

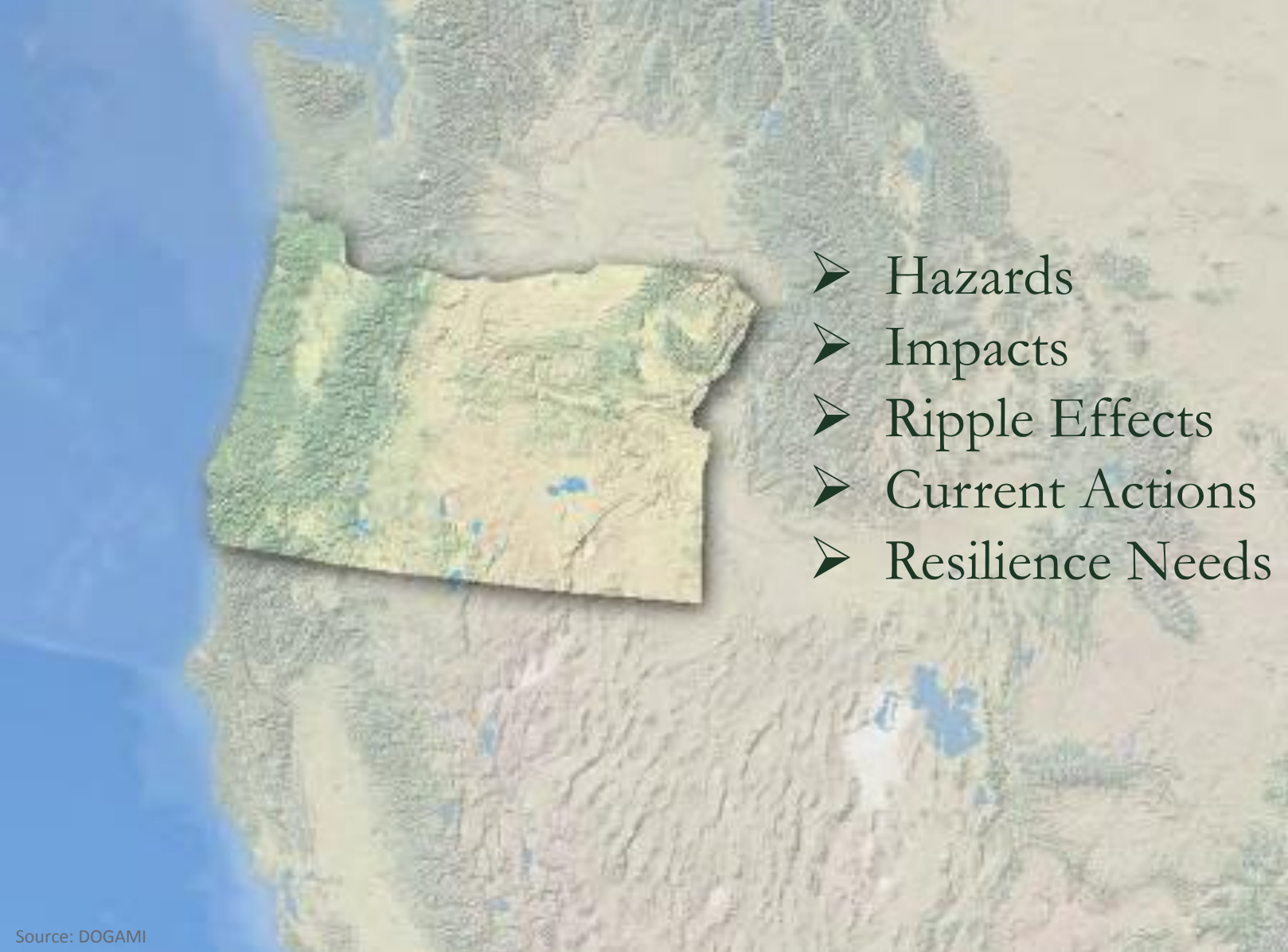
Oregon's Energy Sector Vulnerabilities

Geographical Sciences Committee (GSC)
National Academies of Sciences, Engineering, and Medicine

Fall Meeting on Vulnerability of U.S.
Energy Infrastructure to Coastal Flooding

YUMEI WANG, OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DECEMBER 6, 2018

