Understanding the Fire Risk in California's Power Grid

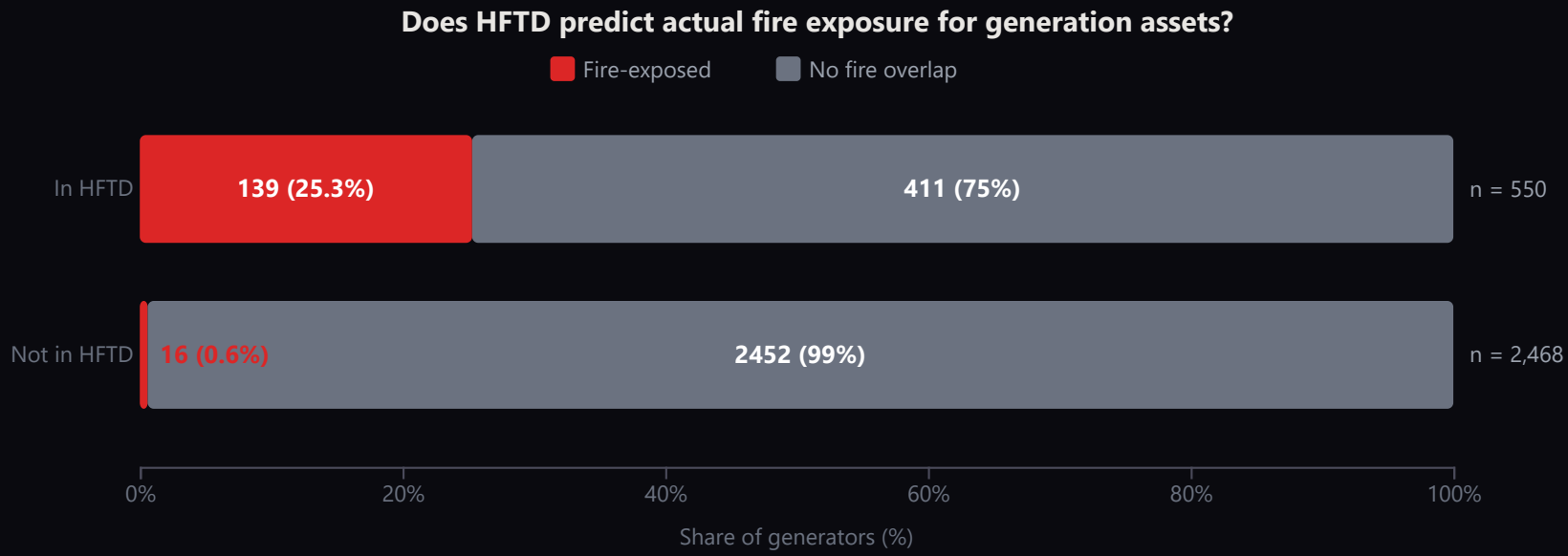
Part 1 of a series on California's energy grid and wildfire risk

Igor Geyn · April 2026

Full analysis: igorgeyn.com/blog

Does HFTD Predict Actual Fire Exposure?

100% stacked bars comparing HFTD-designated generators vs. non-HFTD against 25 years of fire perimeter history. HFTD captures 89.7% of fire-exposed generators—but 75% of HFTD generators have never seen fire.

