Opportunity and Development of Bio-Composites

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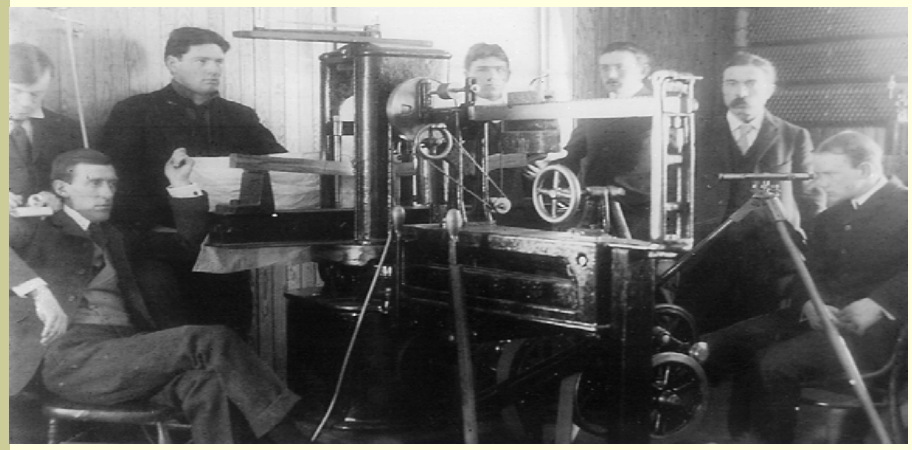
USDA Forest Product Laboratory (FPL)

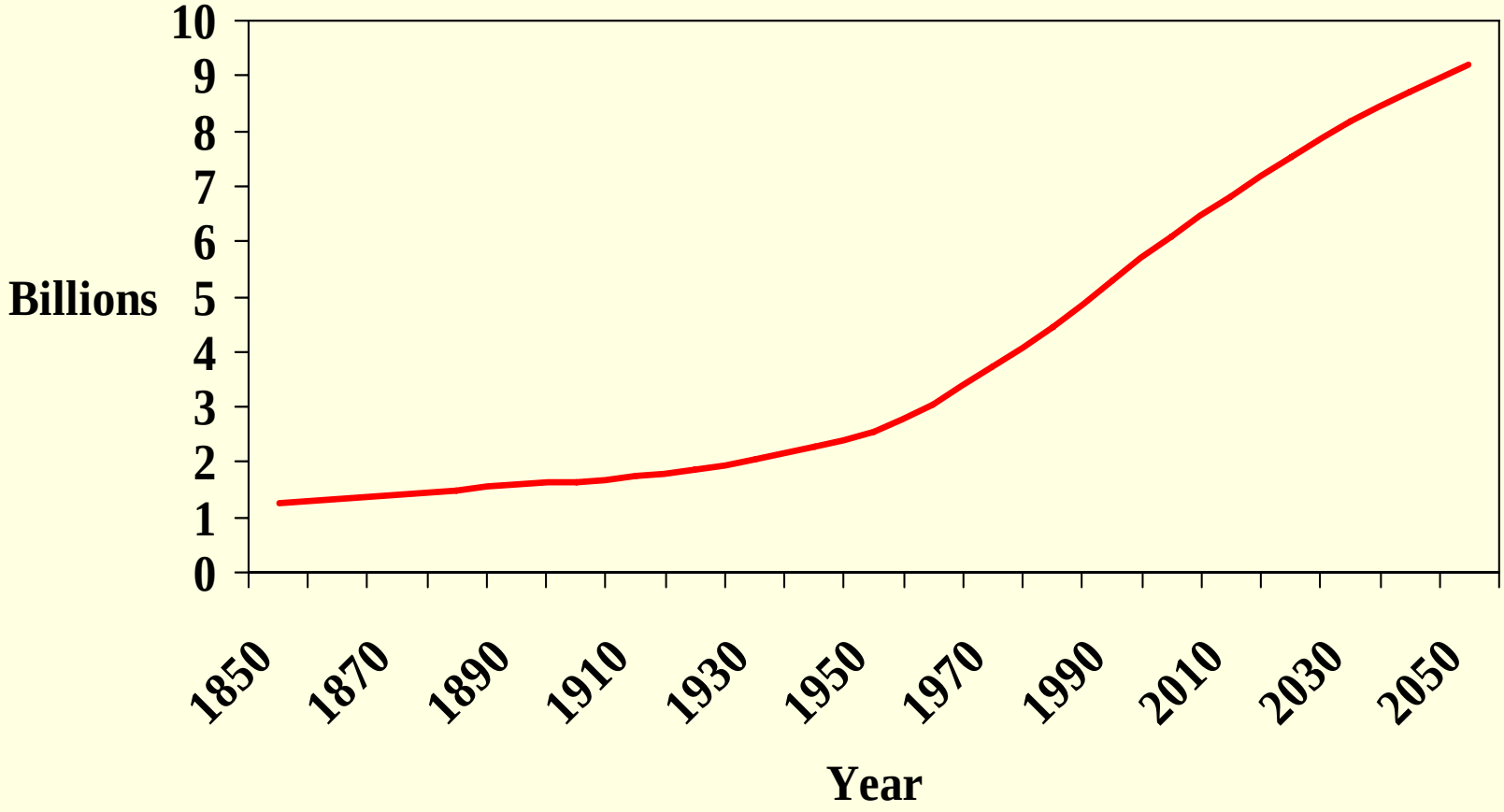


- Established in 1910
- FPL research benefits in conserving the natural resources and reducing the environmental impact.

