# Fall 2018 EPIC Workshop

## *Opening Remarks*

Haritha Adusumilli

November 9, 2018

Together, Building
a Better California

# What is the EPIC Program?

The Electric Program Investment Charge (EPIC) is a statewide program that enables the California Investor-owned utilities (IOUs) and California Energy Commission (CEC) to invest in & pursue new/novel emerging energy solutions to meet California's energy goals & drive innovation in the industry

**EPIC promotes building the energy network of tomorrow through innovation focused on**

**Increased Safety • Improved Affordability • Greater Reliability**

Renewables and Distributed Energy Resources (DER) Integration

Grid Modernization and Optimization

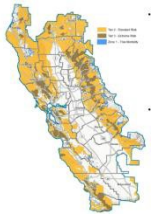
Customer Focused Products and Services Enablement

Foundational Strategies & Technologies

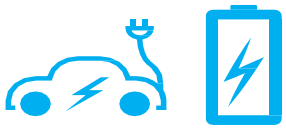
# Adapting to a Changing Industry Landscape

## Drivers of Change

**Climate Change Impacts**

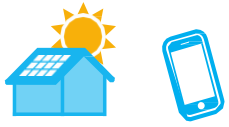


**Environmental leadership policies**



**Rapidly advancing technology**

**Increasing customer choice and engagement**




**100%**
renewable and GHG free by 2045 in CA

**2X**
energy efficiency in existing buildings by 2030 in CA

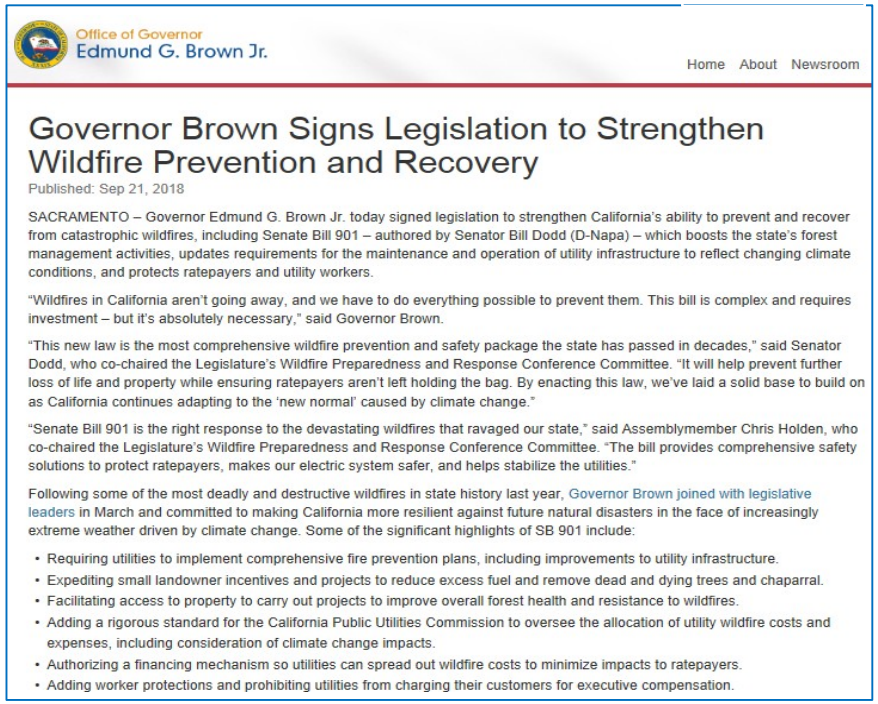
**5M**
zero-emission vehicles by 2030 in CA

# SB 901 – Passed & Signed, 9/21/18

## What is SB 901?

Comprehensive legislation proposed from the Wildfire Response and Prevention Conference Committee, passed by the CA Legislature and signed by the Governor:

- Securitization, authorizing the California Public Utilities Commission to approve low-cost bonds
- Establish a wildfire mitigation plan, focused on identifying risks and actions to harden our systems
- Imposes more restrictive forest management practices and provides support to facilitate work
- Establishes a Wildfire Cost and Recovery Commission to evaluate wildfire reforms



Office of Governor
Edmund G. Brown Jr.

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### Governor Brown Signs Legislation to Strengthen Wildfire Prevention and Recovery

Published: Sep 21, 2018

SACRAMENTO – Governor Edmund G. Brown Jr. today signed legislation to strengthen California's ability to prevent and recover from catastrophic wildfires, including Senate Bill 901 – authored by Senator Bill Dodd (D-Napa) – which boosts the state's forest management activities, updates requirements for the maintenance and operation of utility infrastructure to reflect changing climate conditions, and protects ratepayers and utility workers.

