What Causes Urban Wildfires? Applying L.A.'s Lessons to Portland

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Introduction

- Reed ‘72
- Graduate studies at PSU and Cornell
- Retired Executive at Portland General Electric
- Principal, McCullough Research since 1991 (incidentally, situated across Woodstock from Reed College)
- Active in Energy and Environmental issues from California to Quebec
- Our client list includes the U.S. Department of Justice, the Federal Trade Commission, utilities, Attorney Generals of California, Illinois, Montana, Oregon as well as Public Utilities Commissions, Large Industries, and First Nations.

What is this presentation about?

- Over the last decade wildfire risk has moved north from Southern California through Oregon and Washington and across the border to British Columbia and Alberta.
- Simultaneously, wildfire risk has moved east from California to Colorado and Texas.
- A year ago, Los Angeles lost two neighborhoods to wildfire and almost lost far more.
- L.A. was largely unprepared even with amazingly complex plans, excellent weather forecasts, and a deep understanding of the risks.

What is this presentation about (continued)?

- The laws, our economic models, and our siloed division of labor were central to the failure to protect Los Angeles County from a $30 billion dollar disaster.
- The primary player, Southern California Edison, had just published a massive (939 page) study on how to mitigate the wildfire risk, recommending equally massive planned expenditures.
- Operational entities with a role to play were less prepared and deeply siloed.
- Portland is smaller and less prepared, but shares many similarities to L.A.
- This is a presentation about the political economy of urban wildfires.

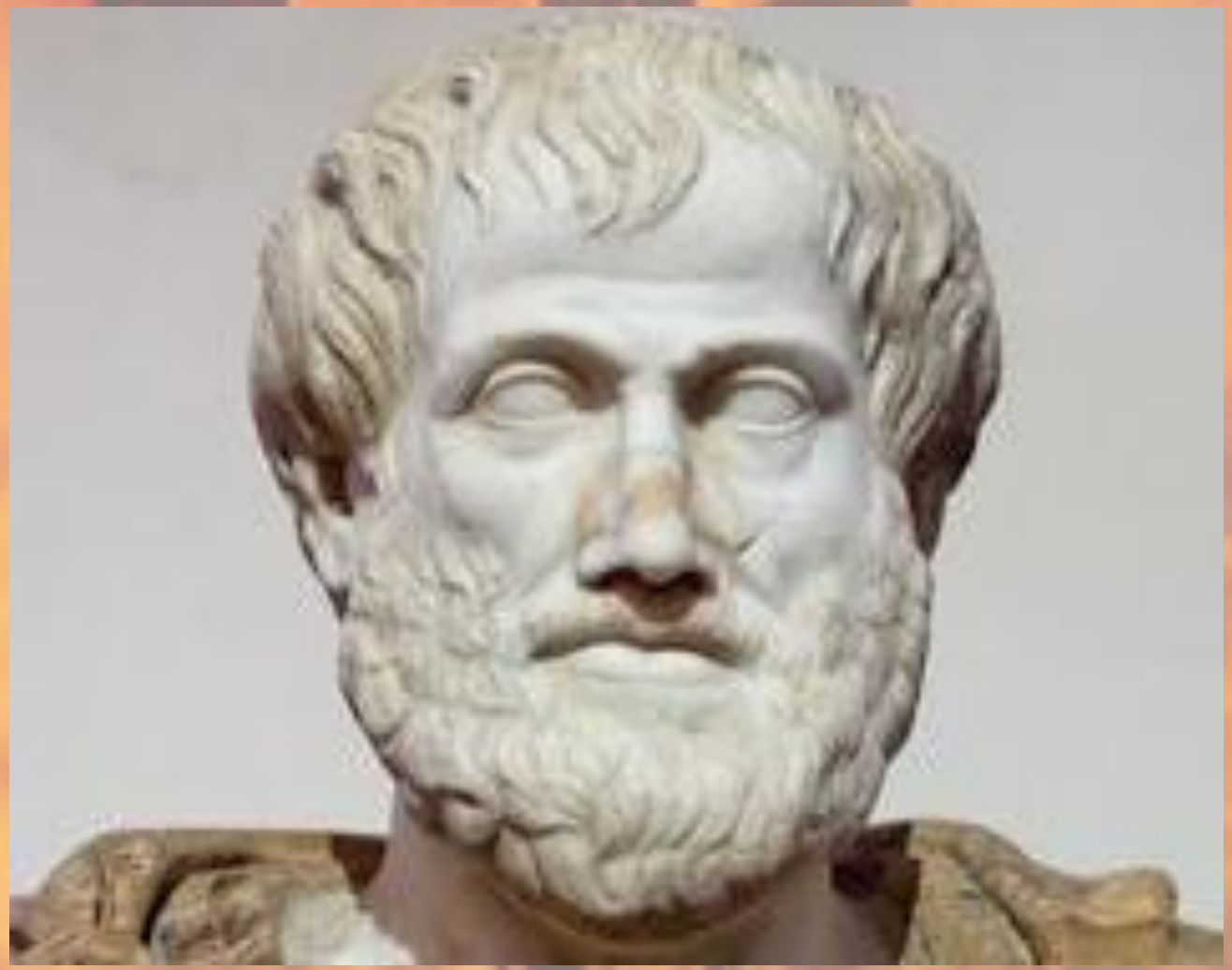
Aristotle's Four Forms of Causation

The material cause or that which is given in reply to the question "What is it made out of?" What is singled out in the answer need not be material objects such as bricks, stones, or planks. By Aristotle's lights, A and B are the material cause of the syllable BA.

The formal cause or that which is given in reply to the question ""What is it?". What is singled out in the answer is the essence or the what-it-is-to-be something.

The efficient cause or that which is given in reply to the question: "Where does change (or motion) come from?". What is singled out in the answer is the whence of change (or motion).

The final cause is that which is given in reply to the question: "What is its good?". What is singled out in the answer is that for the sake of which something is done or takes place.



My talk today is about efficient and final causes

- An engineer would talk today about embers, ignition points, and firebreaks.
- An elected official would focus on tragedy and heartbreaks.
- While we feel for the people who lost their lives in L.A. and the many thousands who are now homeless, we are not engineers, nor are we elected officials.
- I will instead focus on the efficient cause – how do the institutions that operate before, during, and after a wildfire work?
- And, finally, the final cause – the political economy of urban wildfires.

Why use a vintage term like “political economy”?

- The definition of “political economy” is:

  Political economy is the study of the relationships between individuals, society, markets, and the state, focusing on how political and economic factors influence each other.

- We will touch on philosophy (very briefly), history, law, politics, and economics since these help explain what went wrong in Los Angeles and could go wrong in Portland.
- I was taught many years ago to start a talk with the conclusion: in a world of rapid climate change, it is important to anticipate problems, not just react after they arrive on our doorstep. We need to anticipate a wildfire less than a mile away might take place this summer affecting Sellwood/Brooklyn and possibly neighborhoods to their east.

Why are we discussing this here and now?

- Reed College is less than a mile from Oaks Bottom, the second largest High Risk Wildfire Zone in central Portland.
- The Sellwood, Eastmoreland, and Reed neighborhoods are similar in size to the Altadena neighborhood destroyed in the Eaton fire a year ago.
- During hot, dry, and windy periods, steep hillsides are a specifically challenging terrain for controlling wildfires.
- Portland has not deployed standard tools and plans to address wildfires on the Oaks Bottom area.

Let’s start with the Eaton wildfire

- The Eaton wildfire started on the hillside above a middle-class neighborhood east of Los Angeles named Altadena on January 7, 2025, at 6:10 p.m.
- Coincidentally, McCullough Research worked with Ivan Penn of the New York Times, and a high-tech fire detection firm named Whisker Labs to pinpoint the location and time of the Eaton Fire ignition. We can identify the actual time down to milliseconds.
- The fire quickly engulfed the hillside and reached the first homes within thirty minutes.
- Seventeen people died and 9,147 structures were destroyed at a loss of $27.5 billion dollars.