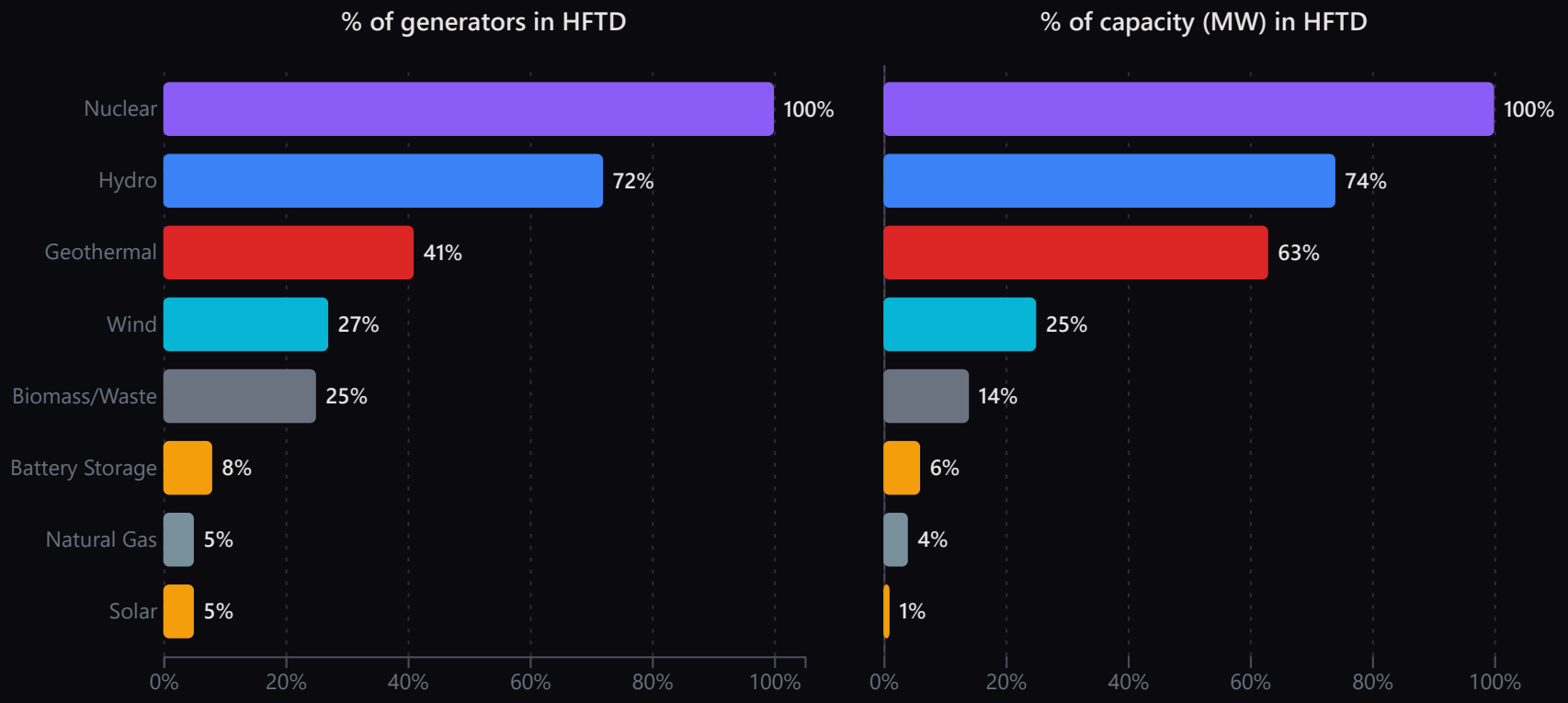


Why this matters: HFTD casts a deliberately wide net for ignition risk. It rarely misses a fire-exposed generator (only 16 out of 155), but three-quarters of the generators it designates have no fire history in 25 years. For generation assets, HFTD is conservative—informative but incomplete.

EIA-860 (2024), CPUC HFTD Tier 2/3 (2024), CAL FIRE FRAP perimeters ≥100 acres (2000–2024). n = 3,018 generators.

Which Technologies Sit in Fire Threat Zones?

Share of generators and capacity in HFTD by technology. Nuclear: 100% in HFTD, 0% fire history. Hydro: 72% in HFTD, 19% fire-exposed. Solar and gas largely outside fire zones.