"Wildfires in California aren't going away, and we have to do everything possible to prevent them. This bill is complex and requires investment – but it's absolutely necessary," said Governor Brown.

"This new law is the most comprehensive wildfire prevention and safety package the state has passed in decades," said Senator Dodd, who co-chaired the Legislature's Wildfire Preparedness and Response Conference Committee. "It will help prevent further loss of life and property while ensuring ratepayers aren't left holding the bag. By enacting this law, we've laid a solid base to build on as California continues adapting to the 'new normal' caused by climate change."

"Senate Bill 901 is the right response to the devastating wildfires that ravaged our state," said Assemblymember Chris Holden, who co-chaired the Legislature's Wildfire Preparedness and Response Conference Committee. "The bill provides comprehensive safety solutions to protect ratepayers, makes our electric system safer, and helps stabilize the utilities."

Following some of the most deadly and destructive wildfires in state history last year, Governor Brown joined with legislative leaders in March and committed to making California more resilient against future natural disasters in the face of increasingly extreme weather driven by climate change. Some of the significant highlights of SB 901 include:

- Requiring utilities to implement comprehensive fire prevention plans, including improvements to utility infrastructure.
- Expediting small landowner incentives and projects to reduce excess fuel and remove dead and dying trees and chaparral.
- Facilitating access to property to carry out projects to improve overall forest health and resistance to wildfires.
- Adding a rigorous standard for the California Public Utilities Commission to oversee the allocation of utility wildfire costs and expenses, including consideration of climate change impacts.
- Authorizing a financing mechanism so utilities can spread out wildfire costs to minimize impacts to ratepayers.
- Adding worker protections and prohibiting utilities from charging their customers for executive compensation.

**"Requiring utilities to implement comprehensive fire prevention plans, including improvements to utility infrastructure"**

# Where we are Today

## Context

Received Final Decision from CPUC approving the IOUs' EPIC 3 investment plans on 10/25/2018

## Our Priorities Moving Forward

- Increase engagement with external stakeholders (including Disadvantaged Communities), to ensure EPIC meets their needs, and to work together for a cleaner California
  - While an EPIC demonstration might not be conducted in a particular community, implementing successful EPIC projects in production can benefit all customers
- Involve Diverse Suppliers in EPIC projects
  - To monitor PG&E EPIC opportunities, register on Power Advocate (www.poweradvocate.com)

## Workshop Objectives

- Provide an update on each administrator's planned EPIC 3 investments
- Obtain feedback on the scoping of these investments, before finalizing and initiating projects

***WE WANT TO KNOW WHAT YOU THINK. LET'S MAKE THIS TWO-WAY DIALOGUE!***

# EPIC 3.15 *Proactive Wires Down Mitigation*

Dan Gilani

November 9, 2018

***Following the wildfires in 2017, some of the changes included in this presentation are contemplated as additional precautionary measures intended to reduce future wildfire risk.***

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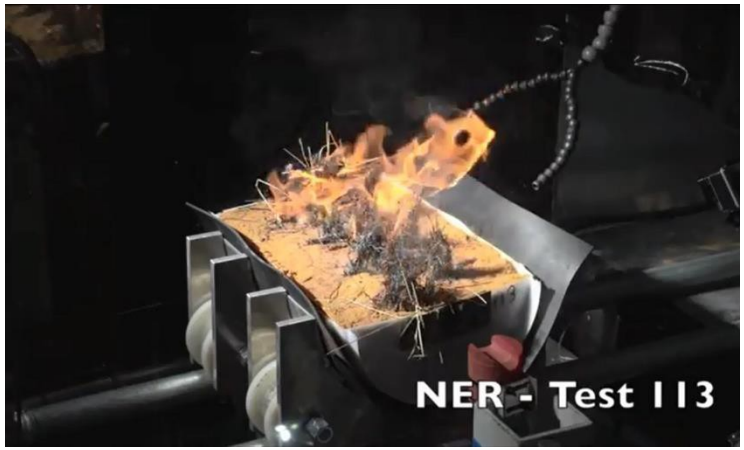
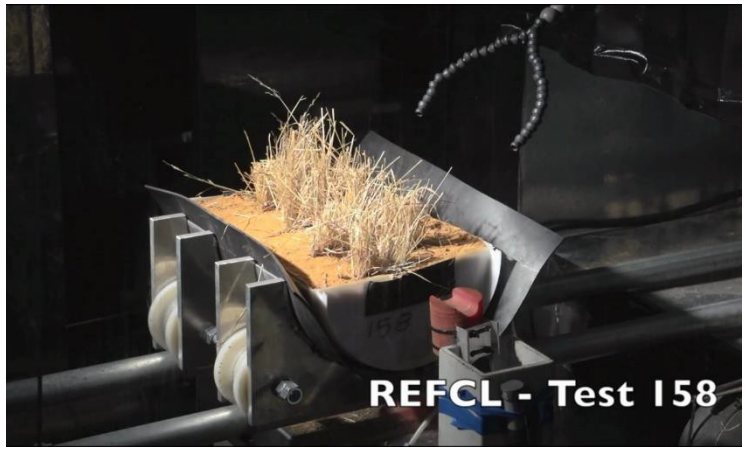
# History of Rapid Earth Fault Current Limiter (REFCL) in Australia