Today, in seeking the efficient and final causes, the heartbreak and drama aren't central

- The real question is how did so many smart people get this so wrong?
- And once we understand that, what do we fix so it doesn't happen here?
- Spoiler alert, we are less than a mile from the second largest High Risk Fire Zone in Portland. The zone, Oaks Bottom, has no ignition surveillance or state of the art risk analysis.
- Probably the most sophisticated wildfire planning exercise in the world was performed by Southern California Edison just a month before the fire.
- SCE's extensive planning and expertise efforts were not effective.

Where do we start?

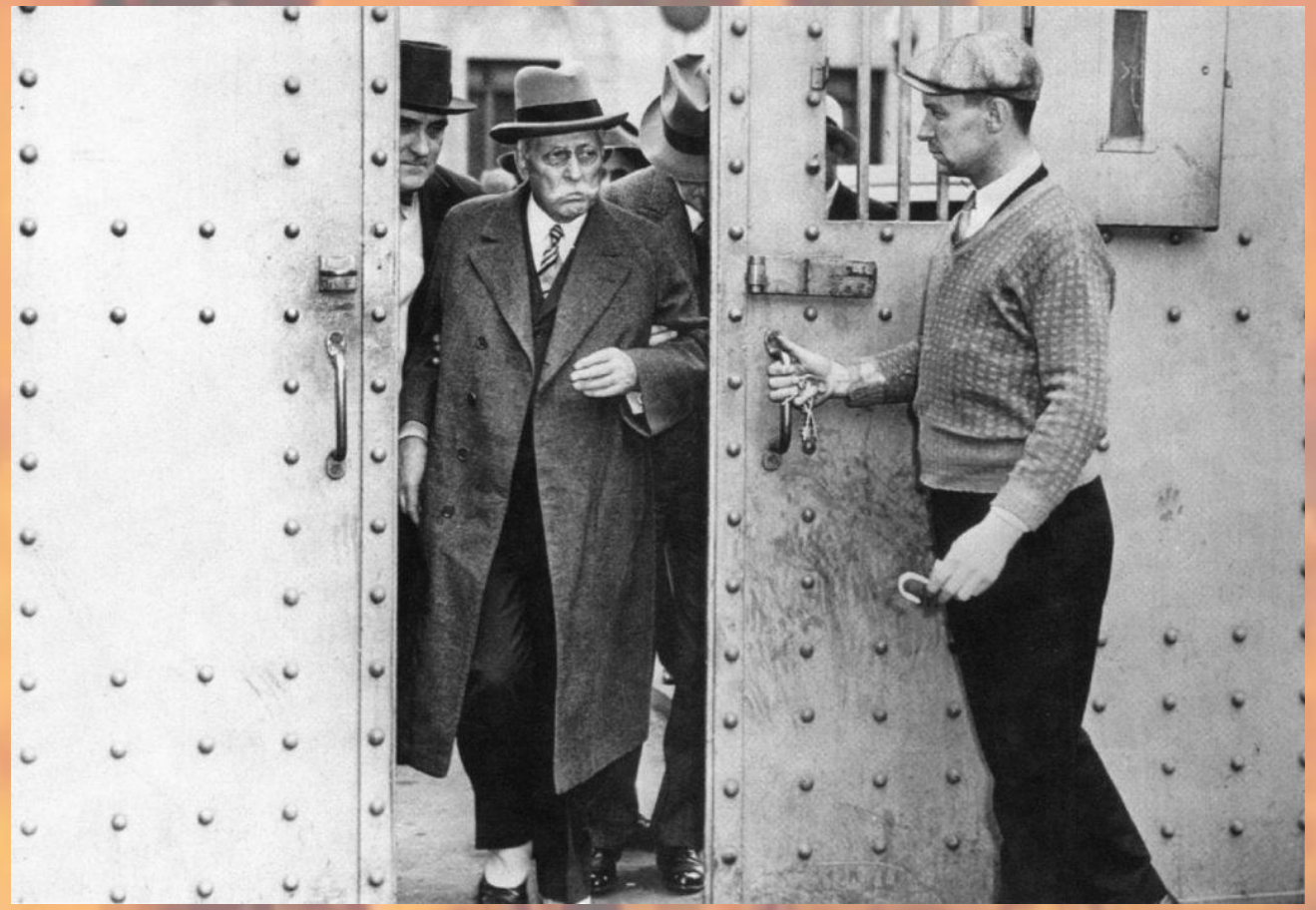
- Not at the ignition of the fire. Once the fire starts, the story is generally close to over.
- The best place to start is where the conditions that enabled the fire and resulting disaster started.
- There are three major ignition causes of wildfires:
  - Human error
  - Nature
  - Utility Infrastructure
- Not surprisingly, utility infrastructure has been the highest profile and is the easiest to address, so let's start with that.

Electric Infrastructure in North America was effectively the work of Samuel Insull

- Sam Insull was Thomas Edison's secretary (man of business) who commercialized the electric business until his empire collapsed and he was imprisoned for fraud during the Great Depression.
- He basically sold utility bonds. He built an industry with very safe bonds.
- He singlehandedly created the industry, wrote the laws, raised the capital, and invented the regulatory model we have today.
- In 1898, he proposed a regulatory model where ratepayers effectively guaranteed utility borrowing. He also created state-level regulation to avoid abuses by the utilities.

Sam Insull leaves Cook County Jail in 1932

- You are more familiar with this picture – and, yes, this is the figure from the Monopoly game.
- The cost-plus structure he invented and implemented dominates the industry today.
- State level regulation keeps consumer prices in check.
- Utilities are discouraged in this structure from solving problems in advance, since regulators may not approve the costs.
- The rule "it is better to ask permission than forgiveness" is baked into the cost-plus structure.



Jumping ahead to 2016: Tehachapi Renewables Transmission Project (TRTP)

- A number of different parties collided on the TRTP:
  - California Public Utilities Commission who limited the cost to $1.8 billion.
  - Southern California Edison who had the incentive to seek the lowest possible costing path.
  - The U.S. Forest Service who leased the path.
  - Altadena, the neighborhood that faced the greatest risk from an infrastructure based wildfire was largely uninvolved.
  - Of course, when the project started in 2008, the wildfire danger was not yet recognized. The disastrous Campfire events did not take place until 2018.

January 7, 2025: The Red Flag Warning from the U.S. Weather Service

- A Red Flag Warning is the most serious warning of an imminent disaster that we have in our toolkit.
- All relevant agencies are put on high alert, shifts reorganized, equipment pre-deployed, emergency communications tested, water supplies readied, and utilities prepared for Public Safety Power Shutdowns (PSPS).
- How did L.A. do on receiving the Red Flag Warning? Not terribly well, fire departments responded fitfully, emergency communications were poor, water supplies were poor, and the only PSPS was on distribution lines.

NEWS RELEASE

FOR IMMEDIATE RELEASE

EXTREME FIRE WEATHER AND MAJOR WIND EVENT PROMPTS INCREASED WILDFIRE RISK FOR LA COUNTY COMMUNITIES

Los Angeles, CA – With critical fire weather conditions and a major wind event forecasted to affect Southern California beginning this afternoon, January 7, 2025, through tomorrow, January 8, 2025, the County of Los Angeles Fire Department (LACoFD) has implemented its augmented staffing plan by ordering additional staffing and pre-deployment of ground and aerial resources throughout Los Angeles County.

According to the National Weather Service, high wind warnings will go into effect today for much of Los Angeles County and Ventura County. The mountains may see gusts from 65 to 80 miles per hour (mph), with local gusts near 100 mph. Coastal and valley areas may see gusts between 60 and 70 mph. The peak of the wind event is forecasted from 10:00 p.m. this evening to 10:00 a.m. tomorrow.

The LACoFD reminds residents living in wildfire-prone areas to take appropriate precautions:

- **See something, say something.** Report any sign of smoke or fire immediately to your local fire department by dialing 9-1-1. If you dial 9-1-1 from your cell phone, be sure to know your location.
- **Have your *Ready! Set! Go!* Wildfire Action Plan in place.** It is critical for residents to be familiar with the *Ready! Set! Go!* program that provides important pre-planning and evacuation information.
- **Prepare for Public Safety Power Shutoffs.** During elevated weather conditions, utility companies may temporarily shut off power in high-risk areas. Please plan for this possibility and consult with your local utility company for more information.

To download the *Ready! Set! Go!* Wildfire Action Plan and view informational how-to videos, please visit fire.lacounty.gov/rsg.

