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

A conversation with homeowners
December 12, 2020

Matteo Garbelotto[1,2], Susan Kocher[2], Steven Swain[2]

[1]University of California at Berkeley

[2]U.C. Cooperative Extension

Acknowledgements

- Michael Gollner
- Max Moritz
- Stephen Quarles
- Van Butsic
- Rick Halsey
- Jay Murdoch
- Mimi Enright

- www.ucbfire.org

- Please take the questionnaire(s)

Agenda

A holistic approach to fire safety: starting from the forest, hone in on the hous

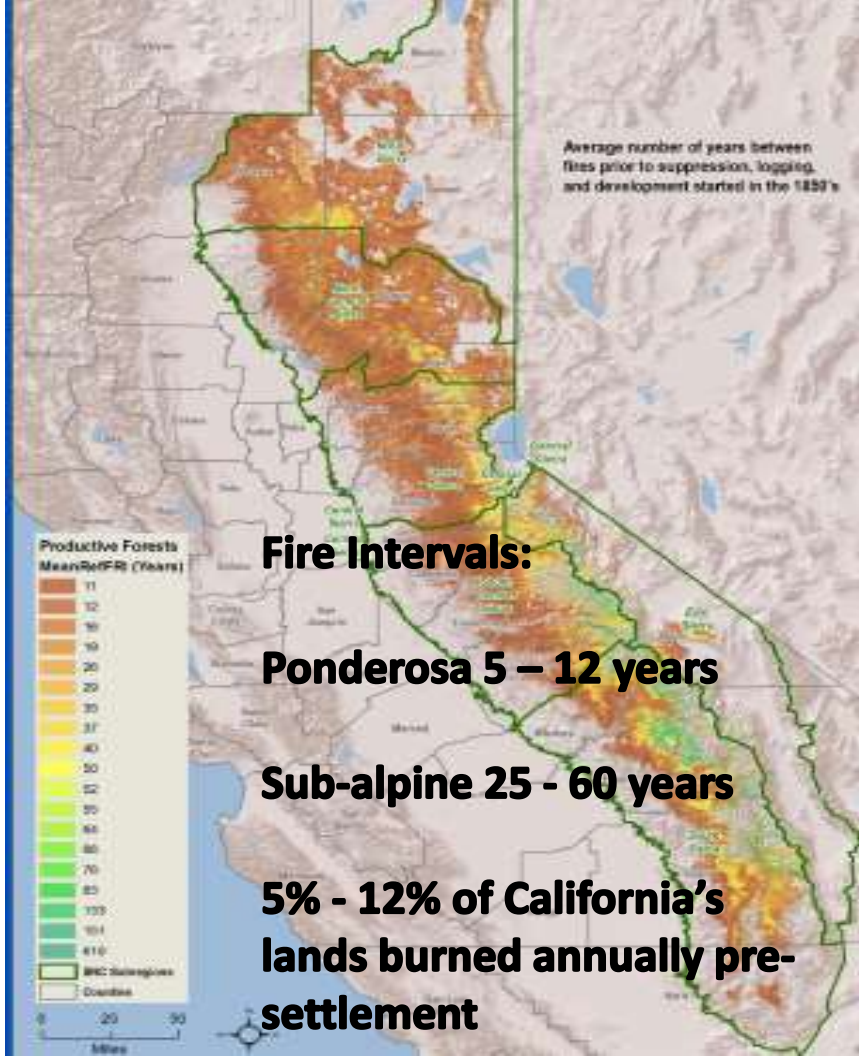
- Fire driven ecosystems
- The Current Situation for Homeowners
- Fuel Management
- Reducing Ignition Events
- Fire Behavior
- Community Level Planning
- Defensible Space
- Your House and Its Immediate Surroundings
- Home Hardening

Some definitions

Fire adapted ecosystem: Many California 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.

Fire return interval studied through dendrochronology



Fire Intervals:

Ponderosa 5 – 12 years

Sub-alpine 25 - 60 years

5% - 12% of California's lands burned annually pre-settlement

Fire regimes are changing & driving higher severity fires

By preventing all fires we have modified fire adapted ecosystems

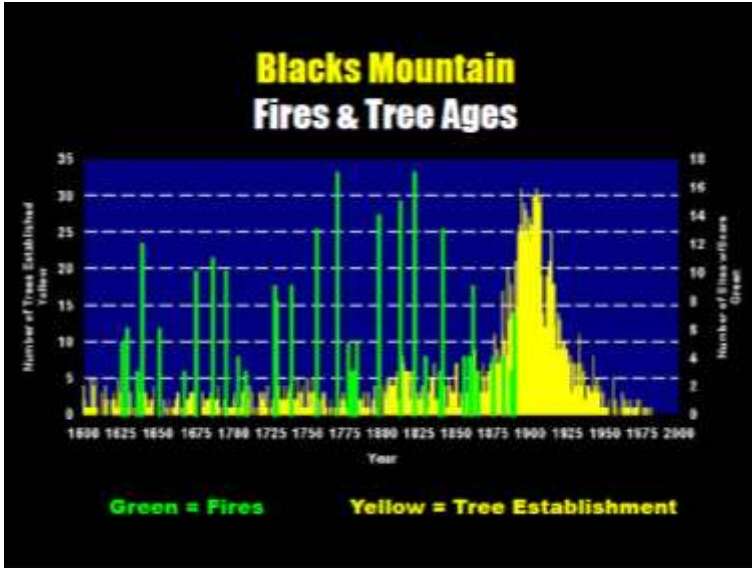
- Higher plant density, often unsustainable
- Higher abundance of combustible fire-intolerant plant species
- Higher accumulation of fuels