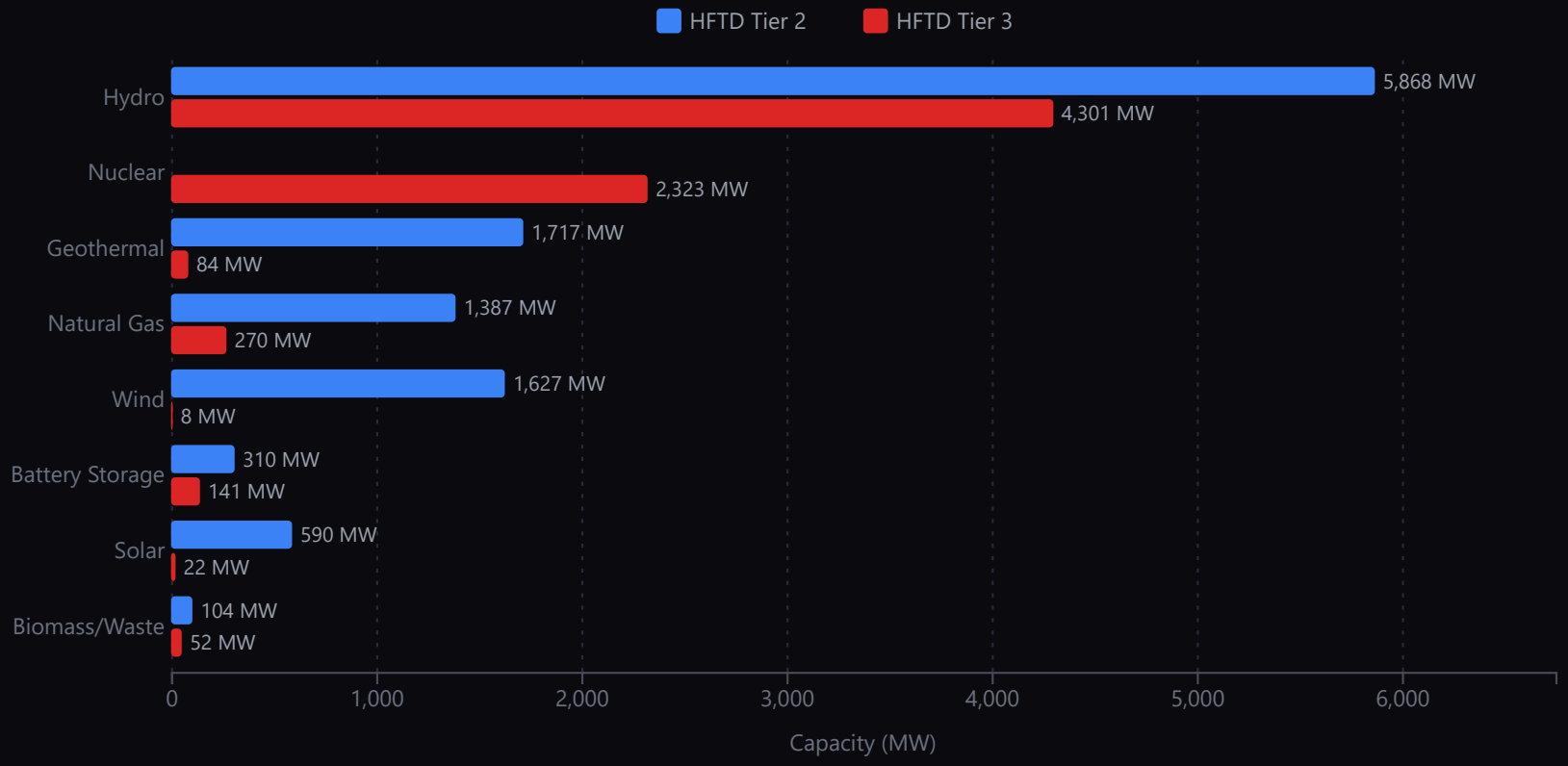


Why this matters: Fire risk to generation is not uniform—it concentrates in hydro (mountain canyons) and legacy siting. The clean energy buildout (solar, batteries) is largely happening in fire-safe terrain by geography, not by regulation.

EIA-860 (2024) for generator locations and capacity; CPUC HFTD (2024) for fire threat designation.

How Much Capacity Sits in Fire Threat Zones?

Installed generation capacity (MW) in HFTD Tier 2 (elevated) vs. Tier 3 (extreme) by technology. Hydro dominates with over 10 GW at risk, followed by nuclear (2,323 MW in Tier 3).