Hindsight is always best

- What should have happened?
  - The property rights of Altadena should have been considered and protected.
  - The U.S. Forest Service should have been responsible for the uses and risks of their property.
  - The California Public Utilities Commission failed to consider the implications of their decision, not just the cost.
  - Southern California Edison should have shown a prescient understanding of the $27.5 billion dollar disaster that was about to unfold.
- What did happen?
  - All parties were unprepared for the Eaton Fire.
  - SCE faces enormous financial risk under the poorly understood Inverse Condemnation doctrine.

What is a Public Service Power Shutoff?

- Just before a fie is ignited and just afterwards, the utility can implement a Public Safety Power Shutoff (PSPS).
- It is important to note that the only significant operational tool that a utility has in wildfires is turning off the power.
- Every other measure discussed in SCE's plan is prospective – vegetation control, new detection equipment, reinforced overhead lines, insulating lines, and undergrounding lines.
- This, in itself, is very risky since our society runs on electricity.
- Was the Tehachapi Renewables Transmission Project de-energized before or after the Eaton fire ignited?
- No.

Why?

- California ISO policies are calm and procedural. Wildfires are not.
- The ISO's Fact Sheet states:

  "What is the role of the California Independent System Operator (ISO)?

  The utilities determine whether to de-energize electrical lines in the interest of public safety. As the power grid operator for much of the state, the ISO is notified by the utility of the decision to de-energize transmission lines, typically 72 to 48 hours in advance of the outage."

Possible PSPS System Problems

- In 2021, the California ISO conducted an extensive set of studies on de-energization events and system stability.
- As far as we can determine, the ISO's analysis of PSPS in 2021 is the only set of transmission studies ever kept confidential.
- "Due to the Participating Transmission Owners' request for confidentiality on the identity of the transmission lines that were de-energized as a result of PSPS or fire events, the ISO does not provide the transmission line names here but only the number of counts of de-energized transmission lines based on voltage levels."

The Inverse Condemnation Doctrine

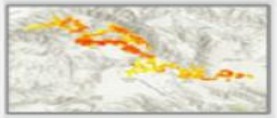
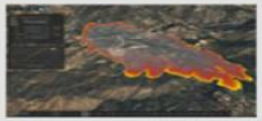
- Under this doctrine, the infrastructure owner is responsible for the damages.
- In practice, the damages are so great, that a political solution is found to allocate the damages between the utility, the ratepayers, and the tax-payers.
- Unfortunately, while this approach is a practical political solution, it is bad public policy because it shields the decision makers from the full cost of their decisions.
- This is what has happened here. We are waiting for the courts to decide the outcome.

SCE's November 2024 Wildfire Mitigation Plan

- On November 6, 2024, two months before the Eaton fire, SCE released its 939 page plan to address wildfires.
- By any standard this is an extremely comprehensive plan.
- It includes supercomputer clusters, drones, new technologies, sophisticated models for weather, wildfire events, and the value of lives and property at risk.

The heart of the plan is the risk analysis

Figure SCE 4-02 - Evolution of SCE's Wildfire (and PSPS) Risk Modeling[16]

2018 GSRP	SMAP / RAMP	2019 WMP	2021 GRC Track 1	2020-2022 WMP	2021 WMP Update	2022 WMP Update/ 2021 GRC Track 4/ 2022 RAMP
• Fault-to-Fire Mapping • Mitigation-to-Fault Mapping • Mitigation Effectiveness / Cost Mitigation Ratios • High Fire Risk Area (HFRA) Definition	*System-wide* • Bowtie (Drivers, Outcomes, and Consequences) • Multi Attribute Risk Score (MARS) • Mitigation Risk Spend Efficiency (RSE)		*Circuit and Circuit Segment Level* • Asset risk prioritization to inform mitigation deployment • Probability of Ignition for Distribution assets • REAX Fire Propagation Algorithm	Fire Incident Analysis (FIPA) • Enhanced Mitigations and Tranching • RSE Calculation Enhancement • Began transition to Technosylva Fire Propagation Algorithm	• Probability of Ignition for Transmission and Sub transmission assets • Inclusion of PSPS reduction to circuit prioritization • PSPS Risk Modeling	• Fire Propagation refinements • Updated fuels model • 400+ additional wind & weather scenarios • Severe Risk Area Methodology
					*Wildfire + PSPS Risk*	

Sept 2018 — Nov 2018 — Feb 2019 — Aug 2019 — Feb 2020 — Feb 2021 — Feb/May 2022

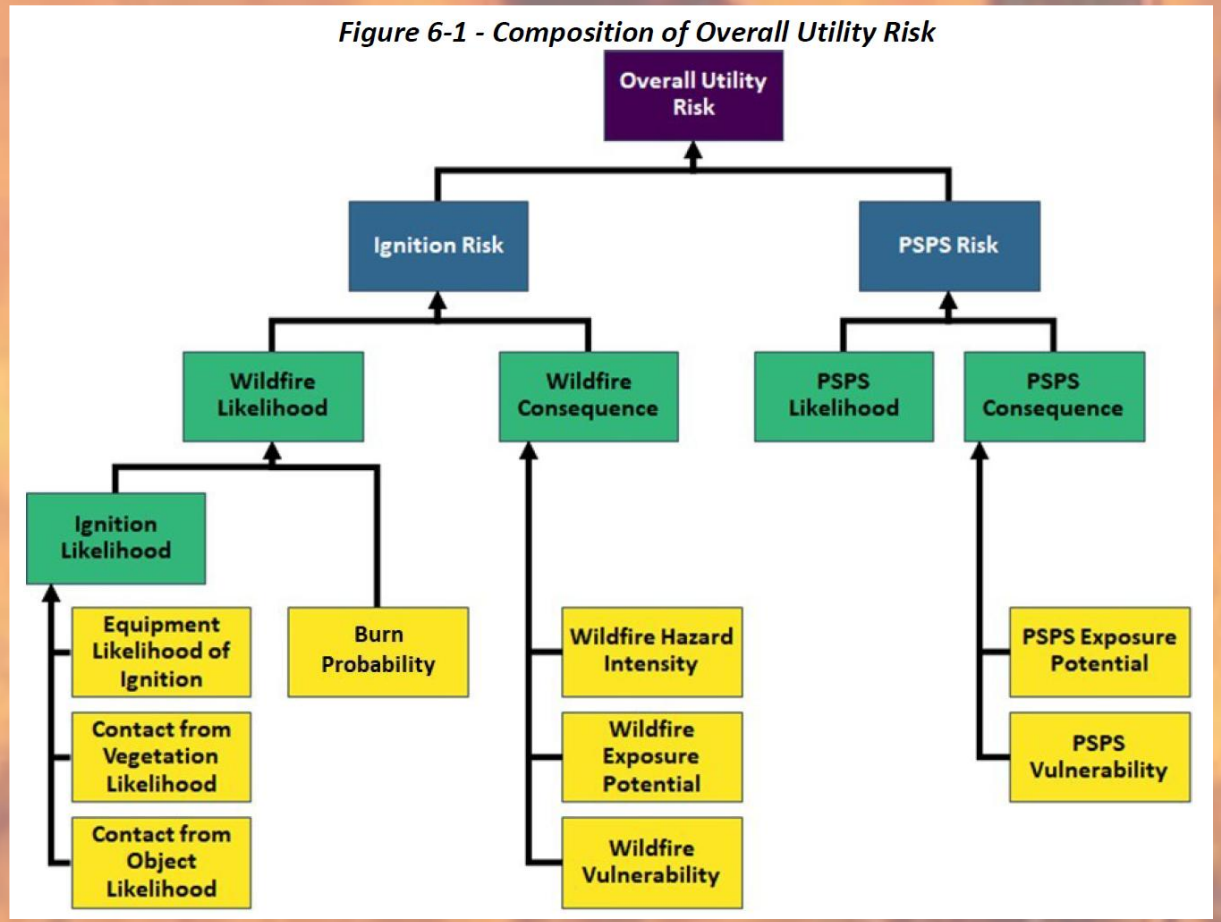
SCE's plan envisaged $2 billion/year for mitigation

Table 4-1 - Summary of WMP Expenditures[12]

