



# Business Resilience to Earthquakes: Lessons from the ShakeOut

Adam Rose

CREATE and SPPD

University of Southern California

Anne Wein

U. S. Geological Survey



# Overview of Economic Impacts

- Economic Impacts
  - Property Damage: \$113 billion
  - Business Interruption: \$96 billion
- Would make this the costliest disaster in U.S.
  - Katrina: less on both counts
  - September 11: much lower on PD; higher on BI



## Conduits of Economic Shock

- Building damage—ground motion (short period)
- Building damage—ground motion (long period, e.g., high rise collapse)
- Building damage—fire
- Lifeline service outage
  - Electric power
  - Natural gas
  - Water
  - Transportation
- Adjust for double-counting of multiple sources



# Types of Impacts

- Direct Stock (property damage from ground motion)
- Direct Flow (on-site business interruption)
- Indirect Stock (ancillary fires, toxic release)
- Indirect Flow (ripple or multiplier effects off-site)
- *Extended Linkages* (amplify losses after the event)
- *Resilience Adjustments* (mute losses after event)



# Resilience to Disasters

- Static: Using remaining resources effectively
- Dynamic: Reducing time to recovery
- Examples:
  - conserving scarce inputs
  - relocating businesses
  - responding to market signals to reallocate
  - recapturing lost production at a later date



# ShakeOut Property Damage

(Billions 2008 dollars)

Indicator	Direct Impacts	Total Impacts
Ordinary Bldg Damage	\$32.7	\$32.7
Related Content Damage	10.6	10.6
Hi-Rise Bldg Damage	2.2	2.2
Related Content Damage	0.7	0.7
Fire Damage	0.0	40.0
Related Content Damage	0.0	25.0
Highway & Pipeline Damage	1.5	1.5
<b>Total Property Damage</b>	<b>47.7</b>	<b>112.7</b>



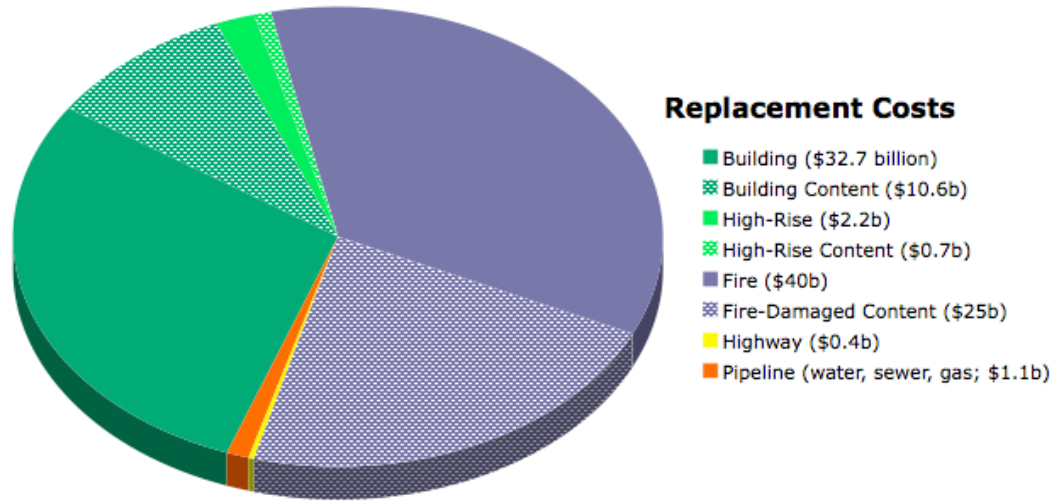
# ShakeOut Business Interruption

(Billions 2008 dollars)

Indicator	Direct Impacts	Total Impacts
BI from Ordinary Bldgs	\$4.3	\$8.0
BI from Hi-Rise Bldgs	1.7	3.2
BI from Fire	12.8	22.4
BI from Power	4.4	7.3
BI from Water	30.0	53.0
BI from Gas	0.6	0.8
BI from Transportation	0.3	0.5
BI from Ports	0.5	1.0
Total Business Interruption	54.6	96.3



