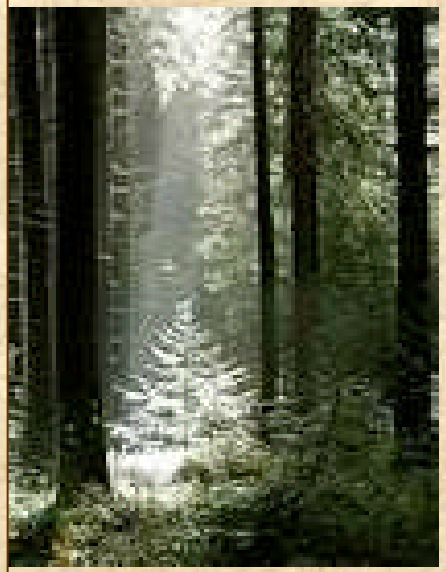
# Proposed
# Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products

**April 26, 2007**

# Outline

- Background
- Available Technologies
- Proposed Airborne Toxic Control Measure
- Benefits and Impacts
- Comments
- Proposed Modifications
- Recommendation

# Background



# *California's Air Toxics Program*

**Identification**

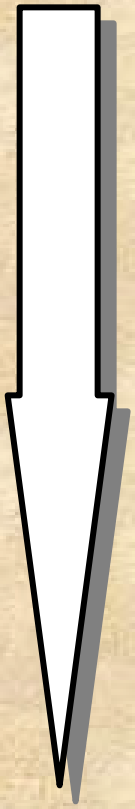
Potential Toxic Substance

ARB/OEHHA Publishes Draft Report

•Public Workshops
•Comment Periods

SRP Reviews Report

Public Hearing



**Risk Management**

Evaluates Source Categories

Investigate Risk Reduction Options
•Public Workshops

Publish Staff Report/Proposal
• Public Workshops
•Comment Period

Public Hearing

# Formaldehyde as a Toxic Air Contaminant

- Identified as a Toxic Air Contaminant in 1992
- No level of exposure considered “safe”
  - Damages DNA
- Inhalation causes cancer in the region of the throat behind the nose
- Non-cancer effects

# Carcinogenicity of Formaldehyde

- More evidence since 1992 listing in California
- IARC Group 1 – Known Human Carcinogen (2004)
  - Sufficient evidence in humans for nasopharyngeal cancers: "… improbable that all of the positive findings for nasopharyngeal cancer … could be explained by bias or unrecognized confounding effects"
  - Strong but not sufficient evidence for leukemia in humans
  - Sufficient evidence in animals

# Carcinogenicity (Cont'd)

- IARC considered supporting animal studies, including information on mechanism of action
- Studies demonstrate nasal cavity cancers in rats from inhalation
- Co-carcinogen by multiple routes
- Damages DNA in animals and humans

# Non-cancer Health Effects

- Occupational exposures induce asthma in workers
  - Sensitized individuals react at low levels
- Workplace exposures associated with significant decrement in lung function, wheezing, shortness of breath; respiratory, eye, nose and throat irritation, rhinitis
- Persistent irritation and cell damage in the nose from long term workplace exposure (basis of OEHHA chronic REL)

# Formaldehyde Exposure: Asthma and Lung Function Responses in Children

Some studies suggest:

- Higher risk of asthma in young children exposed to higher formaldehyde levels in home
- Lung function decrements and increased lung inflammation in kids associated with formaldehyde levels in the home, particularly for asthmatic children
- Increased allergic propensity in children in homes with increasing formaldehyde

# Animal Models of Asthma

- In animal models of asthma, formaldehyde causes:
  - Bronchoconstriction and hyperactivity of airways
  - Increased airway resistance
  - Enhanced response to allergens

# Formaldehyde's Unit Risk

- Formaldehyde Council's petition to revise OEHHA's URF for formaldehyde in 2002
- OEHHA evaluated petition material
- OEHHA's analysis reviewed by the Scientific Review Panel for Toxic Air Contaminants

# Petition to Revisit Formaldehyde Assessment Under TAC Process

- Evidence submitted with the petition does not change determination that formaldehyde is a carcinogen:
  - OEHHA's interpretation remains consistent with IARC, USEPA and earlier OEHHA evaluations
  - No new evidence of a threshold provided
  - Concerns about assumptions in CIIT dose-response model

