Impact of Future Bay Area Earthquakes

Mary Lou Zoback

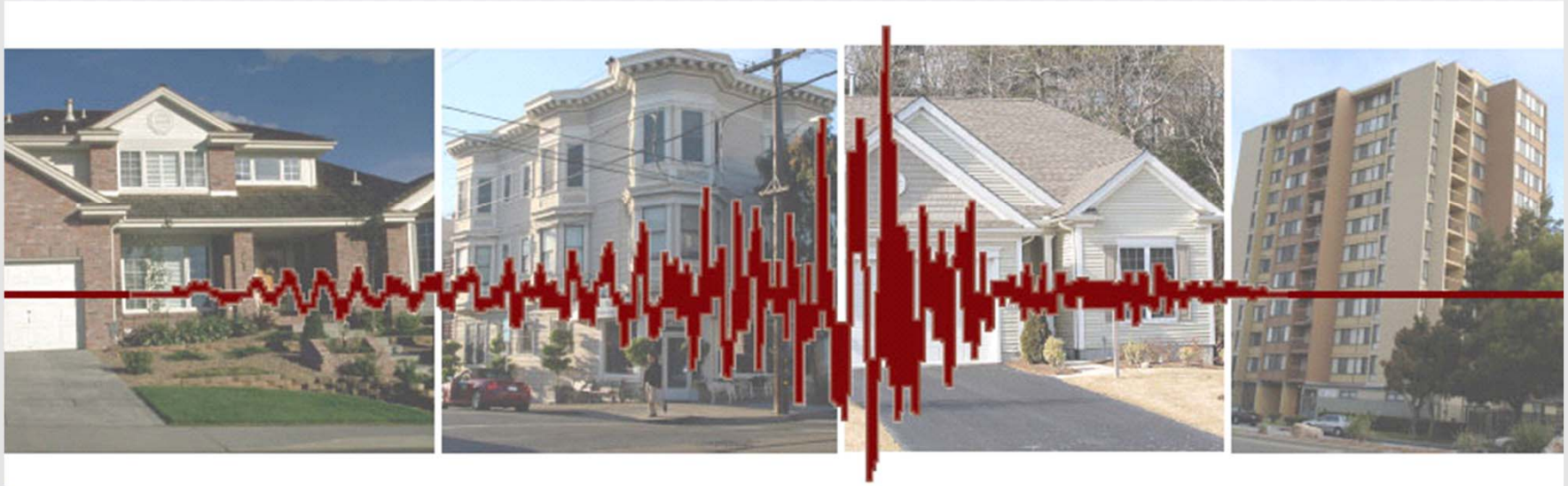
Member, Disaster Roundtable, National Academy of Science

SHAKEN AWAKE!

Monday, June 13, 2011

Creative Ways to Strengthen Housing and Promote Community Resilience in Today's Economy

Association of Bay Area Governments

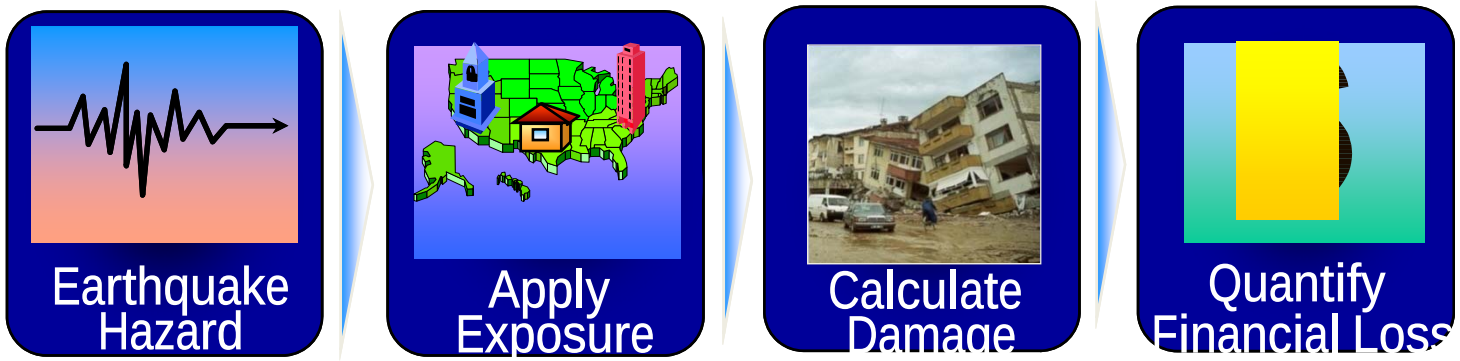


Main points

- Future quakes-residential impacts
- Who will pay? - consequences of being underinsured
- What should we be doing?
  - CAPSS-Community Action Plan for Seismic Safety
  - SPUR-San Francisco Planning and Urban Research

Image NASA
Image © 2008 TerraMetrics

EQ Risk Framework



HAZARD X EXPOSURE X VULNERABILITY = LOSS

Where?

How large?

How often?

How strong are ground motions?

Local amplification?

Where is the exposure?

Types of buildings?

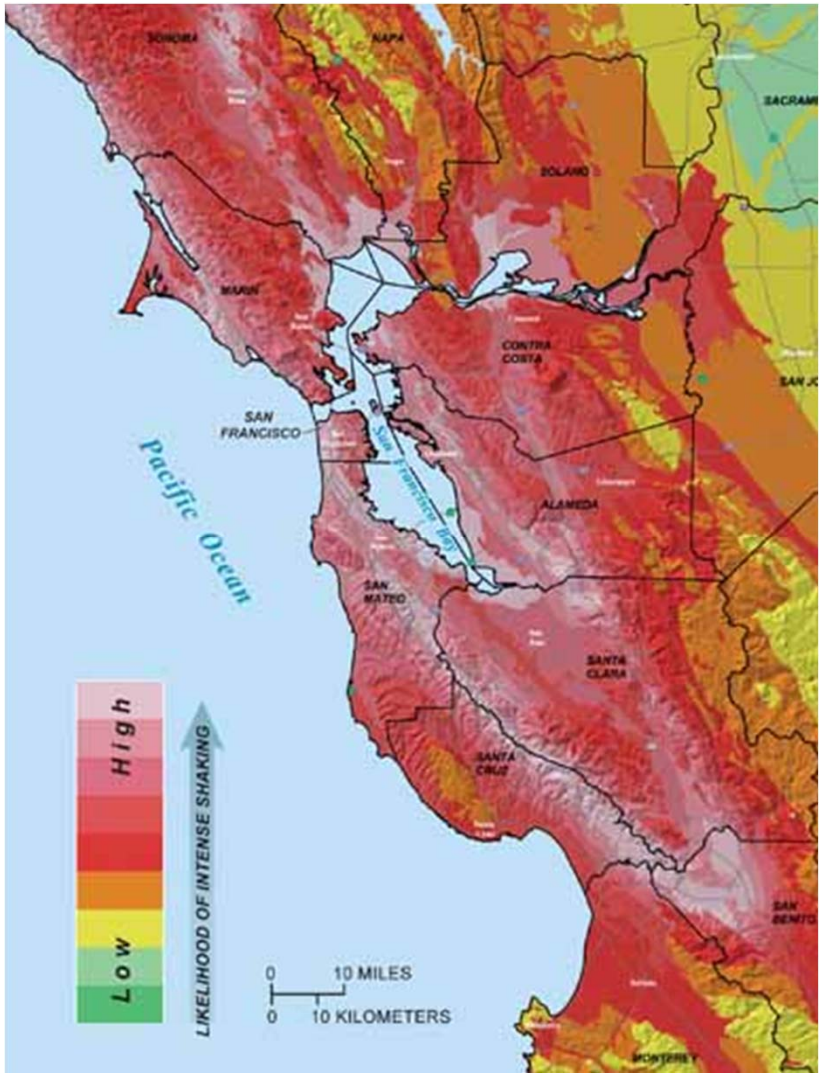
Value?

Occupancy?

What level of damage for given shaking intensity?

Insured vs. Uninsured?