- 2009 Black Saturday fires in Victoria, Australia
  - Burned 1.1 million acres, left 180 people dead, and 414 people injured
- The government performed over 2,000 separate tests to determine what causes electrical ignition events
  - Concluded that REFCLs are 10 to 12 times more effective at reducing bushfire risk than existing best practices
- Utilities in Victoria are required to install 45 REFCLs in bushfire-prone areas
  - The two major utilities in Victoria have each installed two REFCLs
- PG&E conducted benchmarking with these utilities in July 2018 to assess potential for application to our grid

Normal Ground Fault




With REFCL Technology



# EPIC 3.15 Objective

## Objective

- Evaluate methods for rapidly reducing the flow of current and risk of ignition in single phase to ground faults, through the demonstration of REFCL technology at a PG&E substation

## Net New

- REFCL technology is relatively new to the world, with application for mitigating wildfire risk only recently implemented in Australia
- PG&E will be the first US utility to demonstrate this technology (planned November 2018 project launch)

## Potential Benefits

- Safety & Resiliency
  - Significantly lower the energy for single line to ground faults; reducing the potential for arc-flash
  - Reduce risk of electrical fires in a more cost-effective manner than replacing all the wires with covered conductor
- Reliability
  - Lights stay on for momentary outages

# REFCL – Electrical Fire Risk Reduction

## What is REFCL Technology?

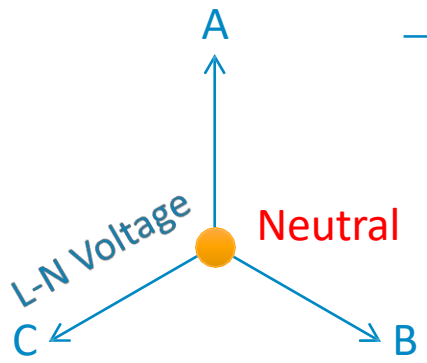
- Consists of an inductor tuned to the network capacitance installed between the substation transformer neutral and ground
  - A controller and an inverter supplement the functionality of the inductor
  - Other terms for this setup are resonant grounding or high impedance grounding
- In effect, this technology moves the neutral to the faulted phase during a fault
  - Reduces the potential to ground on that line to effectively zero (< 250V), which drastically reduces the energy available for the fault

## Anticipated Work

Significantly build upon current state to meet the performance standards & fit PG&E's system

- Fault detection sensitivity
  - Current Transformer (CT) accuracy
  - Balancing network capacitance
- Reliability
  - Fault location – core technology can only tell which feeder the fault is on
  - Fault isolation – significant work required to modify Line Reclosers (LR) to work in REFCL scheme

