Integrating urban planning, vegetation management and fire hardening of buildings to achieve fire safety

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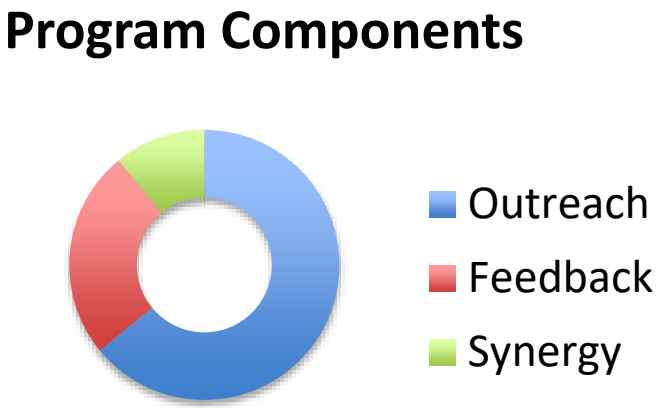
Outline

- Holistic approach about fire safety
- Starting from the forest and honing in on the house
- Wildlands: vegetation management, power lines, forest diseases
- Community level planning
- Defensible space
- The house and its immediate surroundings
- Critical and unresolved issues

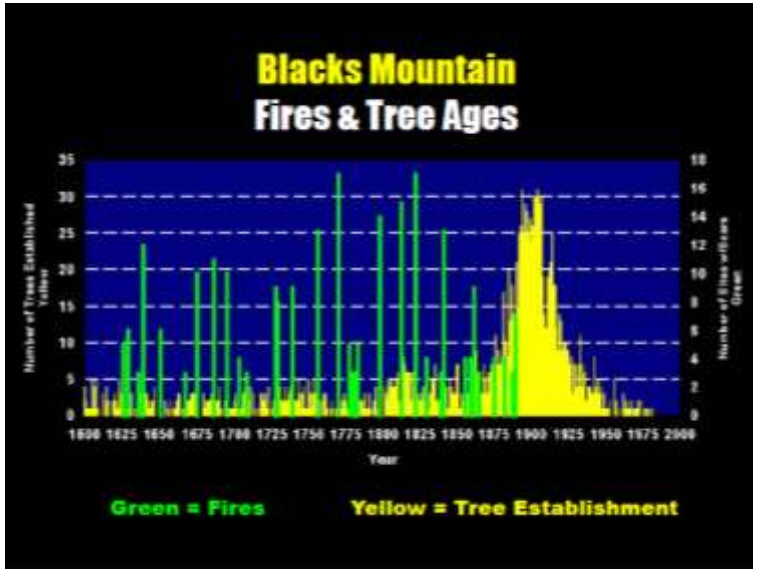


Some definitions

Ecosystem: a biological community of interacting organisms and their physical environment.

Fire adapted ecosystem: Many ecosystems, particularly prairie, savanna, chaparral and coniferous forests, have evolved with fire as an essential contributor to habitat vitality and renewal.[1]

Fire frequency (time interval between fires), intensity and scale will define different natural fire regimes. In California, 5-20 year intervals.


Blacks Mountain
Fires & Tree Ages
Year
Green = Fires
Yellow = Tree Establishment

1919


1993

Fire regimes are changing

Disturbances (I): by preventing all fires we have modified fire adapted ecosystems:

- Higher plant density, often unsustainable
- Higher abundance of combustible fire-intolerant plant species
- Higher accumulation of fuels

