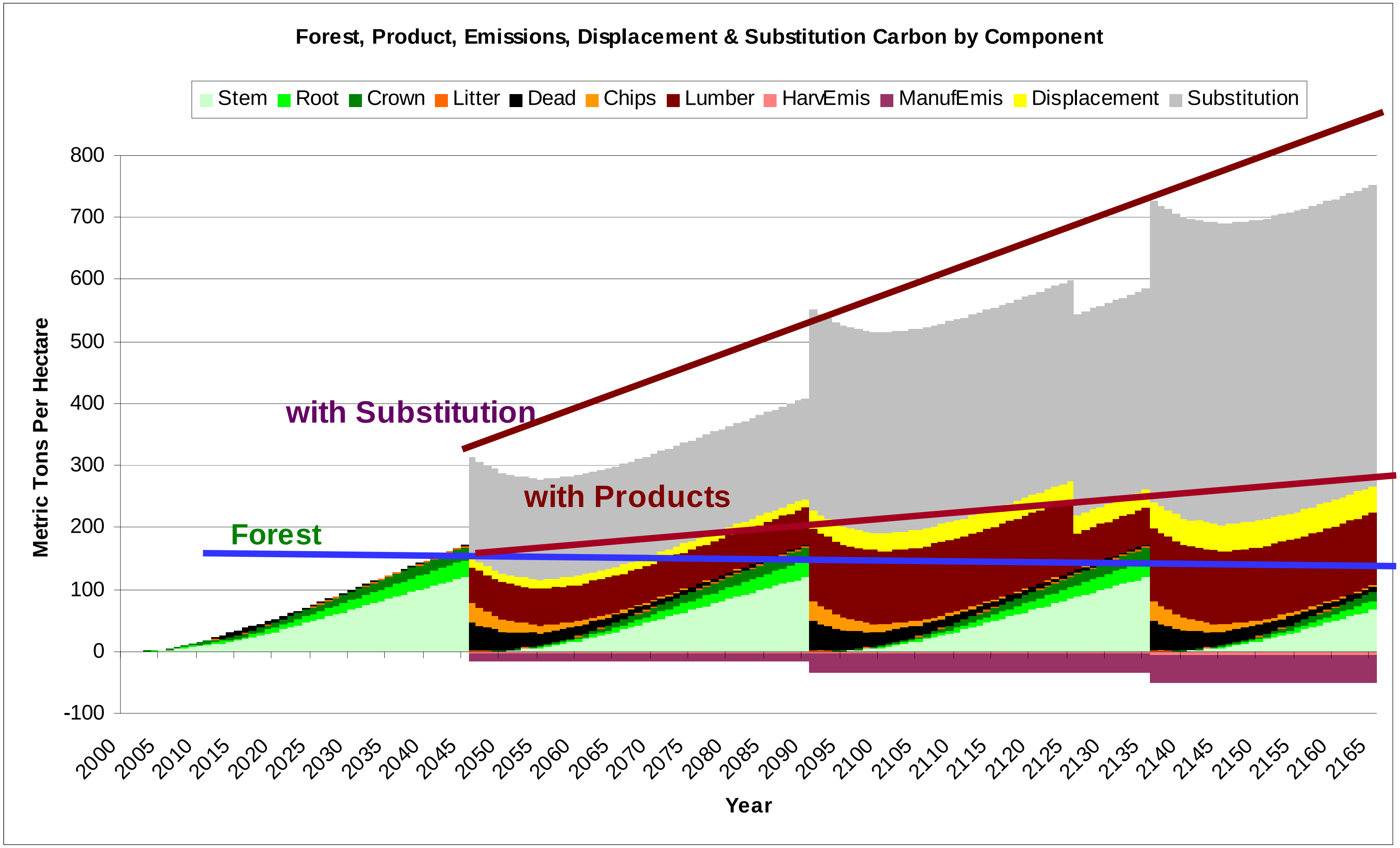
No limits on potential design: *even from reclaimed wood*


Forest Carbon Pools: 45YR Rotation
Metric Tons Per Hectare
250
200
150
100
50
0
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110
2120
2130
2140
2150
2160
Year
Stem
Root
Crown
Litter
Dead