# Scientific Review Panel's Analysis of Petition

- Assumptions strongly affect the inflection point of the "hockey-stick" model
- Allows for large differences in potency estimates at low formaldehyde levels, depending on model inputs
- Additional analysis of assumptions in model is needed
- Recommended petition be denied

# Summary

- IARC classification – formaldehyde is carcinogenic to humans
- Strong respiratory irritant – workers show decrement in lung function, damage to nasal lining
- Occupational asthma
- Possible associations with allergy, lung function, and asthma at environmental exposures
- New data indicates health effects are greater than previously documented

# Composite Wood Characteristics

- Wood pieces, particles, fibers, bonded with resin
- Resin may contain formaldehyde
- Unreacted formaldehyde is released

# Composite Wood Products

- Hardwood Plywood (HWPW)
- Particleboard (PB)
- Medium Density Fiberboard (MDF)

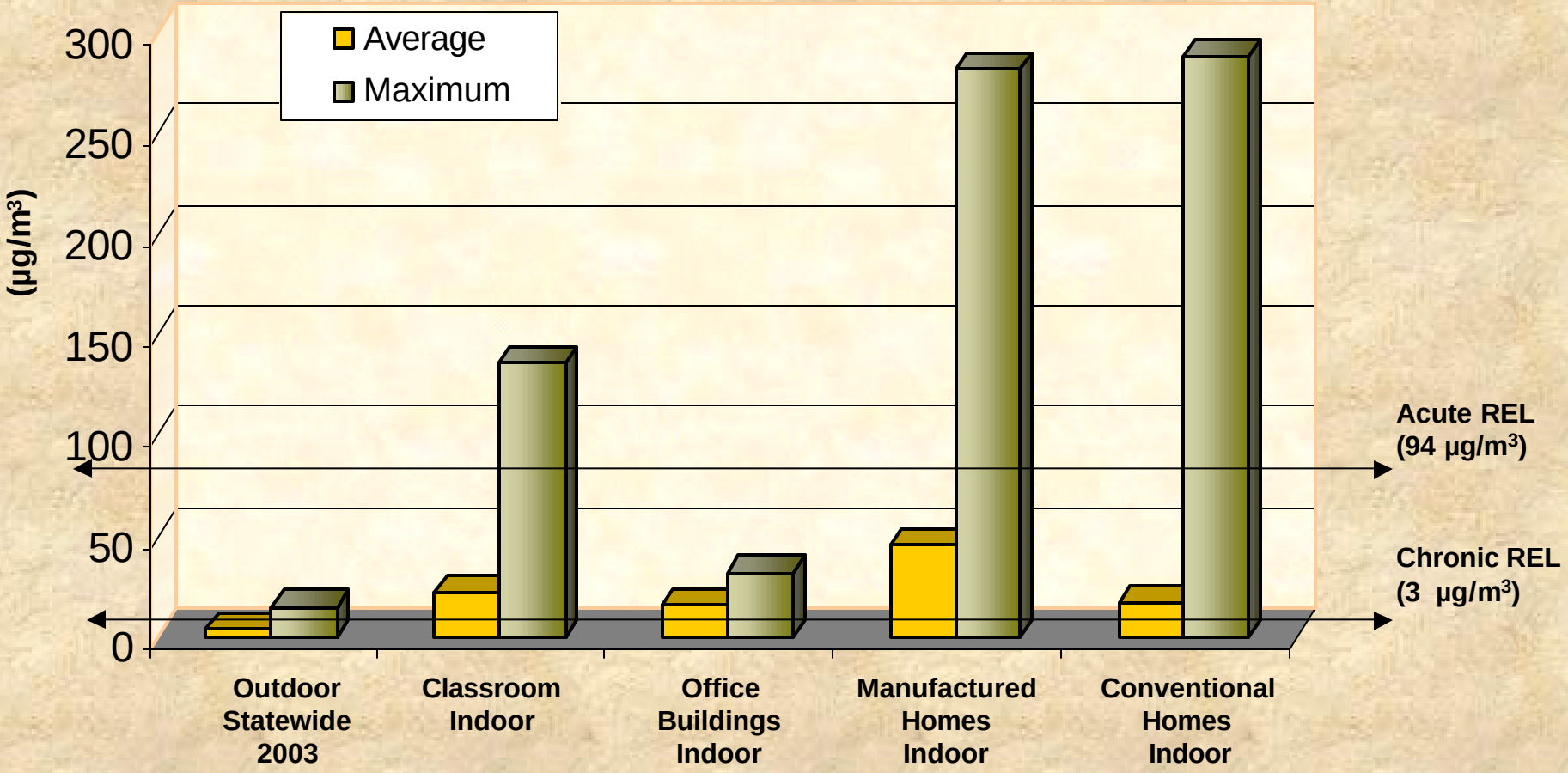
# Formaldehyde Emissions from Composite Wood Products