One Earth

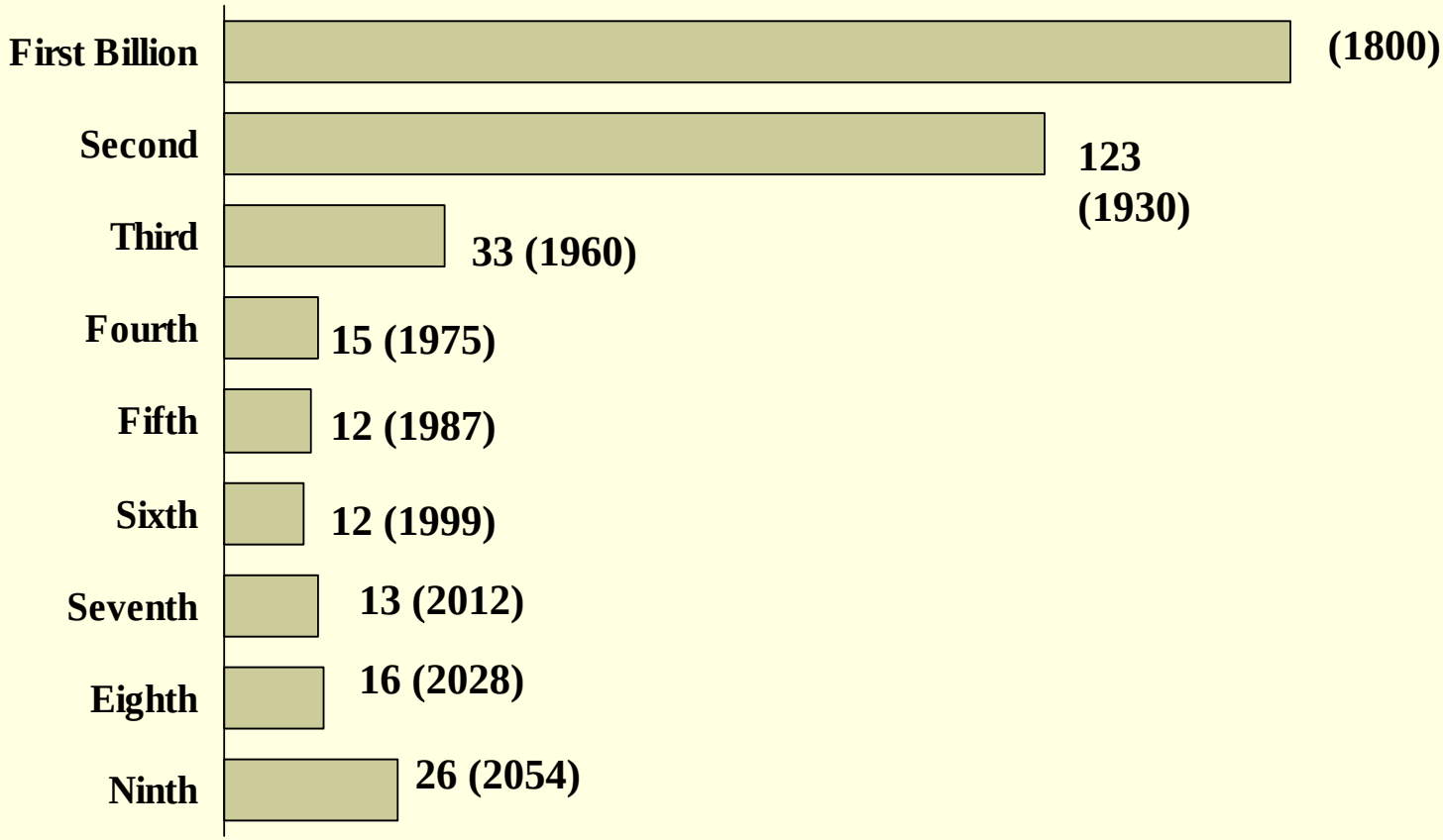
Image courtesy of the Image Science & Analysis Laboratory,
NASA Johnson Space Center

World Population 1850-2050



Source: U.S. Census Bureau, International Programs Center, 2004.

Growth in Global Population



Sources: First and second billion: Population Reference Bureau. Third through ninth billion: United Nations, *World Population in 2300* (medium scenario), 2003.

World Population and Increase Rate

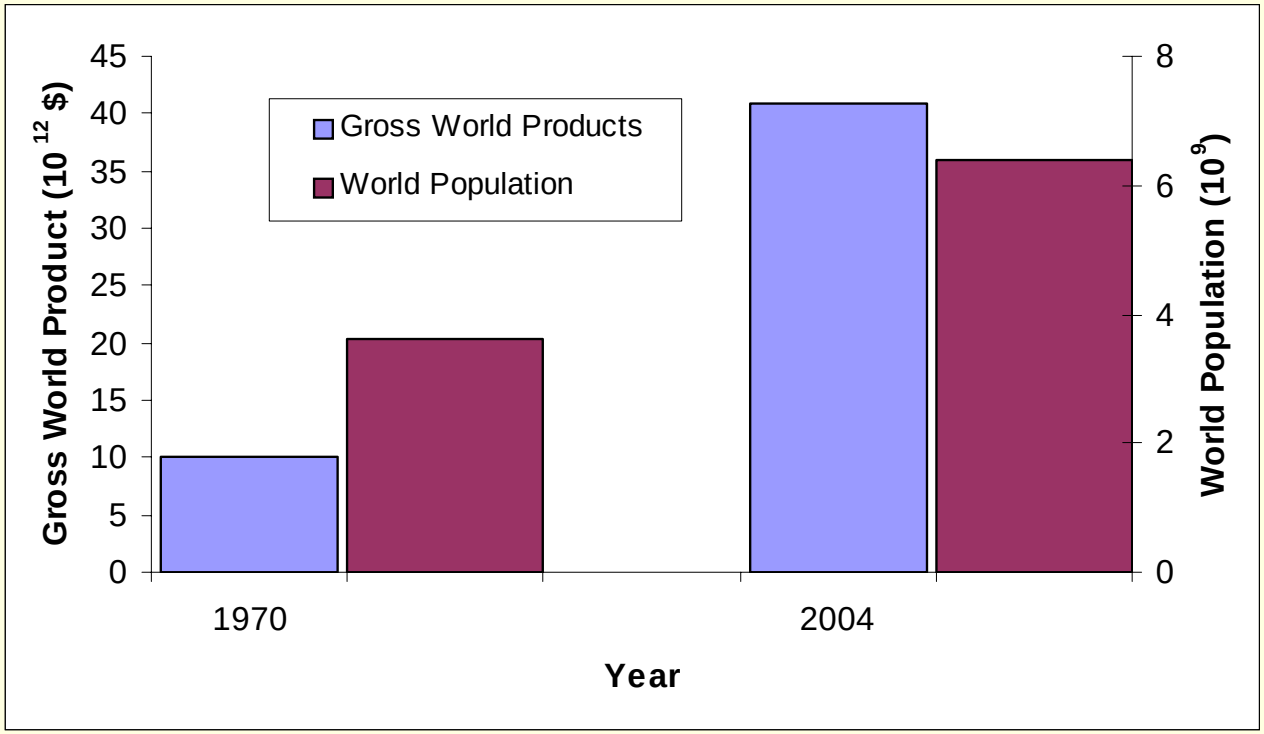
6.40 billion --- Dec. 6, 2004

9.20 billion --- 2050

➔ Increase Rate = 200,000 / day

Source: U.S. Census Bureau, International Division, 2004.