# Regional Economic Impacts



## Damage to Structures and Contents (\$112.7b)

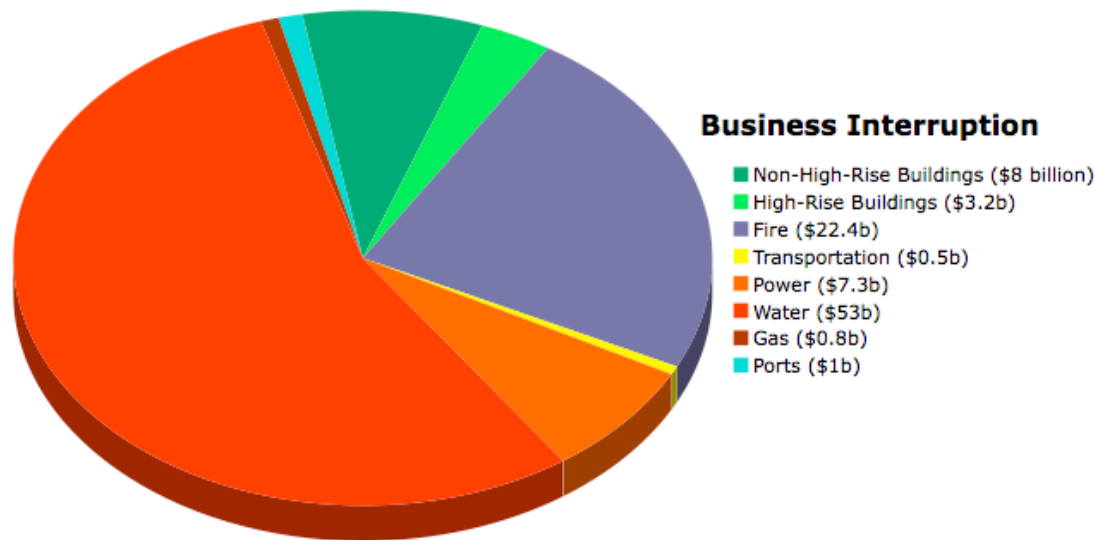
- Fire is biggest shock

## • Business Interruption (\$96.2b)

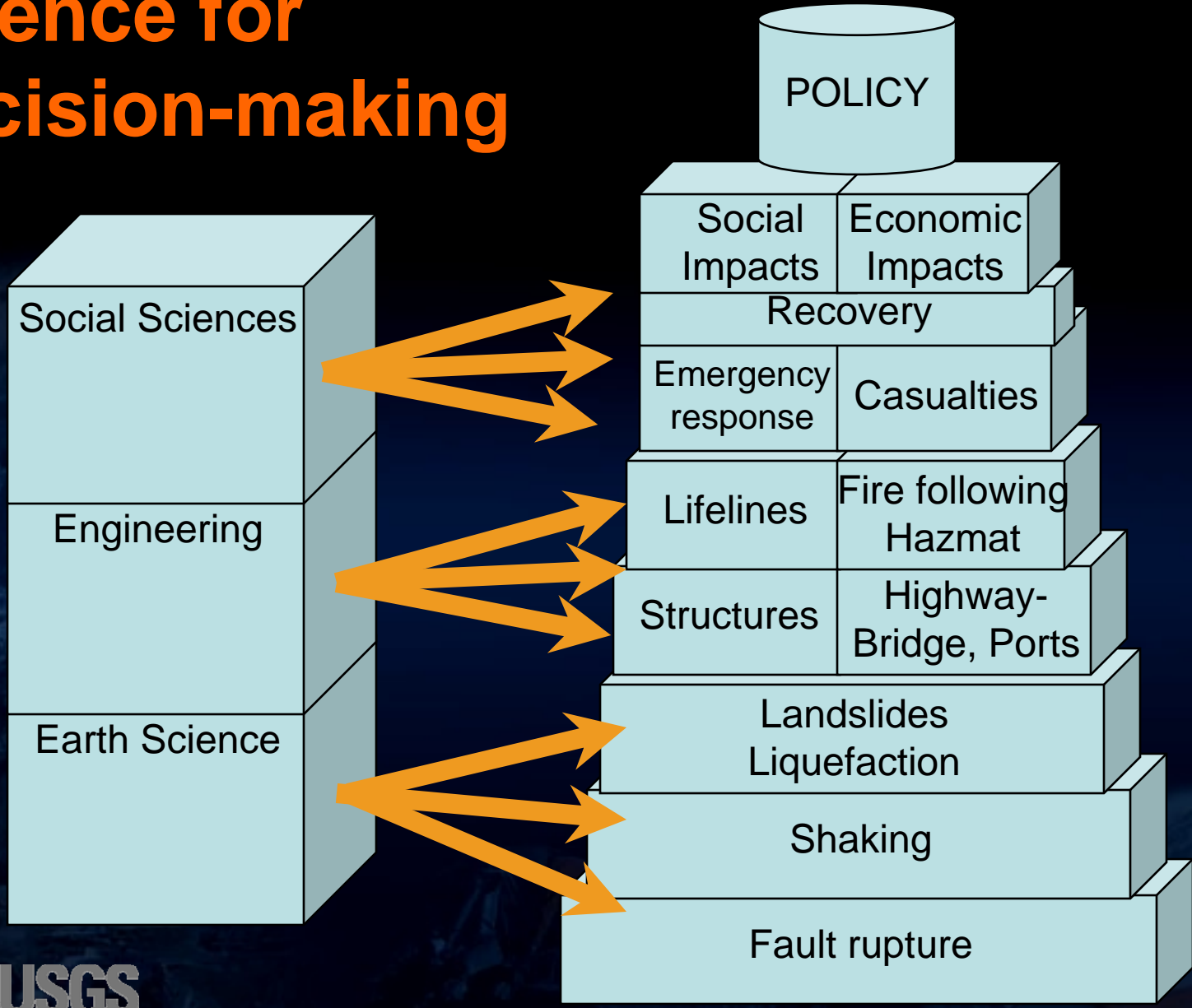
- Water is biggest shock

## • Additional Costs

- Relocation (\$0.1b)
- Traffic Delay (\$4.3b)