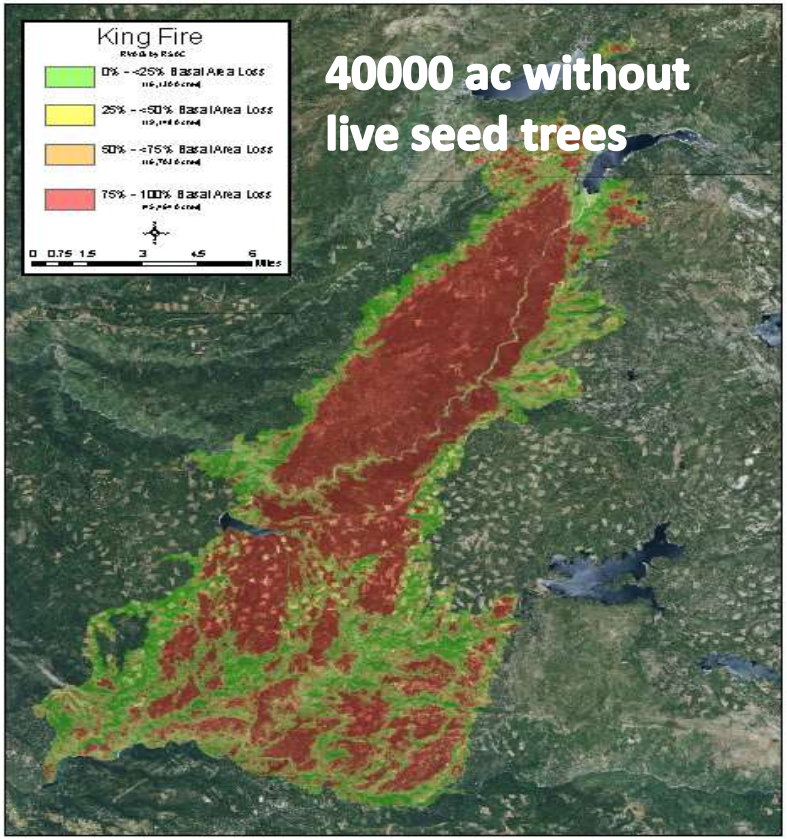
Disturbances (II): forest and vegetation management, invasive species