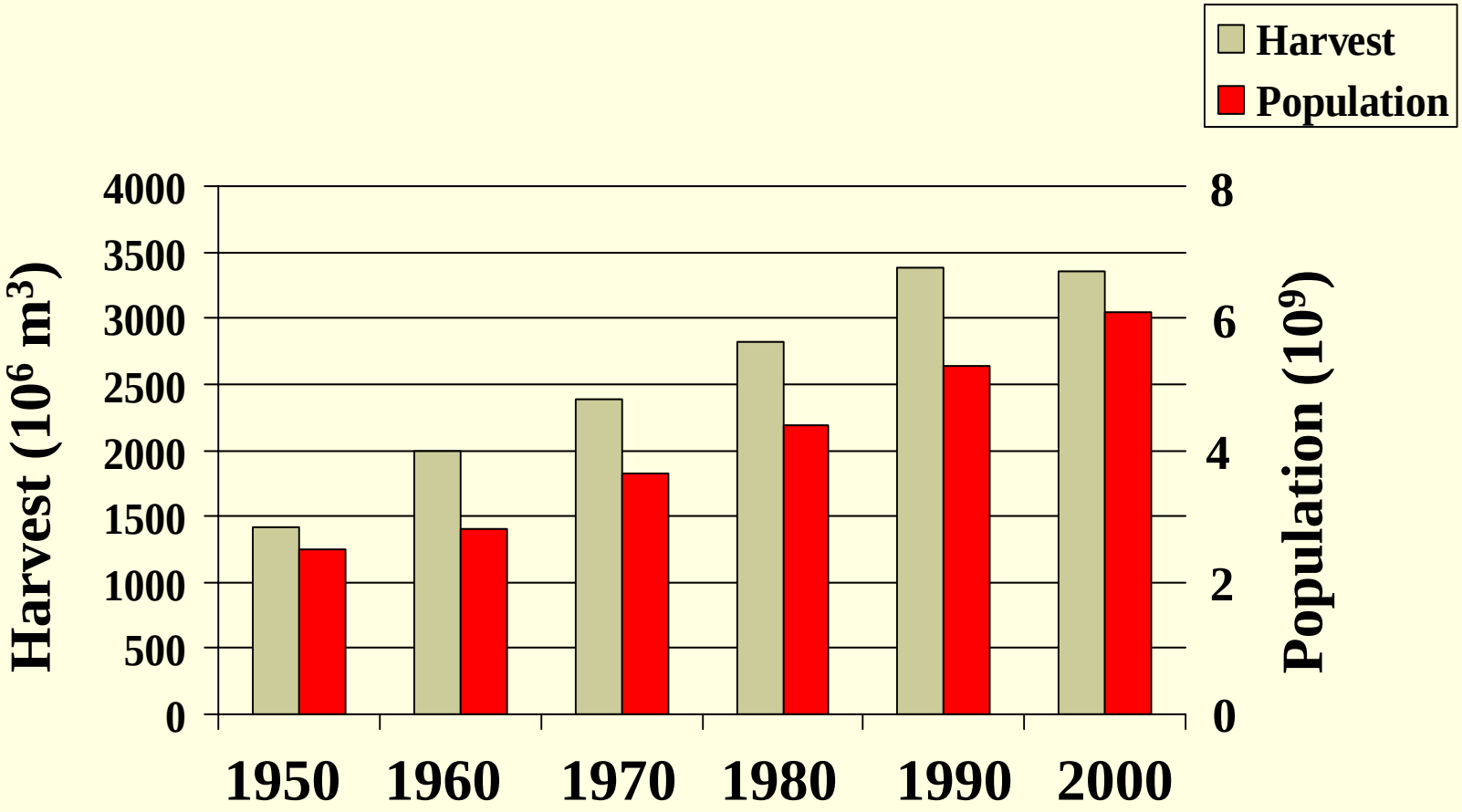
Gross World Product



Gross World Products ➔ 300% increase
World population ➔ 78% increase

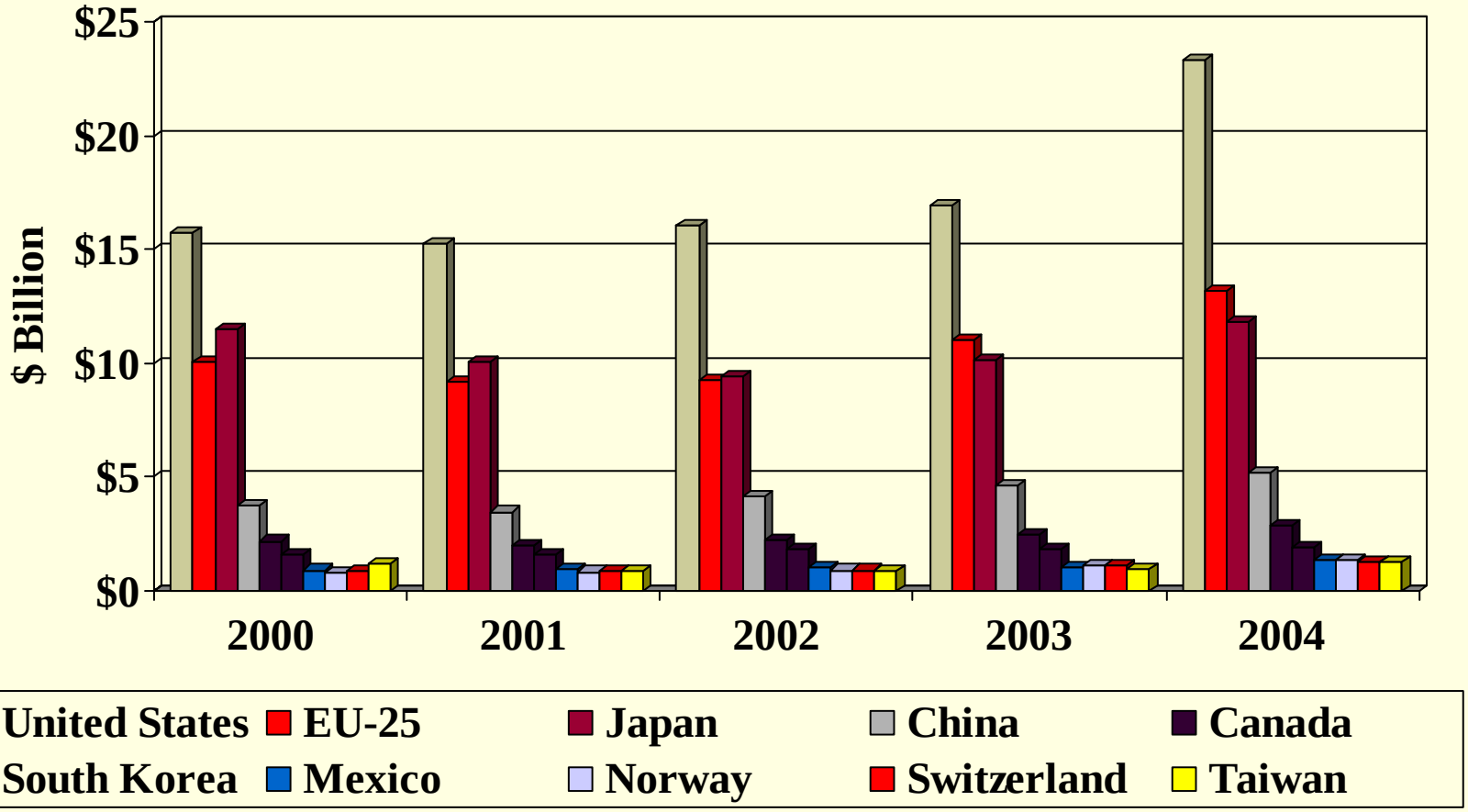
Source: World Bank, 2004

Global Forest Harvest and Population,



Source: J. Bowyer, Univ. of Minnesota from FAO (2001)

Global Imports – All Wood Products



Source: Global Trade Atlas (reporting countries)