- Hardwood plywood
  - 240 tons per year
- Particleboard
  - 450 tons per year
- Medium density fiberboard
  -190 tons per year
- Total of about 900 tons per year

# Emission Sources

- Manufacturing plants
- Fabrication facilities
- Home construction
- Transport
- Indoor air moving outside

# Typical Formaldehyde Levels

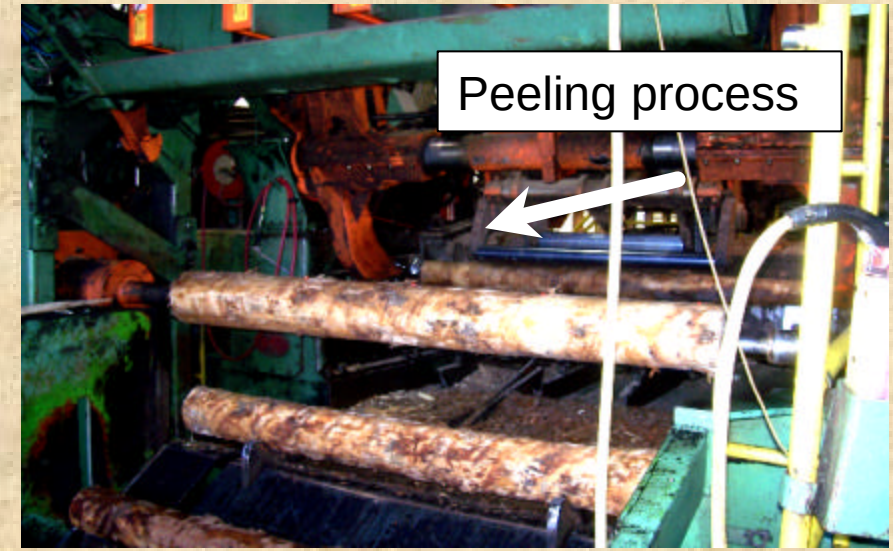