# Science for Decision-making





# Levels and types of decision-making

	Response	Recovery	Mitigation
Federal	GG		
State	GG	GG	
Region			SD
County	GG	GG	SD
Sector	SD	SD	SD
Local	GG SO	GG SD	SD
Business	SO	SD	
Individual	SO SD		

Scenario Development

Golden Guardian '08

ShakeOut

Next steps

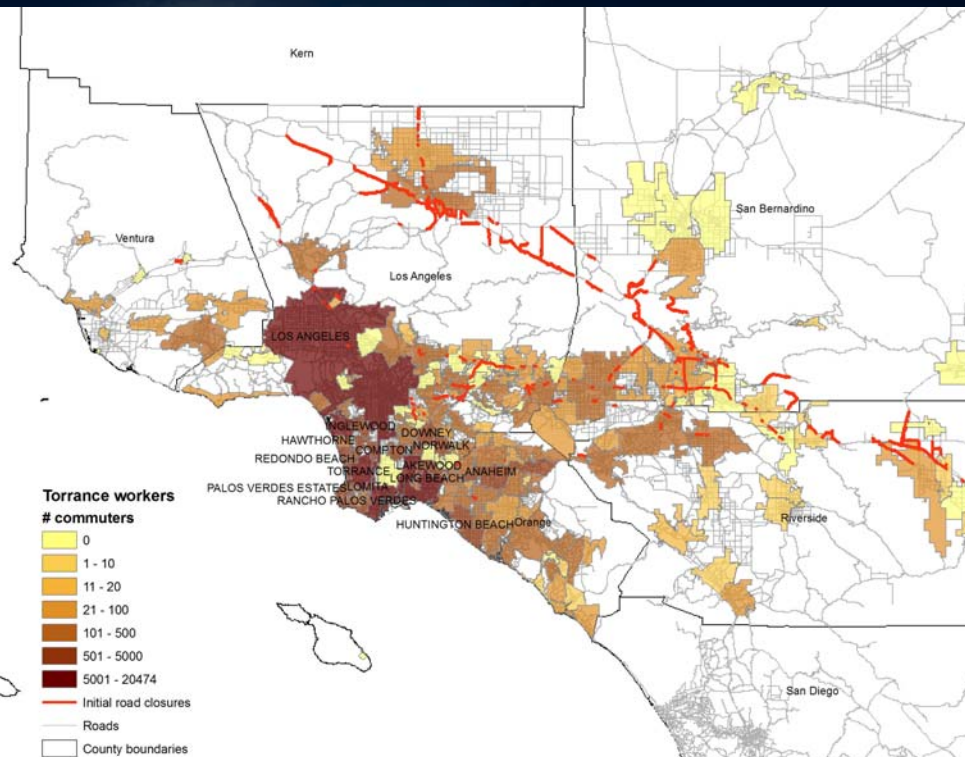
# Policy Implication of Economic Analysis: Financing the losses