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



Trend to have fewer fires of greater magnitude

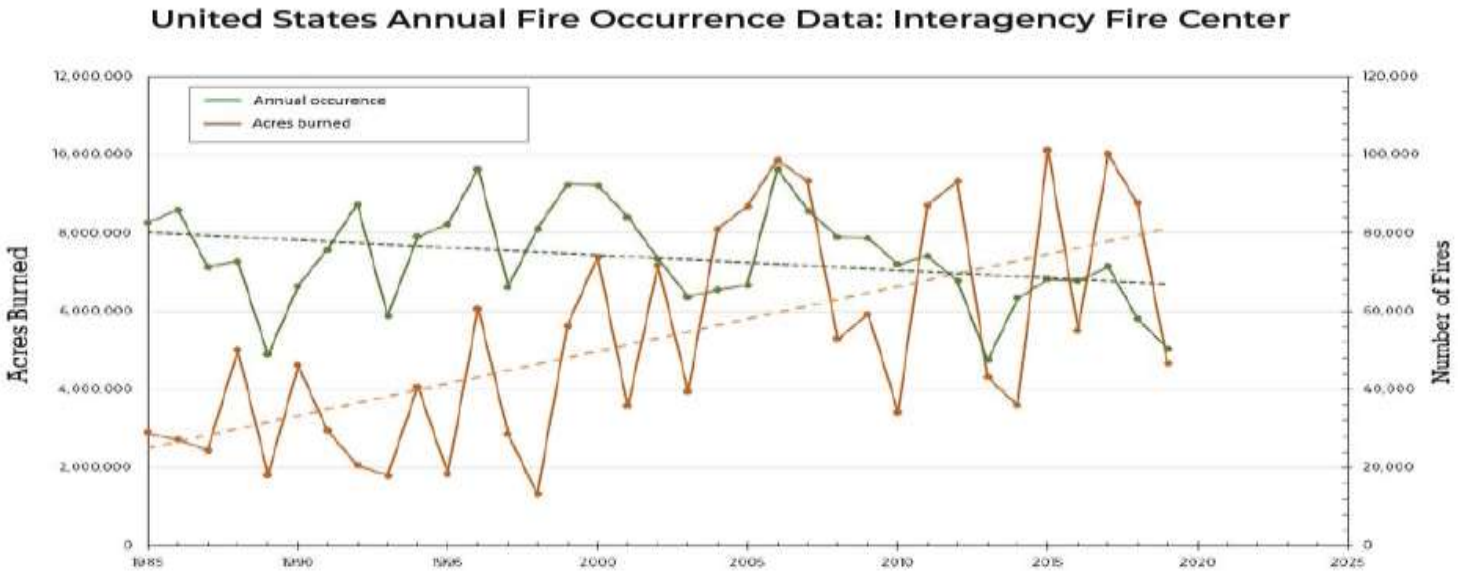
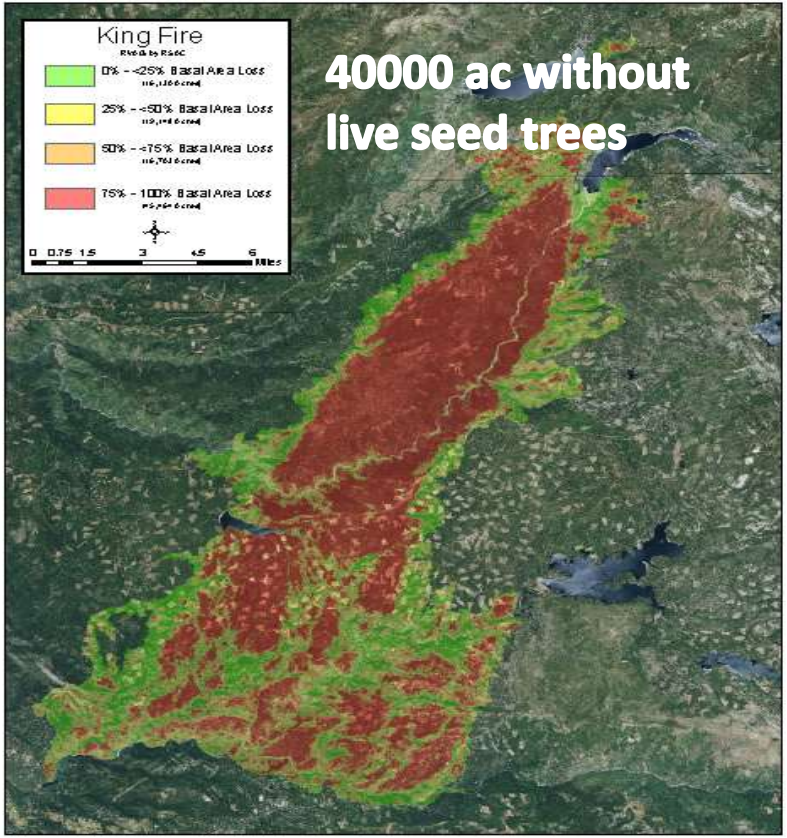


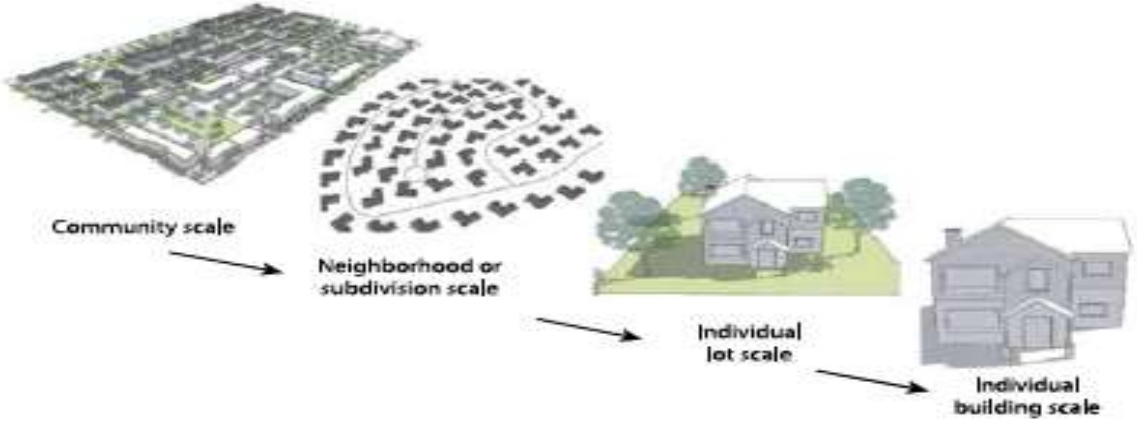
Figure 5. Number of fires (green) and acres burned (brown) since 1985. Linear trend lines (dashed) are also included. Data courtesy of the Interagency Fire Center.

Increase in people living in the Wildland Urban Interface (WUI)

Increase in high severity fires



Current situation for homeowners



- 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

Unpredictability of fire behavior

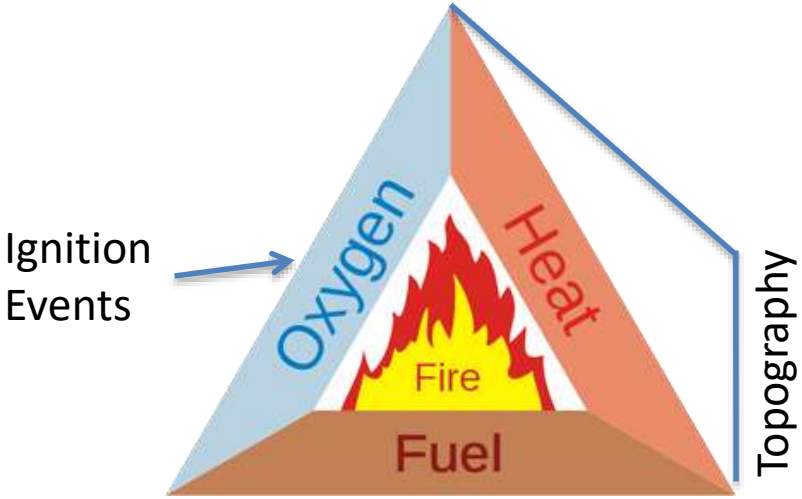
- Each fire has some unique features that make comparative studies quite difficult (threshold effects seem to be key)
- Changing environments make comparisons hard between current and past fires
- There is no consensus on the precise effects of large scale forest pests and diseases on the behavior of wildfires
- Often studies focus on houses that burned down and lack in comparable controls of houses that did not burn down

"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."

What can we do about it?