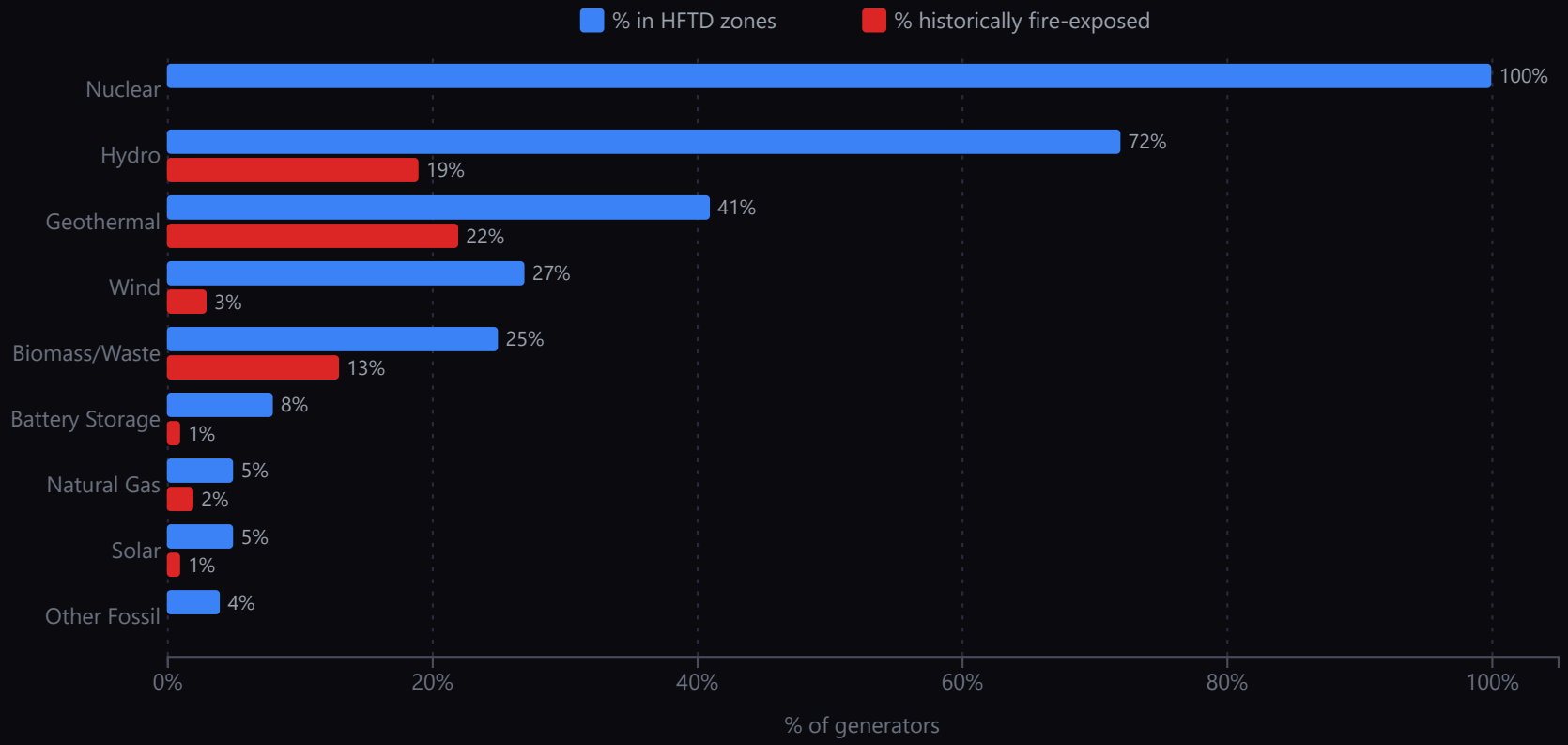


Why this matters: Hydro is California's largest source of dispatchable clean energy—and its most fire-exposed. The Creek Fire put 90% of the Big Creek system (904 MW) inside a fire perimeter in a single event.

EIA-860 (2024) for capacity; CPUC HFTD (2024) for tier designation. Sorted by total fire-zone capacity.

HFTD Designation vs. Actual Fire History

The gap between HFTD designation rates and actual fire-perimeter exposure reveals where HFTD over-designates. Hydro and geothermal track closest; nuclear and wind show the largest gaps.

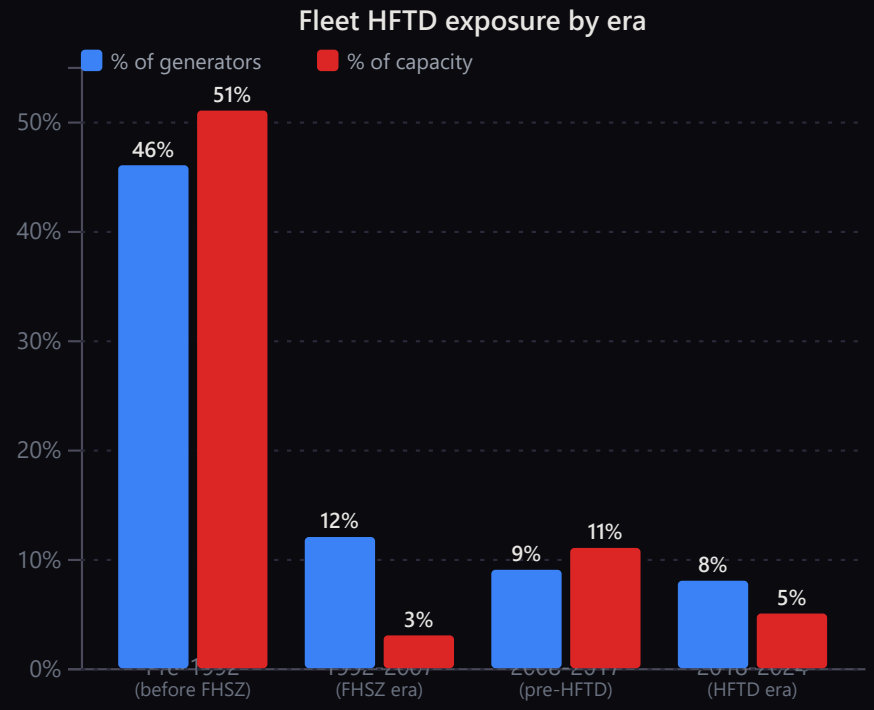


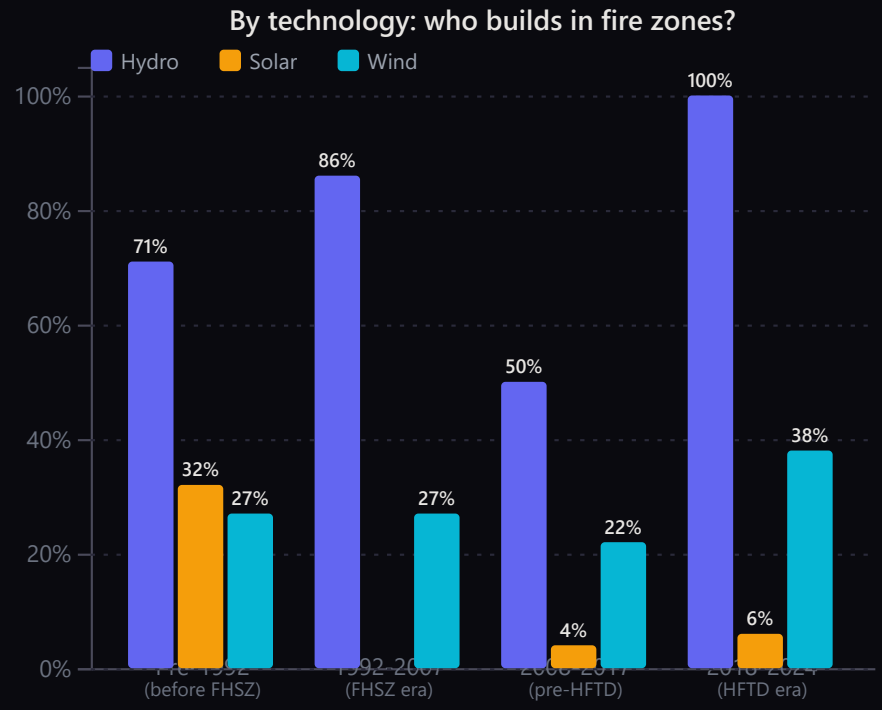
Why this matters: HFTD reliably identifies fire-exposed hydro plants (zero false negatives for hydro). For other technologies, the map substantially exceeds observed fire exposure—a consequence of applying an ignition-risk map to a fire-arrival question.