Forest Carbon: 80 Yr Rotation with Thinnings
Metric Tons Per Hectare
250
200
150
100
50
0
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110
2120
2130
2140
2150
2160
Year
Stem
Root
Crown
Litter
Dead

Sustainable Forest, Product and Substitution Pools

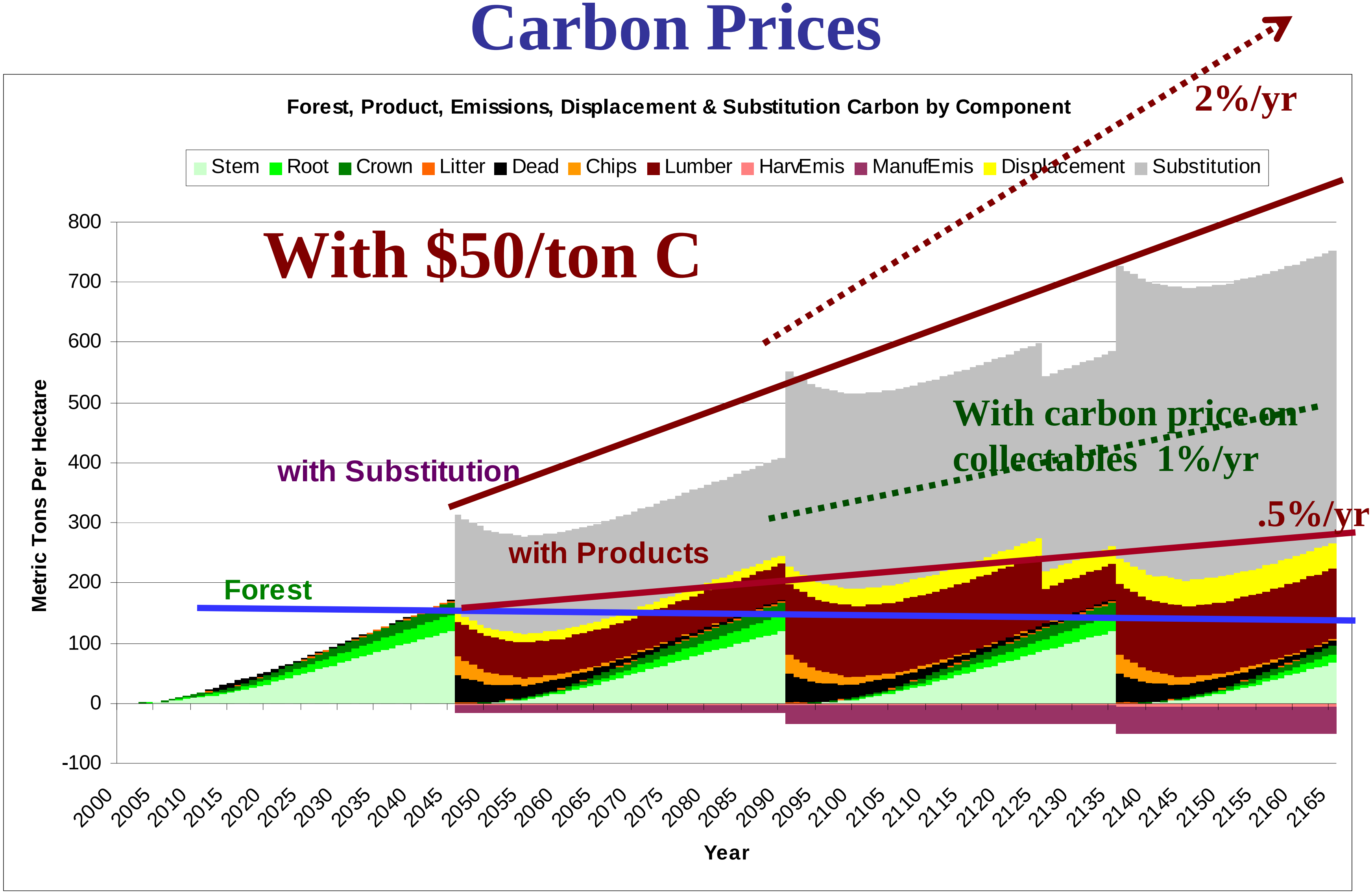
(e.g. concrete frame displaced by wood frame)