Year	Spend (thousands $USD)
2020	Planned (as reported in 2020 WMP update) = $1,308,269 Actual = $1,356,923 ±△ = $48,654
2021	Planned (as reported in 2021 WMP Update) = $1,629,377 Actual = $1,642,980 ±△ = $13,603
2022	Planned (as reported in 2022 WMP Update) = $1,619,252 Actual = $1,599,912 ±△ = $19,340
2023	Planned = $1,869,997
2024	Planned = $1,887,446
2025	Planned = $1,867,889

Risk Framework

Figure 6-1 - Composition of Overall Utility Risk



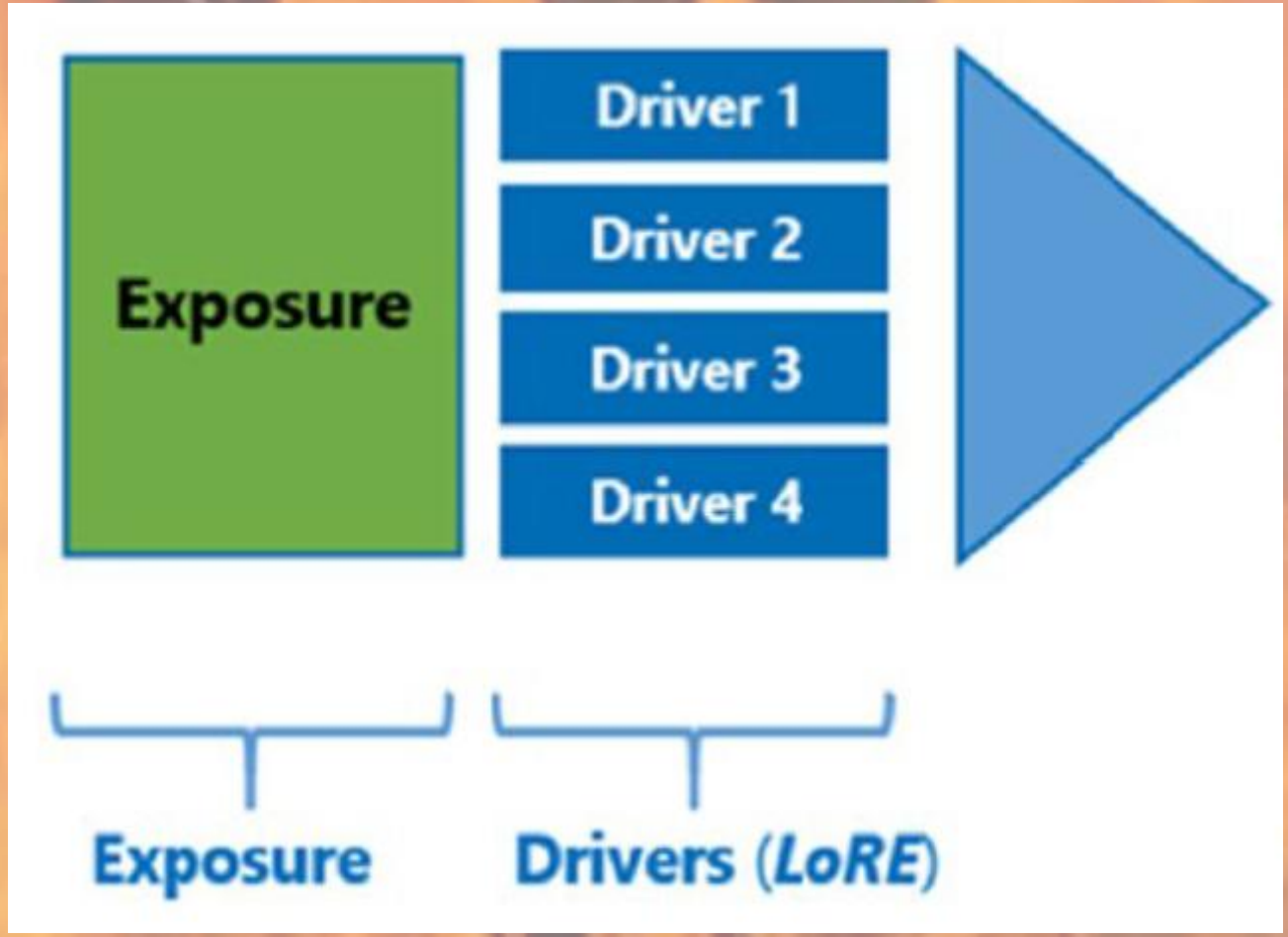
The Risk “Bowtie”

The MARS framework is constructed by using a risk bowtie methodology, as shown below.

Figure SCE 6-02 - Illustrative Risk Bowtie

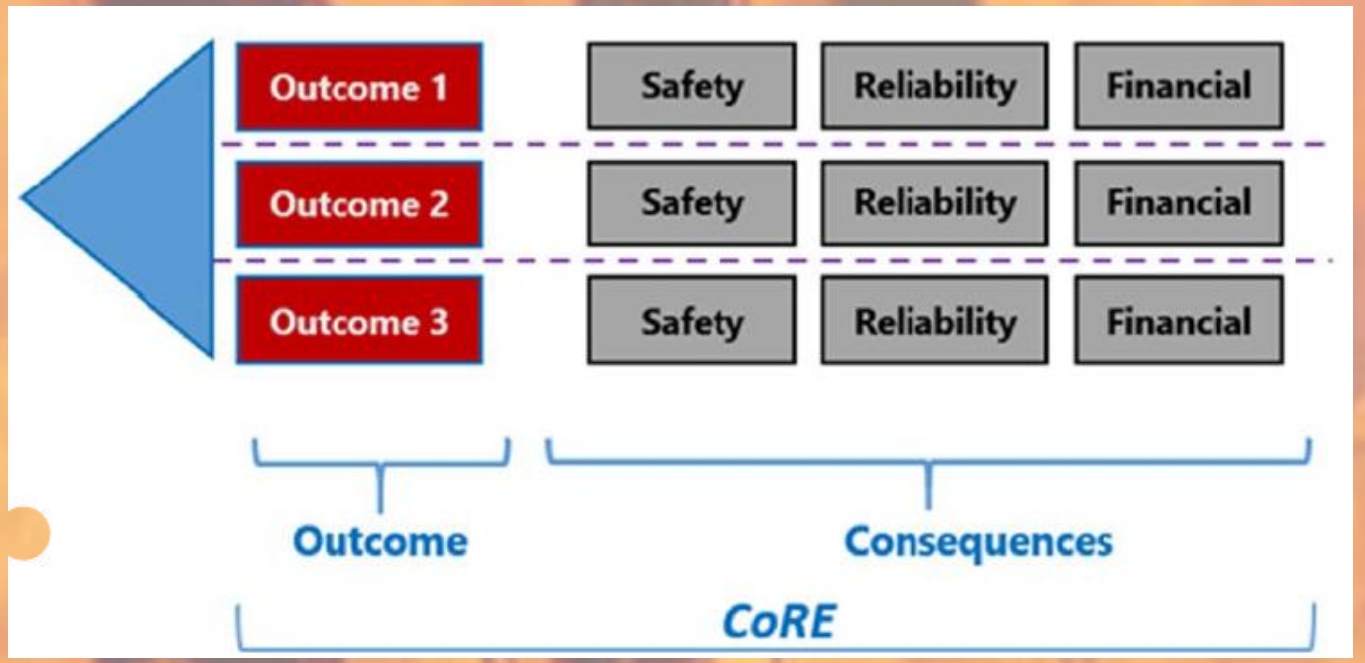
Dissecting the Bowtie

- The left wing of the bowtie is primarily weather and terrain.
- The probability of adverse events -- weather, heat, drought, and wind – is the first step.
- The bowtie must also consider terrain: hillsides are challenging, for example.
- Every part of SCE's service territory was evaluated and sized.