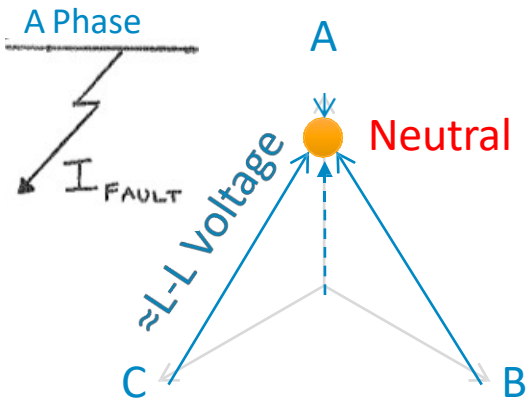
# How REFCL Affects Voltage




— = L-N Voltage

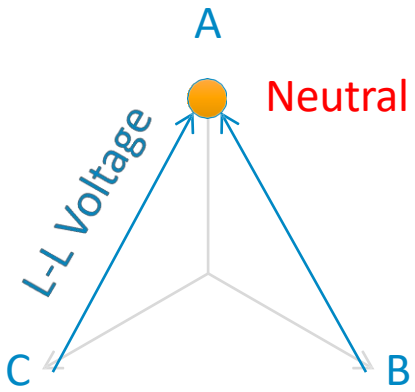
**Normal Operation**

All Line-Neutral voltages are Line-Line/√3




**Passive (Inductor) Operation**

Arc Suppression Coil reduces Line-Neutral voltage at the substation transformer on faulted phase mostly suppressing fault current.




**Passive + Active (Inductor + Inverter) Operation**

Residual Current Compensator injects phase-opposite current into the neutral to cancel out the residual current across the Arc Suppression Coil and further reduce the Line-Neutral voltage on the faulted phase to zero.

# REFCL Deployment Challenges

## Network Upgrades Required to Prevent Electric Ignition

### Line-Neutral Capacitive Balancing

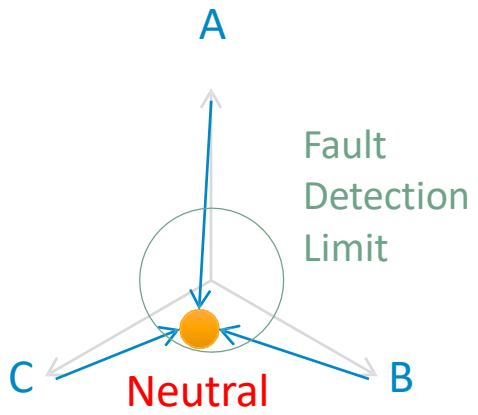
- Line regulators need to add a third regulator for any open delta configurations
- Line-Neutral capacitance must be balanced, if there are imbalances then work must be done to:
  - Phase balance single phase taps

    OR
  - Extend a third phase for single phase taps

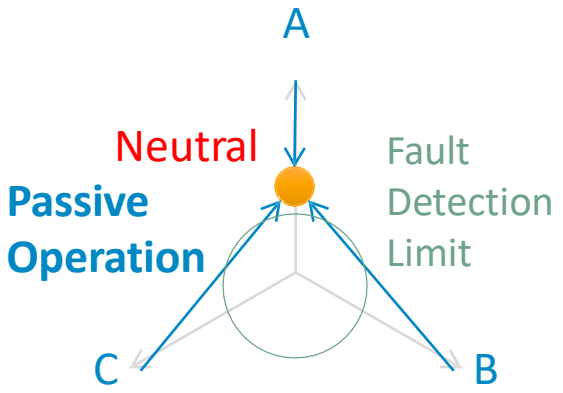
    OR
  - Install capacitive balancing units (L-N variable capacitor banks)

### Network Damping

- May need to increase the size of the Arc Suppression Coil, or install multiple REFCL units in a substation
- May need to install an isolation transformer to isolate a particularly long portion of underground cable