70 years at 1 µg/m$^3$ = 6 lifetime cancers per million

# North American Composite Wood Industry

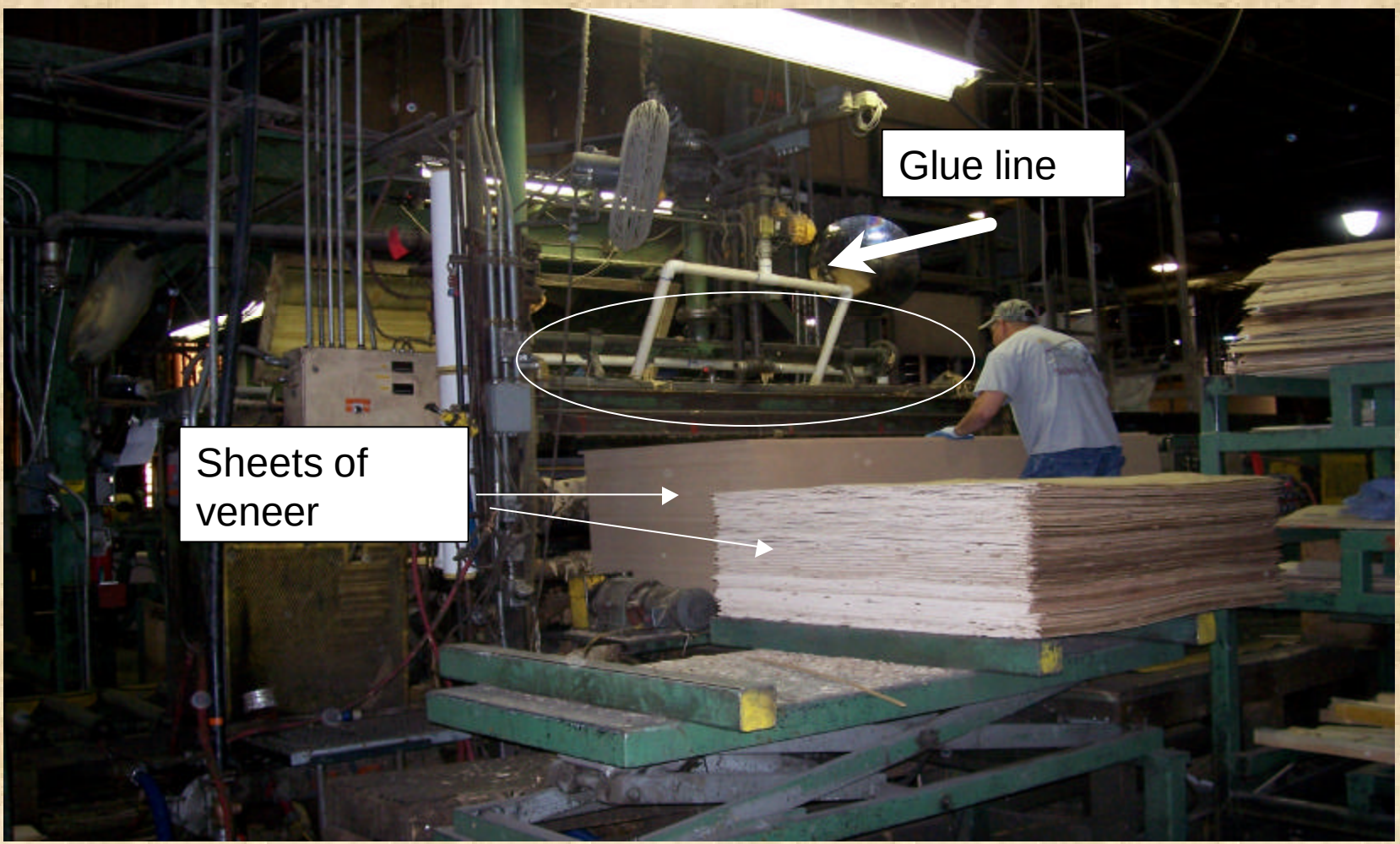
- HWPW
  - 2002 U.S. production: ~2.5 billion sq. feet
  - No. of North American mills: 51
- PB
  - 2002 U.S. production: ~5.4 billion sq. feet
  - No. of North American mills: 40
- MDF
  - 2002 U.S. production: ~2.4 billion sq. feet
  - No. of North American mills: 26