Dissecting the Bowtie

- The right wing of the bowtie is primarily what lives, property, and infrastructure is present in the specific area identified on the left.
- The larger the area identified on the left, the more dire the consequences on the right



The 8 Hour Rule

- The use of a consistent unsuppressed 8 hour burn period allows for direct comparison of the resulting consequences. An eight hour burn period is used to represent the first burn period of which there is certainty in the fuel, wind, and weather conditions at the time of the initial ignition. As evident by CPUC analysis of utility 2019 PSPS events, there is inherent uncertainty in the fuel, wind, weather, as well as suppression, evacuation, and other community response variables beyond the initial burn period.
- **Significant Fires** are simulated fires that, at 8 hours after ignition, burned more than 10,000 acres or had at least one fatality or had at least 50 structures impacted.
- **Destructive Fires** are simulated fires that, at 8 hours after ignition, burned between 300 acres and 10,000 acres with zero fatalities and/or had fewer than 50 structures impacted.
- **Small Fires** are simulated fires that, at 8 hours after ignition, burned less than 300 acres with zero fatalities and no structures impacted.

The Leaning Tower of Pisa effect

- The more complex the computer modeling, the more important to identify the critical assumptions.
- In this case, the risk modeling of the consequences of an ignition along the path of Segment 11 of the Tehachapi Renewable Transmission Project is the critical assumption.
- The 8 hour rule is like the foundation of the Leaning Tower of Pisa's foundation.
- Since the model did not identify the area as a significant fire, SCE did not address mitigation steps such as adding AI equipped surveillance cameras, insulation, undergrounding or Public Safety Power Shut downs.

Is the 8 Hour Rule significant?

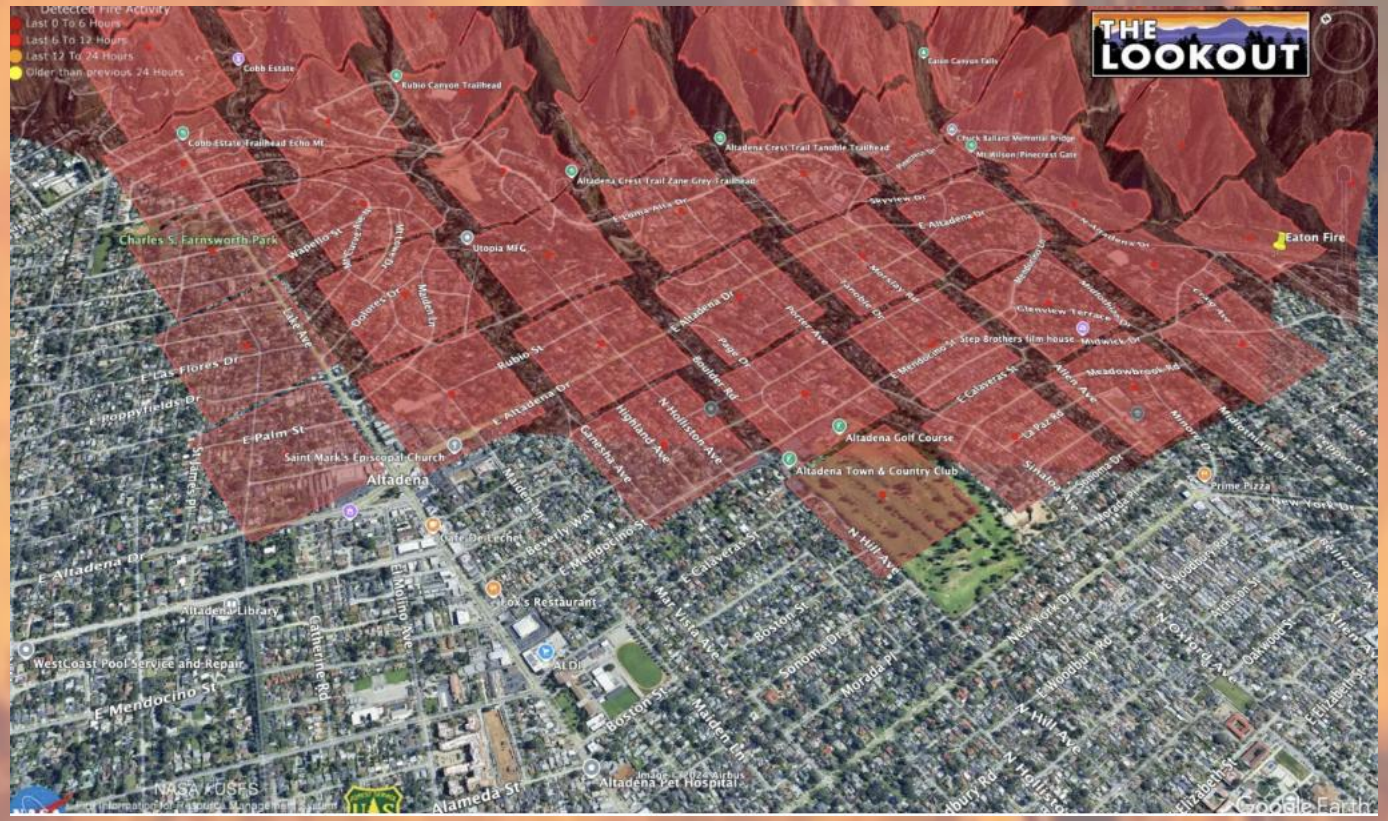
- The causal sequence (back to Aristotle) is assumptions, modeling, consequences, and, finally, mitigation.
- The 8 hour rule “caused” the Eaton fire.
- Is this fair to Southern California Edison? No.
- The 8 hour rule was discussed and adopted at the California Public Utilities Commission and used by SCE (back to Insull.)
- Industry reports indicate that the 8 hour rule is very widespread, if not universal, in utility Wildfire Mitigation Plans.

Actual timeline of the Eaton fire’s first day

The fire's first-day progression was extraordinarily rapid:

- 6:11 PM (Jan 7) — Fault reported on Eagle Rock-Gould 220 kV line to the north.
- 6:18 PM — Fire ignites on the eastern hillside above Eaton Canyon Wash.
- 6:26 PM — Already approximately 10 acres, burning beneath high-tension power lines.
- 6:33 PM — Flying embers setting structures on fire nearly 1 mile away.
- 8:28 PM – CalFire estimates fire at 400 acres – 100acres over SCE’s “High Consequence” classification.
- 10:51 PM — Spot fires reported as far as 2 miles southwest from the origin, in the heart of Altadena.
- 12:07 PM (Jan 8) – Fire has grown to 1,000 acres – SCE’s models imply 200 structures lost.
- 12:47 AM — Fire burning on multiple fronts: hills above Sierra Madre to the east, dense housing blocks a mile from Eaton Canyon to the south, and an expansive western frontier stretching from mountains down to the Altadena Golf Course.
- 6:30 AM — Fire has grown to over 2,227 acres, 0% containment.
- 10:36 AM — Fire exceeds 10,600 acres, still 0% contained.

Satellite imagery of the Eaton Fire at slightly less than 8 hours (red squares show heat)



What should the modelling have shown for the consequences of an 8 hour uncontrolled fire above Altadena?

- This was a significant fire risk that required mitigation:
  - Additional Technosylva risk analysis.
  - Appropriate for a PSPS of Section 11 of the TRTP.
  - Add Pano AI ignition surveillance.
  - Upgrades of the towers along Section 11.
  - Insulation of the lines (if feasible at that voltage).
  - Undergrounding of segments of Section 11.
  - Remove abandoned towers.

Abandoned towers?

- SCE did not remove a series of abandoned, but de-energized towers along Section 11.
- This has caused speculation of an induction effect that started the fire under the abandoned tower. Induction is the action of magnetic fields from the operational transmission causing current to flow on the inactive line.
- Alternatively, faults were detected by WhiskerLabs before the ignition and at the exact moment of the ignition.
- We are still waiting, after fifteen months, for the official analysis.

Positive Reponses to the Eaton fire?