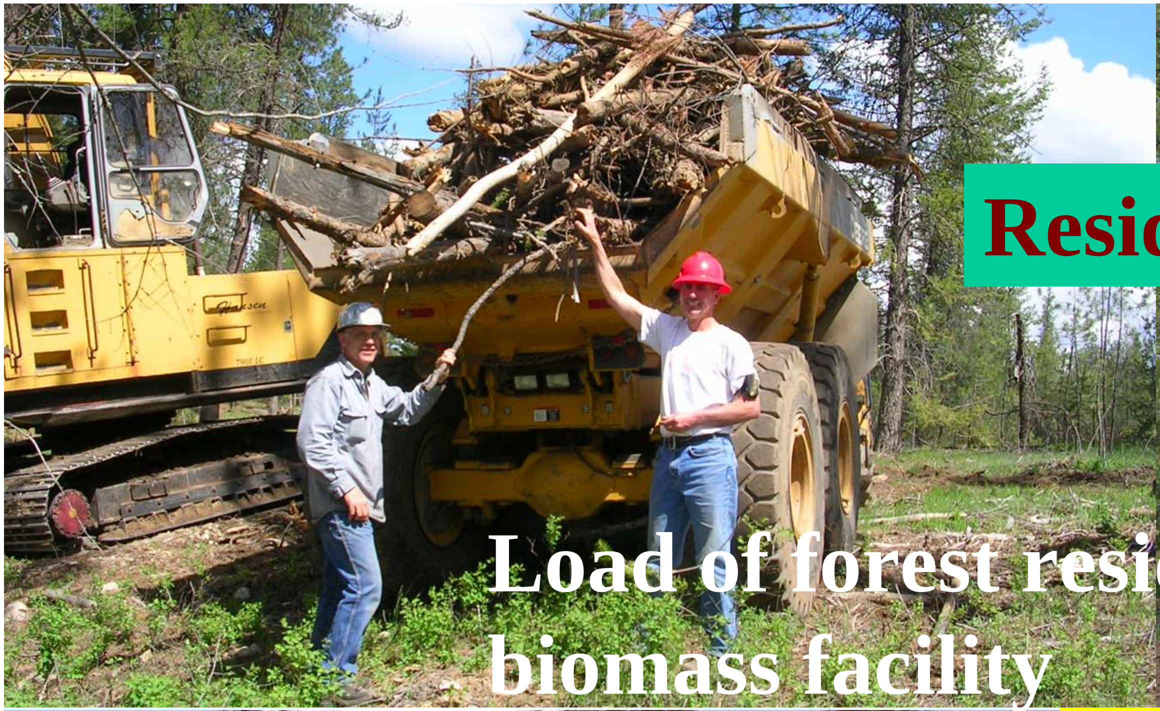
What Future Carbon Prices Will Do:

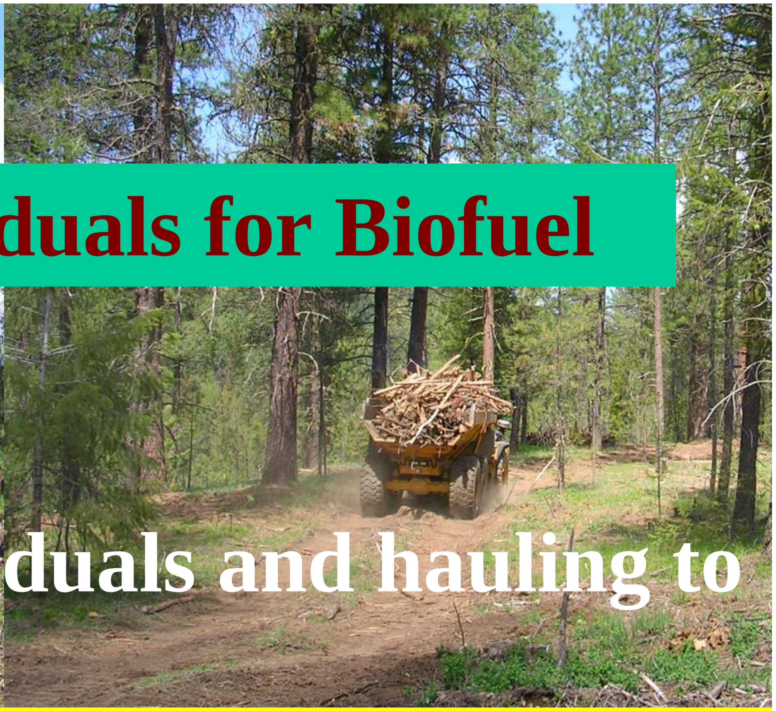
- Pay to collect forest residuals & waste
- Pay to use more wood in construction or other fossil substitutes (furniture etc.)
- Should pay to grow it faster & use it sooner, not grow it longer *(with correct accounting)*