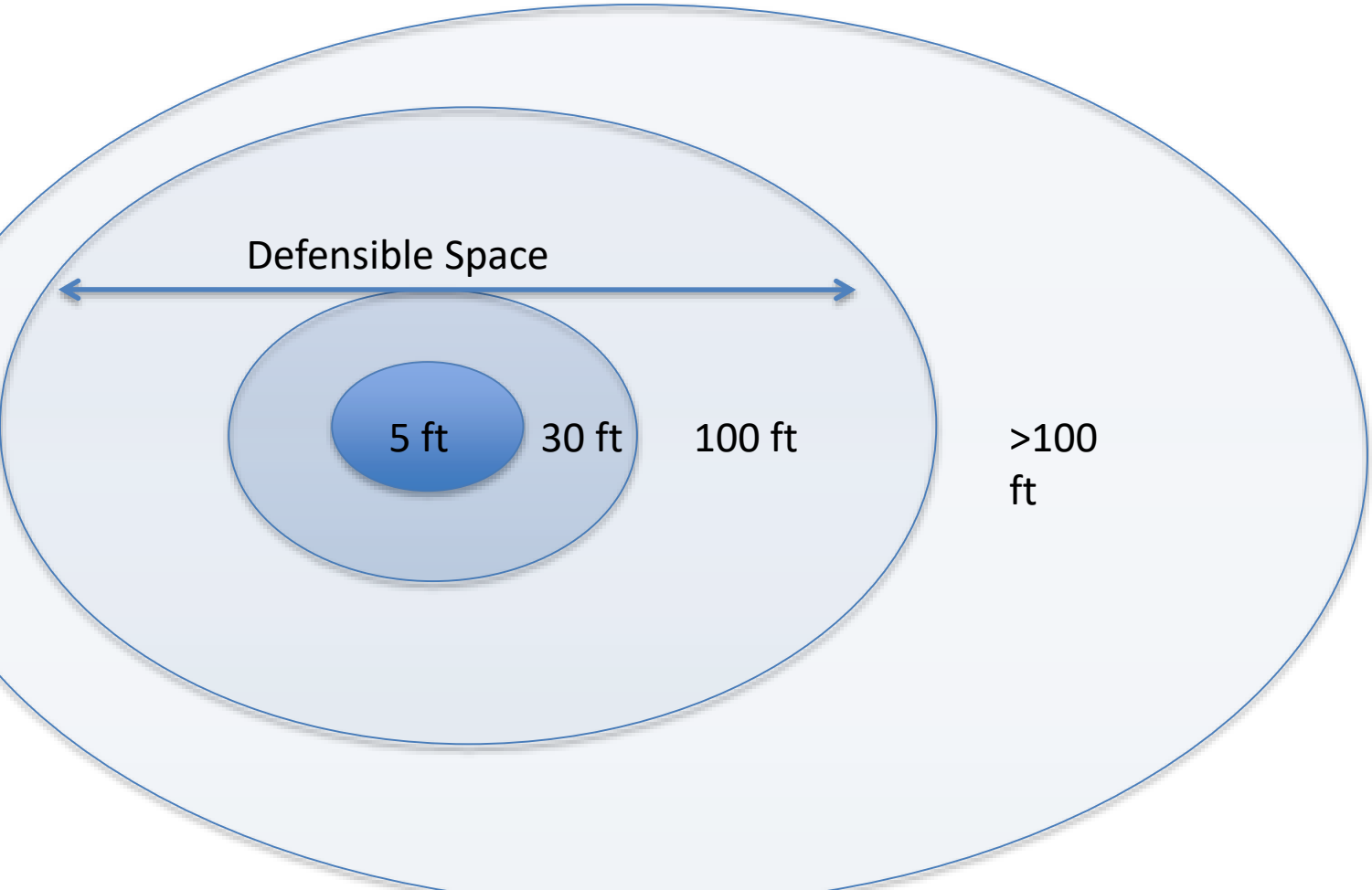
- Lack of thinning in secondary forest results in high tree density
- Higher tree density leads to an increase in infectious diseases
- Introductions of exotic pests increasing disease and fuels
- Restoration efforts resulting in increase of grasses

Climate change:

- Global warming
- Extreme weather events
- Alternation of very dry and very wet periods
- Changes in wind patterns

Increase in high severity fires





➢100 ft

Fire Ignition

Fire Behavior

Community Level Escape/Response /Commu defensible space

Access/Egress to and from properties

Slowing down fire front/Defensible space

Home defense

Ember Control

House hardening

0 feet

Reduce Ignitions:
Vegetation management along power lines

- Utility companies need to mitigate risk of tree failures on lines and infrastructure (4 feet and 12 feet clearance areas)

  - Problems

  – Sheer scale of task; you have to accept **you can only reduce risk**, not zero it

  – Surveys designed based on statistical information, but **key indicators** of tree failure may be missing

  – **Surveys very long,** affected by operator bias, **pencil and paper operation**, data transcription manual

  – Lack of clear prioritization and **many trees are borderline** with actions decided by operator

Can we improve reduction of ignition events?

- Task is arduous: public perception is that too many trees are been abated, when in reality we still have too many trees encroaching power lines.
- Underground lines; better mediation/education between utility companies and the public
- More efficient (faster and to the point) vegetation surveys are needed. Watch out for trade offs!
- Can we generate true collaboration between utility companies in identifying critical issues? What about Citizen Science involving homeowners to monitor lines

Fuel management at the community level

- Reduce risk of ignition by abating **hazard trees**
- Selective **thinning of fire intolerant** species and smaller diameter trees
- Reduce tree density, **intermediate** canopy opening, reduce ladder fuel
- Reduce **invasive plants**
- Reduce or change distribution of coarse **woody debris**
- Choose restoration projects that do not increase **flammable grasses** component

Fire behavior

- Fuel amounts and distribution
- Plant Density and Composition (some species are more flammable)
- Fuel's Moisture Content (seasonality)
- Climate (relative humidity) and weather (wind)
- Topography (slope)
- Pests and Diseases
- Landscape level factors (land use, fire breaks)

How does tree mortality affect general fire behavior?