Entire Bay Area has very high shaking hazard



Exposure - many vulnerable buildings

http://www.spur.org/publications/library/report/dilemma-existing-buildings

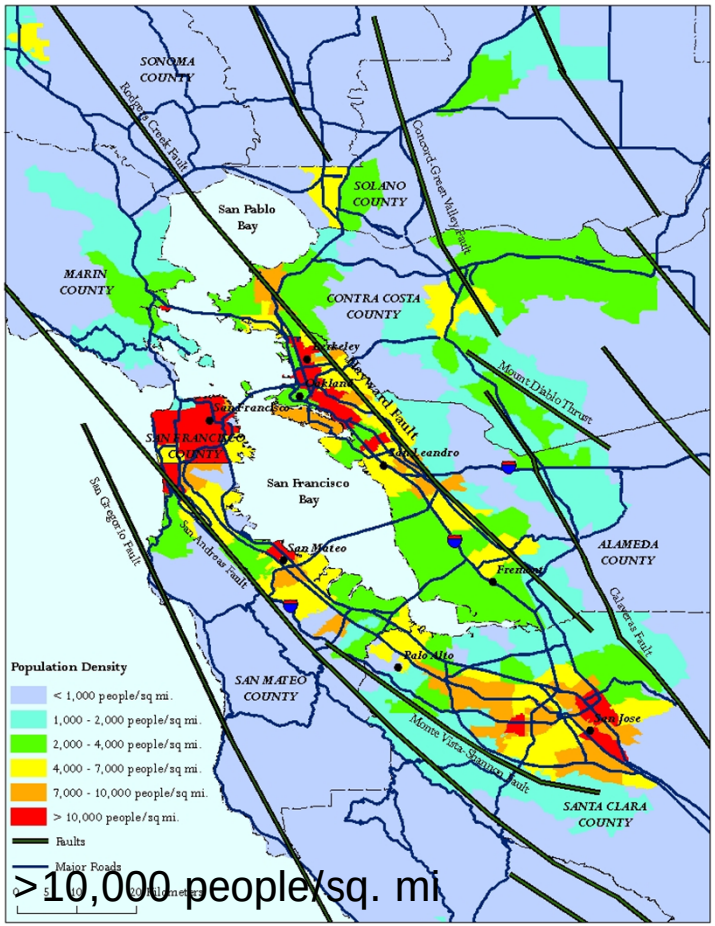
ABAG : Property and People at Risk

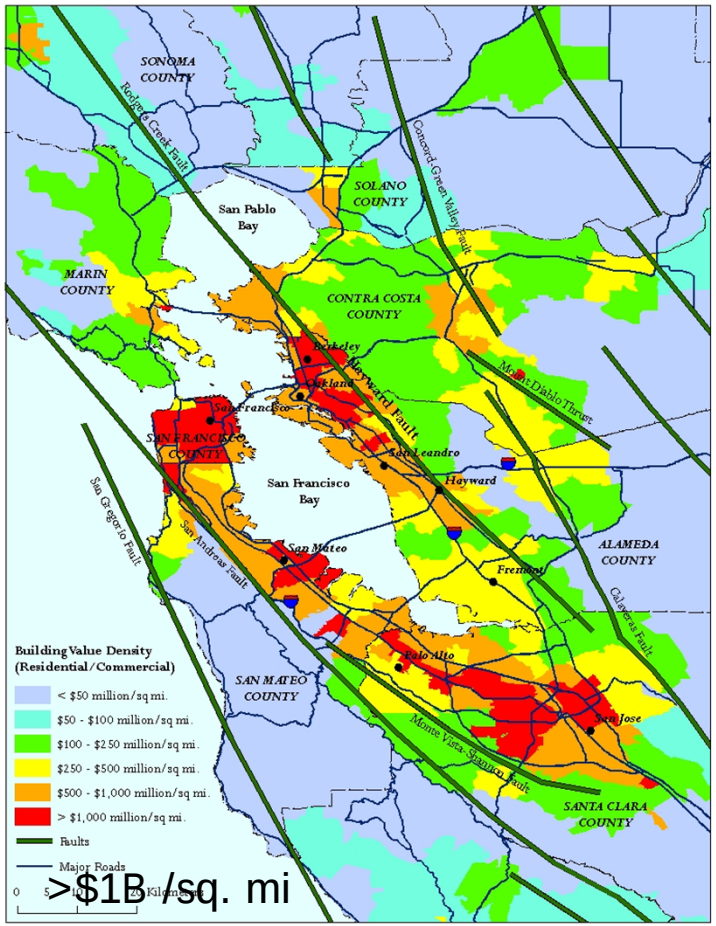
County	Commercial ($ billions)†··	Residential ($billions)†	People (thousands)*
Alameda	$150	$215	1,575
Contra Costa	$ 95	$160	1,075
Marin	$ 25	$ 55	260
San Francisco	$155	$115	8,555
San Mateo	$ 85	$130	755
Santa Clara	$205	$315	1,880
Solano	$ 25	$ 50	425
Sonoma	$ 30	$ 70	4,950
TOTAL	**$770**	**$1,110**	**7,320**

† *http://www.rms.com/publications/Hayward_Earthquake_Retrospective.pdf*
* *Based on California Department of Finance, January 1, 2010 estimates*

~$1.9 trillion and 7.3 million people

Exposure: People and Bldg Value





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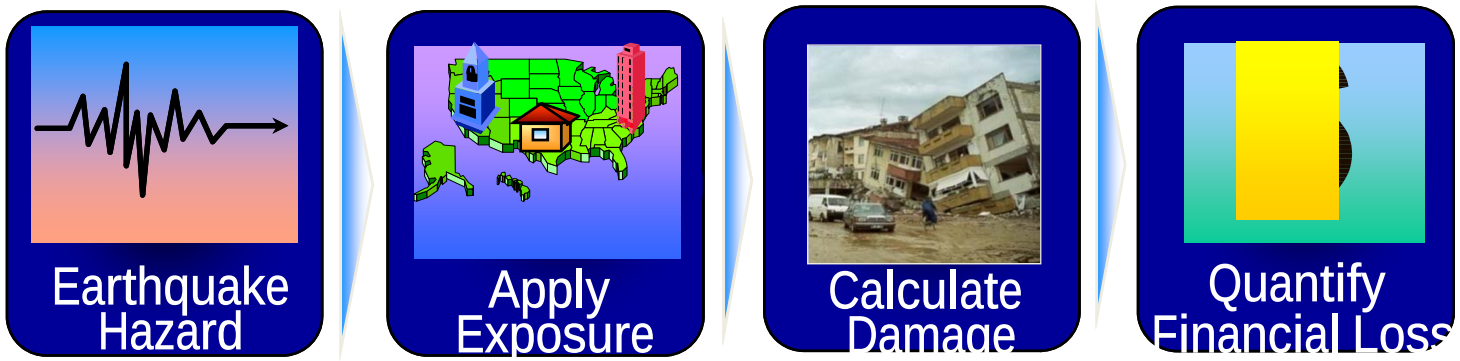

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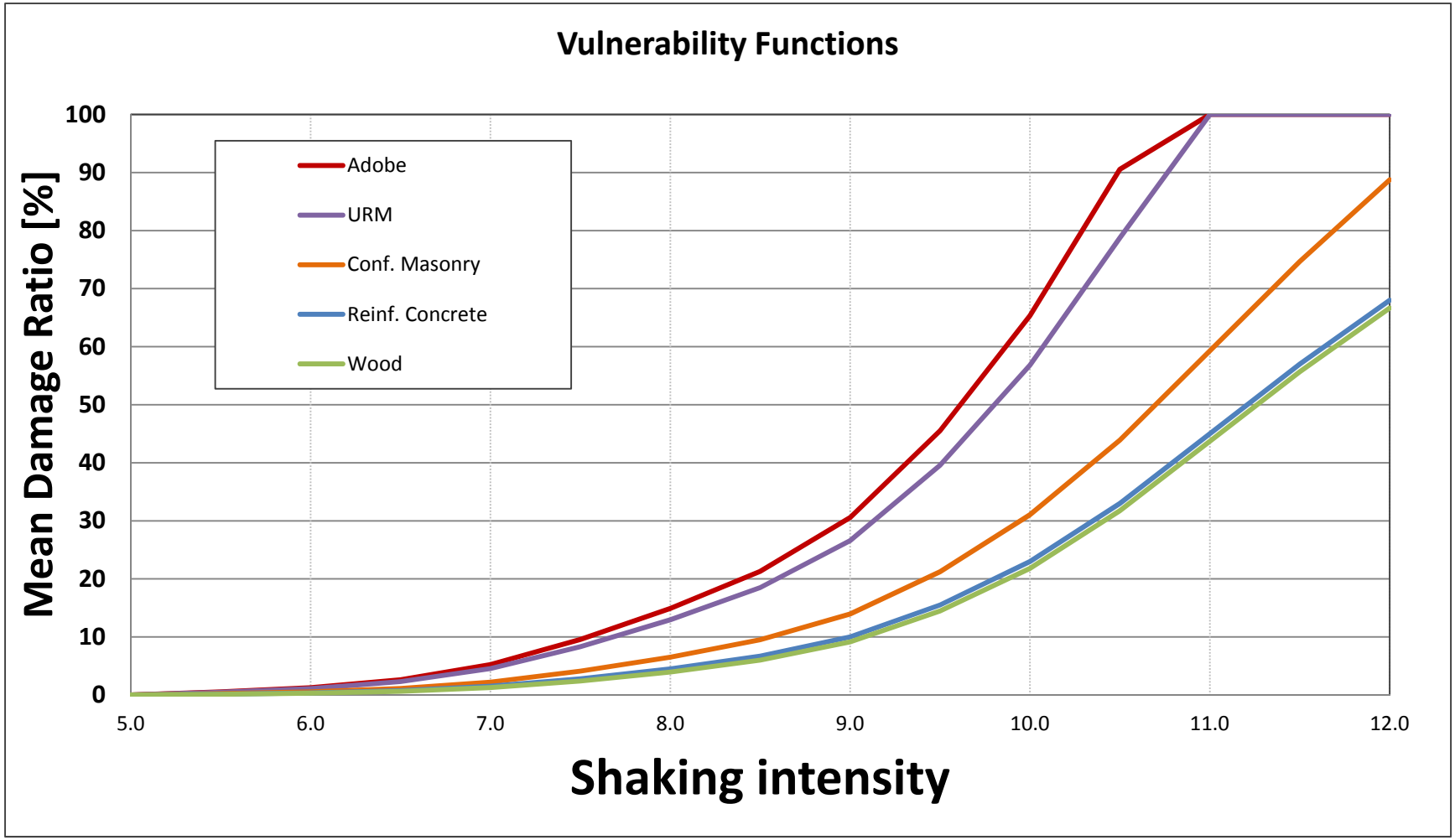
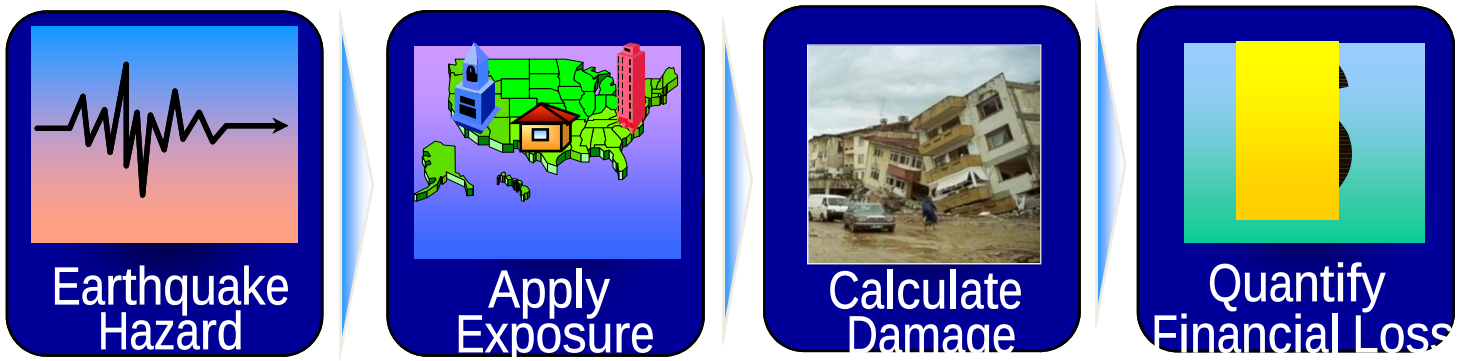
Vulnerability function