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

Fuel + Oxygen + Heat = Fire
Fuel + Weather + Topography= Fire Behavior



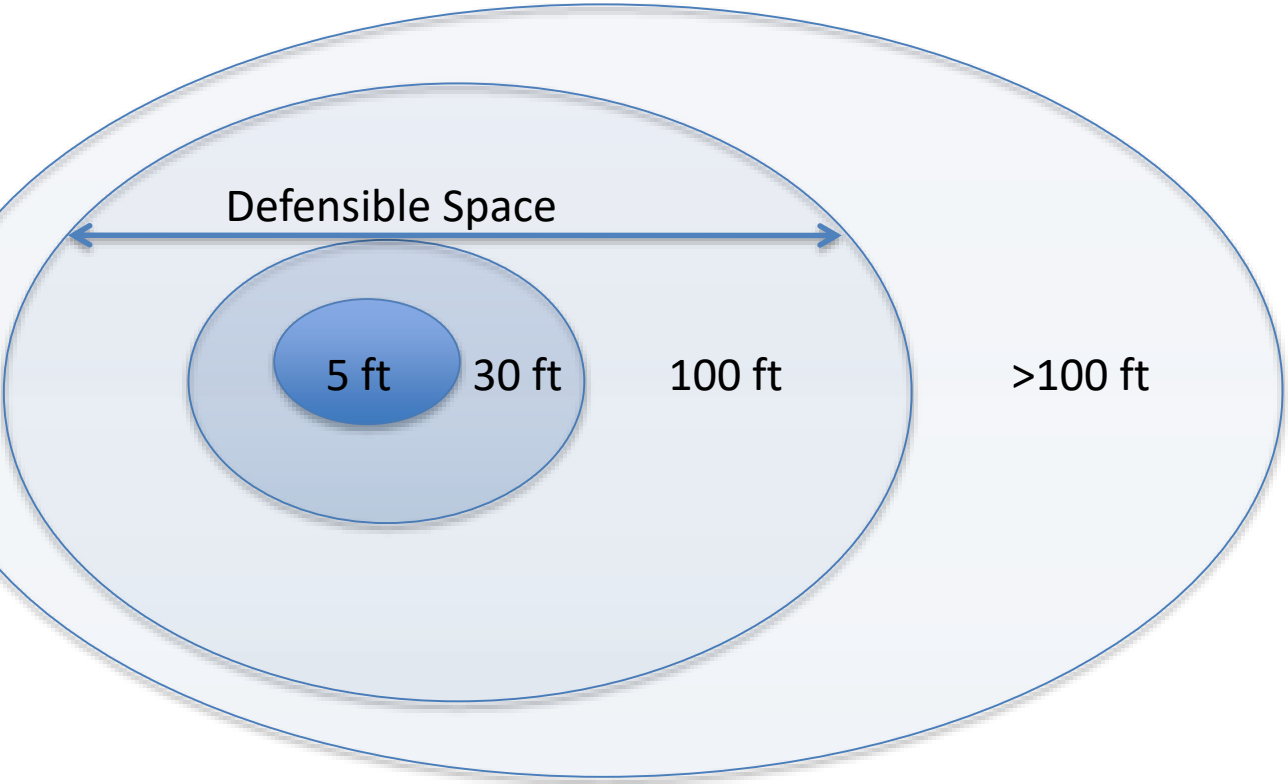
Which of these 5 can you control?

Fuel

Fuels : anything that will burn

- **Vegetation (trees, woody shrubs, perennials)**
- **Landscape mulch**
- **Fencing, roofing, decks**
- **Lawn furniture**
- **Arbors, trellises, planter boxes**

Thinking about your home and the space around it



- 100 ft

Fire Ignition

Fire Behavior

Community Level Escape / Response / Community defensible space

Access/Egress to and from properties

Slowing down fire front/Defensible space

Home defense

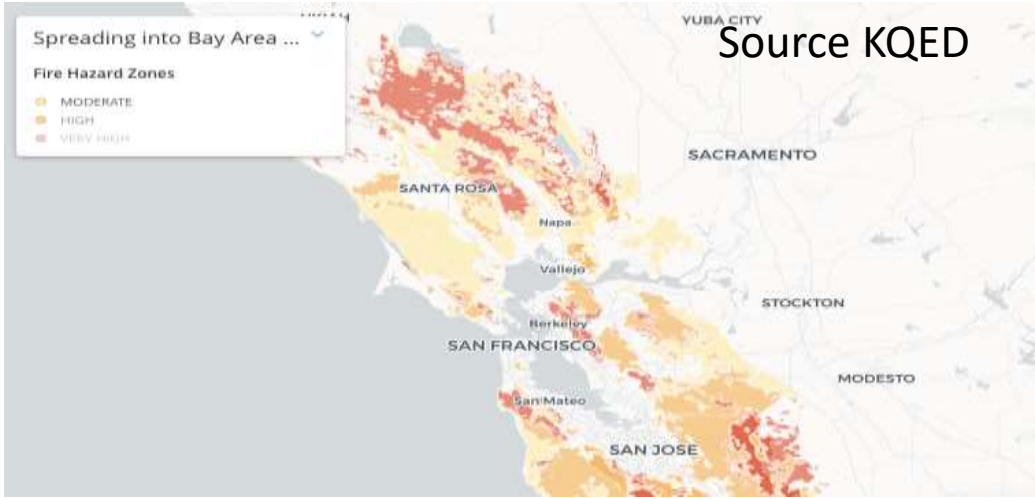
Ember Control

House hardening

0 feet

Risk has been calculated:
how high is risk where you live?

Calfire (others include CPUC)

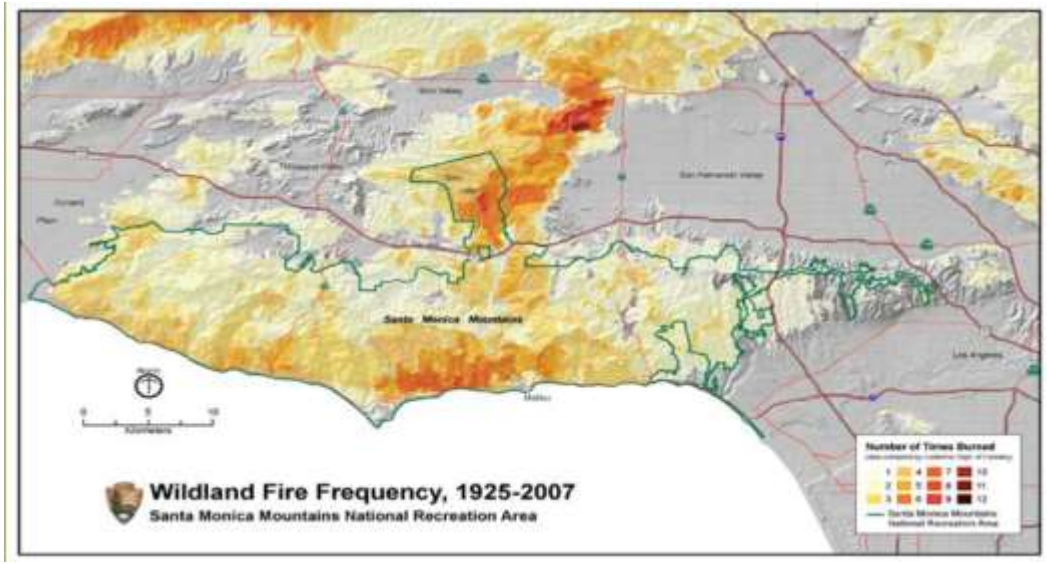


Source KQED

Wildfires of high intensity <u>do not stop at the borders on the map</u>. If you live in proximity of a high or moderate risk area you should assume you are in an area at equal risk

Strengthen your predictive power

- By looking at different risk maps
- By assuming fires can cross borders
- By looking at history of fire in your area
- Slope and (prevailing) wind direction



Ignition Events

- **When:** fire season mostly in late Spring to Early Winter (**June to October**)

- **Where:** with the exception of the Central valleys, large urban and mainly agricultural regions and desert areas, most of California is at risk, but risk varies in intensity

- **What**: natural (lightning) vs. human causes (escaped campfires, car engine ignitions, fireworks, arson, carelessness, **power line-related =10% but that value is much higher when looking at fires in the WUI**)

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) – you can only reduce risk, not zero it**
  - 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!