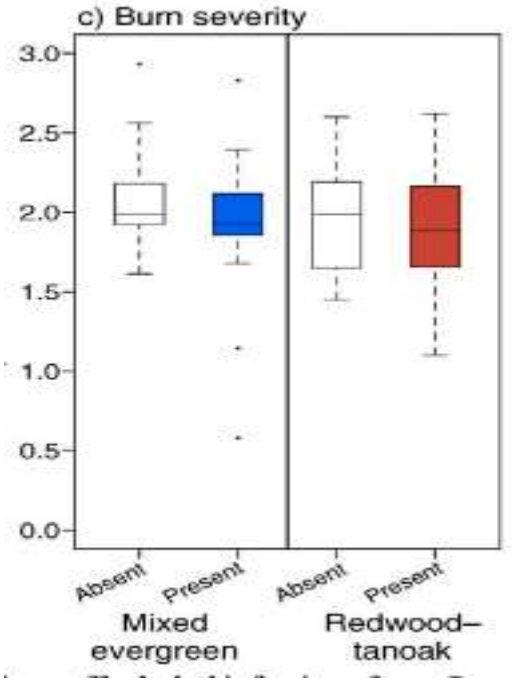
- Diseased and drying trees have a lower moisture content. Dry foliage and branches can ignite easily, creating ladder fuels (vertical fires)

- Diseased trees produce more dead and downed debris which affects fire behavior on the ground

- Stands with trees having reduced canopy sizes allow for more air, thus increasing fire intensity

SOD and fire: frequent local hotspots and increases unpredictability

Overall fire intensity was not altered



Important effects

- Immediate outcome: change of response from manned crews to mechanical (Valachovic et al 2011)
- SOD increased frequency of hotspots that could not be controlled by crews and that increased long distance dispersal of fire and generated variability in burn rates

Dead tanoaks in mid SOD stage carried flames upwards, fire jumped lines, and locally scorched and killed redwoods

Are we doing enough in the “W” part of the “WUI” ?

- Prescribed burns and mechanical removal ok: selective thinning of fire intolerant species must become a priority to decrease combustible loads and density
- Quality (and not just quantity) of restoration projects, some restorations increase grass component. Do we have a body overseeing restorations?
- Funding for removal of dead trees: it comes and goes. We need to identify/generate a definitive source of funds for intervention in areas affected by pests and disease that are not federally owned. Disease creates also ground fuels that generate hazard post fire
- While prescribed burns are ideal they may not always be possible; there are now Low Impact High Technology uses for non merchantable biomass but they require costly infrastructure

Landscape level effects on fire behavior

- Agricultural lands, irrigated parks and golf courses, water bodies can all slow down fires
- Roadways with housing developments on one side, man-made fuel breaks
- Community level defensible space
- Alternative urban planning combined with higher density development

Work with your neighbors!

Photo courtesy of MAST
San Bernadino County

Figure 10. Creation of fuel ladder between two fences.
Photo courtesy of J. Cohen.

Community level issues 1

- Reducing fuel loads around communities is a critical aspect, yet it is not uncommon to identify a clear demarcation between individual parcels of defensible space and defensible space for an entire community, with the latter being less than satisfactory. How can we incentivize townships or counties to generate community level defensible space? Can we delegate and finance homeowners or association of homeowners to make that happen in their neighborhood?