Relationship between earthquake shaking intensity and the extent of the damage - varies by construction type



EQ Risk Framework



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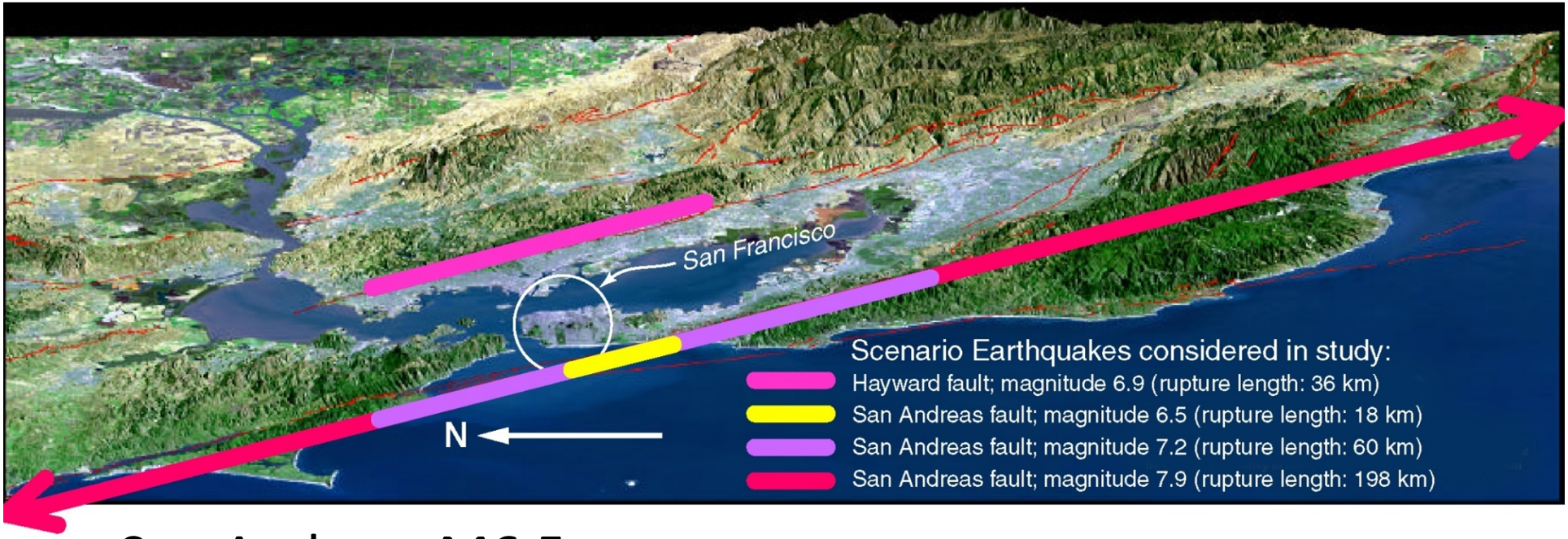
Community Action Plan for Seismic Safety (CAPSS)
Estimated Losses for Four Possible Earthquakes



San Andreas M6.5

San Andreas M7.2 *"expected earthquake"*

San Andreas M7.9

Hayward M6.9

Post-Earthquake Functionality of Buildings after M7.2

Building performance	Number of buildings
Usable, no or light damage	63,000
Usable, some damage	73,000
Repairable, cannot be occupied	23,000
Not repairable	3,600
TOTAL	**160,000**

Safe to occupy

Occupancy depends on City, owners

Cannot be occupied until repaired or replaced

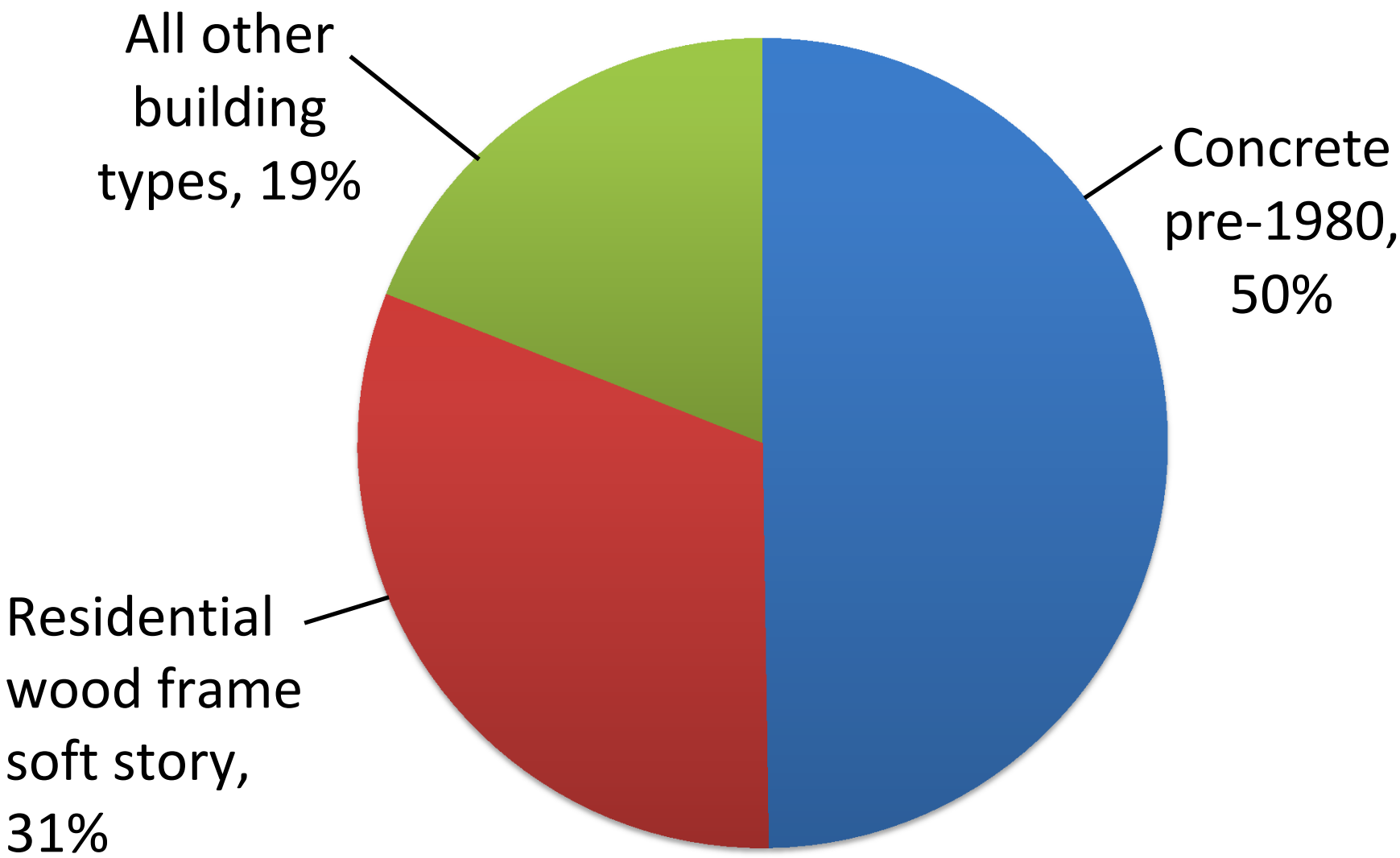
Estimated Fire Damage for M7.2

Type of Impact	Average of 1,000 trials
Number of ignitions requiring professional response	73
Size of burned area not previously damaged	8.7 million sq. ft.