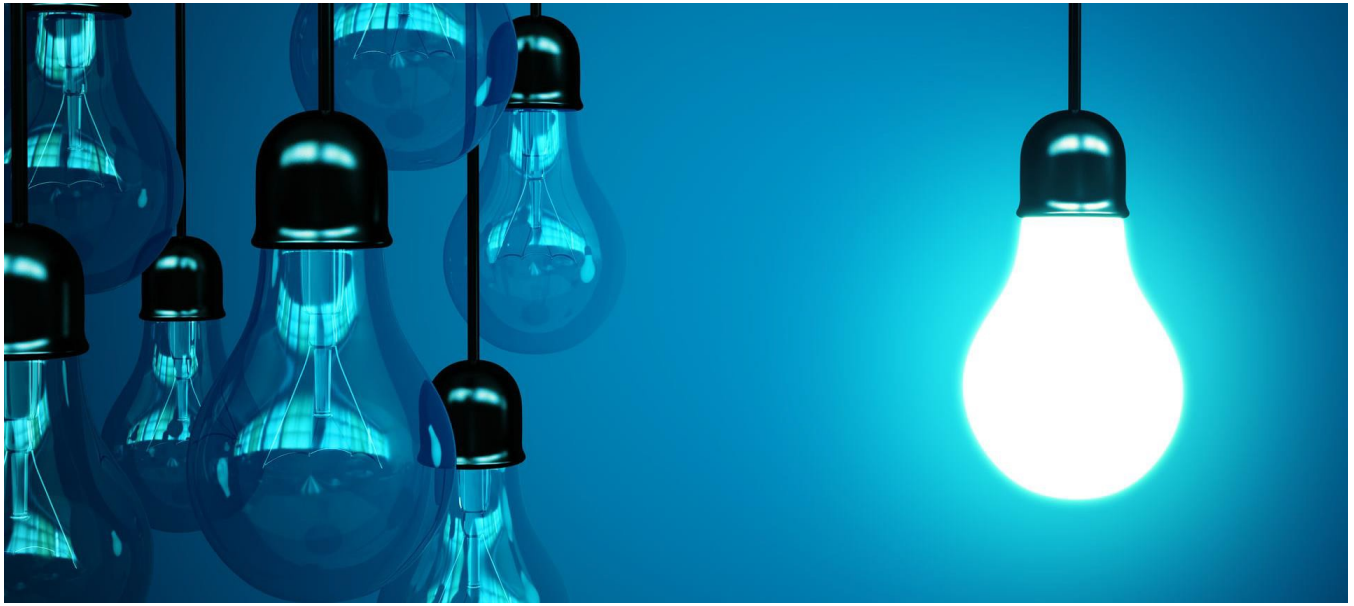



Reduced neutral voltage detection sensitivity for faults on A phase due to unbalanced L-N capacitance




Reduced neutral voltage detection sensitivity during passive operation of ASC for faults due to network damping

# Discussion



…tell us what you think!

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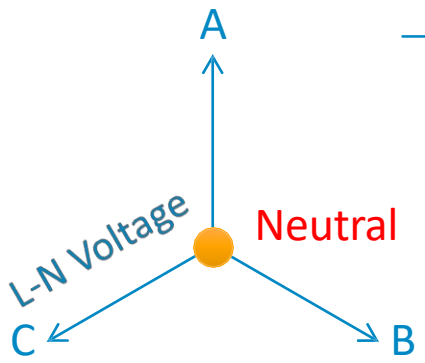
# How REFCL Affects Voltage

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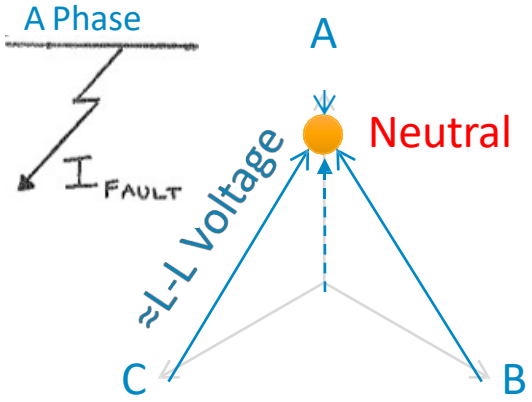


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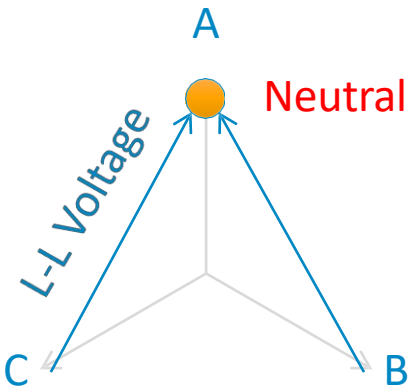


**Passive + Active (Inductor + Inverter) Operation**
Residual Current Compensator injects phase-opposite current into the neutral to cancel out the residual current across the Arc Suppression Coil and further reduce the Line-Neutral voltage on the faulted phase to zero.