Shaking damage + Response & fire damage + BI (+ Tax ) losses

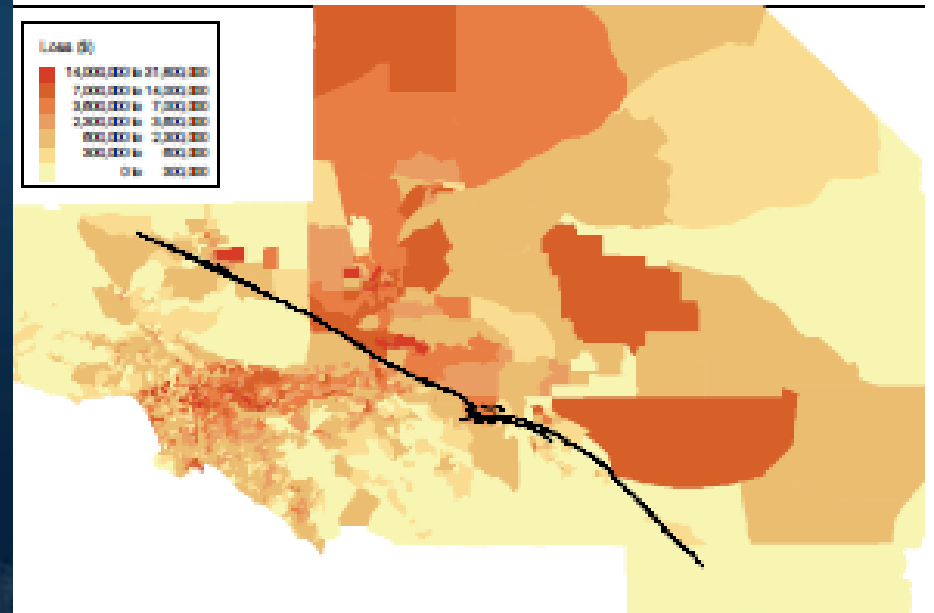
County	# CEA & non-CEA policies	Insured Loss (\$000,000)	Uninsured Loss (\$000,000)	% Losses Insured
Imperial	378	\$1.30M	165.75	0.78%
Kern	16,786	0.36	15.27	2.33
Los Angeles	317,191	345.13	6,313.97	5.18
Orange	124,214	21.00	877.34	2.34
Riverside	54,636	525.68	4,591.19	10.27
San Bernardino	46,760	387.77	7,660.46	4.82
San Diego	16,068	0.05	4.81	0.93
Ventura	37,453	0.66	20.65	3.07
<b>Region</b>	<b>723,486</b>	<b>\$1,282M</b>	<b>\$19,649M</b>	<b>6.12%</b>

-> Pre-plan catastrophic event financing (SwissRe)

# Policy Implication of Economic Analysis: Losses from transportation of goods and people -> prepare plans for commuters and disrupted supply chain