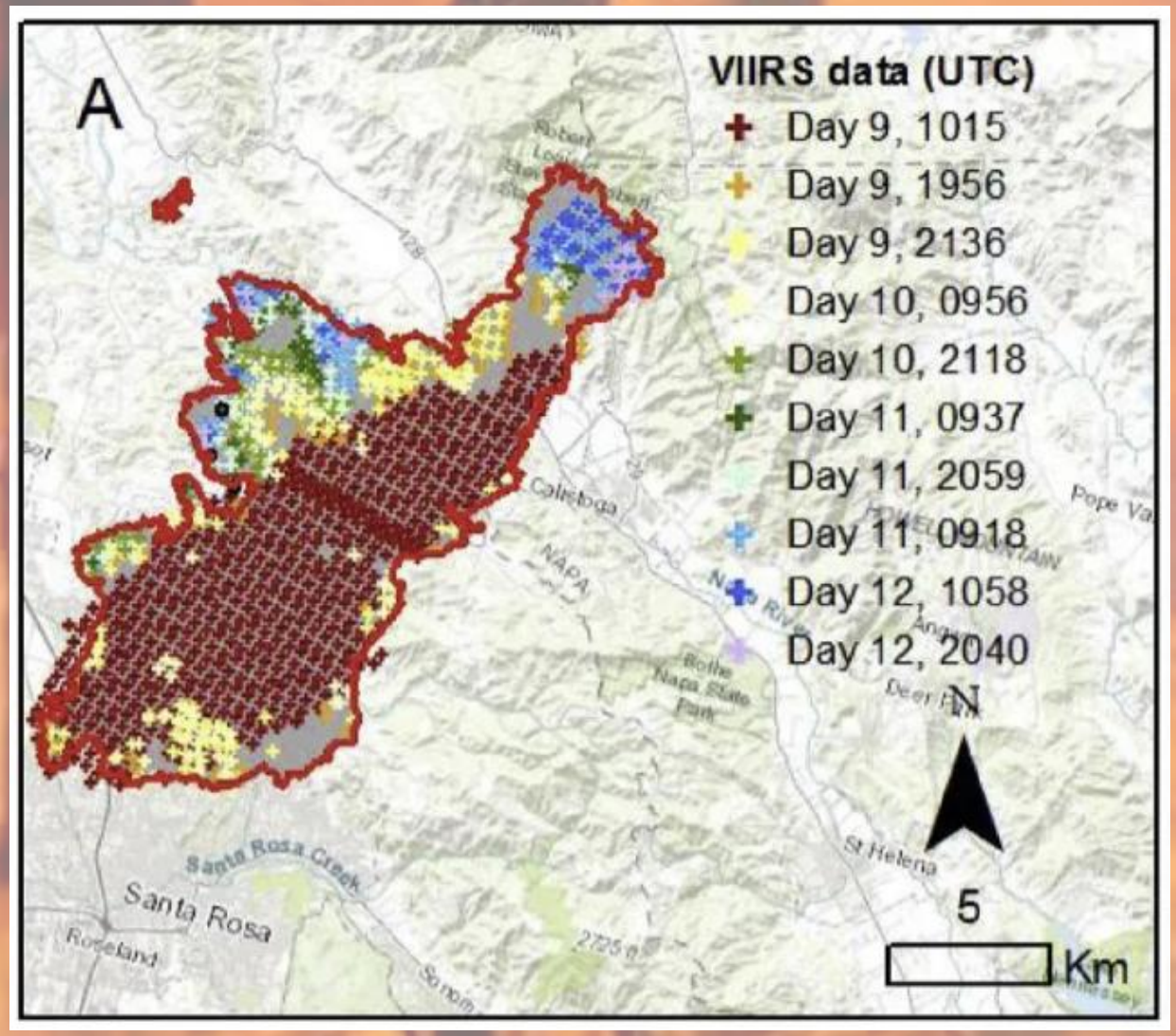
- SCE has committed to substantial undergrounding in Altadena of distribution lines.
  - The cost of undergrounding has been falling.
- As wind speeds increase over time, the distribution system is understood as an increasing area of risk and mitigation expense.
- The technology for real time ignition detecting is expanding.
- Our ability to model fire risk is vastly improved.

New Technologies: Pano AI Ignition Cameras

- Pano AI cameras are tireless scanning devices with the ability to detect smoke and fire.
- L.A. was well equipped with ignition cameras.
- Early warning of an ignition can allow instant response to allow putting the fire out at its source.
- In the case of the Eaton fire, helicopters were dispatched, but were driven away by the high winds.
- An earlier alert might have had the chance of stopping the fire at the transmission tower instead of fighting the fire street by street in Altadena.
- Portland has two Pano AI cameras pointed at the BPA and PGE transmission lines crossing Forest Park.

New Technologies: Technosylva Fire Modeling

- Technosylva has been bringing their technology outside of the utility wildfire planning sector to the firefighting itself.
- This will allow the response to know more and more quickly the conditions they are facing.



Conclusions drawn from the Eaton Fire

- While the scale of SCE's fire modeling is impressive, it clearly and catastrophically missed its mark in Altadena.
- The critical assumption, the size and severity of the Technosylva fire modelling during the first eight hours, was incorrect.
- Since SCE's substantive impacts on the Eaton fire are limited to proactive steps required years before ignition, the assumption was a major point of failure.
- However, the blame must be shared with the regulatory framework that adopted the incorrect assumptions.
- This is a case of it being better to ask permission than apologize built into the Insull regulatory model.

Conclusions (continued):

- The wrong parties were at the table at the wrong times:
  - Fire and water agencies were relatively unsophisticated.
  - Emergency communications were poor.
- Consultation across silos existed, but was painfully insufficient.
- The party with the greatest resources had the smallest role once ignition took place.
- The U.S. Forest Service underpriced the right-of-way for the transmission line which cascaded through the process to provide less investment in fire mitigation during its construction and update.
- The Inverse Condemnation doctrine focuses only on the ignition, not the prevention.

Let’s Turn to Portland, Oregon

- Portland is smaller, much smaller, than L.A. Comparing county to county, L.A. has twelve times the population.
- Portland also has far fewer firefighting staff.
- Both cities are deeply siloed – multiple jurisdictions, utilities, agencies, and bureaus.
- Portland has electrical infrastructure owned by three different utilities – PGE, PacifiCorp, and the Bonneville Power Administration with radically different approaches to wildfire mitigation planning. L.A. has two large electric utilities and a number of smaller municipal utilities.
- Geographically, there are similarities: the West Hills and the Willamette escarpment pose serious ignition detection and firefighting challenges.

How Comparable Are We?

City	Los Angeles, CA	Portland, OR
Population	4.0 million residents	635,000 residents
Firemen / firefighters	3,510 Firemen	843 Firemen
Annual budget	$13.9 billion	$8.6 billion
Area	471 square miles	145 square miles