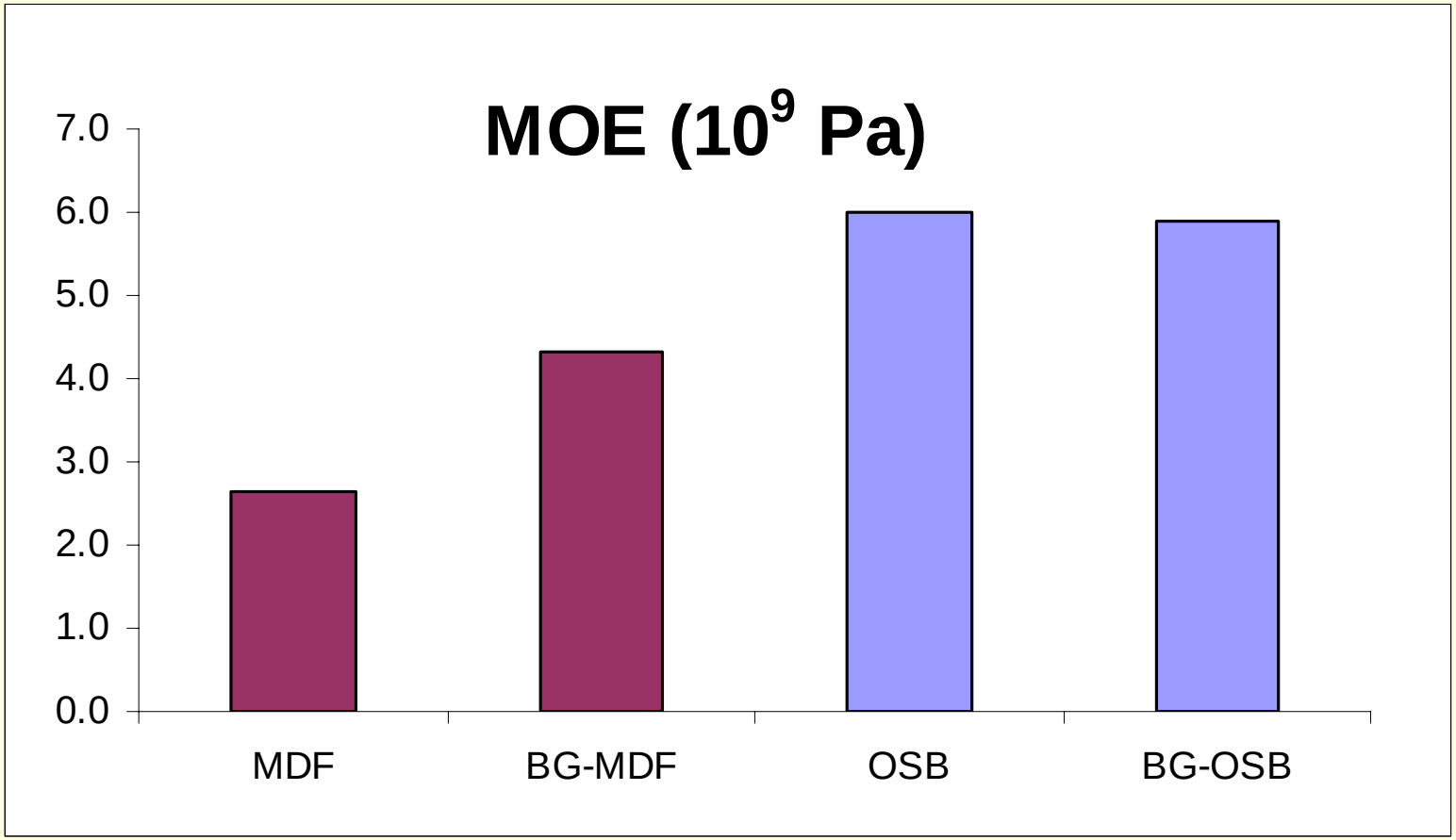
Problems

- World population increase is less than the gross world products.
- It is certain that the demand for raw materials will increase substantially in the future.
- Environmental concerns increase. (waste, pollution, global warming)
- People’s need for safe, affordable, environmentally-friendly homes is expected to increase substantially.