An Oregon Perspective

- 
- Hazards
 - Impacts
 - Ripple Effects
 - Current Actions
 - Resilience Needs



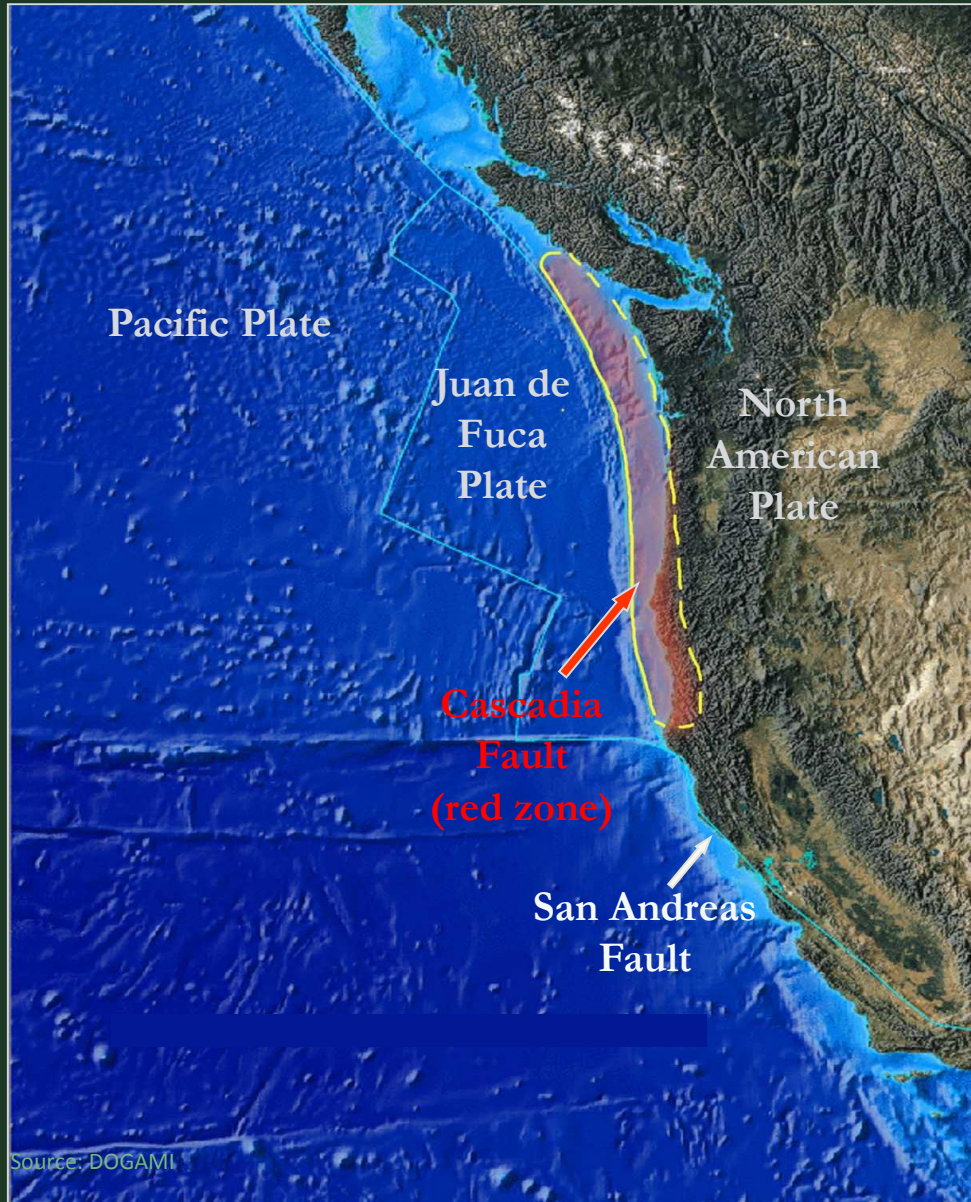
Natural Hazards



Source: DOGAMI



Cascadia Earthquakes



GSC Committee Questions

1. What additional scientific knowledge is needed to support efforts to reduce flood damage to coastal energy infrastructure?
2. What impacts are likely to affect large geographical areas and/or persist for substantial periods of time?
3. Is the relative importance of different ports, production, and distribution systems, and the extents of ripple effects of damage to them well understood?

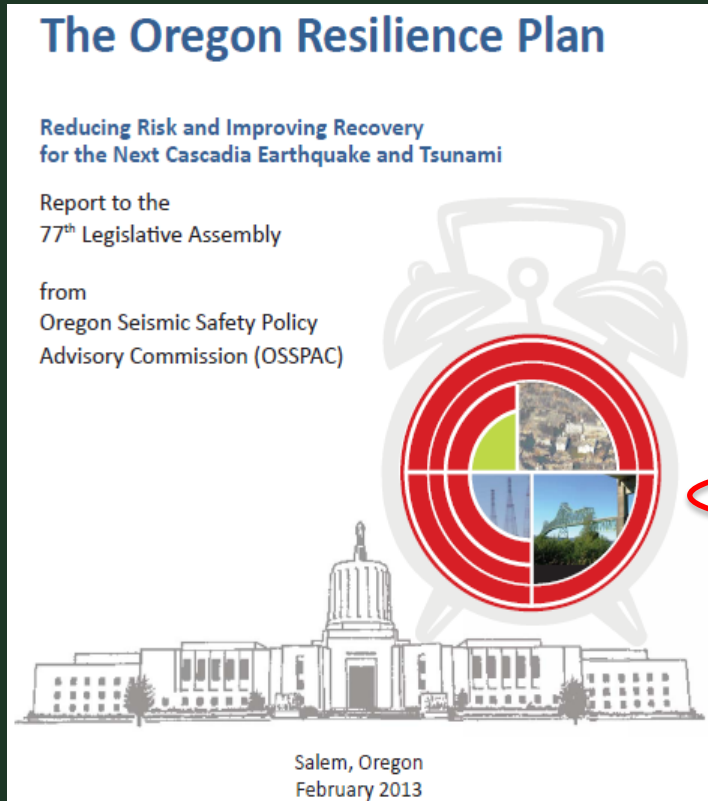


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IMPACTS: Widespread and Long Term



Critical Services	Coast (months)	Valley (months)
Fuel	No Info	No Info
Water	36+	6-12
Wastewater	36+	36+
Electricity	3-6	1-3
Highway (Tier 1)	12-36	12-36
Communication	6-12	6-12
Schools	18	18
Fire	36+	2
Police	36+	4
Healthcare	36+	18