19

4,900

170 - 300 Deaths attributable to various structural types

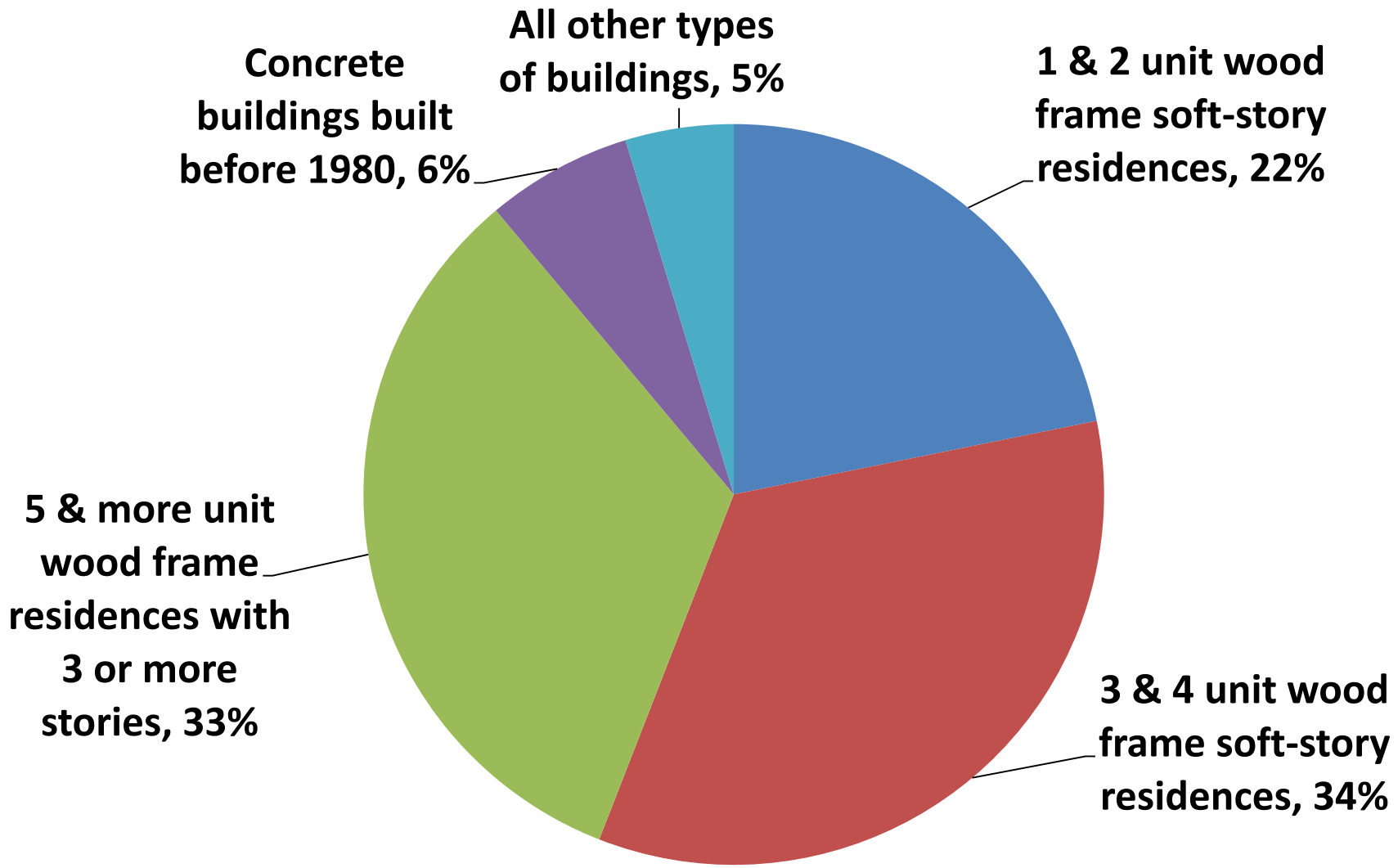


Damage to Residences after M7.2 (in housing units)

Usable, light damage	Usable, moderate damage	Repairable, cannot be occupied	Not repairable, cannot be occupied
120,000	130,000	74,000	11,000

85,000 units unusable

Unusable Units by Structure Type

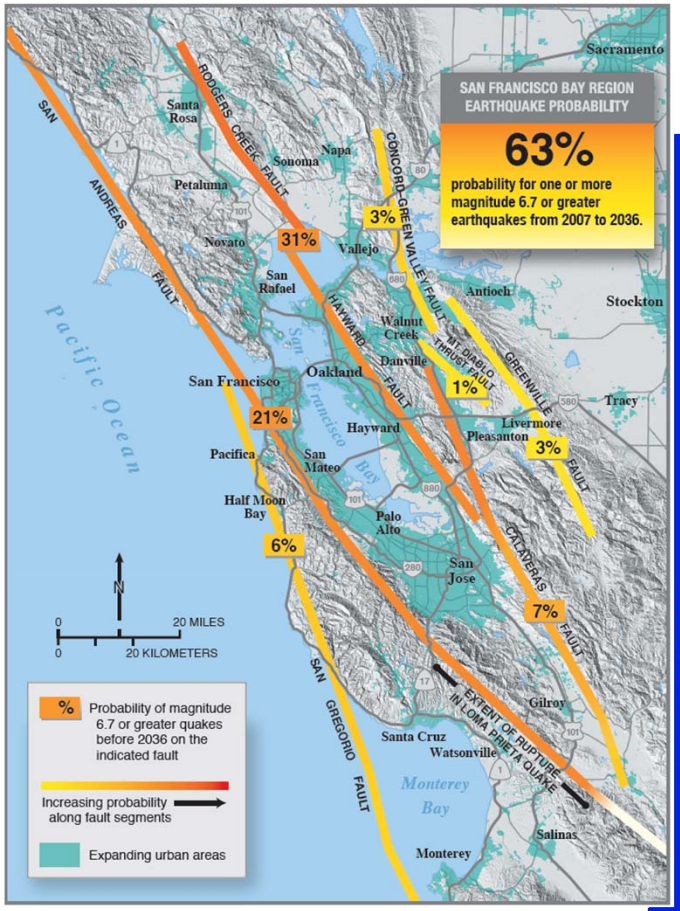


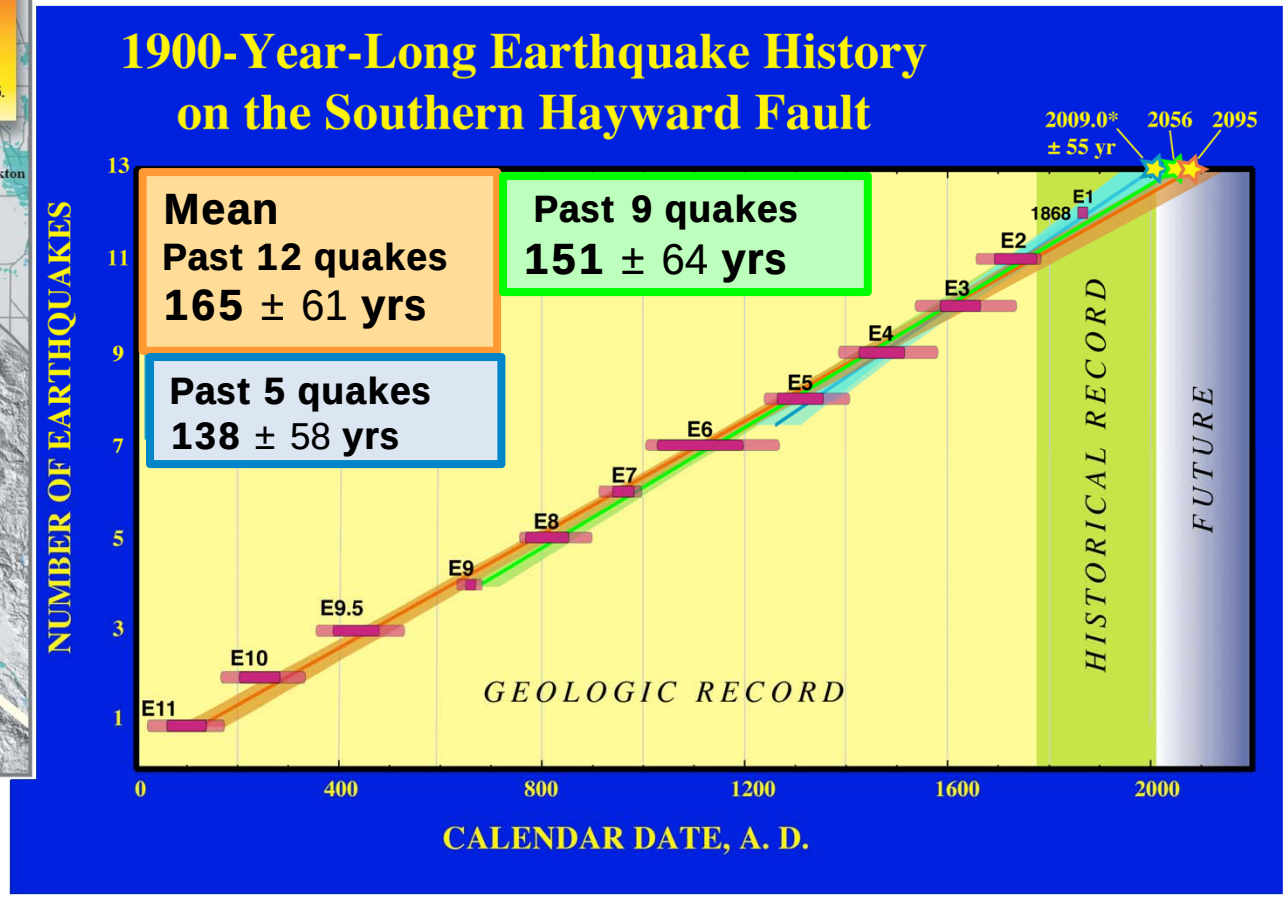
Total Economic Losses for Privately Owned Buildings, M7.2