# Hardwood Plywood



# Hardwood Plywood

## Manufacturing Process



# Hardwood Plywood

## Uses

- Non-structural paneling
- Cabinets
- Furniture
- Engineered floors

# Particleboard

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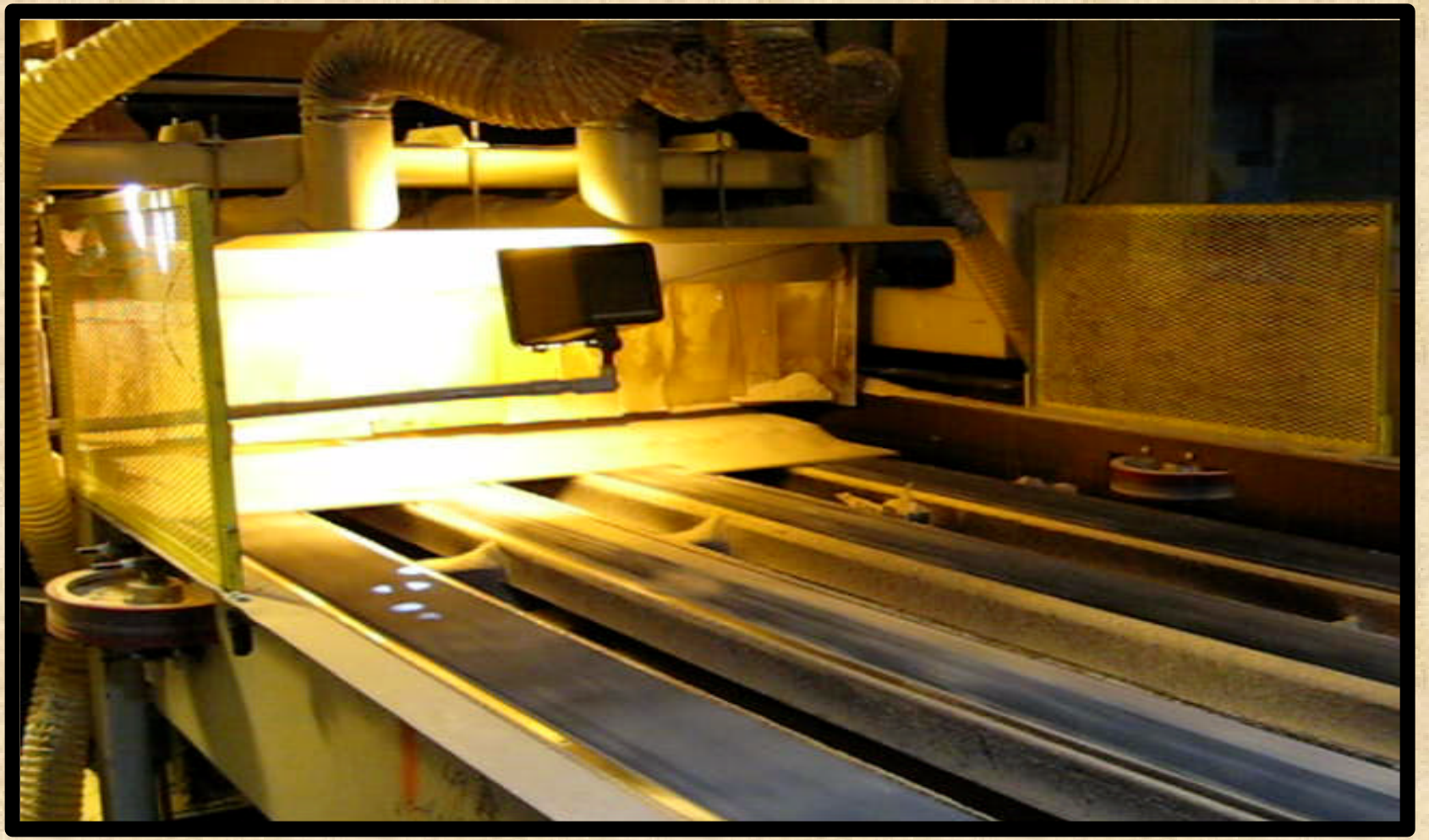

# Particleboard

**Uses:**

- Cabinets
- Countertop core
- Floor underlayment
- Store fixtures
- Shelving
- Stair treads

# MDF

# MDF

Uses:

- Cabinets
- Furniture
- Moldings & trim
- Door skins
- Window components
- Shelving
- Engineered floors
- Speaker components

# U.S. Emission Standards

- United States
  - Set in 1985 by U.S. Dept. of Housing and Urban Development (HUD)
  - Applies only to PB and HWPW in manufactured homes
  - Limits surface emissions
  - High emission rate compared to Europe, Australia, and Japan

# International Emission Standards

- Lower than current U.S. standard
- Programs are fundamentally different; not directly comparable
- Generally not emission caps

# Need for Control

- U.S. HUD standard not protective
- Childhood risk (9 years)*: 23-63 cancer cases per million
- Lifetime risk (70 years)*: 86-231 cancer cases per million

* Based on total daily average formaldehyde exposure

# Available Technologies

# Resin Options

- Common Resins
  - Urea-formaldehyde (UF)
  - Phenol-formaldehyde (PF)
  - Methylene Diisocyanate (MDI)
  - Polyvinyl Acetate (PVA)
  - Soy
- Emerging Resins
  - MDI Hybrids, Tannin-based, other soy blends
  - Modified UF resins – scavengers and blends

# Best Available Control Technology Considerations

- Lowest level achievable
- In use and lab-tested alternative resins
- International standards
- Resin technology cost

# Proposed Airborne Toxic Control Measure

# ATCM Applicability

- Panel manufacturers
- Distributors
- Importers
- Fabricators
- Retailers
- Finished goods

# ATCM Provisions

- Applies to products sold, supplied, used, or manufactured for sale in California
- Proposed standards in two phases
- Sell-through
- Exemptions
- Enforcement

# Rationale for Phase 1 Standard

- Set an industry cap; over 50% of CWP mfrs. need to lower emissions
- Curtail low-cost, high-emitting imported products