Source: OSSPAC

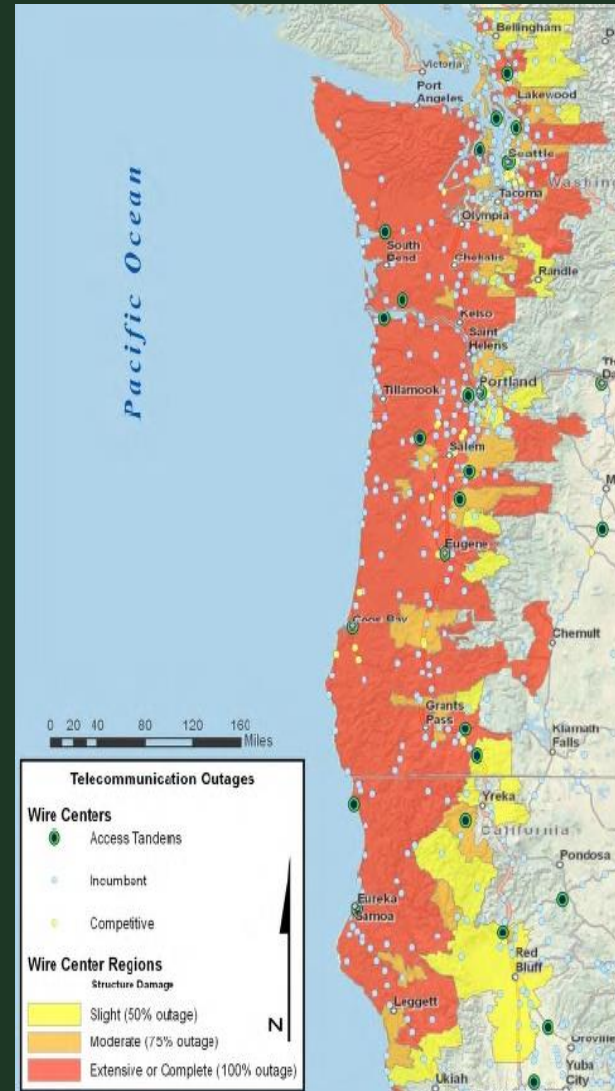
www.oregon.gov/gov/policy/orr/Documents/Oregon_Resilience_Plan_Final.pdf