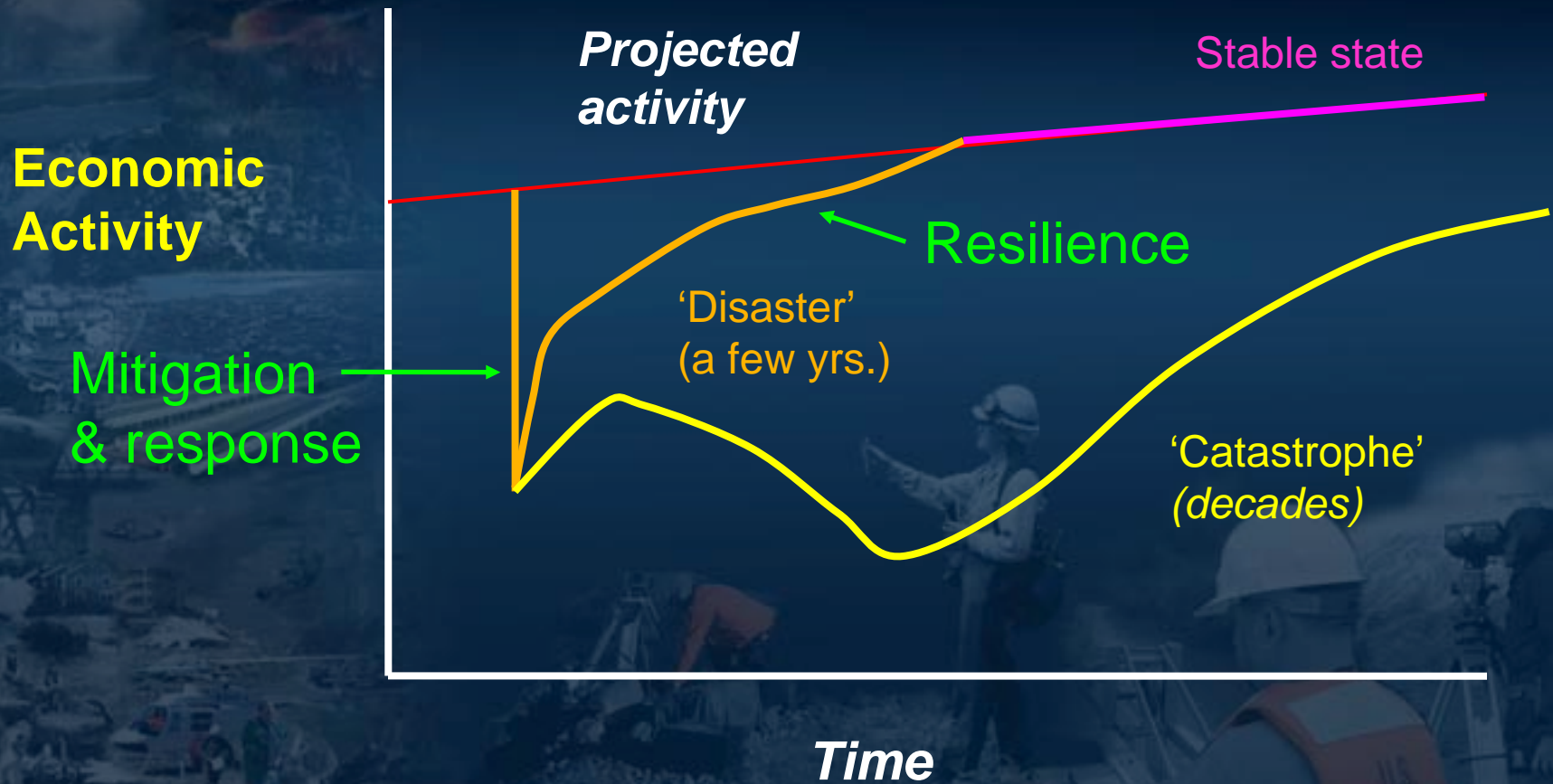
64,738 Torrance residents employed in region  
Estimate 6400 (10%) in high impact city



89,882 Work in Torrance  
Estimate 8000 (9%) reside in high impact city

Losses from passenger and freight trip delays

# Policy Implications of Economic Analysis: Reducing the Losses





# Long-term Resilience

- **Labor and skill supply**
  - Maintain employee focus; set up family communication plans and family preparedness
  - Cross-train employees (rescue, building inspection, high priority jobs)
  - Set up mutual aid arrangements
- **Backups**
  - Generators
  - Geographically dispersed data centers
- **Emergency planning for response *and recovery***
  - E.g., ShakeOut scenario
- **Inventories**
  - Water, fuel
  - Needed: stockpiles (raw materials, parts) for restoration and repair



# Policy Implication of Economic Analysis: Local recovery

- Ex ante mitigation planning is incentivized by DMA2000, and pre and post event mitigation funding sources are available. There is no analogy for recovery planning and community resilience enhancement to reduce the region-wide business interruption losses that accumulate during the recovery period.
- **“Require pre-event recovery plans** as part of local safety elements – one of several mandated elements of local (city and county) general plans in California.” (Ken Topping)

Also,

- **Establish a California Recovery Authority.** Statewide organization could be modeled after the LRA and help facilitate coordination of post-disaster recovery programs across multiple state and local agencies.
- **Create a California Recovery and Reconstruction Plan** with a “strategic vision, objectives, and implementing measures for restoring normalcy for citizens, regaining economic vitality, and rebuilding sustainably after a catastrophe.” This plan should have buy-in from state agencies, utilities, the private sector, and nonprofit organizations, giving particular attention to coordination of federal and state recovery programs for more integrated results.



## Policy Implications: Anecdotal

- Leaders in business continuity are large companies and/or critical infrastructure
  - > Business continuity planning for small business
    - 85% bus., 24% employees <20 , 97% bus., 58% employees <100
- Short run preparation dominates, “30 days” (except SoCalfirst)
  - > Plan for eroding resilience and longer run repair, rebuild, and/or permanent relocation
- Prioritization of restoration discussions deferred
  - > “Prioritize action according to economic impact “ (SoCalfirst)