QUESTION: Can we generate true collaboration between utility companies in identifying critical issues? What about Citizen Science involving homeowners to monitor lines

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

- Prioritization on trees that disproportionately cause fires

-

-Solutions

-Switching from a pencil and paper to digital and verifiable data collection process

- Added key indicators such as presence of visible wounds and mushrooms growing on trees

- Moved from 50 to 15 metrics being recorded. Switching to digital data collection that allows for verified data analyses in real time

- No borderline trees: all are “abate” or “do not abate”

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

There are multiple factors that impact fire speed, size, and strength

- 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

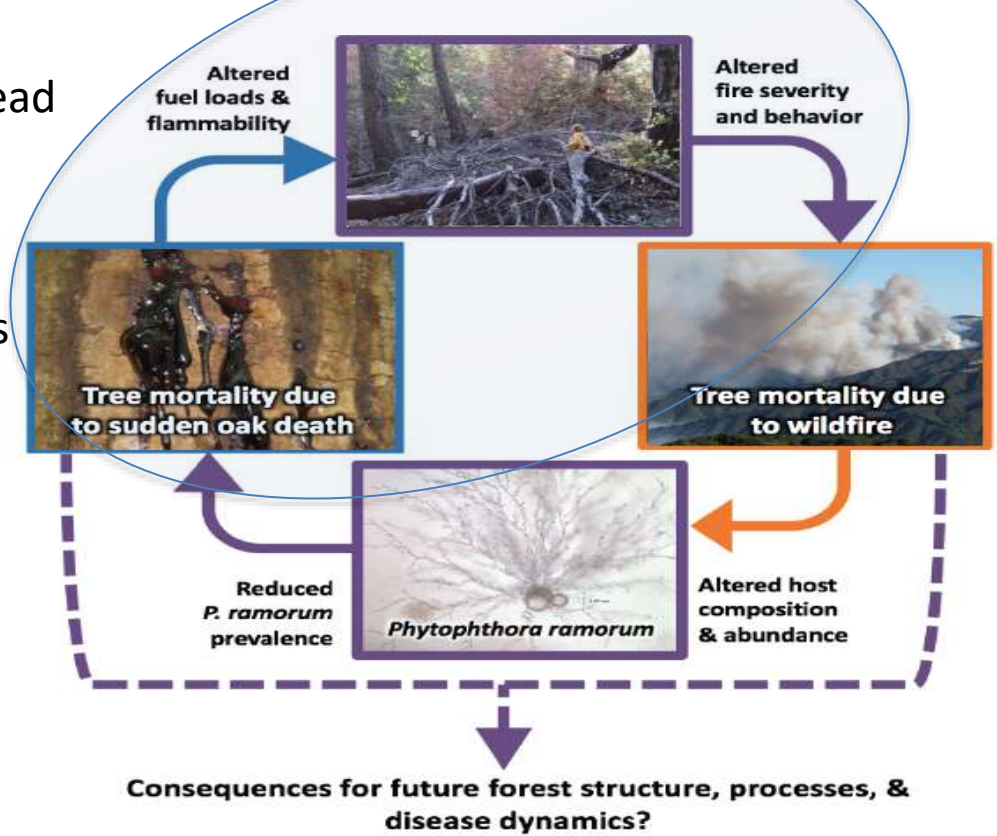
- Stands with trees having reduced canopy sizes allow for more air, thus increasing fire intensity

SOD (fuels)

-2 to 6 times more dead standing trees

-2 to 100 times more

-Coarse woody debris



SOD (fire behavior)

-Flame length tripled

-Spread rate 7-fold

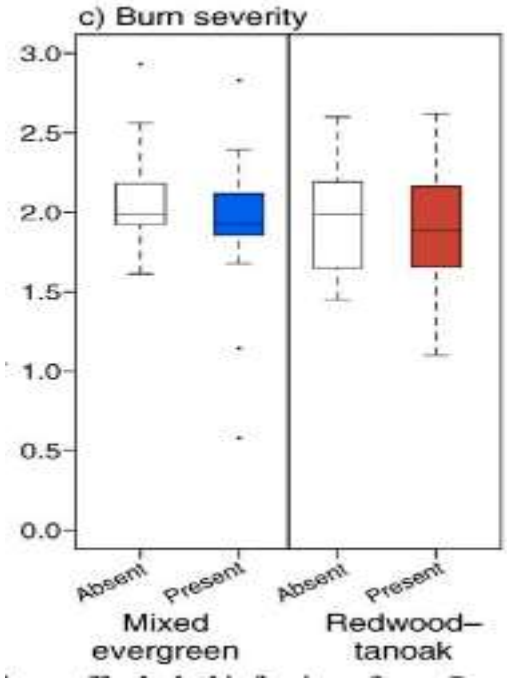
-Fireline intensity 13 X

Figure 1. Conceptual diagram of potential interactions between sudden oak death and wildfire. Solid lines indicate direct effects of either disturbance on forest characteristics; dashed arrows indicate the interactive effects of both disturbances for forest and disease dynamics. Photos courtesy of the Rizzo lab at UC Davis.

SOD = Sudden Oak Death

SOD and fire: frequent local hotspots and increases unpredictability

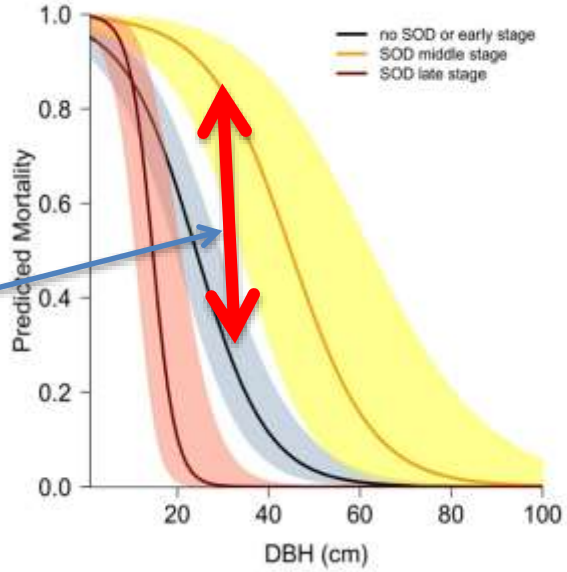
Overall fire intensity was not altered



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



Red arrow identifies redwood mortality due to excessive fire heat when comparing forests with Middle stage SOD and no SOD or late stage SOD

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*

Wildfires in Big Sur, CA (2008)

Mid SOD Hot spot:
Extreme Fire Danger
No manned response
Tree failure risk

Late SOD
Fire Soil Damage

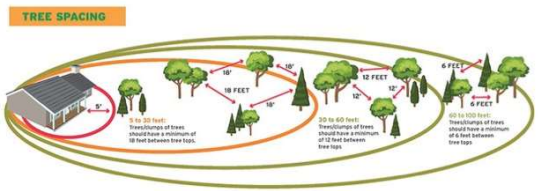
Early or NO SOD
No increased risk

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

The Wildland-Urban Interface (WUI)

Places where potentially flammable vegetative fuels meet or overlap with homesites

NFPA Tree Spacing Guidelines



- Selective thinning of fire intolerant species must become a priority to decrease combustible loads and density
- Some restorations increase grass component. Do we have a body overseeing restorations for quality?
- Must identify/generate a definitive source of funds for intervention in areas affected by pests and disease
- While prescribed burns are ideal they may not always be possible, but alternatives require costly infrastructure

Fuel management at the community level

Prescribed burns

- + Natural way to mimic natural fire regime
- + Does not reduce soil fertility
- + Selectively removes fire intolerant species and many invasives
- + Cost effective
- - Timing and feasibility variable
- - Can cause some tree mortality