Expected Damage: Highways & Communications



Source: DHS FEMA 2011



Source: DHS FEMA 2011

Yumei Wang, DOGAMI, 2018



Existing Coastal At-Risk LNG Facility

NEWPORT LNG TANK

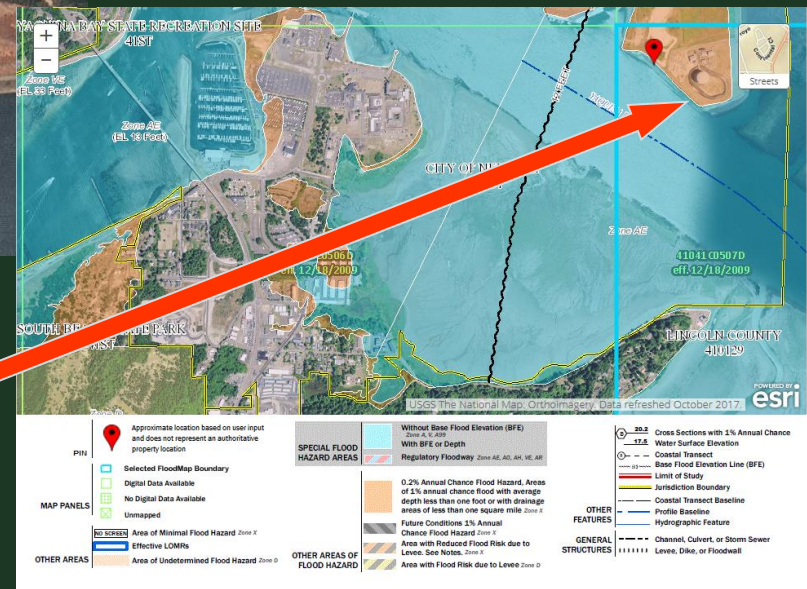


NEWPORT LNG TANK



Source: DOGAMI

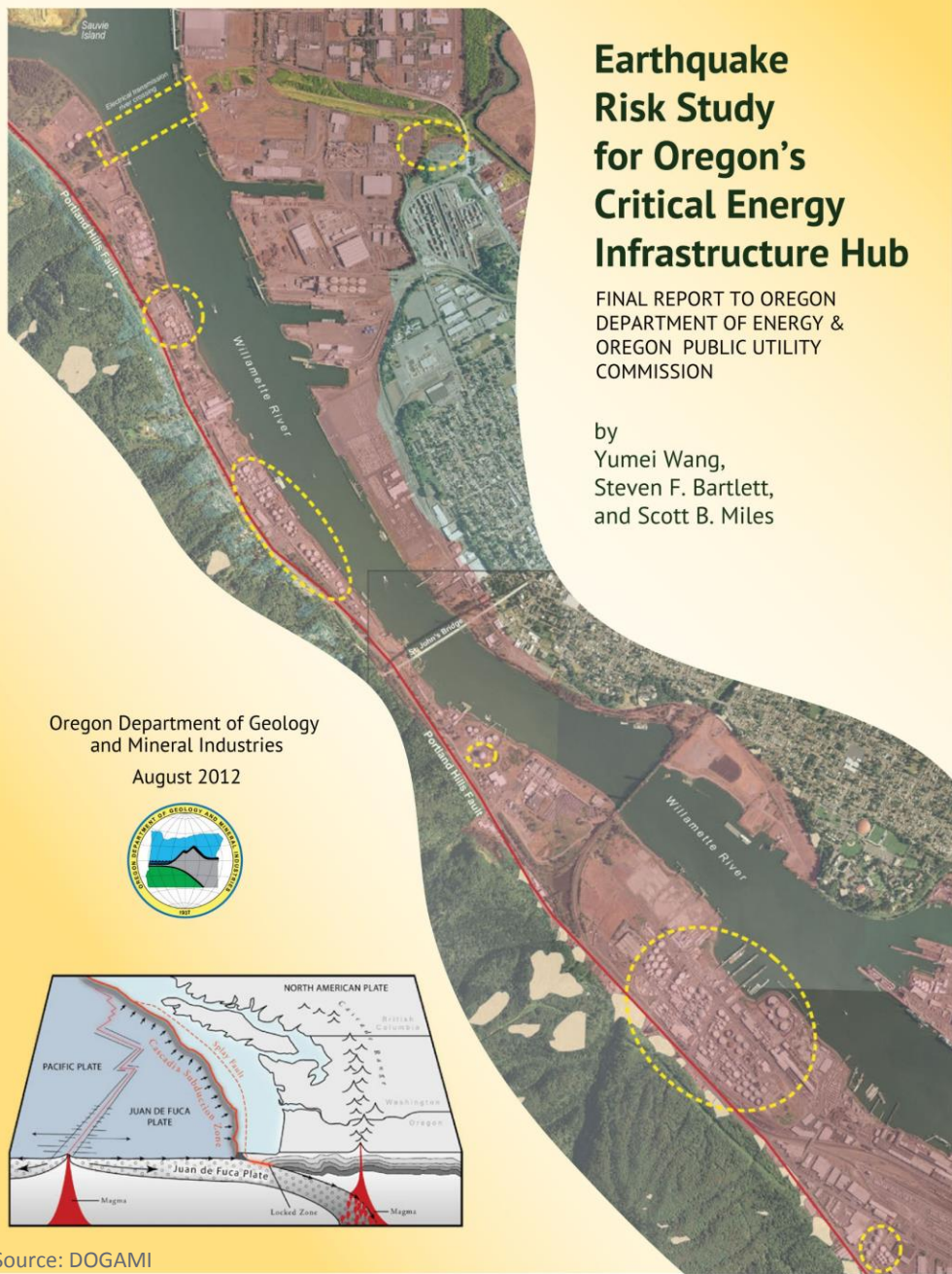
FEMA 100 yr flood zone
and Tsunami hazard zone