- Design and maintenance of community level defensible spaces: meadows, lakes, with non combustible amenities

- Revisit the current zoning in light of changing climate/increased urbanization in WUI zones. Is there an easy fix? (If you are within x yards from a high risk zone, you are at risk…)

- Emphasize end enforce the respect of the codes regarding any cross-property feature that may facilitate spread of fire within a community: fences, trees or structures near property borders. This is an area where legislators and insurance companies could work together. Funding should also be identified

Community level issues 2

- Wildlife or Riparian corridors intersecting neighborhoods: do we have standards to maintain biodiversity while mitigating fire risk
- Escape routes, removal of bottlenecks etc: these are key in saving lives
- Can we have facilities (water ponds, communal well designed wood storing areas) shared by groups of neighbors that are going to mitigate fire spread
- Pests and infectious diseases move across property lines: we need stronger programs to obtain buy-in from homeowners to follow necessary prescriptions to slow down the spread and the increase of plant diseases and insects. Can we identify funding sources for the implementation of community wide prescriptions aimed at curtailing the spread of diseases

The overarching goal of fuel management around a house

- 1. Converting tall continuous flames into sparse fires with shorter flames within 30–100 ft of the home.

- 2. Converting short and sparse flames into low-intensity creeping fire within 5–30 ft of the home.

- 3. Stopping the creeping fire from reaching the home by using noncombustible materials within 0–5 ft of the home.

Current situation

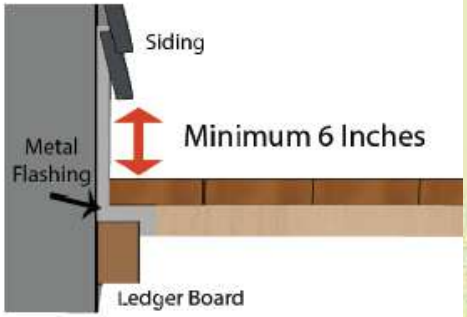
- Fire Maps – Are They Still Relevant? Fires don't know to stop at some line on a severe hazard map. Use them properly

- Wildland Fire Code (Chapter 7A) Best in the Nation But May Need Improvements
  - Written 15 Years Ago without current improvements
  - Non-Standard Tests Creates Unlevel Playing Field for Materials
  - Lab Tests Don't Reflect Real Fires
  - Many aspects are locally enforced, creating a patchwork of ordinances

- Code = Lowest Standard of Care Allowed Under the Law: The least you can get away with under law
- Promote Best Practices: We should be focusing on above code best practices, not the least permitted under law.

"During the 2018 “Camp Fire” in Paradise, more than 12,000 homes burned. Of the homes built since 2008 to California’s “Chapter 7A” building standard, 51% survived! Only 18% of the homes built before 2008 survived."

Image source: https://www.nbcnews.com/news/us-news/death-toll-rises-56-northern-california-s-camp-fire-n936466 - Josh Edelson / AFP - Getty Images



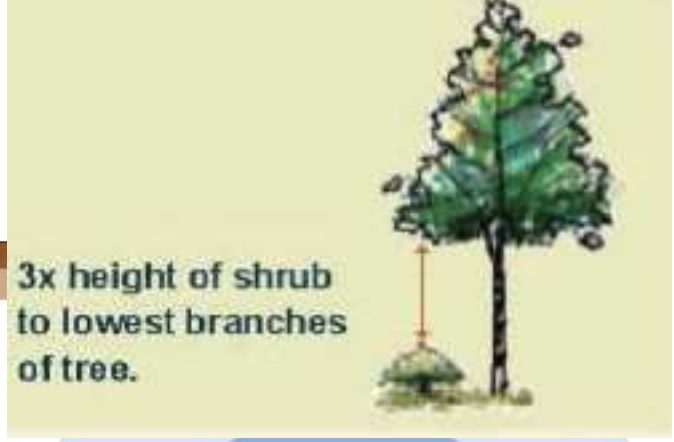


Figure 9.1. Landscaping zones for wildfire-prone areas. All codes lump Zones 1 and 2 into a single description, neglecting to emphasize the importance of the 0-5' near-home landscaping area.

Will these distances be effective during wind driven **wildfires**?