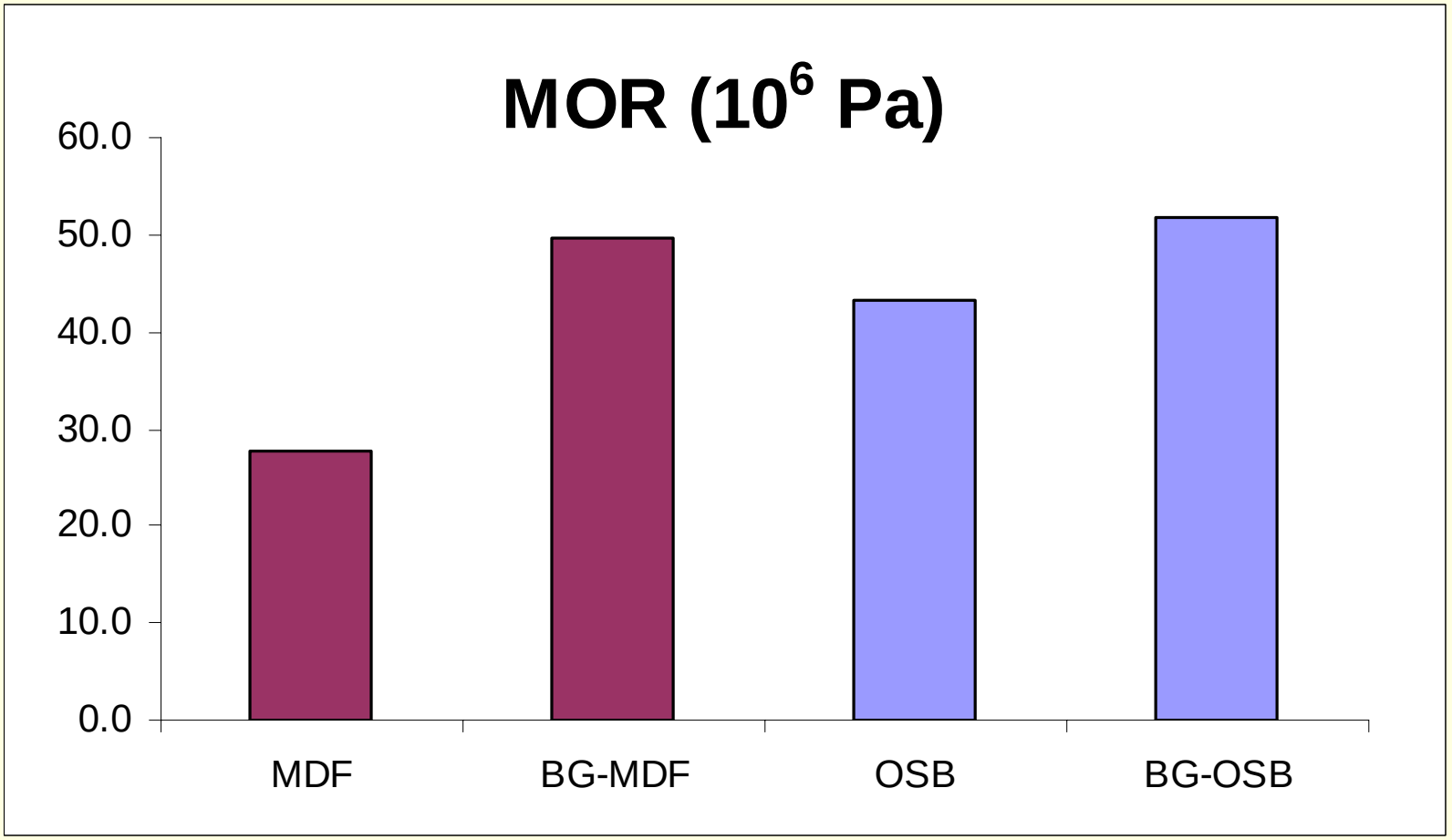
Opportunity

- Resources
  - Naturally renewable
  - Less energy
  - Environmentally friendly
- ➔ Bio-based materials
  - Wood fiber
  - Agricultural fiber
  - Other woody fiber --- bamboo and rattan