Source: <https://msc.fema.gov/portal/home>

Y Wang, DOGAMI, 2018



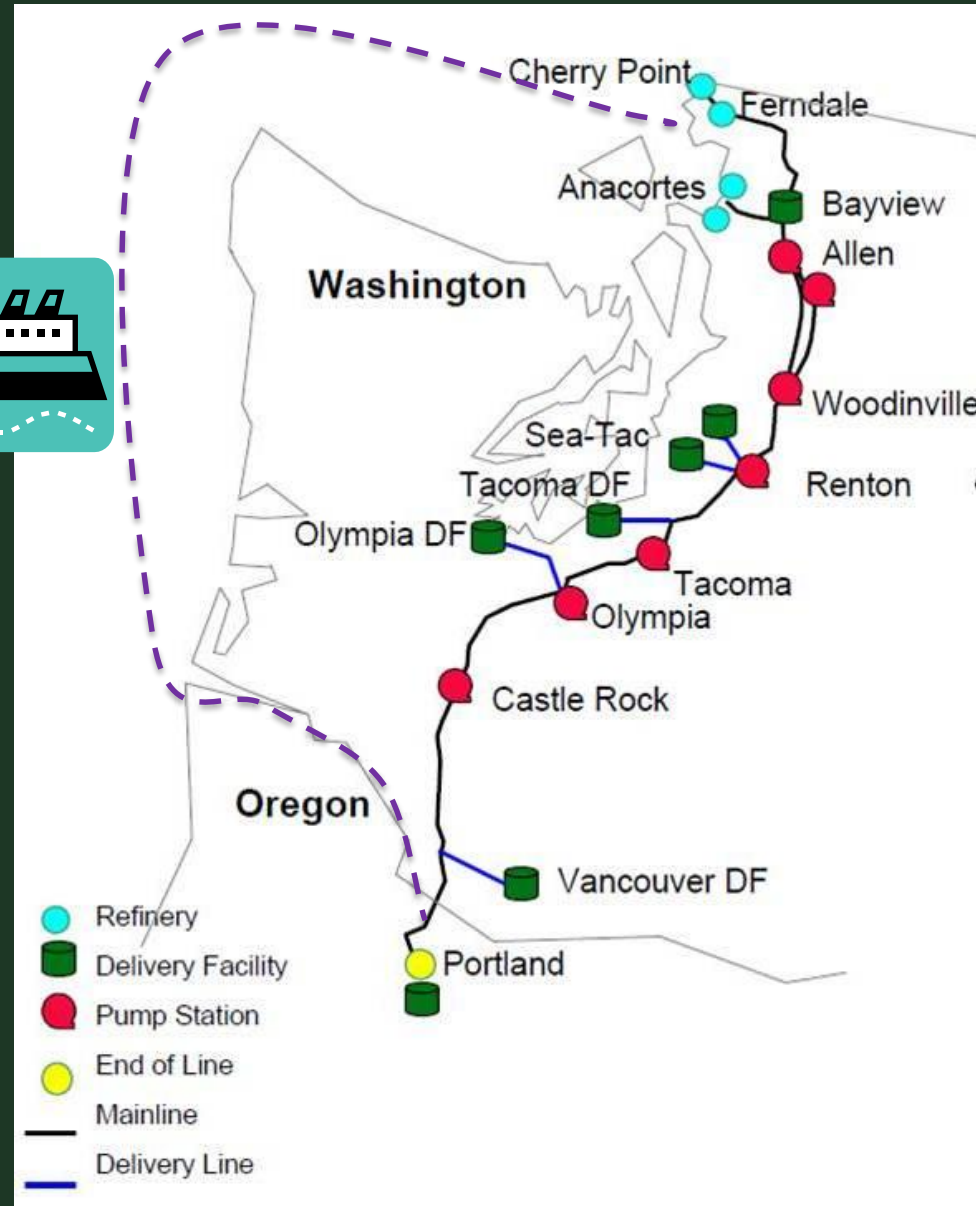


2013 Oregon Risk Study on Critical Energy Infrastructure
<http://www.oregongeology.org/pubs/ofr/p-O-13-09.htm>



Liquid Fuel Supply Chain

- WA Refineries
- Delivery Systems
 - 1960s pipeline
 - Marine vessels
- Fuel Terminals in Portland for Statewide Distribution



Modified from Olympic Pipeline



Fuel Terminals in Portland

Many facilities built before seismic design codes & vulnerable

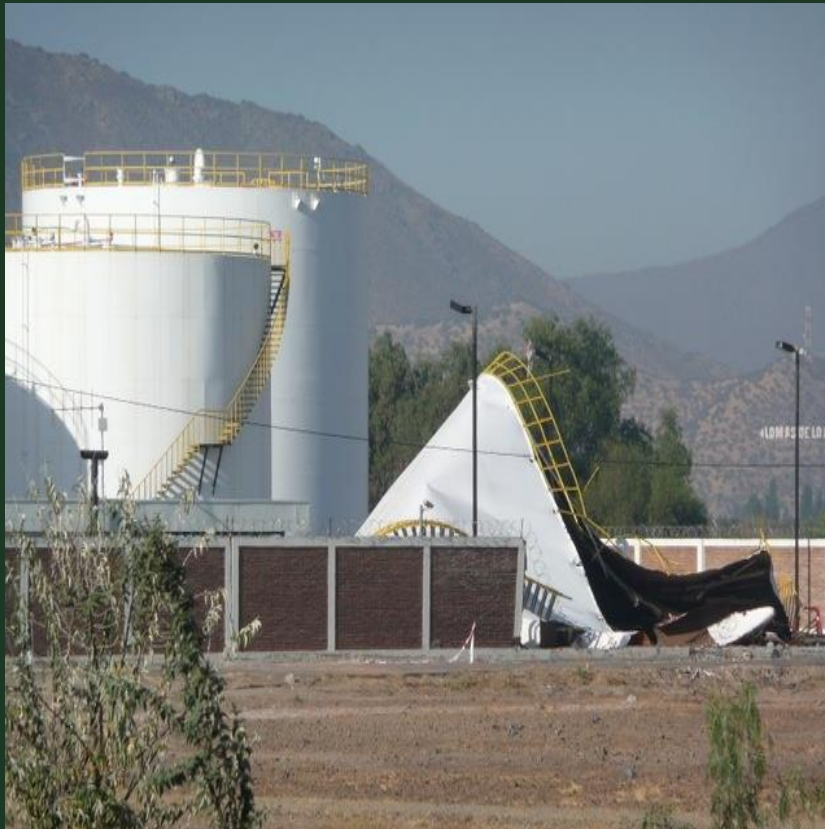


Source of 3 photos: Y. Wang



Expected Prolonged Fuel Shortage

- Fuel spills and fires
- Limited response capacity



Water Tank at Fuel Tank Farm. 2010 Chile earthquake. Photos Source: Yumei Wang



Credit: AP Photo/Kyodo News



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Critical Lifeline Infrastructure Interdependencies