EIA-860 (2024), CPUC HFTD (2024), CAL FIRE FRAP (2000–2024). Fire-exposed = generator coordinates inside a recorded fire perimeter.

Has Generation Siting Shifted Away from Fire Zones?

HFTD exposure by commissioning era. The overall rate dropped from 46% (pre-1992) to 8% (HFTD era)—but this reflects a technology transition (hydro to solar), not a fire policy response.



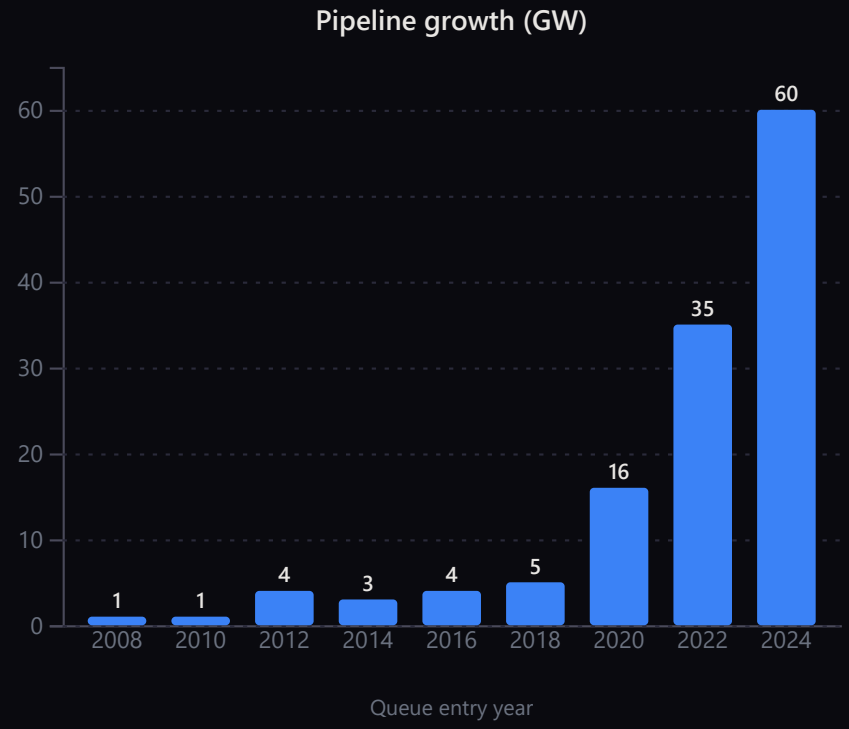


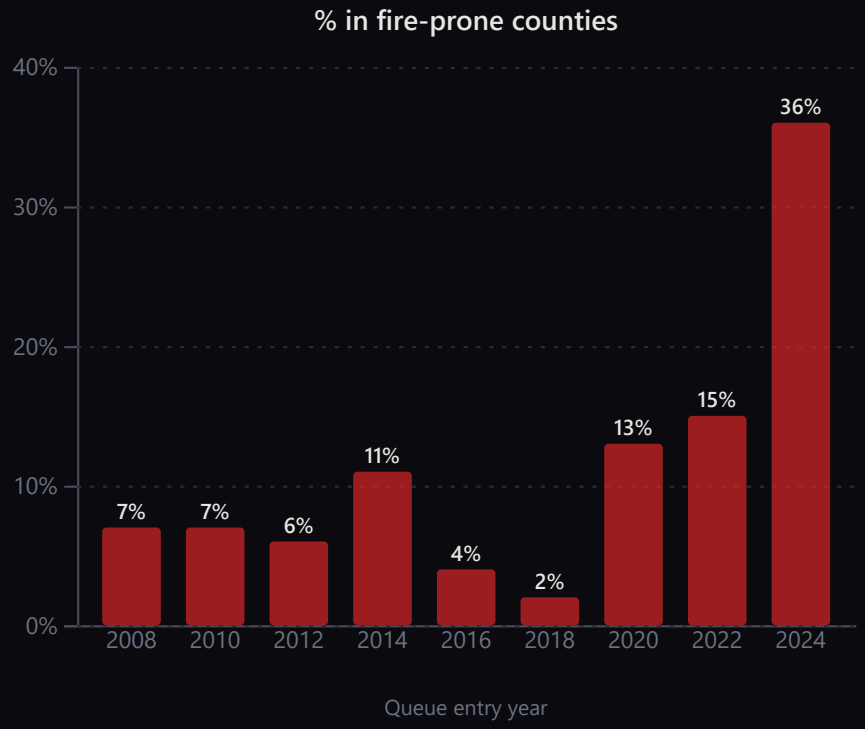
Why this matters: The geography of California's energy transition is incidentally moving generation away from fire zones. Solar resource maps and fire risk maps are near-inverses. But when resource geography pushes toward fire zones (wind), siting doesn't avoid them.