# EPIC 3.29

## *Advanced Customer Bill Scenario Calculator*

Henry Vuong

November 9, 2018

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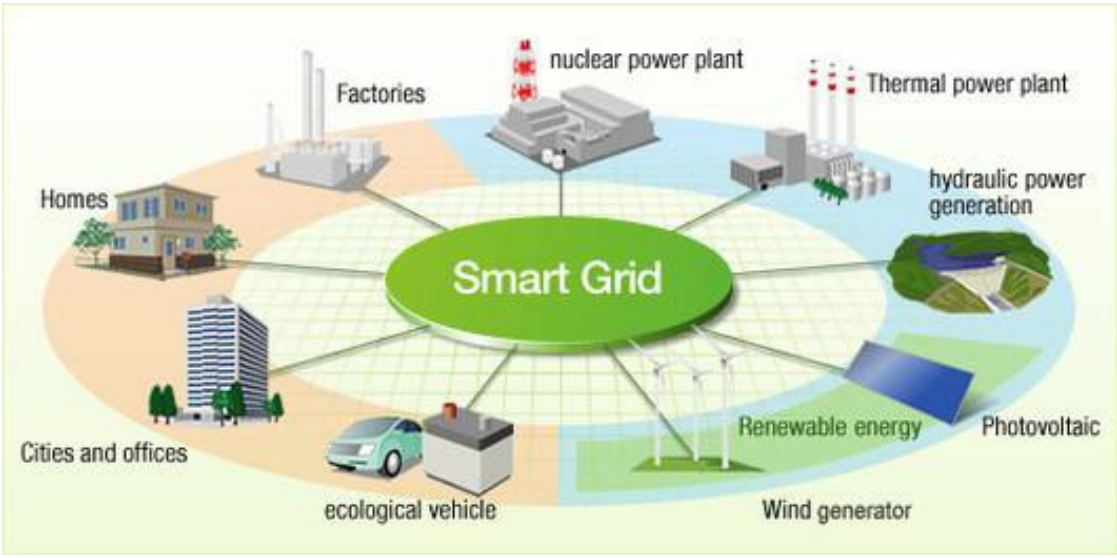
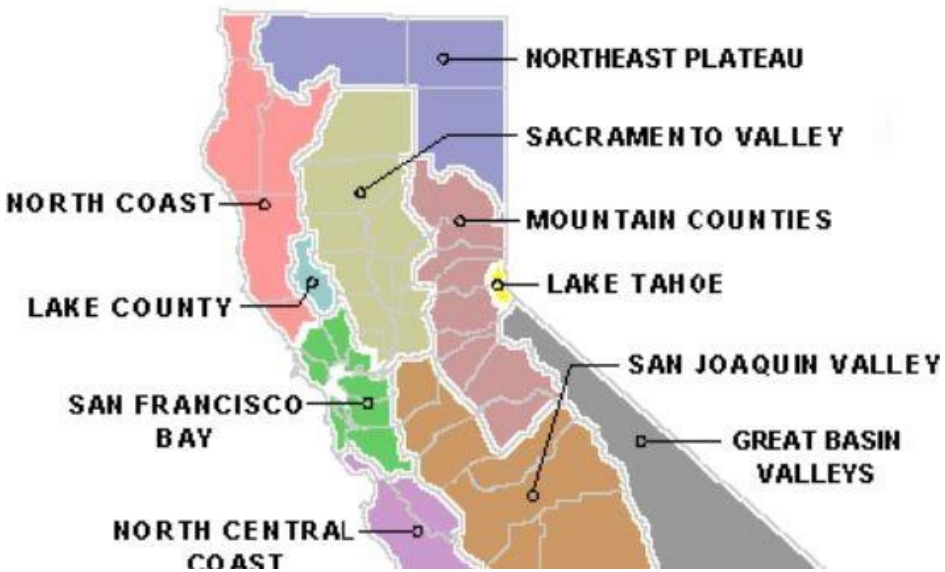
# Background


- As DER penetration continues to increase, more customers will become increasingly engaged and want to optimize their bills

- Current tools
  - Multiple stand-alone, single purpose tools
  - Targeted towards mass-market, allow simple rate analyses

# Objectives




- Create an online tool for customers to more easily understand how behavioral changes and technology investments affect their bills
- The tool would highlight financial and environmental advantages of the different technologies to promote understanding and adoption of DERs
- Leverage tool usage data to inform the distribution planning and geospatial forecasting processes

# Current Calculators

## Solar

**Pros:**
- Customizable system size, # of panels, savings target etc.
- Interactive and simple
- Provides Best Rate Analysis

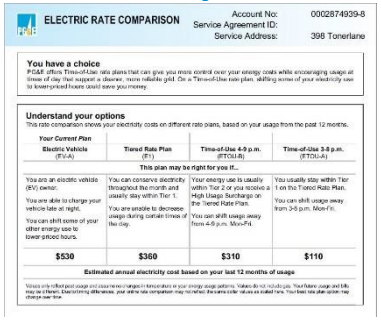
**Cons:**
- Not personalized with actual usage
- Stand-alone tool with limited what-if scenarios