Type of Loss	$ Billions
Damage to buildings from shaking	$30
Damage to buildings from fire	$4.3
Additional direct economic losses	$10
Total Direct Losses	**$44**

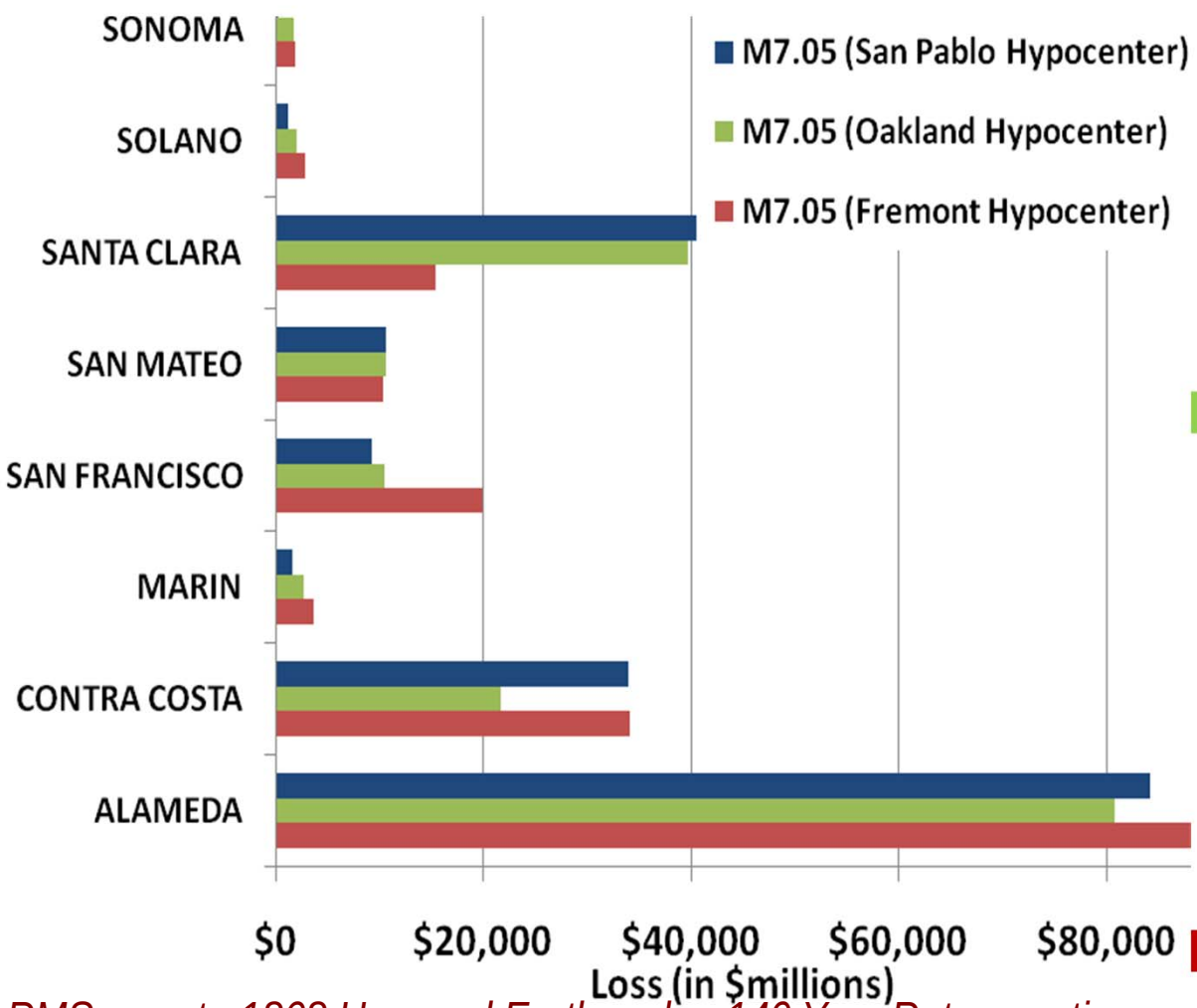
Indirect losses would be on par with or greater than a recession

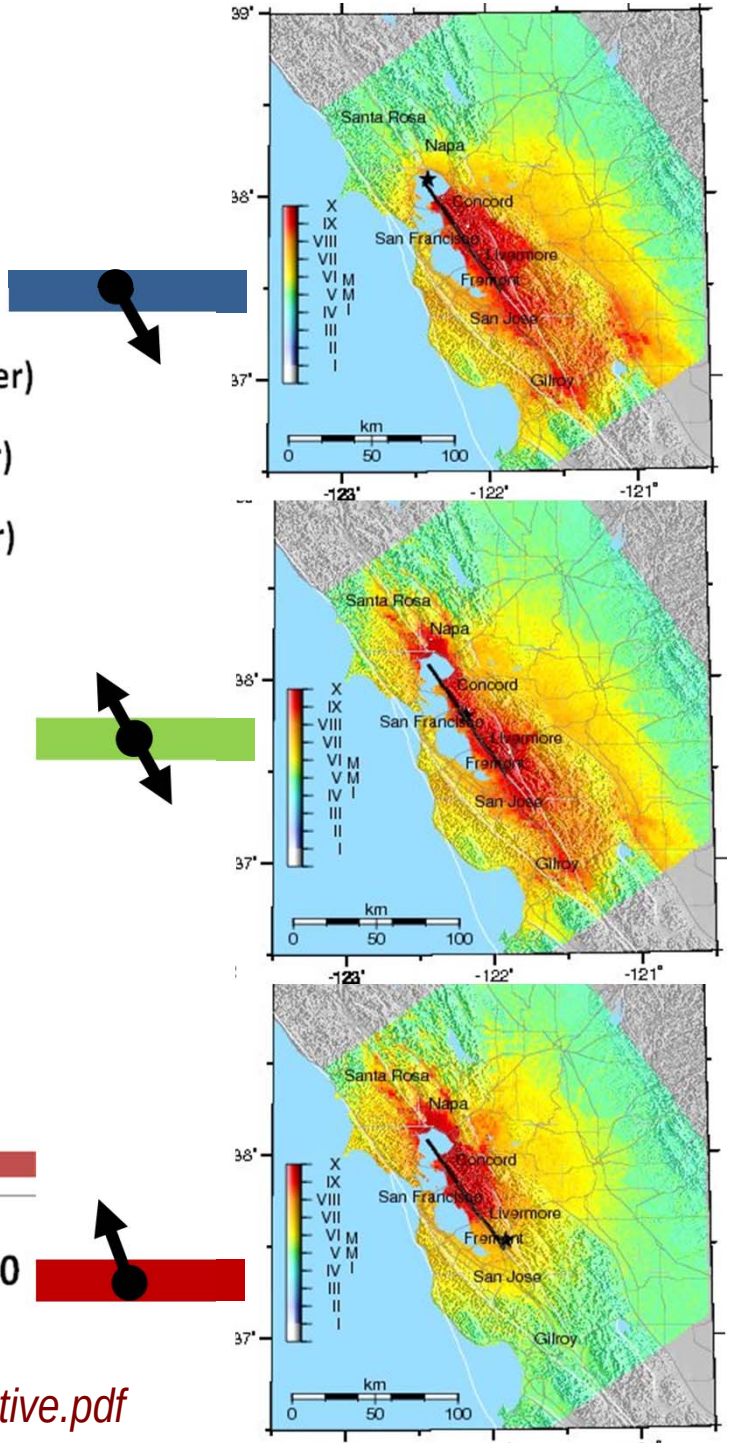
Moving to the other side of the Bay





Losses by county - M7.0 scenario





RMS report: 1868 Hayward Earthquake: 140 Year Retrospective
http://www.rms.com/publications/Hayward_Earthquake_Retrospective.pdf

Modeled Economic Losses – including fire following

(private buildings, contents, additional living expenses, and business interruption)

Scenario	Commercial ($Billions)	Residential ($ Billions)	Total ($Billions)
S Hayward M6.8			
Fremont epicenter	**$52**	**$47**	**$99**
range	$49 - 52	$46 - 48	$95 - 100
S+N Hayward M7.0			
Oakland epicenter	**$90**	**$84**	**$174**
range	$90-96	$84-90	$174 - 186