Mechanical removal

- - Human selection not natural of what is removed
- - Impacts significantly site
- - Not possible in some sites
- - Removal of biomass can lead to loss in fertility
- - Wounds can increase disease
- + New exciting uses of woody biomass

Neighborhood Considerations

- Start with your house & defensible space zones. Then talk with your neighbors! Work together to develop a fuel reduction plan for the entire neighborhood.
- Watch for maintenance needed -- debris accumulating on a neighbor's roof, uncovered woodpiles, unmown tall weeds.
- What is total volume of vegetation in area? Any ladder fuels?
- 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

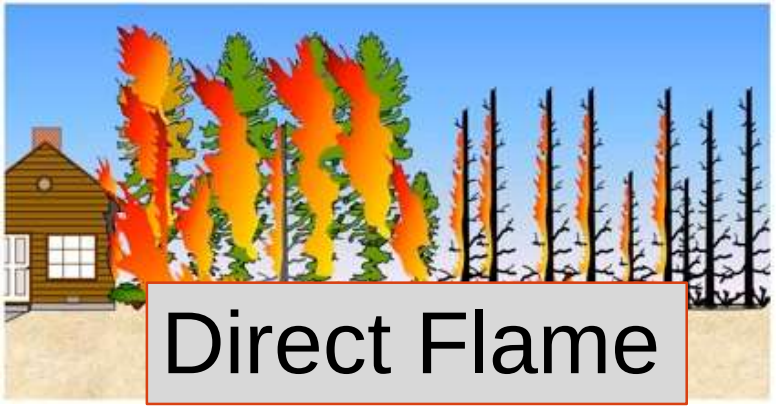
Work with your neighbors!

Photo courtesy of MAST
San Bernadino County

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

Community & Neighborhood Level Issues

Issue	Questions to Consider
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?
Few communities have facilities (water ponds, communal well designed wood storing areas) shared by groups of neighbors that can help to mitigate fire spread	Can we design and maintain community level defensible spaces: meadows, lakes, with non-combustible amenities?
Need to 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…)
Not all communities emphasize and 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	Is this an area where legislators and insurance companies could work together? Funding should also be identified
Not all communities have escape routes. These are key in saving lives	Does your neighborhood have an escape route? Have bottle necks been removed?
Wildlife or Riparian corridors intersect with neighborhoods	Do we have standards to maintain biodiversity while mitigating fire risk?
Pests and infectious diseases move across property lines: need stronger programs to obtain buy-in from homeowners to help slow down the spread and 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


Direct Flame


Radiant Heat


Embers

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.

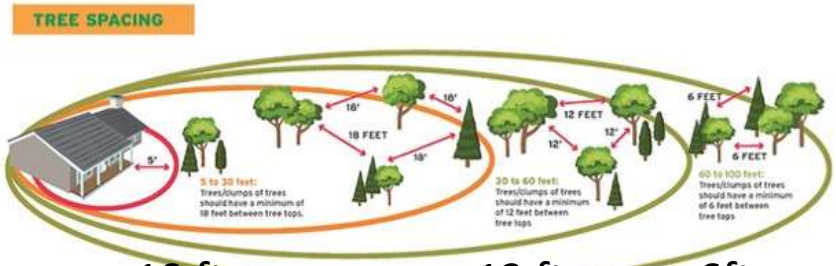
- 3. Stopping the creeping fire from reaching the home by using noncombustible materials within 0–5 ft of the home.

To create a fire-wise landscape (5-100 feet from house)

- **Choose** fire resistant landscape materials or “hardscapes” (stone, bricks, boulders)
- **Arrange** landscape plants in islands with adequate spacing to disrupt a fire
- **Favor** low groundcover if possible (shrubs, herbaceous perennials, succulents) Plant trees only if you will trim them. Choose plants knowing the size they will attain
- **Place** flammables (shed, woodpiles, **mulch**) at least 30’ away from house
- **Ensure** access to yard through 4-5’ walkways and water supply
- **Maintenance** is necessary;
- Follow the **Law**

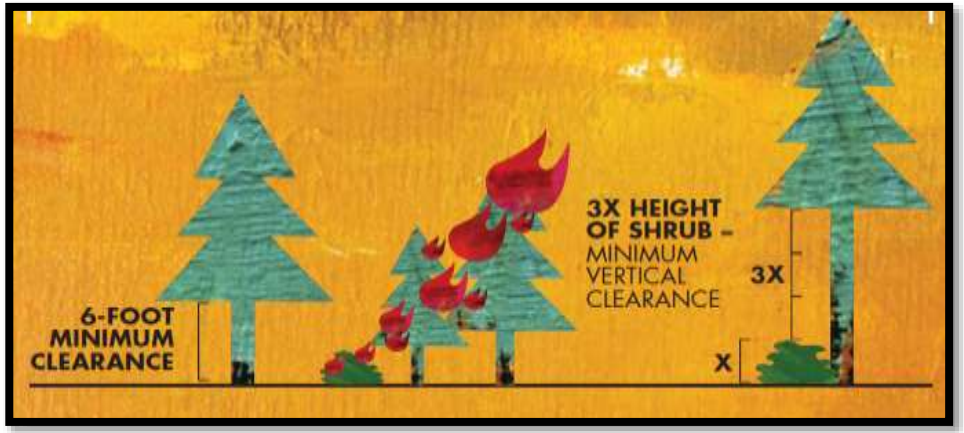
- Remove invasive plants
- Mow grasses 2 to 4”
- Water plants to maintain health & regularly maintain to remove dead/dry material
- Choose mulch that is less flammable
- Avoid flammables near wood pile or use fire resistant tarp
- Leave a gap under bottom of wooden fence
- Be more stringent when **<u>less than 30 feet</u>** from house

NFPA Tree Spacing Guidelines



18 ft----------12 ft---------6ft

(triple on steep slopes over 40%)



Eliminate ladder Fuels

All plants will burn!

- Even “Fire Safe” plants
- Be sure to keep all of your landscape plants healthy with appropriate watering, proper pruning and upkeep to reduce risk

Rather than following a specific plant list, here is what you should consider. All plants within the 100-foot zone should:

- 1. Not produce a lot of litter (avoid pine trees, eucalyptus), dead wood (avoid acacia shrubs), or material that can easily ignite (fronds from palm trees).
- 2. Be easily maintained and of appropriate size
- 3. Require a minimal amount of water to remain hydrated (many native plants fit this category). Healthy, hydrated plants are difficult to burn.
- 4. Not be in the list of plants regarded as dangerous by fire fighters.
- 5. Not be an exotic or invasive plant.

Figure 2. Idealized diagram of a typical suburban street and cul-de-sac. The pink 0–5 ft noncombustible zone is provided for reference.