EIA-860 (2024) for generator locations, capacity, and operating year; CPUC HFTD (2024). Eras aligned with fire policy milestones.

Where Is the Pipeline Siting?

294 active interconnection projects by queue entry year. The pipeline is dominated by solar and storage in fire-safe terrain. Projects in fire-prone counties withdraw at a modestly higher rate (79% vs 69%).



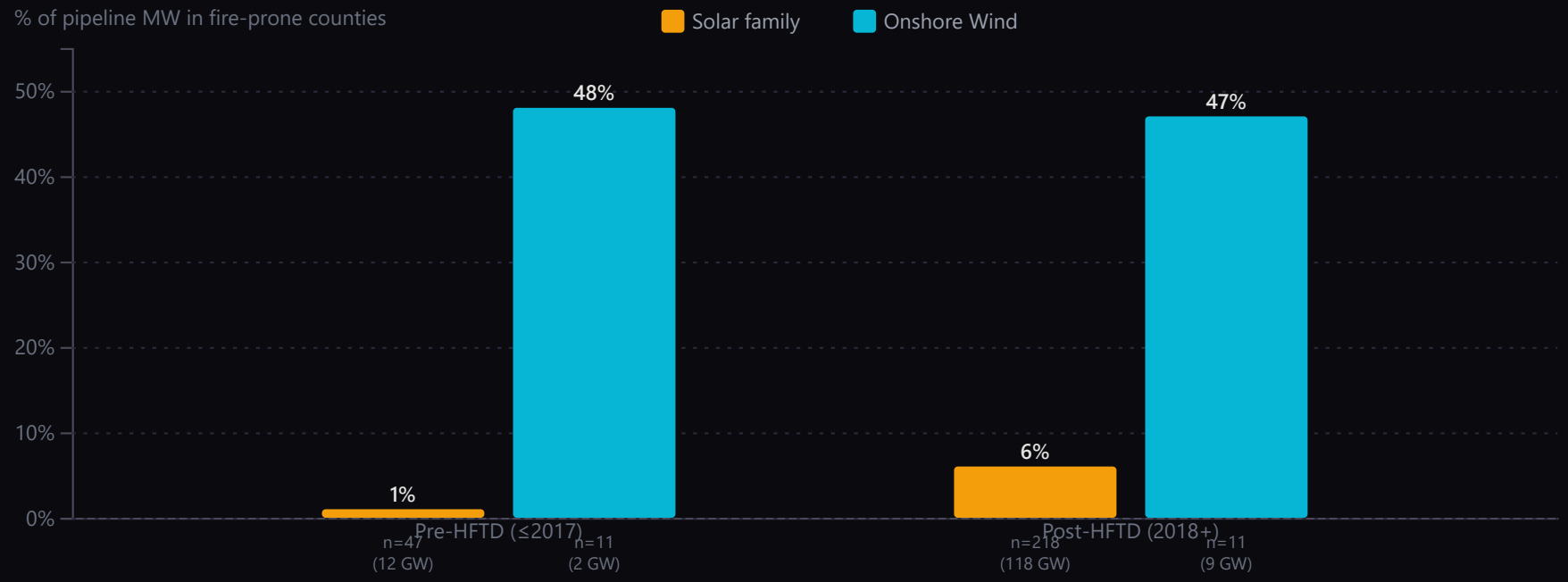


Why this matters: The pipeline's low fire-county share reflects the dominance of solar and storage. The overall shift away from fire zones is a byproduct of the solar/storage boom, not a response to fire-risk regulation.

LBNL Interconnection Queue (through 2024). 294 active projects; withdrawn excluded. Fire-prone county = ≥25% of existing generators in HFTD.

Wind Consistently Sites in Fire Zones

Wind vs. Solar pipeline fire-county exposure, pre- and post-HFTD adoption. Wind holds steady at ~48%, while solar stays below 6%. Good wind sites are on ridgelines and mountain passes—fire terrain.