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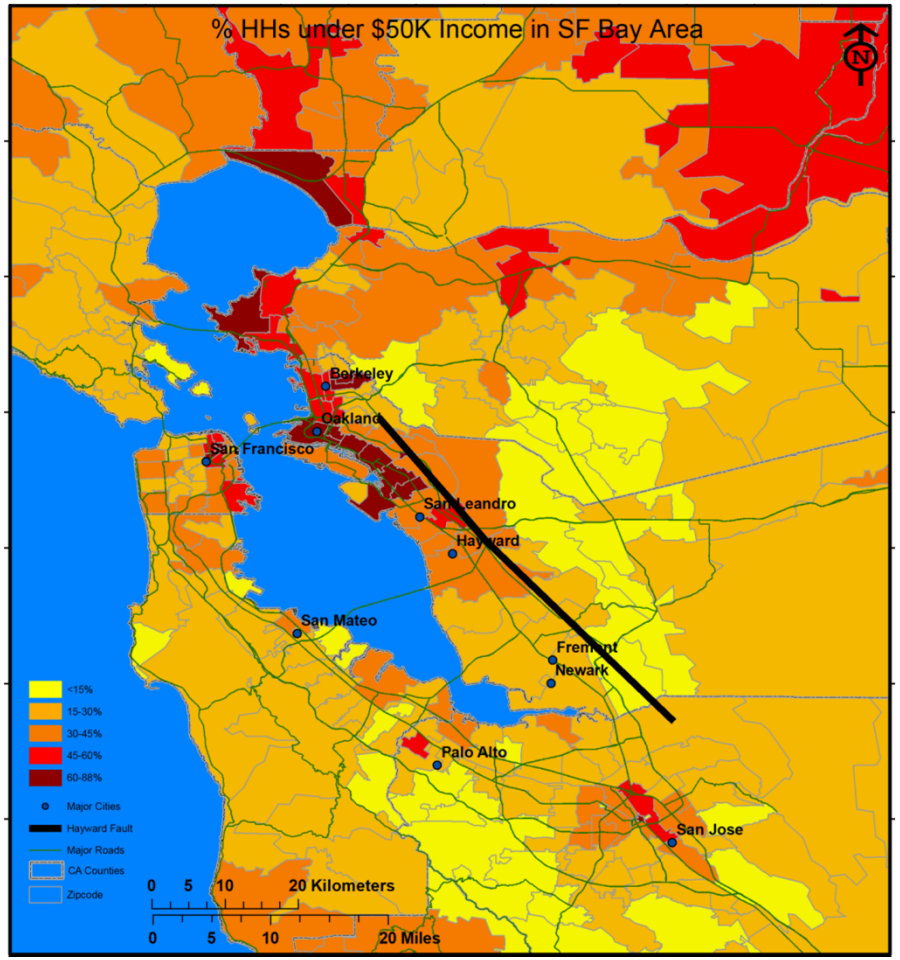
Modeled Casualties and Displaced Households (2pm weekday)

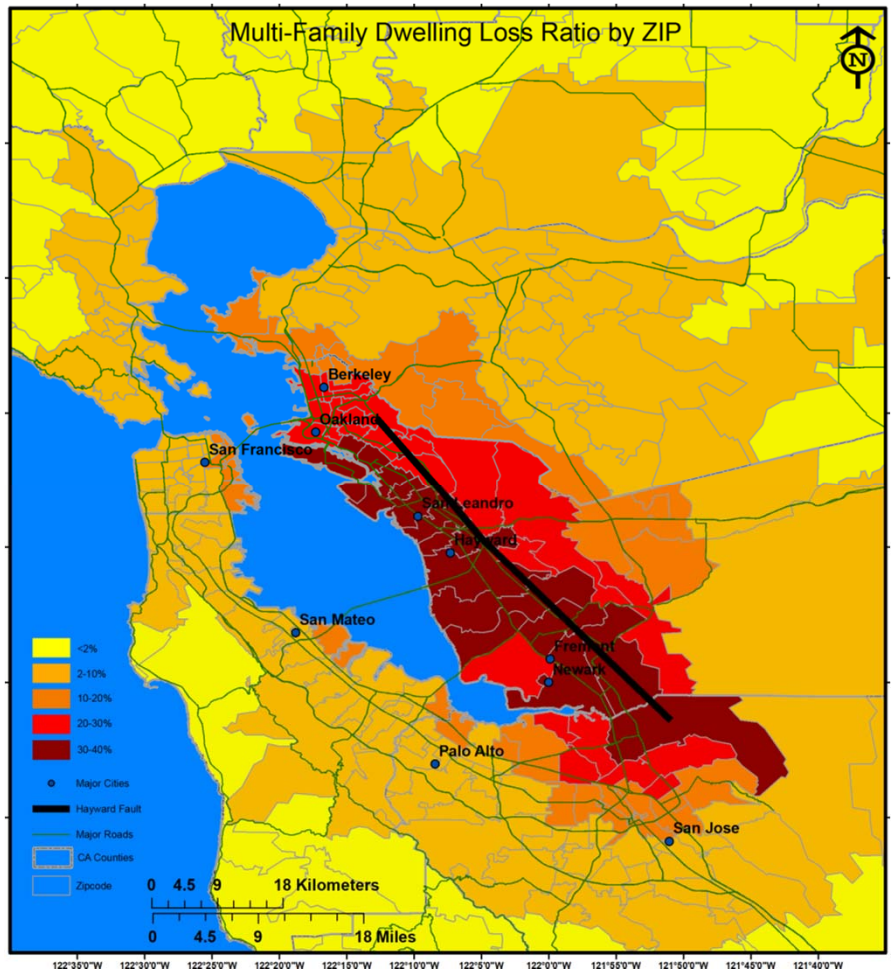
Scenario	Casualties		Displaced Households HAZUS-MH *(ABAG estimate)*
	Injuries	**Fatalities**	
S Hayward M6.8			
Fremont epicenter	**16,500**	**1,100**	**73,000**
range *(ABAG)*	13,000 – 16,500	850 – 2,000	57,000 – 73,000 *(93,000)*
S+N Hayward M7.0			
Oakland epicenter	**52,000**	**3,700**	**104,000**
range *(ABAG)*	35,000 – 50,000	3,500– 4,500	104,000 – 140,000 *(156,000)*

http://www.rms.com/publications/Hayward_Earthquake_Retrospective.pdf

Most vulnerable households - least control over seismic safety



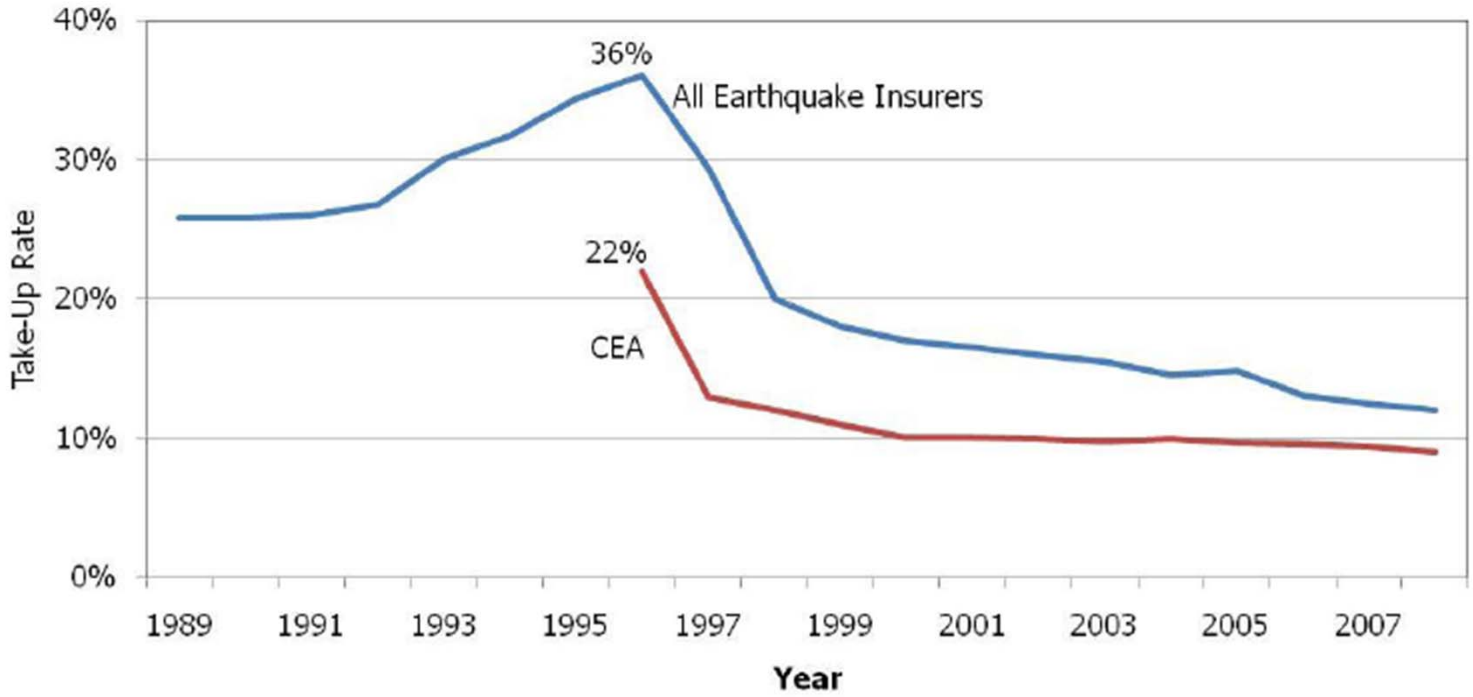
% Households with income <$50K BY ZIP



Loss Ratio: Multi-family dwellings BY ZIP

WHO WILL PAY?