To restore electricity, need to reopen roads



Source: ASCE TCLEE members

To restore water service, need electricity



Source: www.public-domain-image.com

To restore fuel supplies, need electricity



Credit: AP

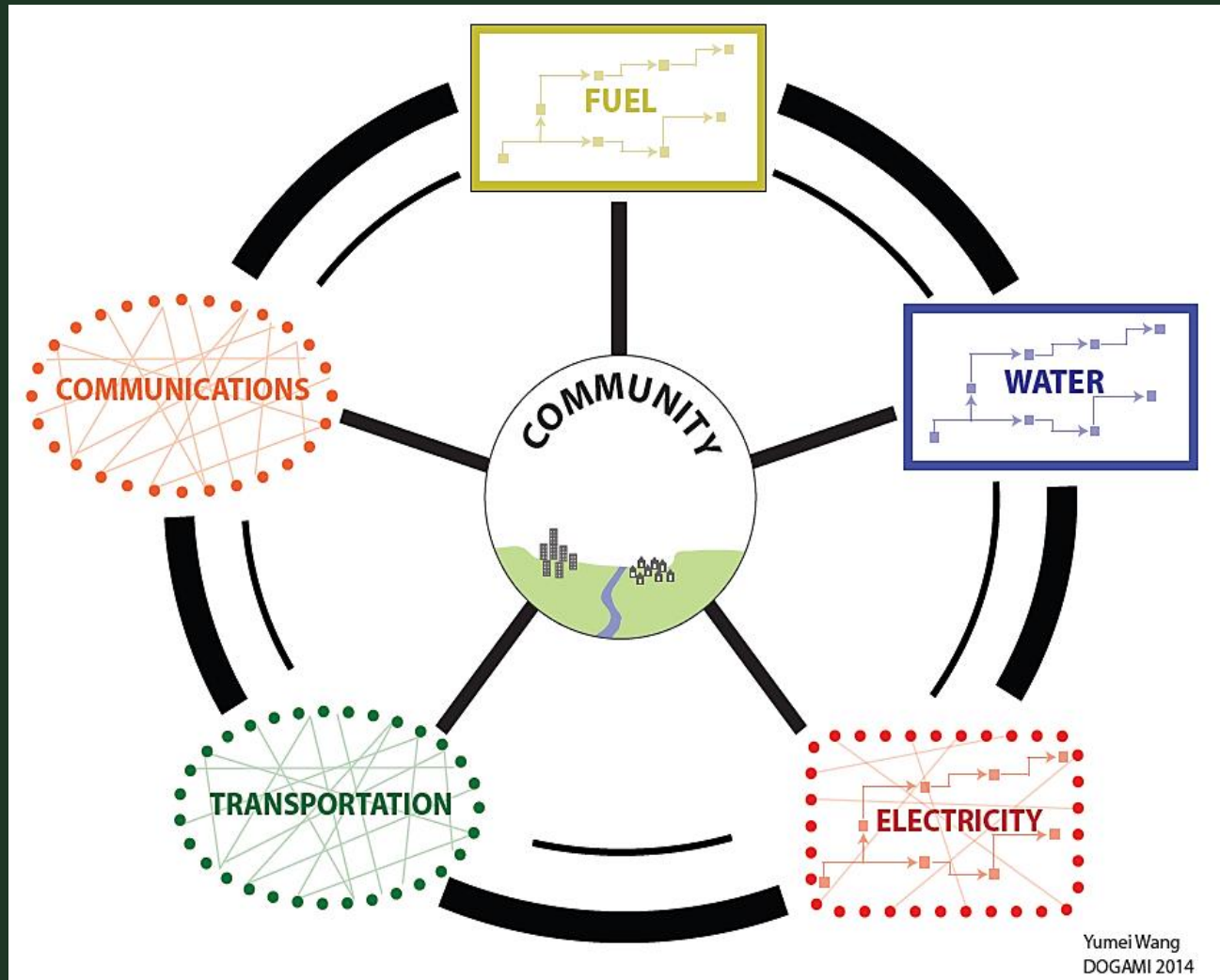
To reopen roads, need to restore fuel supplies