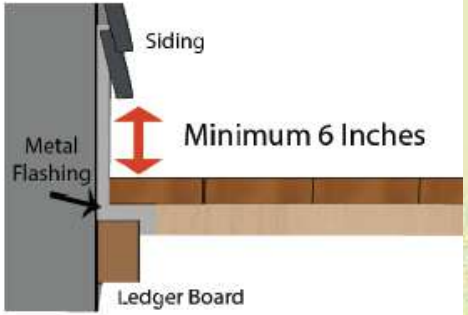
Zone 0: 0-5’ Non-combustible Zone

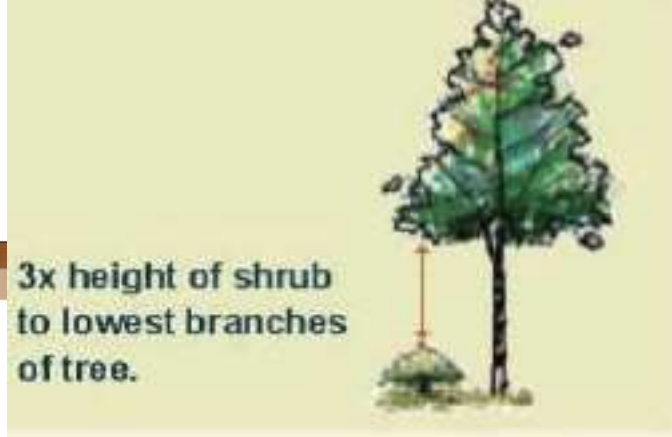
- NO combustible materials in this zone!!!
  - Use non-flammable mulch such as gravel or stone
  - Remove natural fiber door mats
  - Remove wooden furniture and wood piles
  - Avoid planting in this zone
- Remove or replace any flammable fencing material or deck attached to house. Use non flammable material at least within 5 feet from structure. Avoid double layer fences
- Clean up & dispose of leaves, pine needles & other plant litter
- Remove debris from roof & gutters, but also from gaps in between weathered boards
- Limbs 6’ above roof and 10 ‘ from chimney outlet or stove pipe. Vines should be removed (local codes)

Figure 11. Importance of 0–5 ft noncombustible zone (home ignition zone) for a home under ember attack.

Important numbers

- 5 foot around house: non combustibles only
- 4 foot high decks= ensure vegetation clearance
- Decks less than 4 foot above ground: mesh or other methods to prevent debris accumulation under them
- 6-in. vertical noncombustible zone between any wall structure (e.g. siding) or fence and the ground
- Structures (sheds, barns) should be 30 ft way
- Limbs 6 ft from roof, 10 ft from chimney outlets





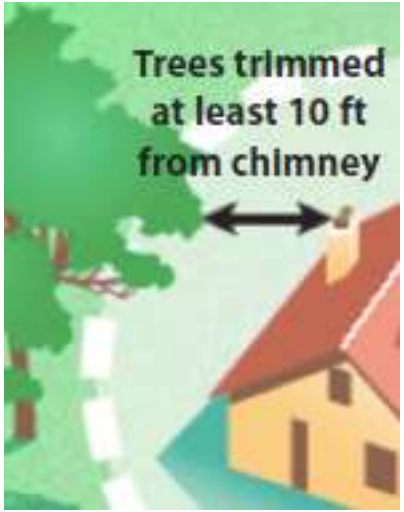


Figure 9.1. Landscaping zones for wildfire-prone areas. All codes lump Zones 1 and 2 into a single description, neglecting to emphasize the importance of the 0-5' near-home landscaping area.

Will these distances be effective during wind driven wildfires?

Are the distances recommended in high density urban settings? NO! Community planning will be required

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

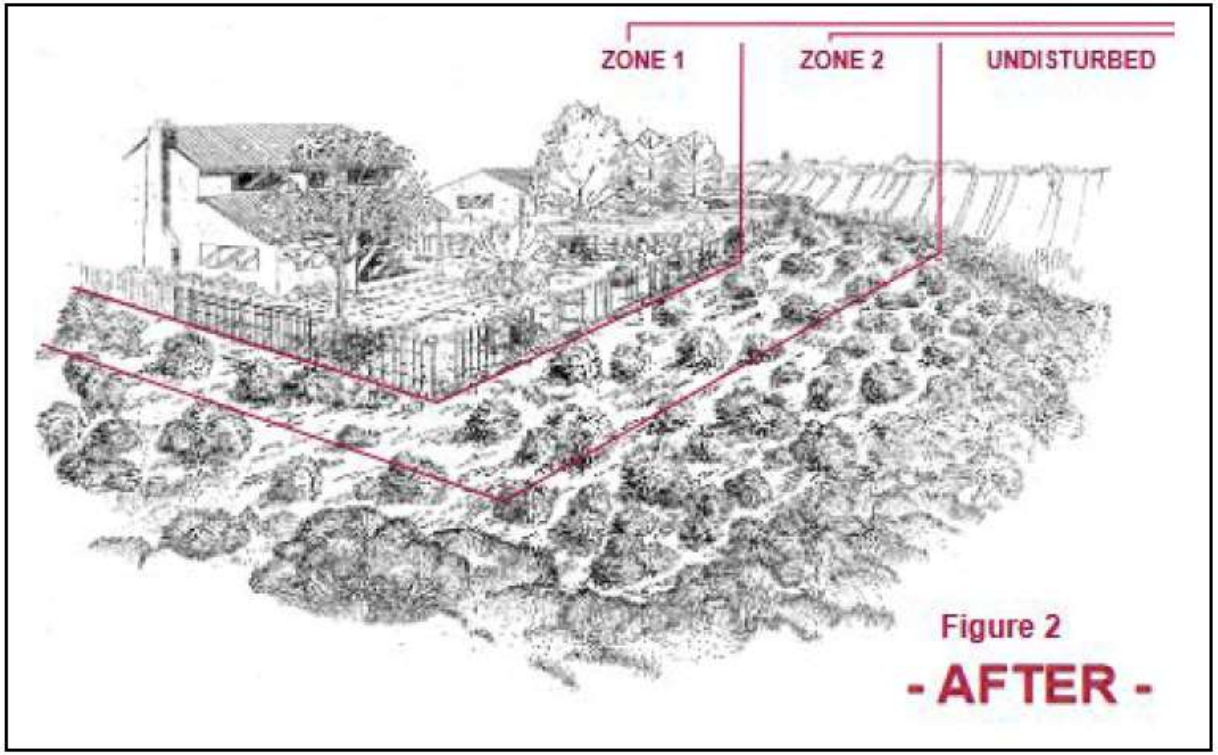
- More in the next and final section

NO

YES

- Codes and recommendations to be taken as minimum precaution: do more !
- “Overkill” may not be better: total lack of vegetation in yard may make house vulnerable
- Benefits of “right choices” may be lost, if there is no maintenance during fire season
- Remember that most things eventually can catch fire, avoid sense of false security
- Zoning: fires do not stop at borders