CA Residential earthquake insurance coverage



Source: CEA, Marshall, 2009

The math

- Average Bay Area, wood frame ranch home = 2500 sq ft
- Construction cost = $400/sq ft -> $1M
- Policy for older, retrofit home in zip 94305 = $4.4K/yr
- 15% standard deductible = $150K
- 10 years of premium = $44K
- Damage must exceed $194K in order to receive any payment at all

Modeled Insured Losses

(private buildings, contents, additional living expenses, and business interruption + Fire Following)

Scenario	Commercial ($Billions)	Residential ($ Billions)	Total ($Billions)
S Hayward M6.8			
insured	**$7.5**	**$3.3**	**$10.8**
total economic	$47	$51	$98
% loss insured	**16%**	**6.5%**	**11%**
S+N Hayward M7.0			
insured	**$15.7**	**$6.3**	**$22.0**
total economic	$93	$88	$181
% loss insured	**17%**	**7%**	**12%**

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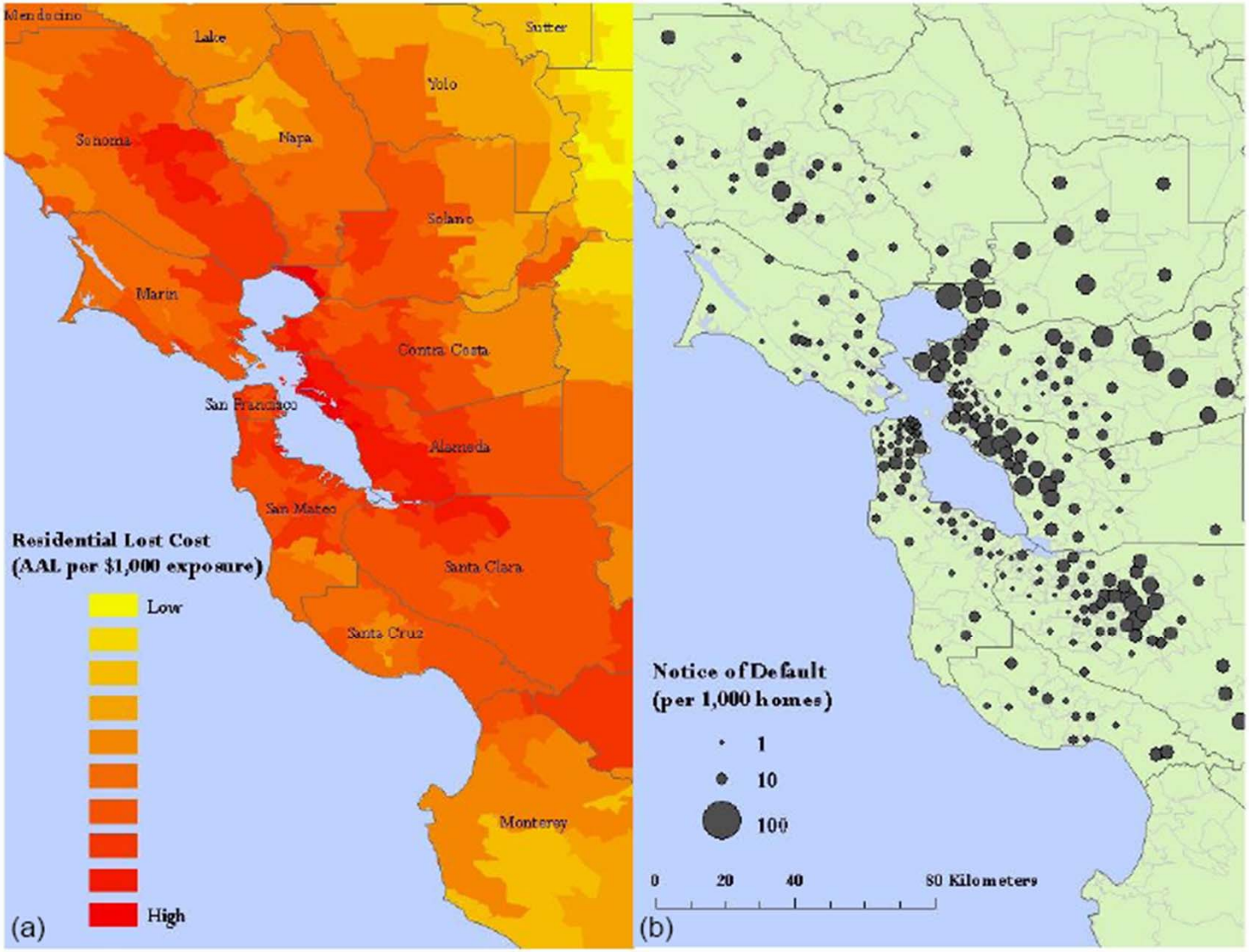
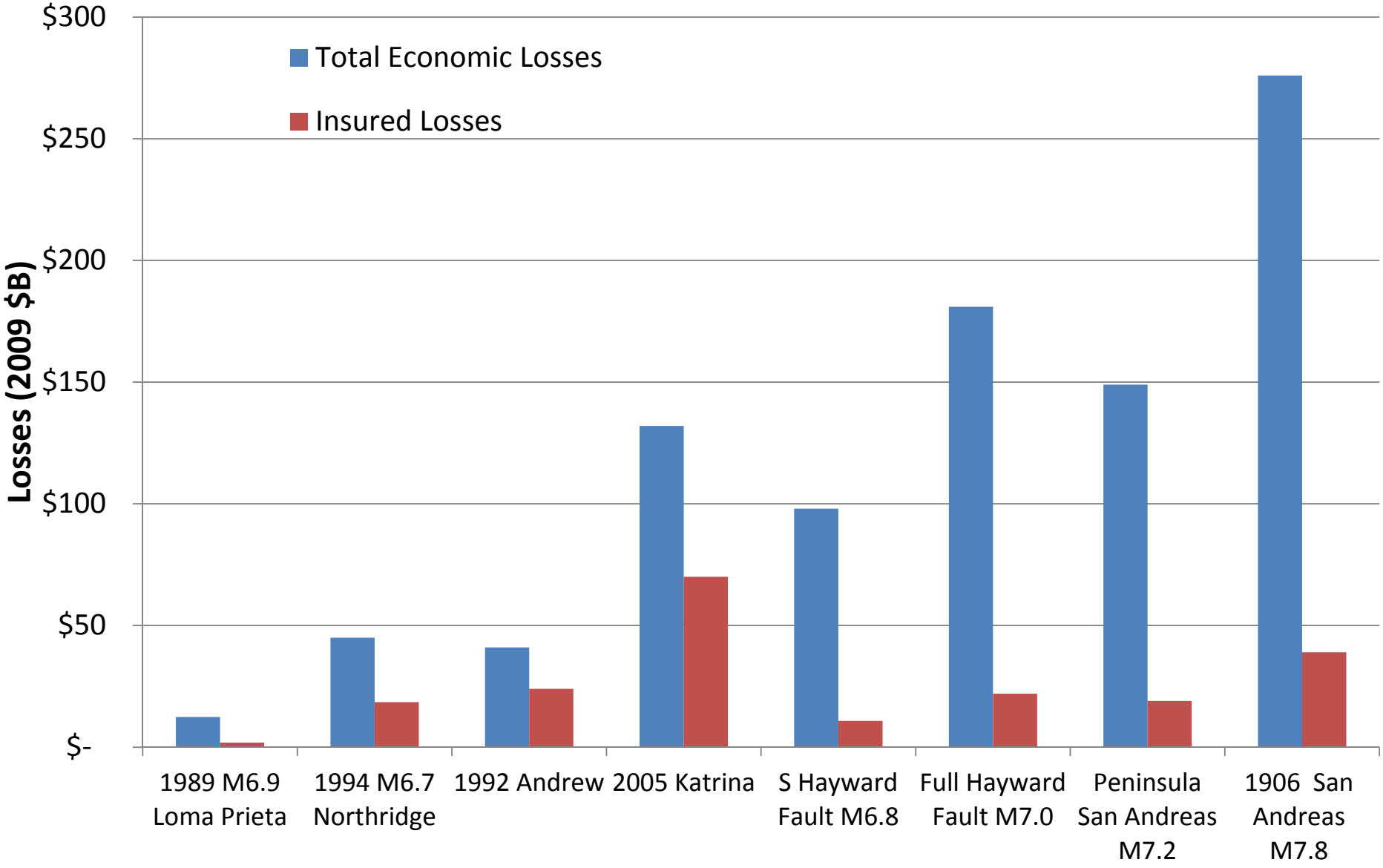
Avg. Annual Loss vs. Mortgage Default notices