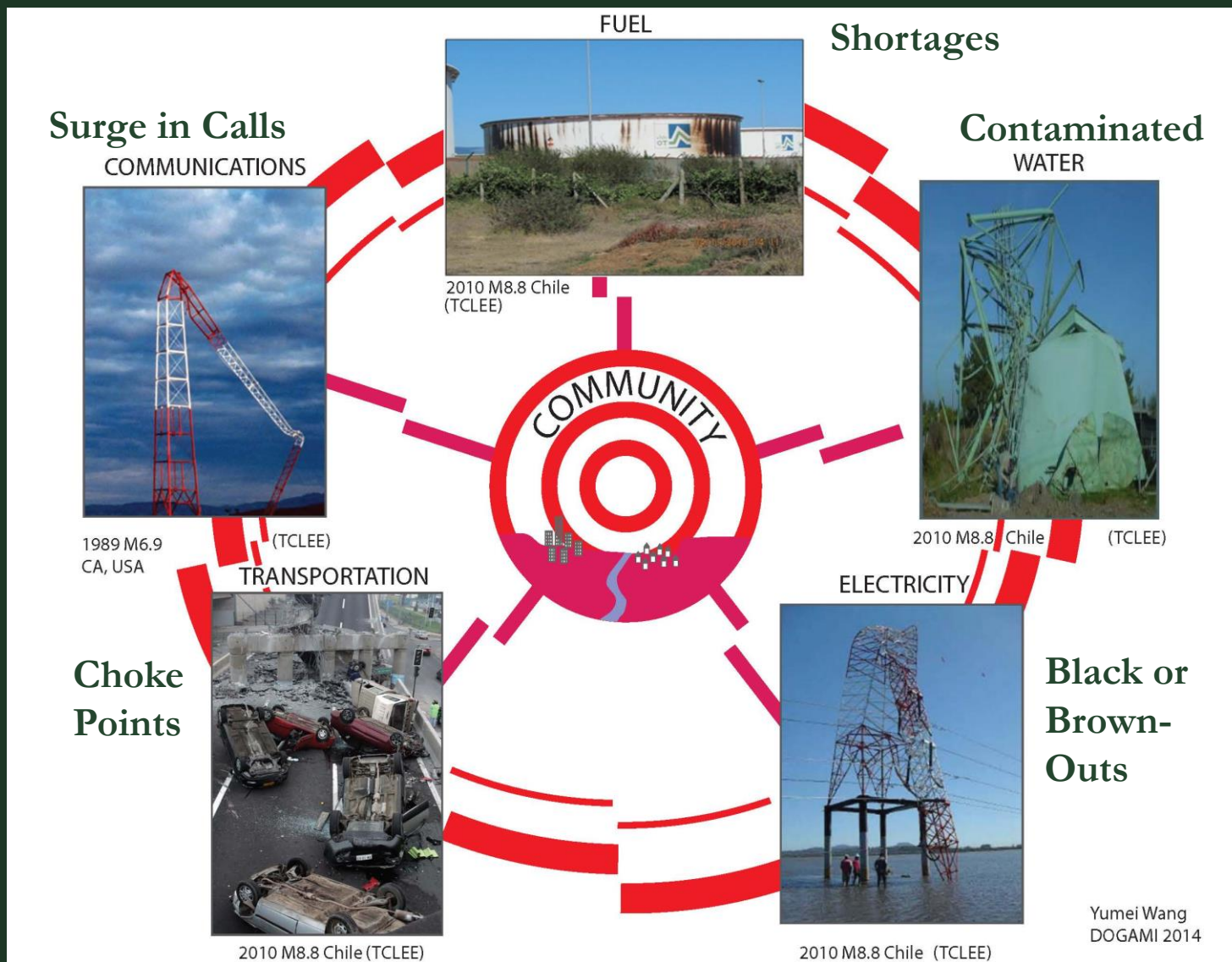
Source: ASCE TCLEE members



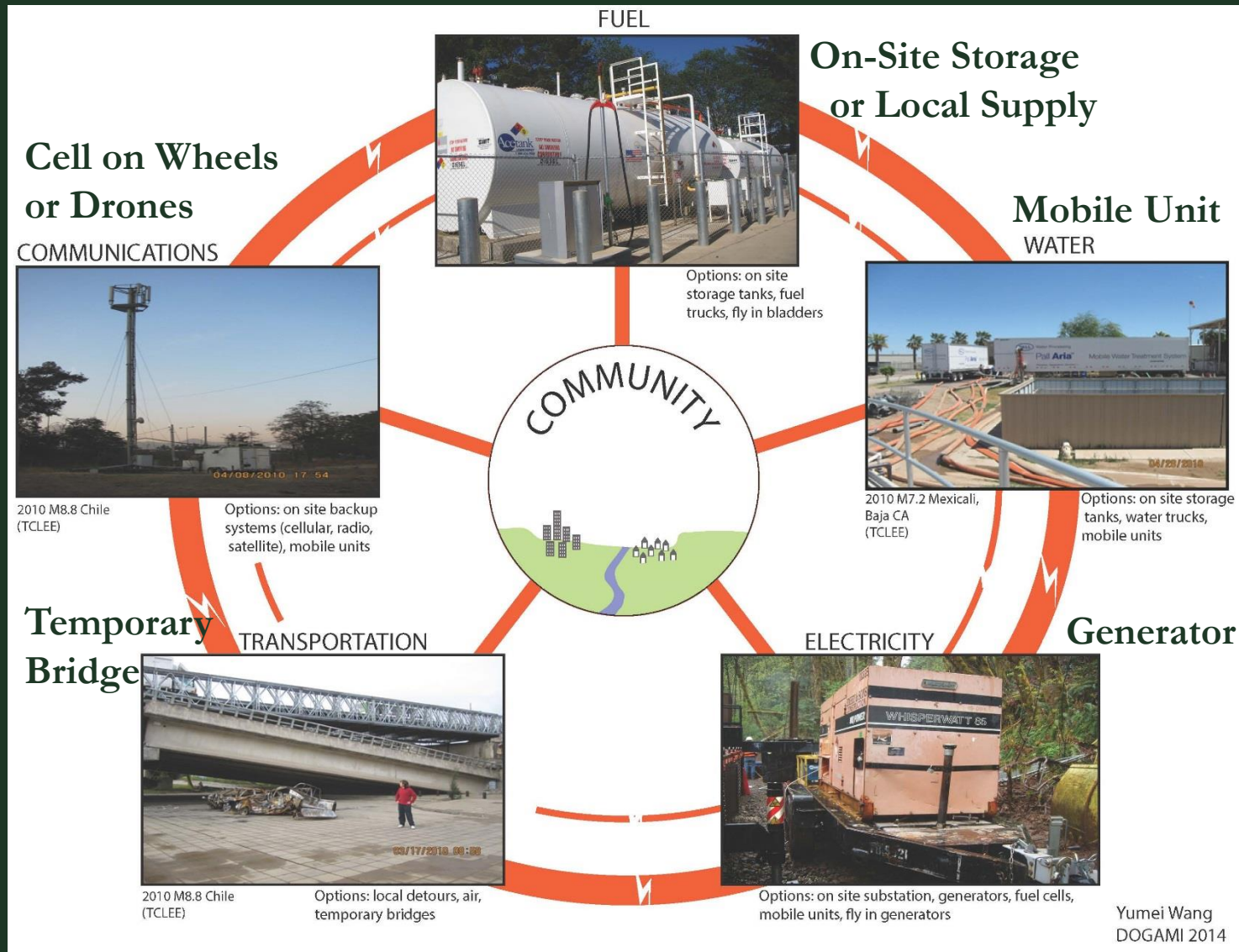
Lifeline Systems “at a glance”