Defensible space 1

- I am concerned about the numbers we are using in our outreach messages. Are these numbers really safe, given we are facing more intense fires. This is a big responsibility.
- Two examples: 5 feet (Zone 1 or 0) non combustible zone (BTW this should be specifically included in the codes..). It has been said that defensible space can safely stop at 100 feet. Based on my experience the presence of a tree dying because of SOD 100- 200 feet from house is a huge hazard as it will create a hotspot capable of igniting the house (through embers) and also cause soil issues
- Issue of overkill: is lack of vegetation really bad ,are there alternative garden design with limited vegetation that are attractive and safer
- I think we need to have more of a two way communication among the different groups of stakeholders. For instance we should engage firefighters in sharing their personal thoughts on issues in the yard (presence of some plant species or yard design) that interfere with rescue operations

Defensible space 2

- I am a bit surprised by the insufficient emphasis of creating a clear access (no vegetation, no combustibles, no structures, sufficient width) for egress/access by people and firefighters in particular
- There are some situations that require a different set of rules: trailer parks and mobile homes are a great example. Currently there is little attention with incredible downsides
- More in the next and final section

Fuels vary with disease stage

Early… **…Late**

More crown fires, scorching, torching

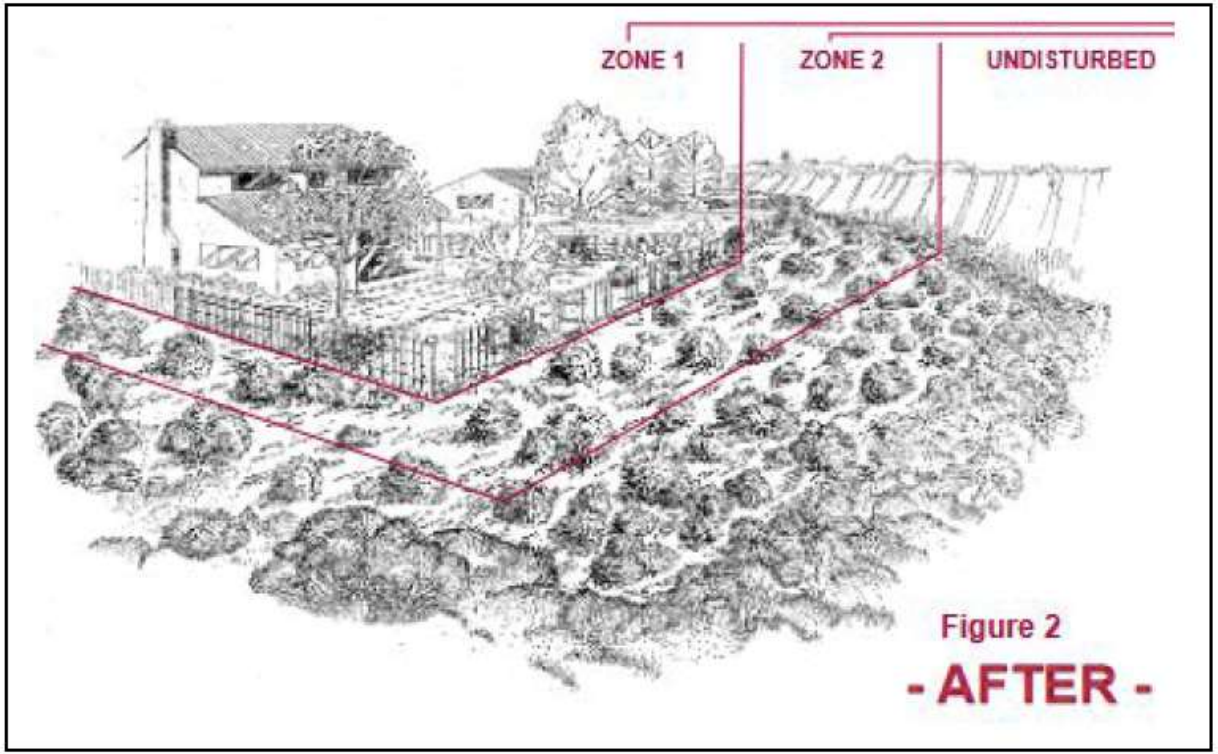
More logs, greater soil burn severity

HOTSPOTS

Surface, ladder and aerial fuels
Various stages of fragmentation and decay

Kuljian & Varner 2010 *Forest Ecol & Mgmt;* Valachovic et al. 2011 *Forest Ecol & Mgmt;* Metz et al. 2011 *Ecological Applications;* Metz et al. 2013 *Ecology*

A document from the San Diego City Fire Department provides one reasonable plan to reduce fire risk around your home WITHOUT unnecessary, excessive clearing.