From: CATASTROPHE MODELING AND CALIFORNIA EARTHQUAKE RISK: A 20-YEAR PERSPECTIVE

http://www.rms.com/Publications/LomaPrieta_20Years.pdf

LOSSES - Economic vs. Insured



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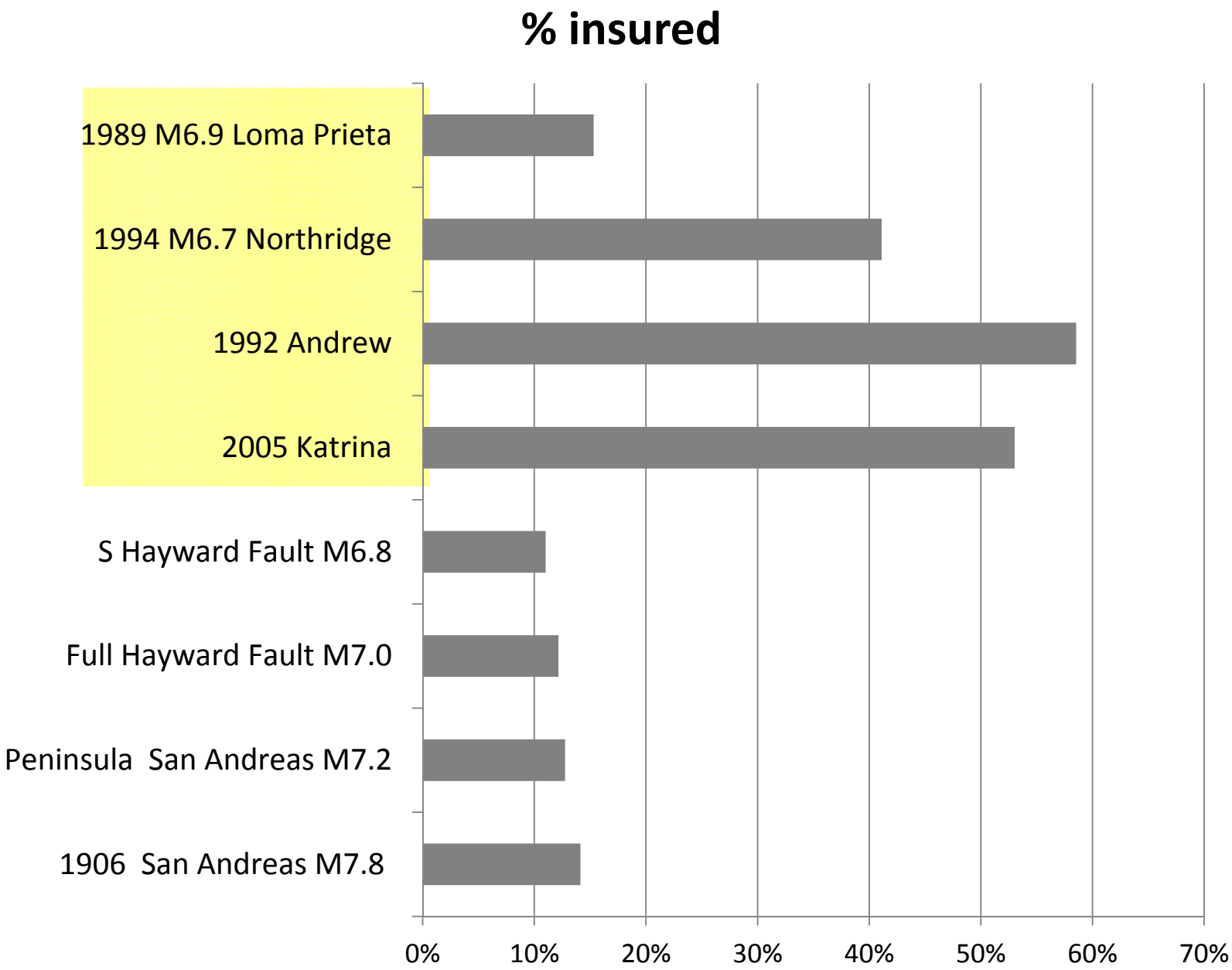
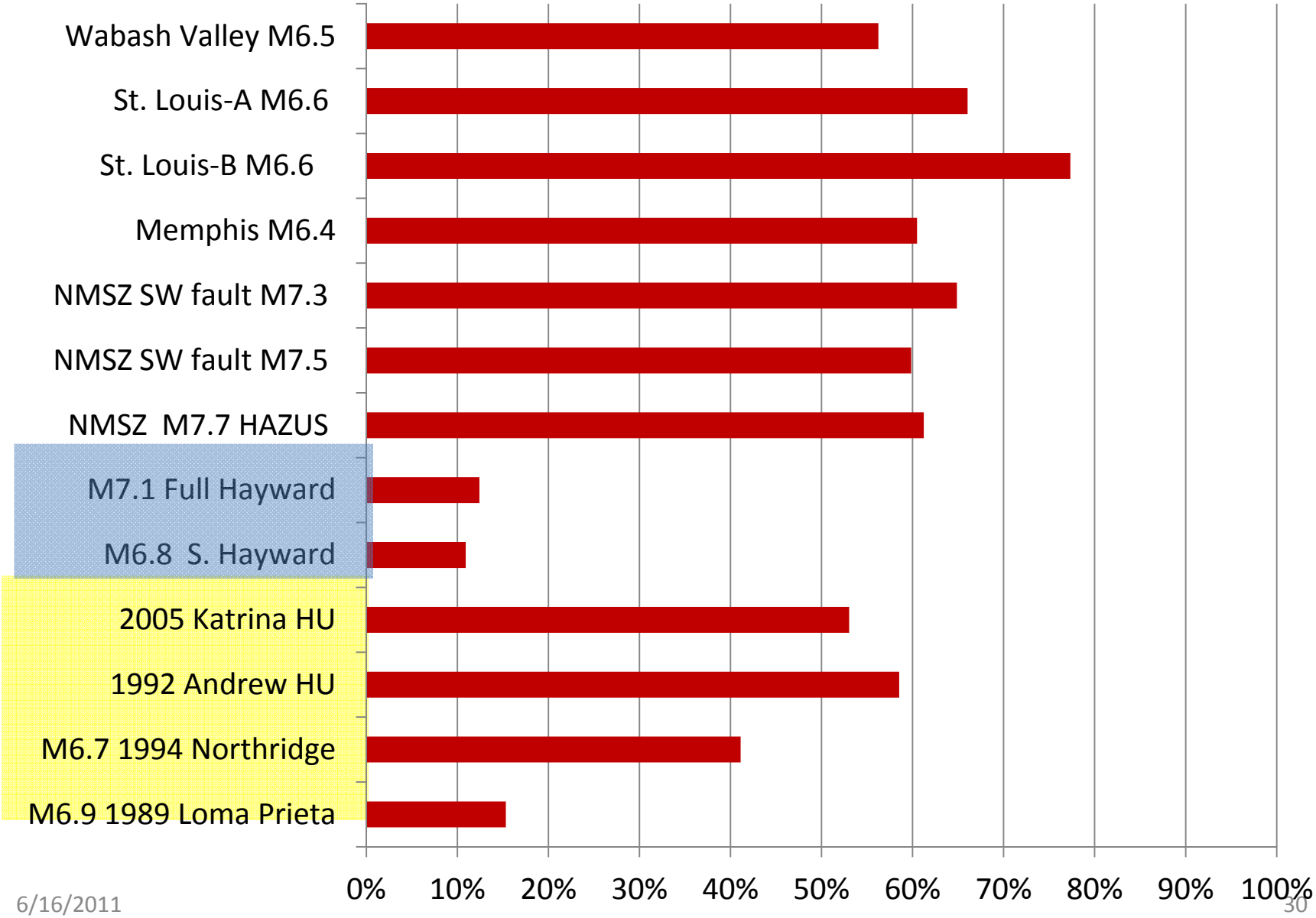

% insured
1989 M6.9 Loma Prieta
1994 M6.7 Northridge
1992 Andrew
2005 Katrina
S Hayward Fault M6.8
Full Hayward Fault M7.0
Peninsula San Andreas M7.2
1906 San Andreas M7.8
0%
10%
20%
30%
40%
50%
60%
70%

% LOSS INSURED



From RMS Special Report on New Madrid Earthquake Risk, in prep., will be available on line

WHAT CAN WE DO TO STRENGTHEN HOUSING AND PROMOTE COMMUNITY RESILIENCE?

What behaviors do we want to encourage and incentivize?

- *Insurance—huge deductible remains a barrier, no guarantee of payment even with damage*
  - *Alternative policy structures*
  - *Much lower deductibles*
  - *Mutual insurance companies - clients are owners*
- *Retrofit very desirable alternative, nudge the market*
  - *Oakland - work with real estate community*
  - *Oakland & Berkeley - Property transfer tax rebate*
- *Other alternatives*
  - *Natural hazard mortgage insurance*
  - *Home equity line of credit for ready repair cash*

What can we do? - 1

- Addressing housing requires an integrated approach
  - Can't expect people to stay or return to neighborhoods without services, schools, and shopping
    - While public school construction high standard for nearly 80 yrs, other key facilities are not: private schools, medical clinics and pharmacies, and assisted living facilities
    - *SF- Lifeline Council, for infrastructure interdependencies*
  - Carry out CAPSS/SPUR type exercises for your city
    - Vulnerability assessment
    - Performance goals
  - Conduct structural inspection of all expected shelters
  - Repeated success of retrofit bond measures indicates public's willingness to invest - extend that civic concern to their homes and their buildings
  - Encourage retrofit adoption, nudge market by requiring evaluations (upon sale? Deadline?), Information is power

What can we do? - 2

- Assure continuity of government
  - All critical offices should meet "occupiable during repair" standard
    - *San Leandro model of strong Senior Center as EOC*
  - Insist upon non-structural mitigation in all offices
  - Remote storage or backup of all city data
  - Prior arrangements for working from home
  - *Resilient SF- recovery governance, funding, eye to community and long term recovery*
- Manage expectations
  - Post-event: Be realistic, do not tell public they will be made whole again, only makes life miserable for city staff
  - *Be prepared for new normal, interim solutions, messy process (SC)*
  - Beforehand:
    - Establish "shelter-in-place" as a long-term city goal
    - Emphasize personal responsibility
    - Model desired behavior - "Do as I do….."
- Have legislation/ordinances ready to go

What can we do? - 3

- Vulnerable populations will need the most help
  - Community-based organizations (CBOs) know these communities best and have their trust
  - Organize a network of CBOs, business community, and government beforehand
    - *Bay Area Partners in Preparedness-Gilead*
- Create a culture of resilience--Bay Area residents believe future damaging eqs coming
  - Emphasize personal responsibility and self sufficiency
    - Encourage CERT-NERT training for all, again model behavior
    - *San Leandro-Retrofit workshops, tool library, plan set, small fee, work with owners*
  - Risk communication - letter to all residents outlining their specific hazards: strong shaking, liquefaction, and landsliding
    - Provide them with customized options for actions they can take to improve their safety
    - Let them know what city plans are in place, where shelters are located, what to bring to shelters, etc.