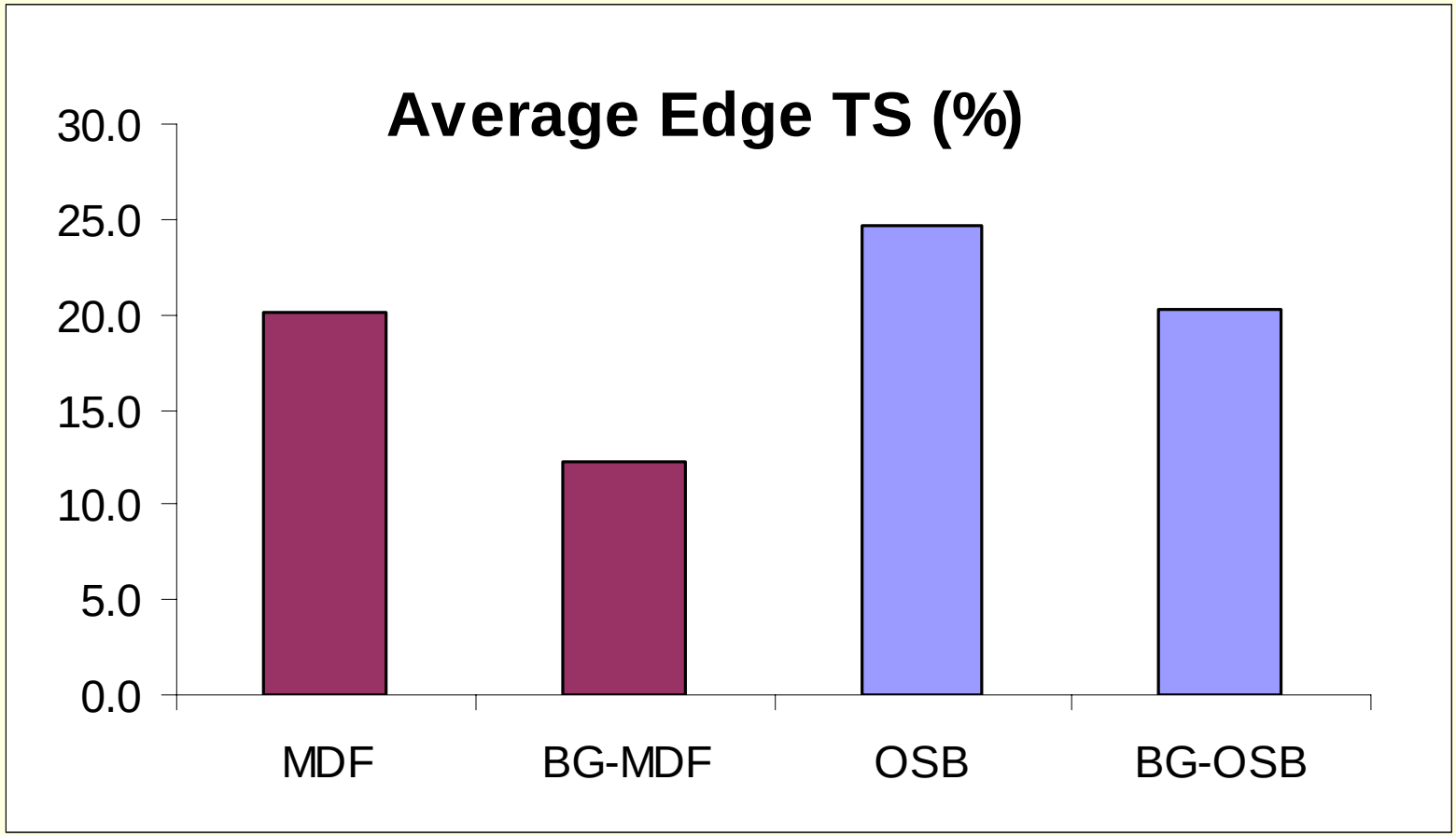
Bamboo-wood composites



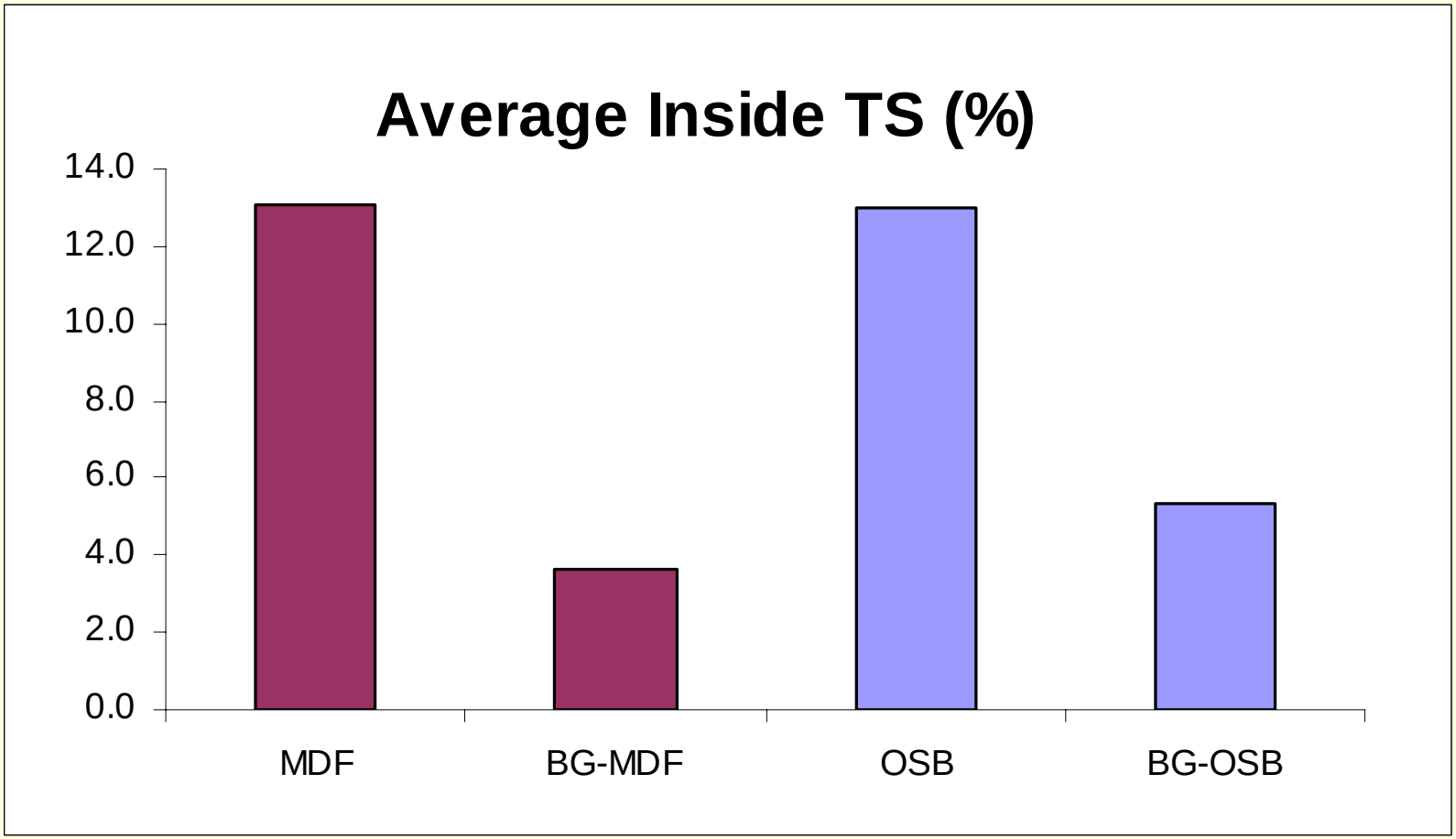
Bamboo-wood composites



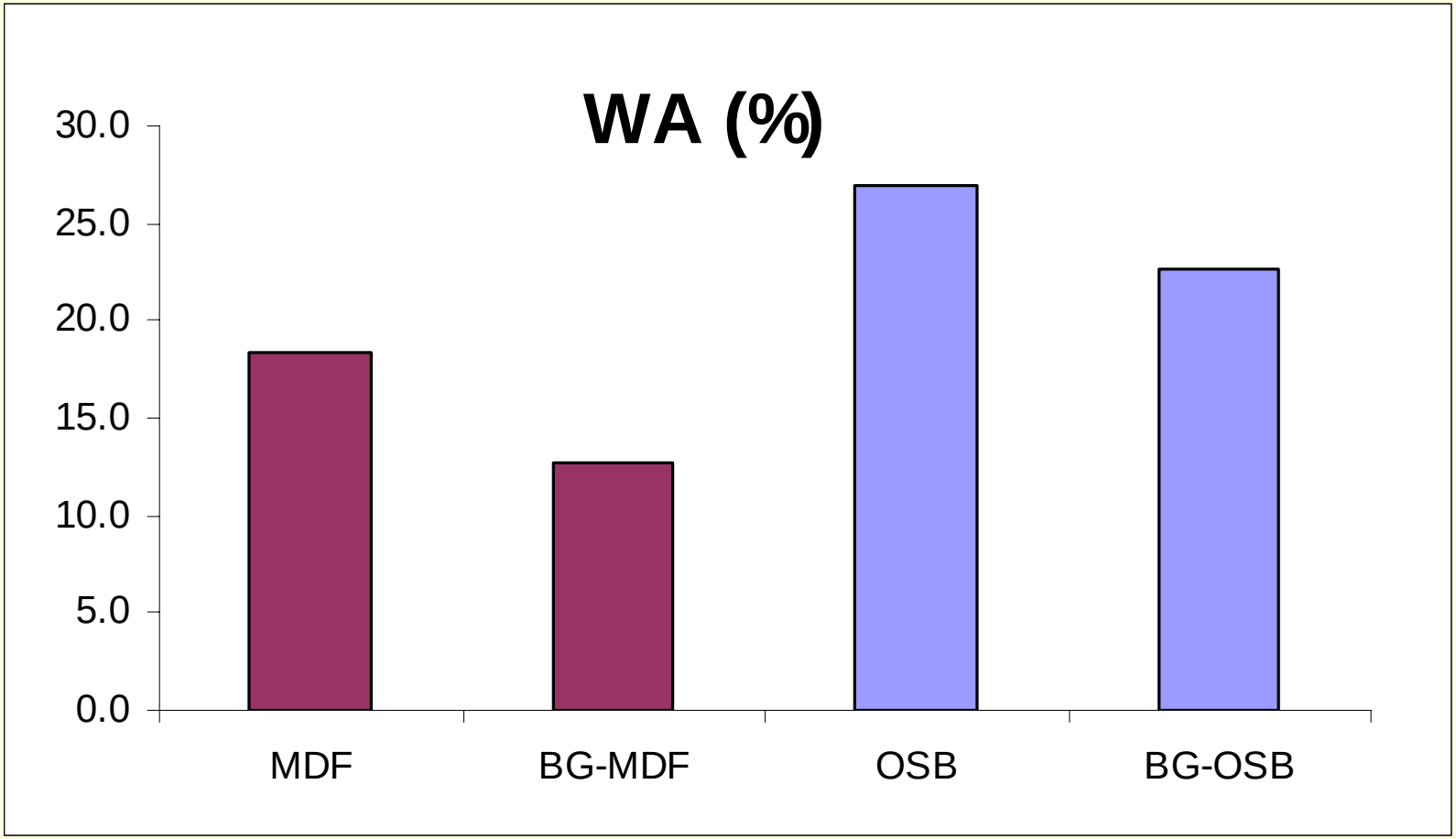
Bamboo-wood composites



Bamboo-wood composites



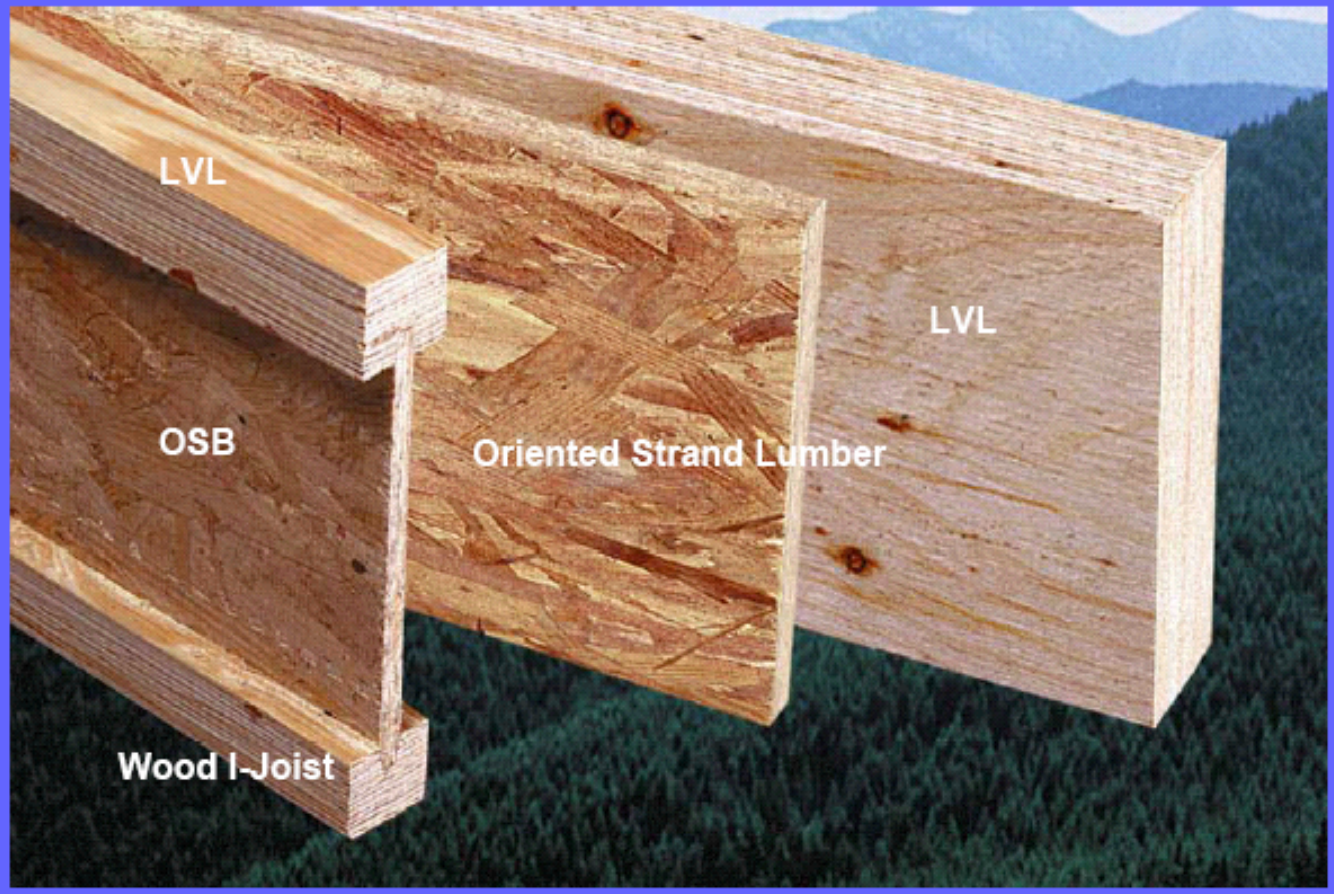
Bamboo-wood composites



Development of Bio-Based Composites

- Version
  - To build safe and affordable homes with naturally renewable bio-based materials
- Strategy
  - Identify the R&D and market needs
  - Understand the performance requirement
  - Engineering the processing
  - Implement the product

Engineered Wood Products (EWP)



Source: APA

Plywood Development

- Chinese furniture --- thousands years ago

  --- Shave wood and glue them together

- Tombs of the Egyptian pharaohs

  --- laminated wood

- European countries --- 17th and 18th century

  Decorating wood surfaces

Plywood Development – cont.

- Patented in 1865 by John K. Mayo
  - "The invention consists in cementing or otherwise fastening together a number of these scales of sheets, with the grain of the successive pieces, or some of them, running crosswise or diversely from that of the others…"