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

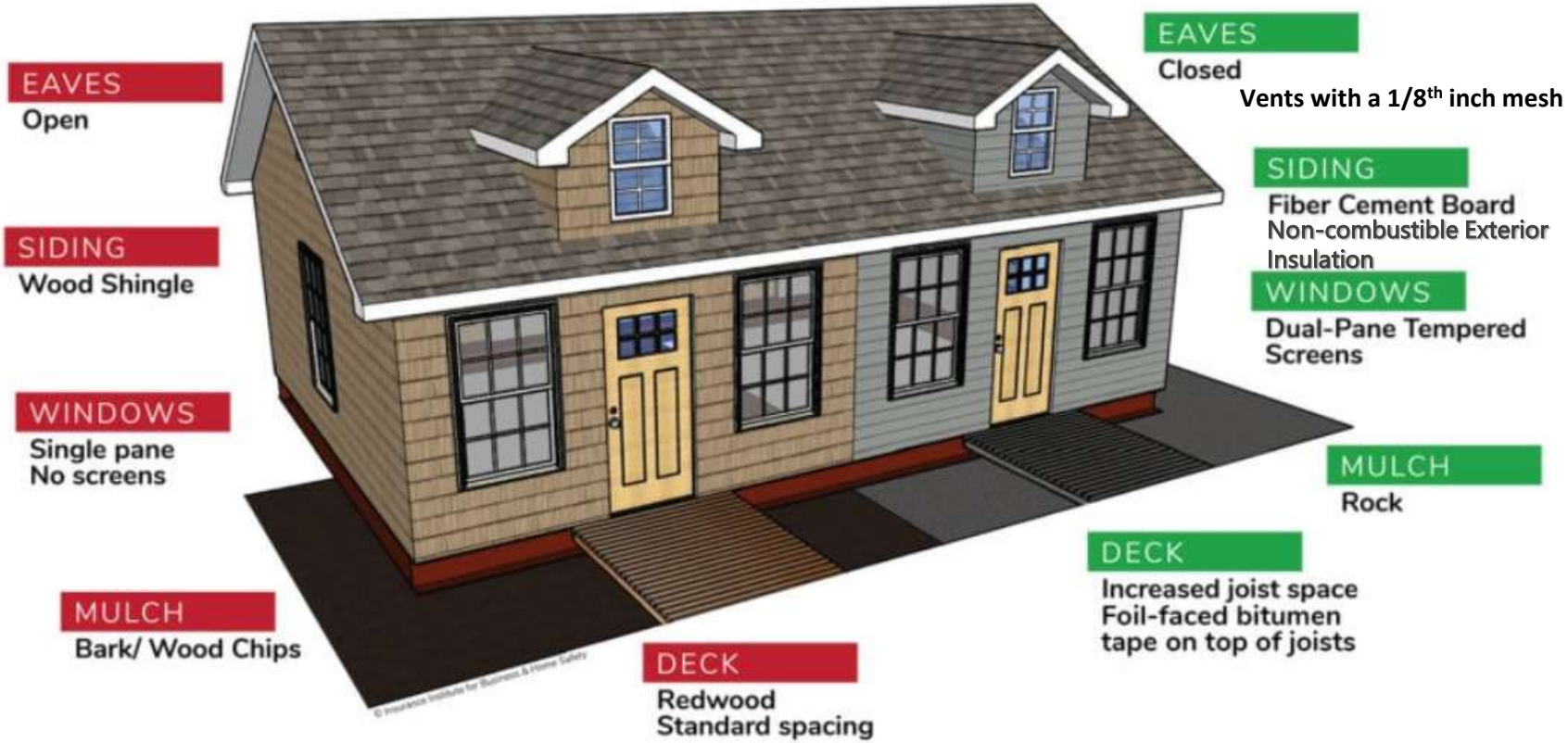
Increasing the no combustible vertical space from 6 to 12 inches

Increasing the horizontal non combustible space over 5 feet

CALIFORNIA BUILDING CODE: CHAPTER 7A SUMMARY

VEGETATION MANAGEMENT	BUILDING COMPONENTS
• 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.	• **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.

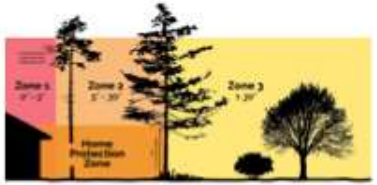
Fire hardening IS about making the right choices



Source: https://disastersafety.org/wildfire/protect-your-home-from-wildfire/

Figure 11. Importance of 0–5 ft noncombustible zone (home ignition zone) for a home under ember attack.

FIRE HARDENING YOUR HOME



- Are the materials that were used on the outside of the house (siding, window and door frames, roofing, steps) combustible or not, Are they Class A?

- Are there architectural components/designs that may facilitate ignition: exposed sofits, open bay windows. If so cover (sofits), fill in (protruding Bay windows), or place mesh (vents,see below)

- Weathering and age can generate cracks and openings that either expose combustible materials or allow for debris accumulation

- Vents and windows: vents need to have 1/8-in. or finer noncombustible mesh that prevents embers from entering attics. Double pane windows with one tempered pane required by code, and metal framing

Definitions

- **Non combustible**: A material that, under the conditions anticipated, will not ignite or burn when subjected to fire or heat (e.g. mineral wool, concrete, bricks, gypsum).

- **Ignition resistant**: A material or an assembly. The California Building Code defines ignition-resistant in a specific way – based on meeting a minimum flame spread rating after the material has been subjected to a specified weathering procedure. Treated wood siding, or foams that incorporate fire retardants belong to this group

- **Fire resistant**: minutes a material subject to fire before losing structural integrity (for exterior walls 5-40 minutes)

This fire demonstration compared a noncombustible (fiber-cement) siding product (left-hand side) with a wood siding product treated with an exterior-rated fire retardant chemical (right-hand side). Charring is evident on the FR treated wood in the first six courses. Vertical flame spread would have extended up the wall in a non-FR treated wood siding product.

Wood

- **Size**: larger size is less likely to ignite (4 inches ok)
- **Density of boards**: high density better
- **Type of wood**: softwood (conifers) is worse, hardwood tropical woods often better
- **Treatments** with fire retardants

WALL CONSTRUCTION – Energy efficient

Wood Studs +
Cavity Insulation

Structural Sheathing

Foam Insulation Board over
Structural Sheathing

Combustible Siding
& Trim

WALL CONSTRUCTION – ENERGY EFFICIENT <u>& FIRE HARDENED</u>

Wood Studs +
Cavity Insulation

Structural Sheathing

<u>Non-Combustible</u> Mineral Wool
Board over Structural Sheathing

<u>Non-Combustible</u>
Siding & Trim

Spray polyurethane foam: pros and cons

Application	Reasoning
Unvented Attic	Provides air seal and thermal insulation to the roof deck simultaneously, but is often under-insulated from the energy code
Underfloor	More consistent contact with the underfloor surface than some other methods
Band joist / Rim joist	Can be faster than other methods, particularly with limited-access cavities
Vapor Barrier	Can eliminate the need for an additional membrane in cold climates, like with blown-in insulations

Issue	Reasoning
Contamination	Foam is a mix of two reactive substances that sprayed in 1:1 ratio will ”foam”. Priming substances are rather toxic and both overspray and unusable leftovers are problematic
Need to vacate	PPE needs to be worn, and property needs to be vacated for at least 24 hours
Toxic fumes and other dangers	It will burn after a certain exposure and produce toxic fumes. It is also an exothermic (potentially explosive) reaction
Odor and Pest Analysis	Odor may linger, It makes observation of underlying structure for pest control, difficult

NFPA 286


SMOKE:
117 M²
05:43:38
CLOSED CELL SPRAY FOAM

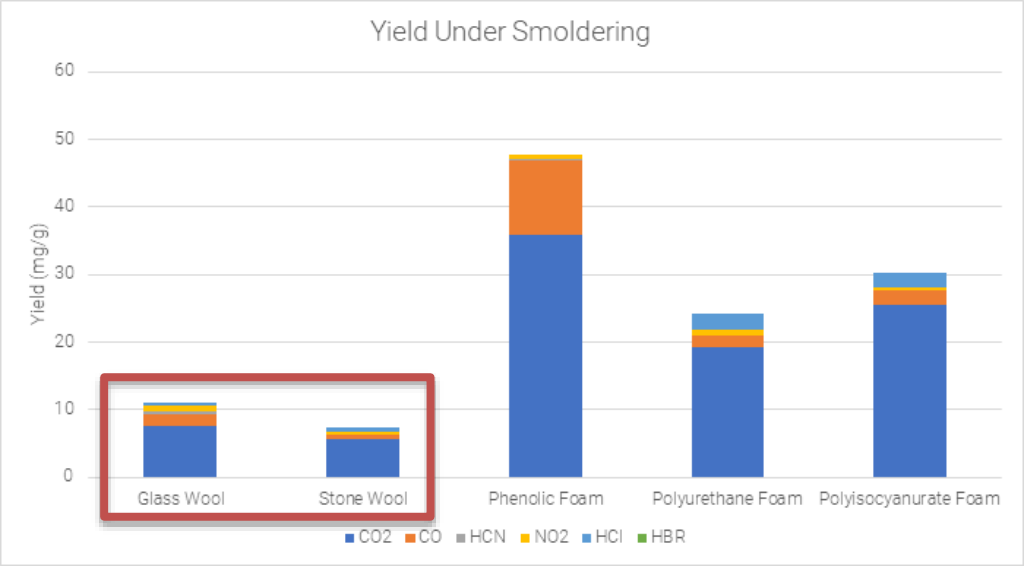

SMOKE
433 M
OPEN CELL SPRAY FOA


05:43:58
SMOKE:
11 M²
FIBERGLASS BATTS


SMOKE
14 M²
05:43:6
MINERAL WOOL BATT

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

Figure 1.1. New construction costs by component in typical home and wildfire-resistant home.