Codes vs. best practices

What can we do above and beyond the code that will improve the fire resistance of a property?

Class A materials obviously a better choice, but non combustible materials may be a better one

Increasing the no combustible vertical space from 6 to 12 inches

Increasing the horizontal non combustible space over 5 feet

CALIFORNIA BUILDING CODE: CHAPTER 7A SUMMARY

VEGETATION MANAGEMENT

- Follows Public Resources Code (PRC) 4291
  - Two zones:
    - The Lean, Clean and Green Zone that includes the 30 feet immediately surrounding the home or building.
    - The Reduced Fuel Zone that includes the zone from 30 to 100 feet (or to the property line).

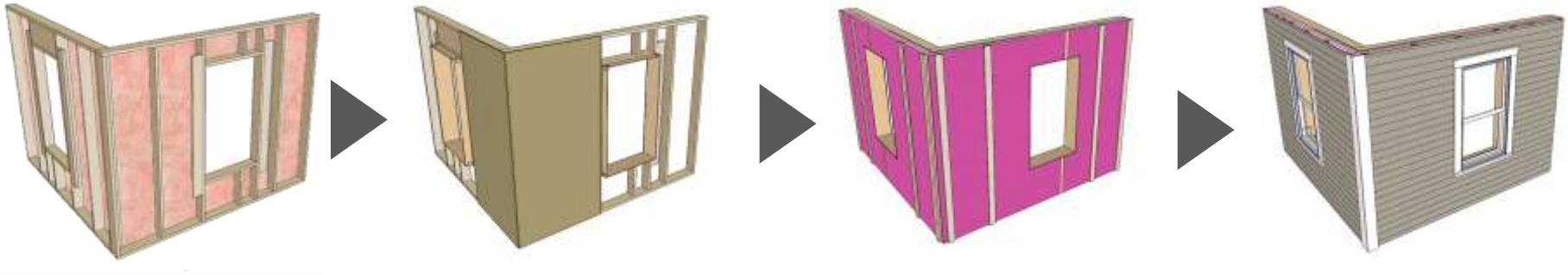
The provisions of Chapter 7A apply to new construction (residential and commercial) and to remodels that occur on buildings constructed after 2008, when Chapter 7A was implemented. Check with your local building code official for any local modifications to the state building code.

Some jurisdictions, during their code adoption process, incorporated a "significant remodel" provision that requires compliance with Chapter 7A if the remodel exceeds a specified square footage or dollar value.

BUILDING COMPONENTS

- **Roof:** Class A, B, or C, depending on Fire Hazard Severity Zone.
- **Gutters:** Resist accumulation of debris, usually through use of cover devices. Vinyl and metal gutters are both okay.
- **Vents:** Corrosion-resistant metal mesh, not less than 1/16 inch. Under-eave vents not allowed unless accepted by the Office of the State Fire Marshal as resisting the entry of embers and flame.
- **Siding:** Noncombustible and ignition-resistant materials okay. Combustible siding products must pass a fire-resistance test.
- **Windows:** Dual-pane with at least one pane tempered glass. Any frame material is okay.
- **Decking:** Noncombustible okay. Combustible products must pass a test that evaluates heat release rate. Restrictions on siding products will apply if the decking product has a Class C flame spread index.