- Unsuccessful in implementing and marketing

Plywood Development – cont.

- Birth of the plywood industry --- 1905
  - Portland, Oregon
  - World Fair --- asking for display
  - Portland Manufacturing Co.
    - --- fruit basket and coffee drum
  - Early plywood panels
    - Animal glue – protein based
    - Hand brush
    - Wooden press with house jacks
    - Overnight pressed
    - One press load per day

Plywood Development – cont.

- Business senses
  - Marketing and sales (Tom Autzen)
  - Doors and draw bottoms
- Growing
  - Process improvement
    - Automatic glue spreader
    - Hand press
    - Edge trim
    - 420 panels a day
  - Open its own door manufacturing plant

Plywood Development – cont.

- Technology improvement
  - Efficient peeling process
  - Hot press
  - New resins
  - ➔ improve performance
  - ➔ low the production cost
- Market develop and Product Promotion (1920)
  - Door
  - Running board and trunk stock
  - ➔ 17 plywood mills
  - ➔ 0.32 x 10^6 m^3

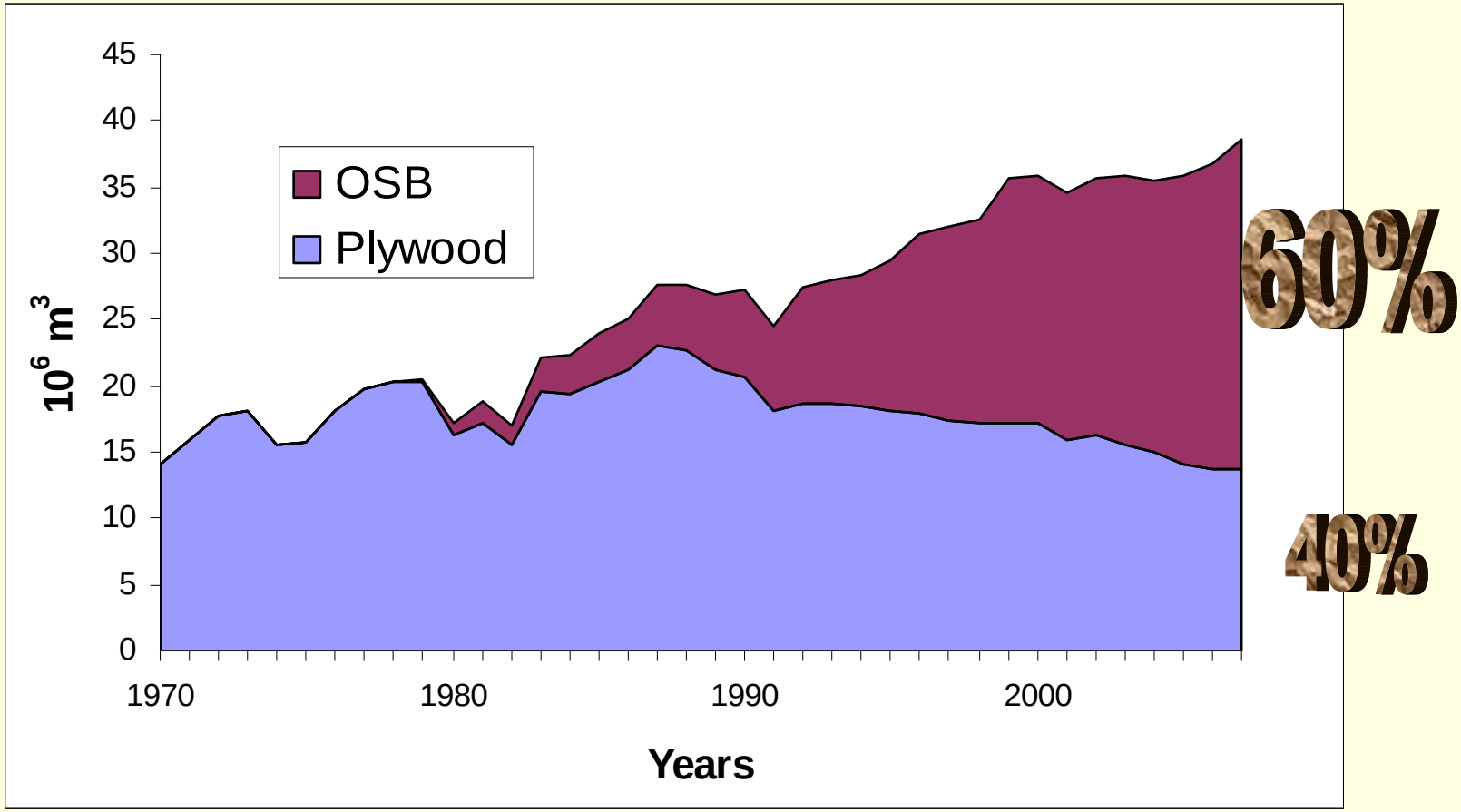
Plywood Development – cont.