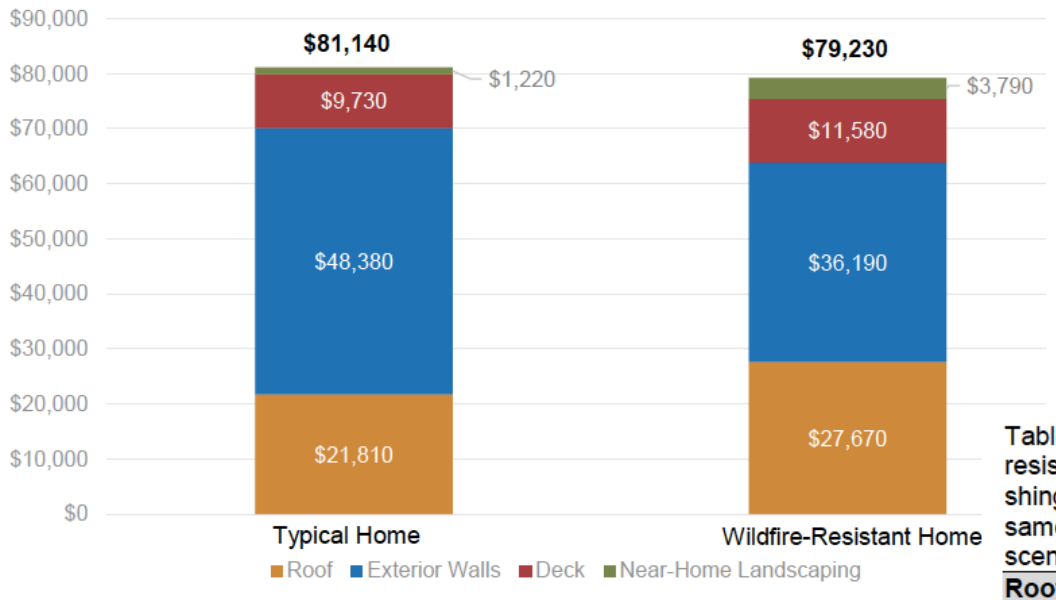
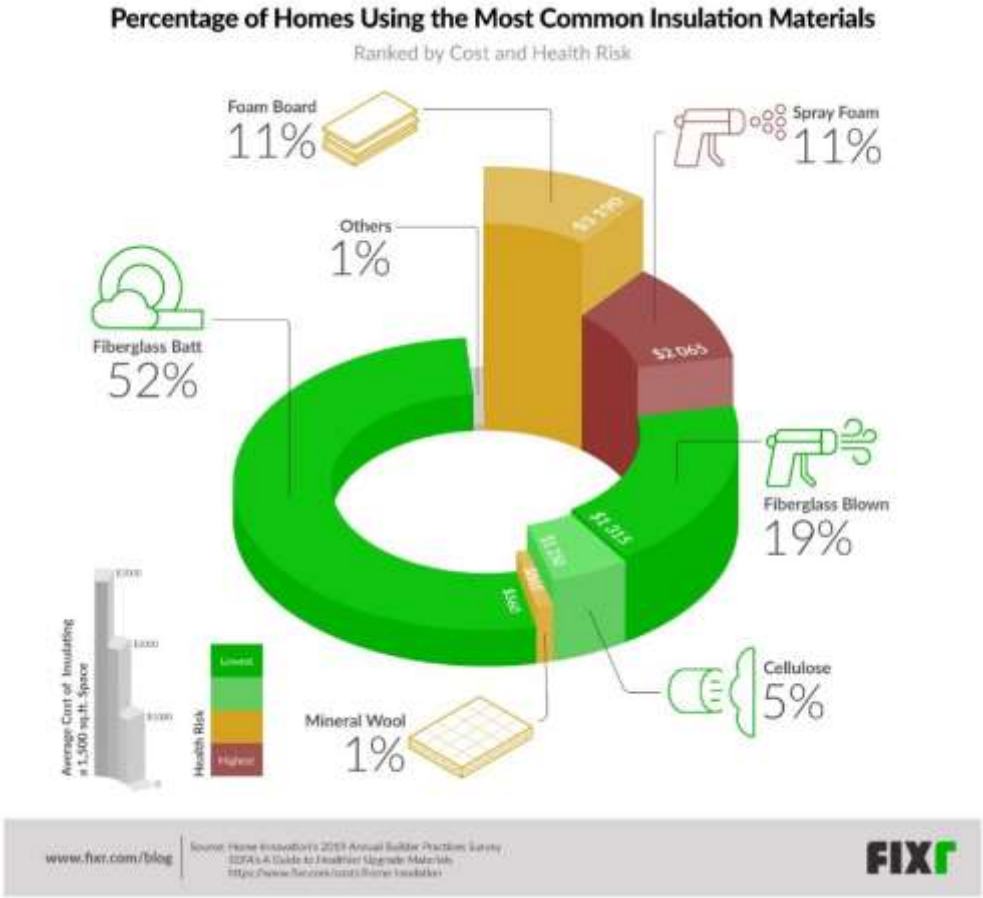


Table 5.2: Cost of retrofitting roof and exterior wall from typical to wildfire-resistant. Costs shown are for model home and assume removal of wood shingles on the roof and wood siding on the walls, to be replaced with the same wildfire-resistant materials described in the new construction scenario.

Roof	
Roofing	13,180
Vents	370
Soffit & Fascia	5,600
Gutters	2,860
Subtotal	**$22,010**
Exterior Walls	
Sheathing and Siding	20,580
Doors	8,120
Windows	12,050
Subtotal	**$40,750**

Insulation – cost & health



Structural maintenance is key

Wear on an asphalt composition roof. Because the surface

Aging and weathering reduce the ability of materials to resist ignition

Take home messages 1

- NO matter how “fire safe” your house is, evacuate, make sure escape routes are viable
- The wildfire situation is dynamic: zoning may not properly match risks
- Codes are minimum standards, if possible use best management practices
- Fire resilience: both structures and vegetation require regular maintenance

Take home messages 2

- Work with neighbors and local government to increase community wide fire resilience and safe escape routes
- When choosing stepwise retrofitting, prioritize actions and combine based on location.
- Choose green: combine energy efficient with clean production, think of side effects (toxicity of products once they burn, spread of invasive plants)
- Talk to your firefighters

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

http://ucanr.edu/ucbfiresurveys

Take advantage of our new website, where you can find resources, watch educational webinars and ask questions :

www.ucbfire.org

UC Fire Experts
https://ucanr.edu/sites/fire/Contact/

Buildings

Yana Valachovic
Stephen Quarles
Sabrina Drill

Landscape vegetation

Mimi Enright
Steven Swain
Susie Kocher
Mike Jones

Fire Science

Max Moritz
Scott Stephens

Community Planning & Response

Van Butsic
Maggi kelly