## Electric Vehicle

**Pros:**
- Basic customizations
- Easy to follow
- Provides comparisons with and without EV

**Cons:**
- Provides analysis based on zip code
- Stand-alone tool with limited what-if scenarios

## Rate Comparisons


ELECTRIC RATE COMPARISON

Account No: 0002874939-8
Service Agreement ID:
Service Address: 398 Tonerlane

You have a choice

Understand your options

| Your Current Plan Electric Vehicle (EV-A) | Tiered Rate Plan (E1) | Time-of-Use 4-9 p.m. (ETOU-B) | Time-of-Use 3-8 p.m. (ETOU-A) |
|---|---|---|---|
| This plan may be right for you if... | | | |
| You are an electric vehicle (EV) owner. You are able to charge your vehicle late at night. You can shift some of your other energy use to lower-priced hours. | You can conserve electricity throughout the month and usually stay within Tier 1. You are unable to decrease usage during certain times of the day. | Your energy use is usually within Tier 2 or you receive a High Usage Surcharge on the Tiered Rate Plan. You can shift usage away from 4-9 p.m. Mon-Fri. | You usually stay within Tier 1 on the Tiered Rate Plan. You can shift usage away from 3-8 p.m. Mon-Fri. |
| $530 | $360 | $310 | $110 |
| Estimated annual electricity cost based on your last 12 months of usage | | | |

**Pros:**
- Provides personalized rate comparisons based on actual historical usage

**Cons:**
- Limited what-if scenarios based on current options / programs / equipment

# Scenario Analysis Tool



## We want a tool that can:

- Run analysis based on actual customer usage
- Perform What-If analysis with one or more DER
- Allow more advanced customizations such as targeted load shifting/load reduction
- Provide rate analysis and rate recommendations based on selections
- Be interactive, user friendly, & easy to understand

# Track Customer Engagement


## Based on engagement & selections:

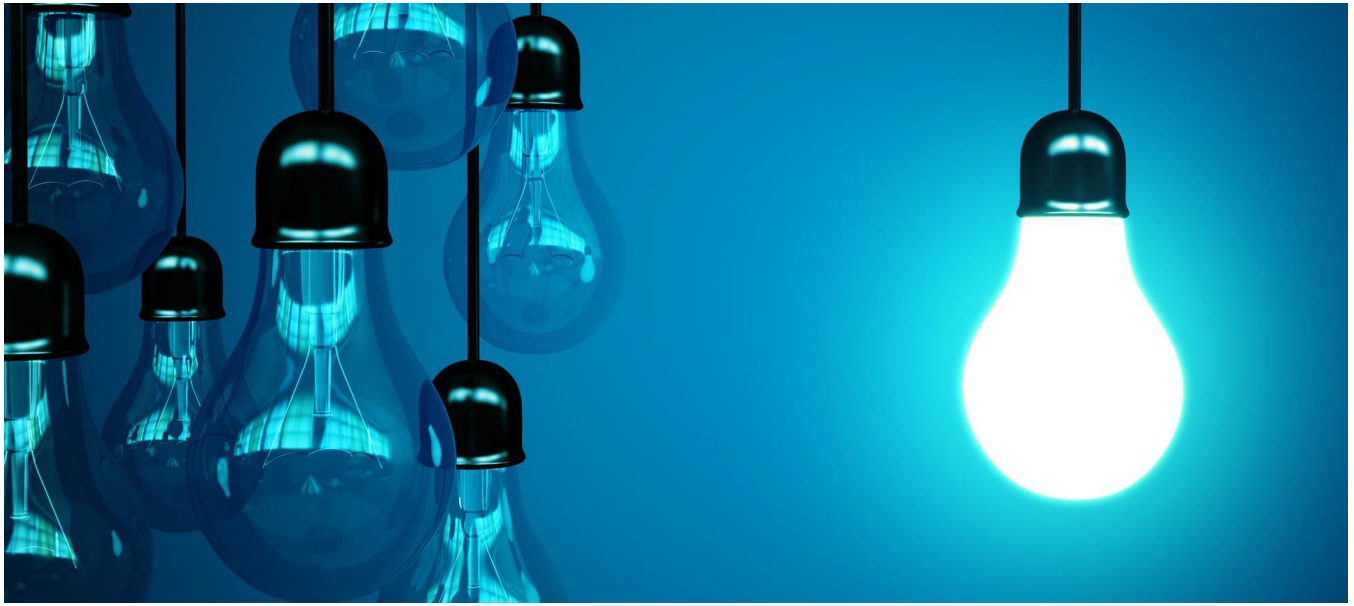
- We can better understand geographically where customers are more interested in solar, EV's, storage etc.
- Tailor and target communication and outreach
- Enhance distribution planning
- Identify strategic locations for EV charging stations
- Increase overall customer satisfaction