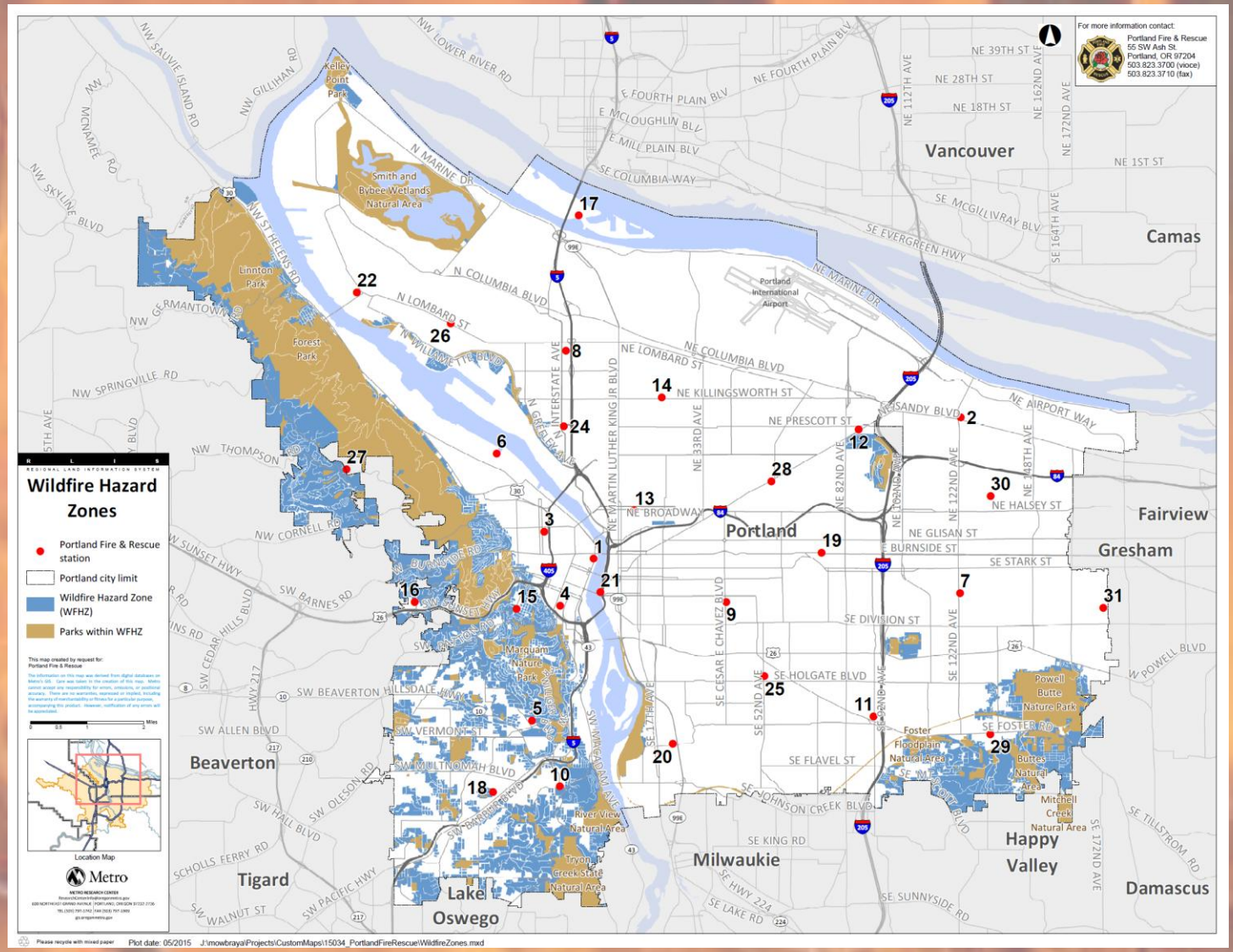
Wind Speeds

- Portland holds a record for the highest urban wind speeds at 116 miles per hour on the Morrison Bridge during the 1962 Columbus Day storm.
- And, yes, this is Portland's city hall.
- Los Angeles winds have had lower extremes – 67 miles per hour in the urban area and 102 miles per hour in the neighboring mountains.

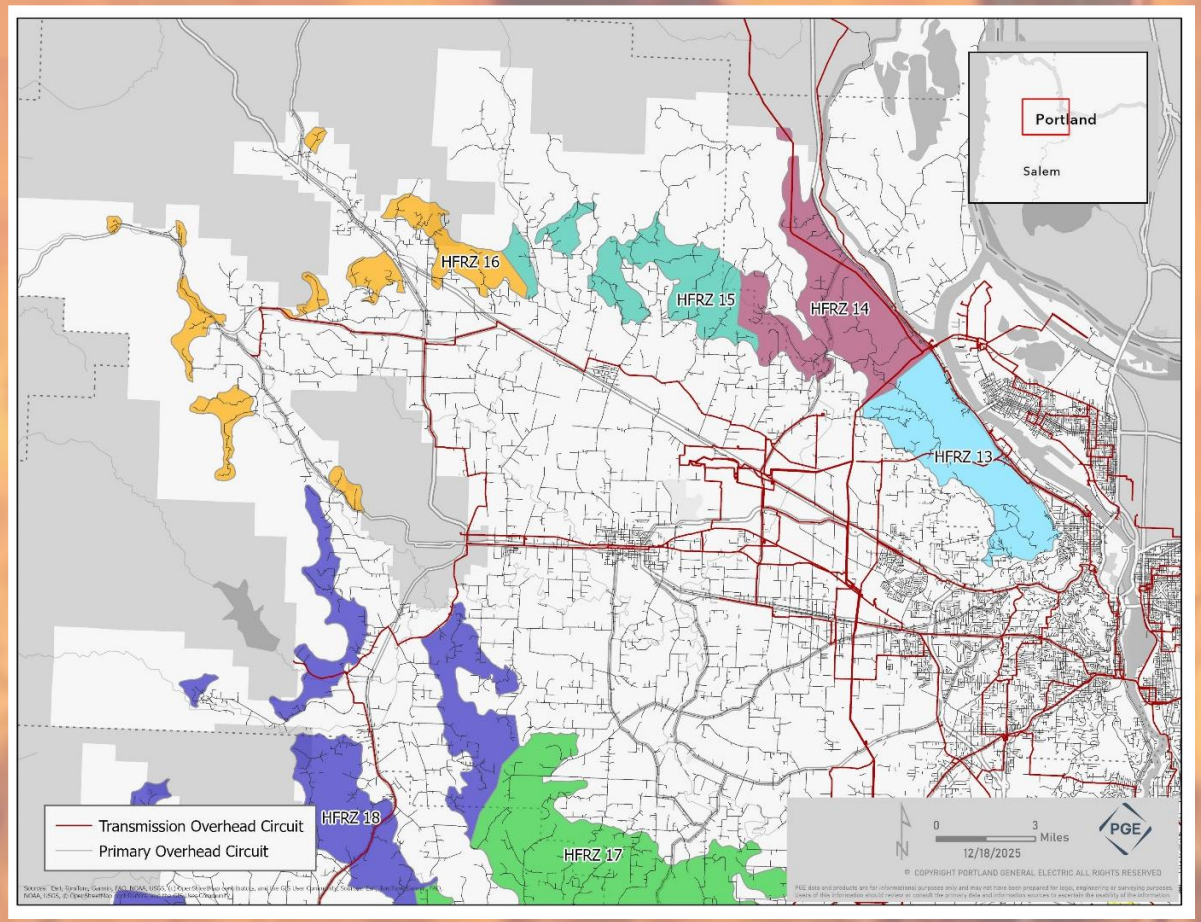
The basic institutional conclusions from L.A. also apply to Portland

- PacifiCorp's fire mitigation strategies have exemplified the "better to seek permission than forgiveness" regulatory challenges. It is currently facing bankruptcy in the ongoing litigation from previous wildfires. The recent Oregon Court of Appeals decision delays but does not eliminate their financial risk.
- PGE poses the greatest infrastructure risk with transmission in both of the major High Risk Fire Zones: Forest Park and Oaks Bottom.
- Like the Eaton fire, the two HRFZs are immediately adjacent to homes and businesses. Forest Park has an additional area of risk since it is adjacent to six miles of petrochemical tank storage farms.