Forest, Product and Substitution Pools with Higher Carbon Prices



Residuals for Biofuel





Load of forest residuals and hauling to biomass facility

Residuals piles at processing yard

Ground Slash Feedstock = 50% of merch logs

Research Gaps that need filling

- Using forest residuals
- Avoiding fires
- Growing biomass faster (short rotation crops)
- Biofuel processing and displacement (selected feedstock)

- Substitution for fiber products (furniture, pallets, et al)
- Recycling & collecting wood & mixed wastes
- Avoiding or capturing landfill emissions
- Environmental performance product development
- Reducing barriers (policy conflicts & disincentives)
- More and effective Education

The Future Will Be Different

Architects, builders, product developers are beginning to see the potential for designing for sustainable living buildings:

- Structures/materials with lower carbon footprint
- Cladding designed for durability & thermal adaptability
- Architecture for low energy livability and recyclability

The search is just beginning

Counterproductive Policy Traps?

- Offering credits to one pool (like forestry) independent of all others. Yet that is what carbon exchanges do.
  - Forest carbon credits will likely reduce harvests increasing the use of fossil intensive products.
- Ethanol credits subsidize diverting feedstock away from best mitigation uses.
- Renewable energy standards fragment supply, a barrier to efficient production & divert feedstock from better uses.

Counterproductive Policies (CONT)

- A tax on fossil extraction would be allocated efficiently in the market and could be tax neutral with offsetting tax cuts.
  - But fails to tax all emissions at the border reducing competitiveness
  - Inflationary bias unless CPI adjusted for carbon value as quality
- A cap increases fossil prices for some suppliers like a fossil tax but reduces prices for others: economic distortion.
  - Reduces open market oil prices promoting accounting fraud at the border
  - Cannot credit the many alternative carbon pools involved
  - Instability between constrained and unconstrained markets (multiple tier pricing)

More Productive Policies

- A credit for reduced emissions from new structures (highest carbon offset leverage) could increase substitution leverage and bid the value back through the supply change.
  - Non-LCA based criteria like LEED are partially if not mostly counterproductive.

Conclusions

- We can assess the environmental performance of products. Guessing cannot.
- There are many potential improvements by using less fossil intensive products and more wood products .
- Energy for heat production remains the driving factor in wood processing energy, but could be bioenergy (if fuel costs or incentives were higher).
- The opportunity exists to steer the trend of product and design standards to LCA performance measures.
- Increasing fossil fuel prices i.e. carbon, will increase product substitution, collection of wastes and improve efficiencies in processing including biofuel collection and processing.
- Wood used in long term products provides the greatest reduction in fossil fuel use & emissions.
- Wood residuals used in biofuels should reduce emissions further but could displace products with greater leverage on GHG. Barriers are evident.
- Forest fires reduce carbon storage, a lost opportunity.
- Carbon cap and trade cannot emulate efficient markets: we need more LCA labeling and LCA based fossil taxes.

Support Acknowledgements

- CORRIM- Consortium for Research on Renewable Industrial Materials
  - 15 research institutions and 30 authors
- DOE & 5 companies funded the Research Plan
- USFS/FPL, 10 companies & 8 institutions funded Phase I&II
- Open access to survey product manufacturers is key

More Details

CORRIM: **www.CORRIM.org**

Athena: **www.athenaSMI.ca**

LMS: **http://LMS.cfr.washington.edu**

USLCI database: **www.nrel.gov/lci**