- Establishment of plywood association (1933)
  - Standardization
  - Test/evaluation
  - Promoting plywood – demo. house
  - Providing directions in home constructions
- Opportunity and boom (1940)
  - During the War
  - Post-WWII housing boom
  - ➔ 18×10^6 m^3

Plywood Development – cont.

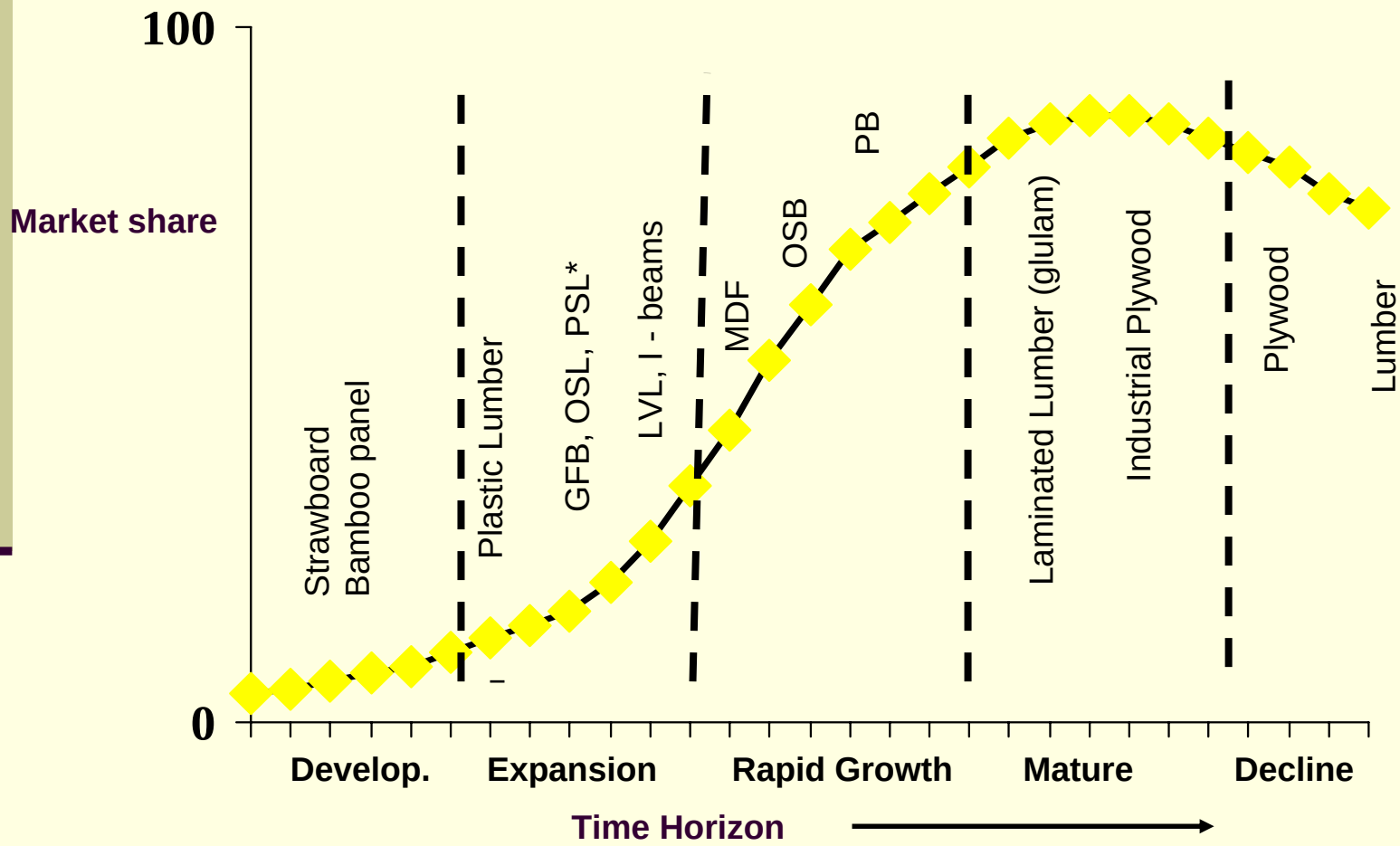
- Successful for half century
  - Efficiency in wood usage
  - Product quality
- New technology ➔ engineered wood products
  - structural wood panels: OSB, plywood, structural composite panels
  - glued laminated timbers: glulam;
  - structural composite lumber: LVL, PSL, and OSL;
  - prefabricated wood I-joists or I-beams;
  - Non-structural composites: MDF, particleboard.

Structural Panel Production



Source: APA

Product life cycle depends on competition, resources, new technology.



Source: Al Schuler – USDA Forest Service

Summary – New Product Development

- Economic considerations
  - Market
  - Competition and opportunity
  - Weakness and strengths
  - Raw material supply (resource)
  - Long term profitability
  - Investment return and risk
- Environmental considerations
  - Natural impact
  - Chemical emission & toxic materials
  - Recyclable

Summary – New Product Development

- Research and Development
  - Raw material preparation
  - Processing
  - Performance, standard, and specification
    - Mechanical and physical
    - Fire and water
    - Durability (decay and insect)
    - Chemical emission and toxicity
    - ….
  - Optimization
  - Recommendation

Summary – New Product Development

- Manufacturing
  - Management
  - Safety
  - Industrial hygiene
- Advertisement and sales
  - Model house
  - Distribution
  - Education

➔ Products don’t sell itself.

Thank You!