Lifelines During Disaster Conditions

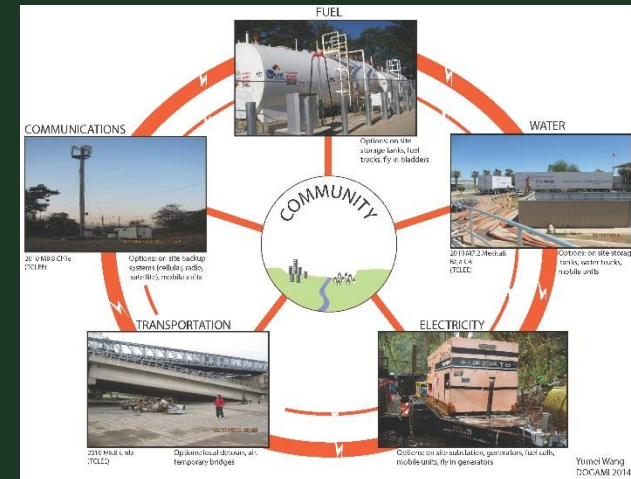
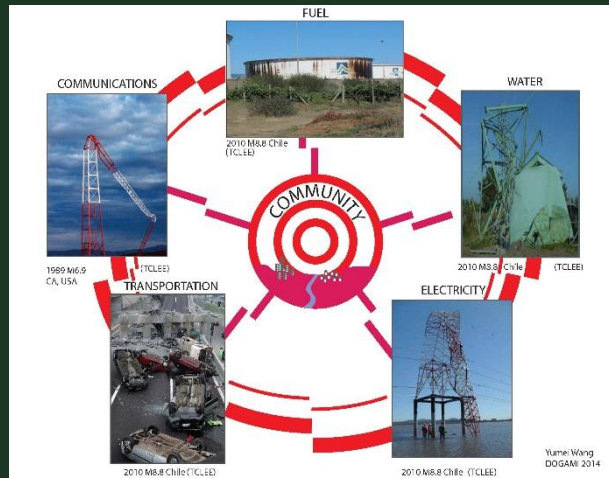
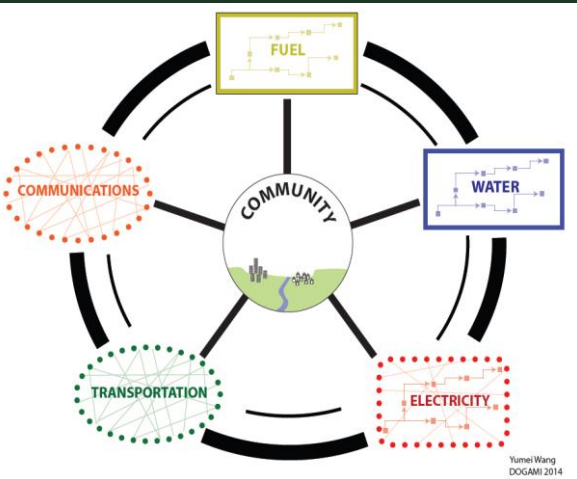


Options During Emergency Response Conditions



Lifelines

Before, During and After Disasters



Normal
Conditions



Disaster Conditions



Emergency Response
Conditions



2018 Coastal Hospitals Resilience Project

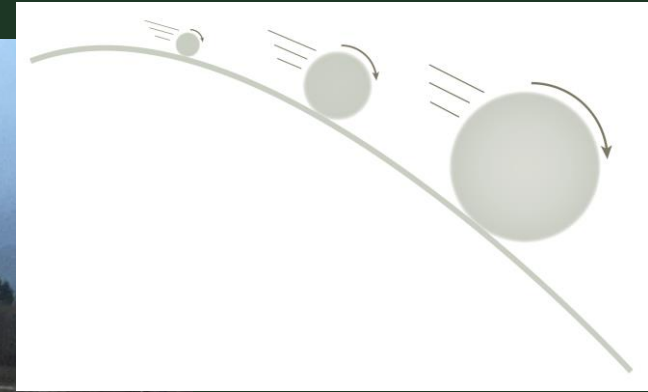


Photo taken 12/9/2015
Permission from: Jordan Phillips

Y Wang 2018



11 Coastal Hospitals



Source of 3 images: DOGAMI

Yumei Wang, DOGAMI, 2018



Need Uninterrupted Fuel Supply

Cascadia
Earthquake
occurs



3 weeks



Stage 1: On-Site Fuel



Source: DOGAMI

Stage 2: Off-Site Fuel



Source: DOGAMI

Stage 3: State Delivers Fuel to County

Oregon Fuel Action Plan



Plan, Prepare, Respond, & Recover
From Severe Fuel Shortages



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What Knowledge to Reduce Risk?

- Post-Cascadia earthquake flood conditions
- Changes in storm patterns and magnitudes
- Storm surge, high tide and riverine flood conditions
- Flood disaster scenarios of energy facilities
- Coastal flood mitigation options
 - e.g., relocation, sea walls, flood barriers

To reduce impacts of flood disasters in the energy sector, we need to be proactive!



www.OregonGeology.org