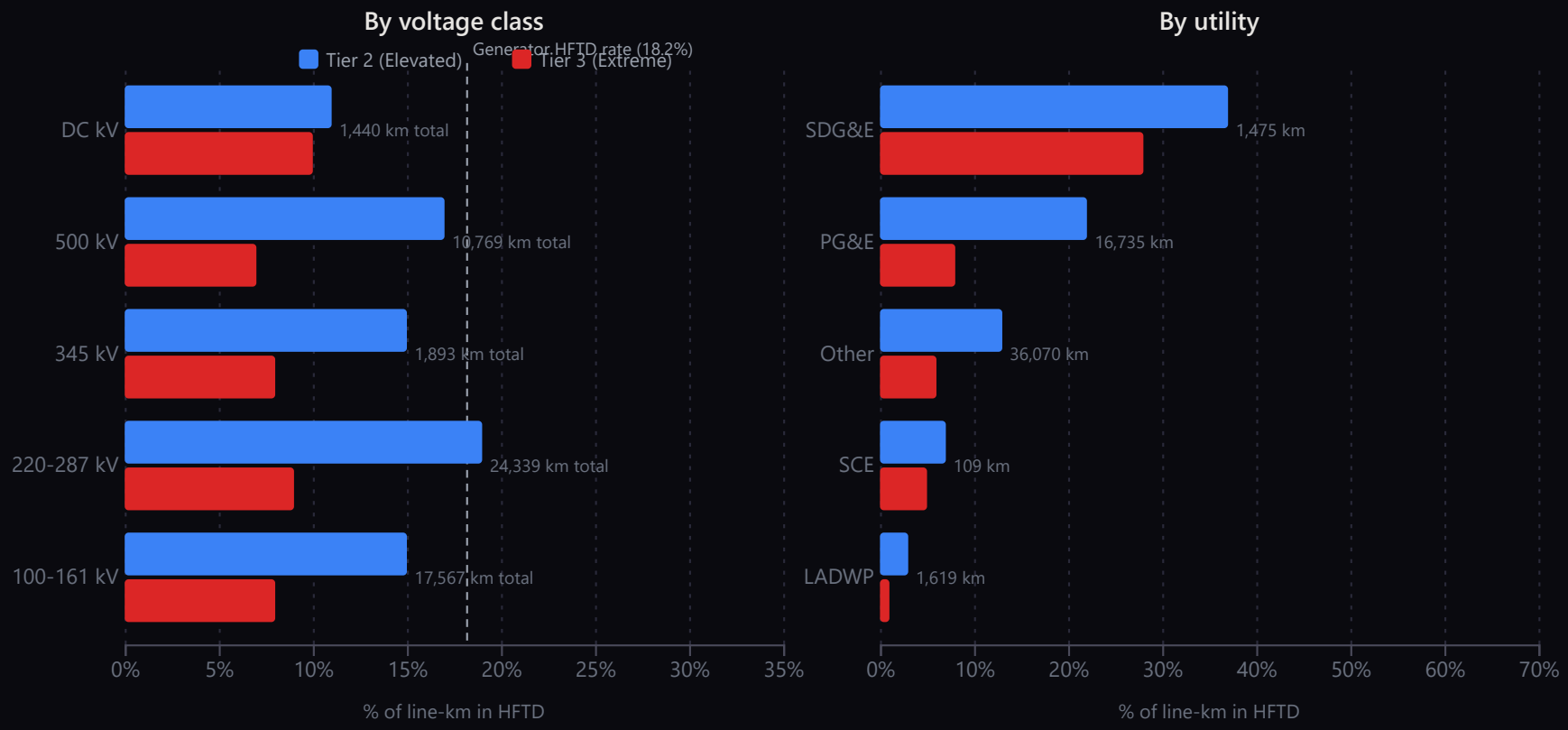


Why this matters: Wind is the test case for whether fire-risk awareness changes siting. The answer, in this small sample, is no—47% of post-HFTD wind pipeline capacity sits in fire-prone counties, essentially unchanged from 48% pre-HFTD.

LBNL Interconnection Queue (through 2024). Wind: n=22 total (11 per period). Solar family includes Solar + Solar+Storage.

Transmission Is More Fire-Exposed Than Generators

23.2% of California's 56,008 km of high-voltage transmission runs through HFTD—vs. 18.2% of generators. The 220–287 kV backbone is most exposed at 27.8%. SDG&E stands out at 64.6%.