Portland Parks and Recreation's HRFZ Map

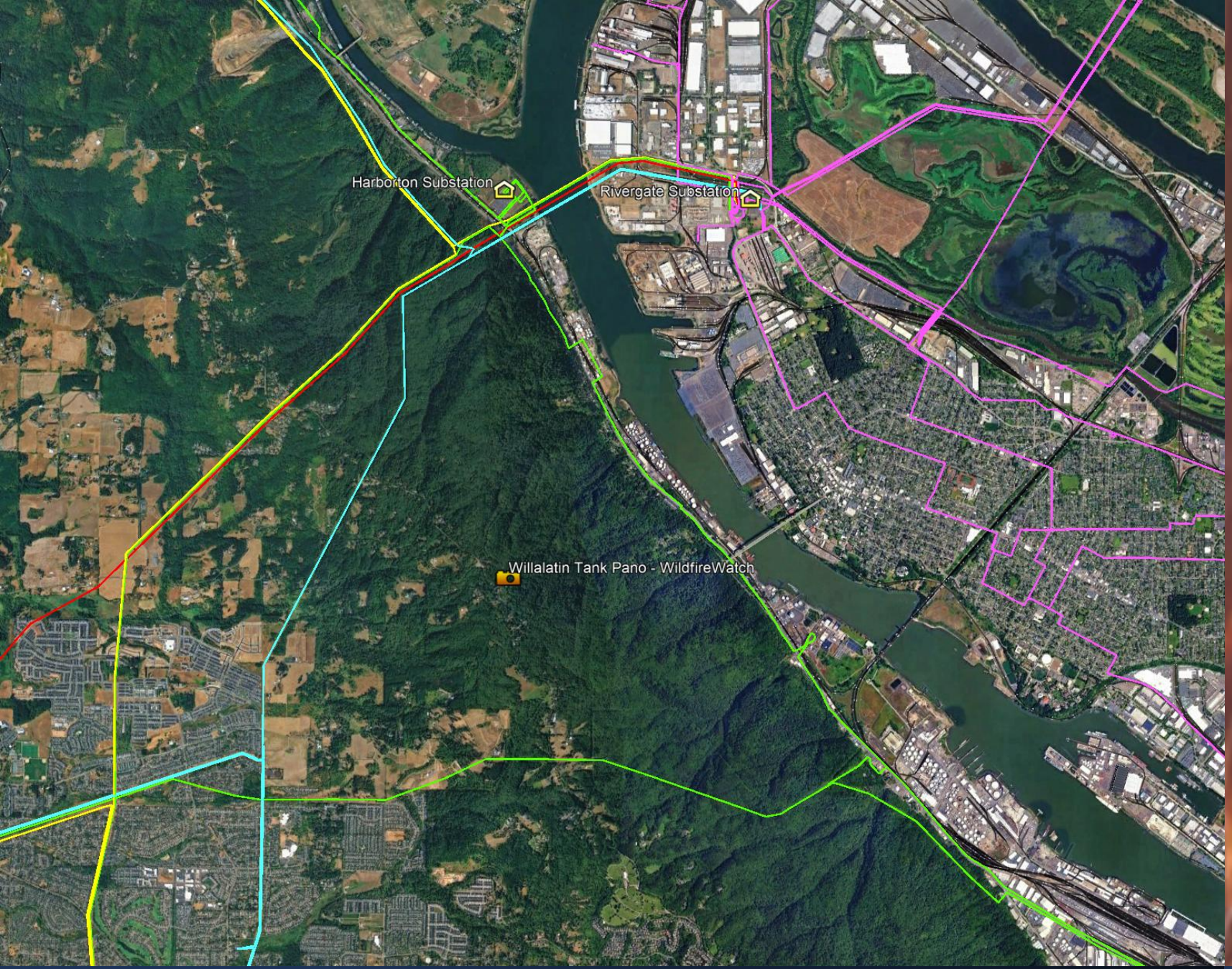


PGE's High Risk Fire Zone Map



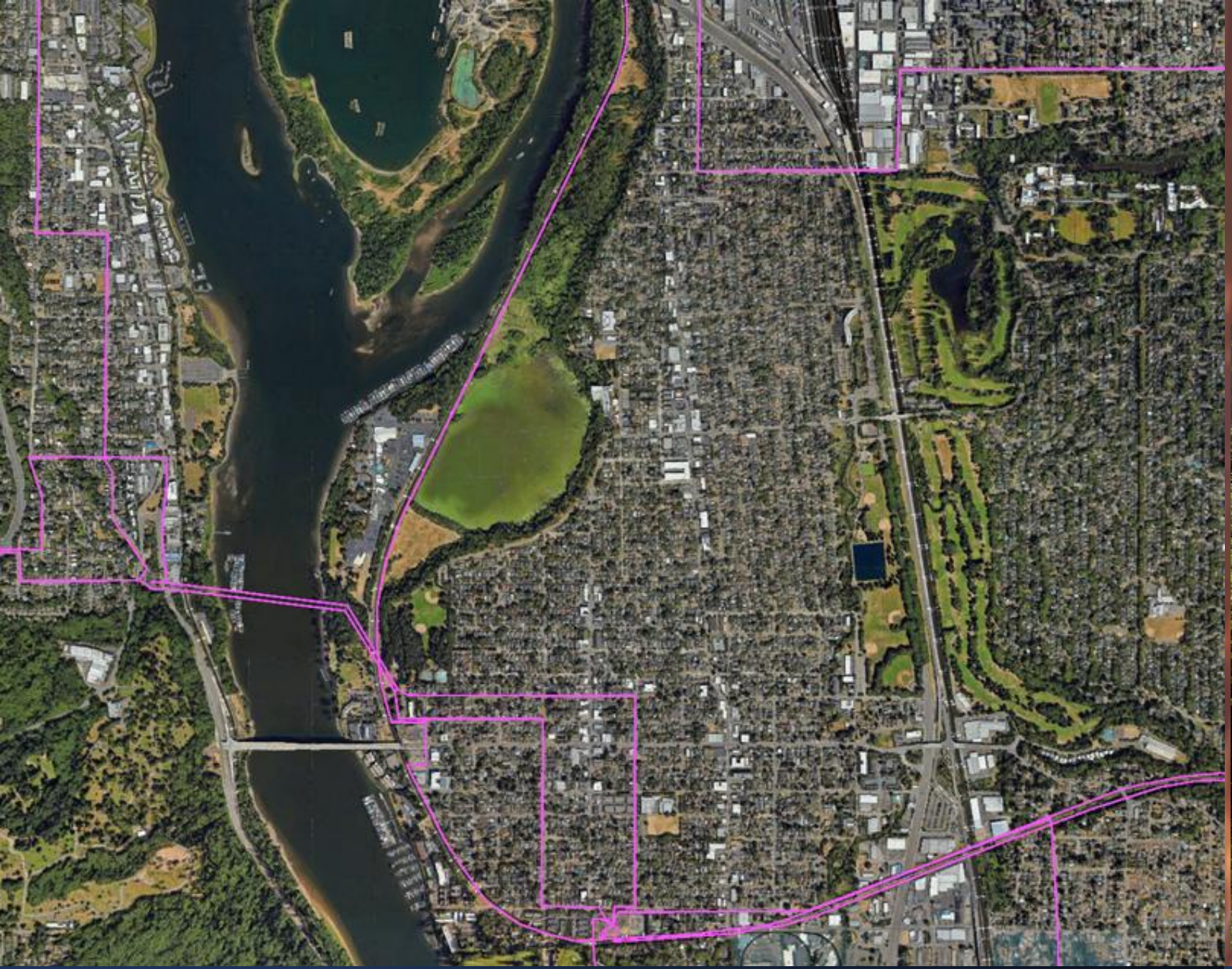
Not surprisingly, PGE and Parks share concerns about Forest Park

- The two entities do not share concerns about the Willamette escarpment, which is not surprising since PGE's transmission lines are less significant along the Willamette escarpment.
- However, PGE has transmission lines that cross the Willamette close to Oaks Park and down the river along the Springwater trail.
- The smaller, but equally dangerous escarpment by the University of Portland is also not on PGE's wildfire zone map.



Transmission lines at Forest Park

Transmission Lines at Oaks Bottom



Oaks Bottom

- While Technosylva is mentioned in PGE's Wildfire Mitigation Plan the focus is Forest Park and the petrochemical tank farms near their Harborton substation.
- Two Pano AI cameras are directed for ignition surveillance towards the lines that cross Forest Park near Harborton.
- Oaks Bottom also has transmission infrastructure risk, but not Pano AI cameras and no mention of a Technosylva risk analysis.
- Like L.A., Portland suffers from "siloing" among disparate governments and companies with different agendas and resources, but inadequate coordination.

Where are we?

- The building we are in is less than a mile from the escarpment above the Springwater Trail.
- On a hot, dry, windy day, the speed of a wildfire is remarkably fast. Indications from the Easton fire are that a mile from ignition was reached in less than thirty minutes.
- In the absence of a Pano AI camera facing east from the hillside above the Sellwood Bridge, the fire could be reaching homes and businesses before the fire station at Bybee and McLoughlin could reach Oaks Bottom.
- The final extent of the Easton fire was roughly the area of Sellwood and Eastmoreland and equally inconceivable before it happened.

Is this a moment to call our Senator and Representative to action?

- Actually, no. U.S. Senator Wyden lives in Eastmoreland and U.S. Representative Dexter lives in Woodstock. They are both cognizant about the increasing urban wildfire risk.
- This really isn’t a political problem, per se.
- To return to the analysis and conclusions of the Seaton fire, it is a problem of political economy. Our situation is so very similar to the Eaton fire that the possible outcome might well be as severe.
- Mentioning the issue to your city council member might be more appropriate. The eastern shore of the Willamette also needs Technosylva risk assessments and Pano AI cameras.

What is to be done?

- Vladimir Lenin asked this question in 1902 and caused quite a stir.
- Our issues are not quite so severe.
- However, we do need a more proactive regulatory approach – hindsight is precise, but expensive when emergencies cost lives and vast economic losses.
- The pricing of right of ways needs to reflect the underlying risk, not a nominal amount that transfers the risk from the property owners to the ratepayers of the utilities.
- Silos are a persistent problem in Portland (as they are in L.A.) and need to be addressed.

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