WALL CONSTRUCTION – Energy efficient



Wood Studs + Cavity Insulation

Structural Sheathing

Foam Insulation Board over Structural Sheathing

Combustible Siding & Trim

WALL CONSTRUCTION – ENERGY EFFICIENT & FIRE HARDENED

Wood Studs + Cavity Insulation

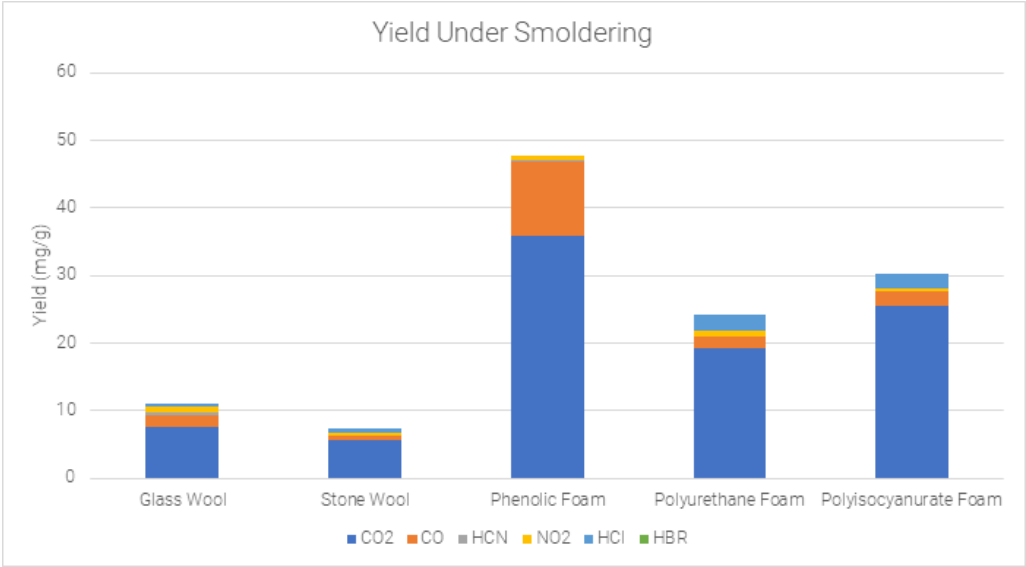
Structural Sheathing

Non-Combustible **Mineral Wool Board over Structural Sheathing**

Non-Combustible **Siding & Trim**

Smoke Toxicity

- Glass wool and stone wool show limited combustion – low smoke toxicity
- Foamed plastics show higher yields of toxic products when in combustion



Stec, A and Hull, T (2011) Assessment of the fire toxicity of building insulation materials. Energy and Buildings, 43, 498-506.

Home hardening

- Codes are obviously good: but can we raise the bar with best practices? These decision should not be driven by industry but by cost/benefit analysis. Non combustible should be preferred in zones at risk, this is not what the code specifies

- Green/Energy Efficient/Non Toxic should be the desired goal. How can we make that happen? Why has it not happened already

- Is it better to have more local enforcement of codes or is it better to have stronger and standard statewide codes

- There are solutions that have not been implemented yet where positive synergy could be generated between legislators/insurances/firefighters on one side and homeowners on the other. One easy first step would be the creation of a self certification in which each homeowner ticks the appropriate box for a standardized number of house and yard features. The self certification is uploaded on a database that can be accessed by government to provide financial incentives/aids/ reimbursements, by insurance to lower premiums and by firefighters to learn what threats may be present in each home they work in

We have initiated a substantive approach for two-way communication through the use of questionnaires. Please participate in a survey!!!

http://ucanr.edu/ucbfiresurveys