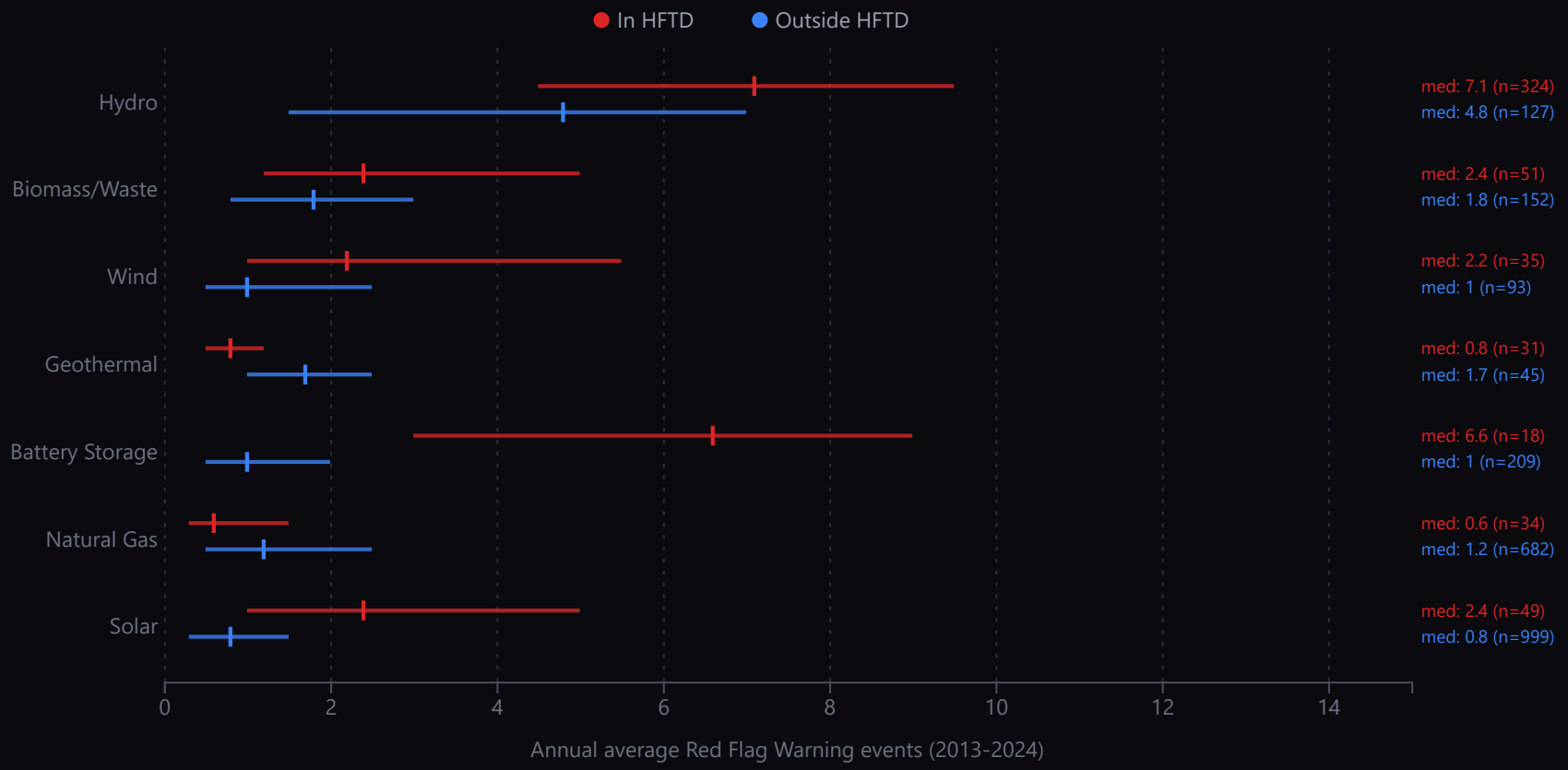


Why this matters: Fire risk to generation is not just about where the plant sits—it's about the wires connecting it to load. ~590 generators outside HFTD connect through corridors with ≥25% fire exposure. The grid behind the generators is more exposed than the generators themselves.

HIFLD National Transmission Lines (2024), 2,132 lines / 56,008 km. CPUC HFTD (2024). Spatial overlay in EPSG:3310.

Fire Weather: What HFTD's Static Map Misses

Annual Red Flag Warning events by technology and HFTD status. HFTD generators average 5.6 events/year vs. 2.8 for non-HFTD (~2x). But the ratio varies by technology—some categories show the reverse pattern.



Why this matters: Two generators in the same HFTD tier can face dramatically different fire weather. HFTD's binary designation obscures variation that ranges from 0 to nearly 15 annual Red Flag events across the fleet.

NWS Red Flag Warning archives via Iowa Environmental Mesonet (2013–2024). EIA-860 (2024). Assigned at NWS fire weather zone level.

Key Takeaways

1	**Fire risk is concentrated in hydro.**	72% of hydro generators are in HFTD, and the Creek Fire alone put 90% of Big Creek (904 MW) inside a fire perimeter.
2	**The clean energy buildout is mostly in fire-safe locations.**	Solar and batteries go where it's flat and treeless. Wind is the exception—~47% of pipeline capacity is in fire-prone counties.
3	**HFTD is informative but incomplete.**	Zero false negatives for hydro, but 75% of HFTD generators have never seen fire. And it misses fire weather variation entirely.
4	**The grid is more exposed than the generators.**	23% of transmission runs through HFTD, and ~20% of non-HFTD generators connect through fire-prone corridors.

Read the Full Analysis

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