# Proposed Phase 1 Standards

| Product | Jan 1, 2009 | Jul 1, 2009 |
|---|---|---|
| **HWPW-VC** | 0.08 ppm | ----- |
| **HWPW-CC** | ----- | 0.08 ppm |
| **PB** | 0.18 ppm | ----- |
| **MDF** | 0.21 ppm | ----- |
| **Thin MDF** | 0.21 ppm | ----- |

# Resin Technologies for Phase 1 in 2009

HWPW, PB and MDF:

- UF + 4% Melamine
- Low mole ratio UF co-blend

# Rationale for Phase 2 Standards

- Technology forcing
- Defines BACT

# Proposed Phase 2 Standards

| Product | Jan 1, 2011 | Jan 1, 2012 | Jul 1, 2012 |
|---|---|---|---|
| **HWPW-VC** | 0.05 ppm | ----- | ----- |
| **HWPW-CC** | ----- | ----- | 0.05 ppm |
| **PB** | 0.09 ppm | ----- | ----- |
| **MDF** | 0.11 ppm | ----- | ----- |
| **Thin MDF** | ----- | 0.13 ppm | ----- |

# BACT for Phase 2 in 2011-12

- **HWPW**
  - UF + 15% Melamine
  - PVA
  - PVA-Soy Blend
- **PB**
  - Low mole ratio UF + 8% Melamine
  - Low mole ratio UF + Scavengers
  - PF
- **MDF**
  - Low mole ratio UF + 12% Melamine
  - Low mole ratio UF + Scavengers
  - Polymeric MDI

# Sell-through

- Allows sale of non-compliant products manufactured before standard effective
- Time period limited
- Differing sell-through periods

# Exemptions

- Products not for sale in California
- Products subject to HUD standards
- Windows containing <5% composite wood
- Military specification plywood
- Vehicles

# Enforcement Provisions

- Third Party Certification
- Statements of Compliance
- Recordkeeping
- Product Labeling
- Facility Inspections
- Compliance Testing

# Importance of Enforcement

- Necessary to achieve ATCM benefits
- Fair competition between imports and domestic products
- Essential to viability of industry

# Benefits and Impacts

# Emissions, Exposure, and Risk Reductions

- **Emission reductions**
  - 180 tons per year - Phase 1
  - 500 tons per year - Phase 2
- **Exposure reductions***
  - 15% - Phase 1
  - 40% - Phase 2
- **Lifetime cancer risk reductions***
  - Baseline 86-231 cases
  - 12-35 cases reduced – Phase 1
  - 35-97 cases reduced – Phase 2

* Based on total daily average formaldehyde exposure

# Increase in Panel Production Costs

| Product | Phase 1 | Phase 2 |
|---|---|---|
| **HWPW** | < $0.20 | $4 to 6 |
| **PB** | < $1 | $3 to $4 |
| **MDF** | < $1 | $4 to $6 |

# Costs to Consumers

- Panel Price Increase in Phase 2
  - $3 to $7 per 4’ x 8’ panel
- Median Priced Home ~2000 ft² ($574,000)
  - Cabinets, countertops, shelving, and moldings
  - Incremental cost increase ~ $400
- Bookcase
  - Pre-cut PB in ready-to-assemble kits ($27)
  - About $1 more in Phase 1; $8 in Phase 2

# Annual Industry-wide Costs

| Product | Phase 1 | Phase 2 |
|---|---|---|
| **HWPW** | $6 million | $17 million |
| **PB** | $5 million | $61 million |
| **MDF** | $9 million | $49 million |
| **Total -- All** | ~$19 million | $127 million |

# Projected Profitability Impacts

- 25 mills nationwide
- Costs per mill
  - HWPW $0 to $7 million
  - PB $120,000 to $18 million
  - MDF $0 to $16 million
- Average change in return on equity = 11.6%

# Comments

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- Standards too stringent
- Standards not stringent enough
- Accelerate Phase 2 standards implementation
- Phase 2 incremental production cost underestimated
- Total industry-wide cost underestimated

# Comments (Cont'd)

- Exterior and garage door exemptions
- Clarify "architectural plywood" definition
- Performance-based compliance testing flexibility
- Several clarifying suggestions

# Proposed Modifications

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- Move HWPW-VC implementation up one year
- Exemption for garage and exterior doors
- Performance-based compliance option for low-emitting formaldehyde based resins

# Proposed Modifications (Cont'd)

- Sell-through provision dates
- Definition of "architectural plywood"
- Other clarifications

# Recommendation

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- Adopt the proposed ATCM with modifications suggested by staff