# Other Positive Outcomes


## The online tool can:

- Increase overall awareness of various rate options
- Make customers aware of their options and the potential return on their investments
- Help customers in Disadvantaged Communities (DACs) understand their options to save energy and money and eligible programs they can participate in

# Discussion



…tell us what you think!

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# EPIC 3.21

## *Advanced Vegetation Management Insights Using Prescriptive Analytics*

Eric Woodyard
November 9, 2018

***Following the wildfires in 2017, some of the changes included in this presentation are contemplated as additional precautionary measures intended to reduce future wildfire risk.***

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# PG&E Electric Vegetation Management By The Numbers…

**1**

**100,000**

**1,400,000**

**120,000,000**

# The Challenge: Vegetation Risk

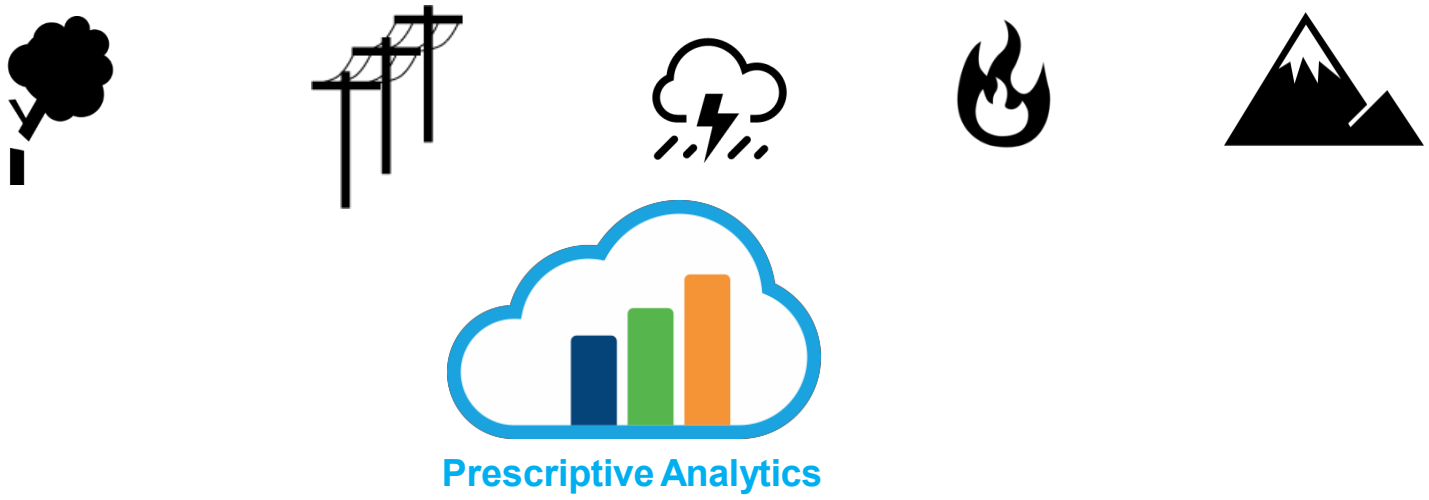
- Trees are alive.
- Trees are dynamic. They move, they grow and they breathe.
- Trees have deformities and their health declines due to illness and age.
- And trees die.
- Are we able to determine which tree will get sick next?
- Or are we able to predict an area where an epidemic will occur?

# EPIC 3.21: Tackling Vegetation Risk

## Objective

- Leverage PG&E's remote sensing data, historical outage data and other information to create a prescriptive analytics model for vegetation-related power outages to recommend mitigation efforts for predicted wire down or power line-related wildfire ignition events.

## How to predict when and where the next tree failure will occur?




## Benefits

- Optimized risk assessment, improved reliability work planning, and increased public safety.

# Tree Failure Profiles

| | A | C | D | G | H | I |
|---|---|---|---|---|---|---|
| 1 | CENTRAL COAST DIVISION PS&R SPECIES PRESCRIPTION GUIDE | | | | | |
| 2 | Name | outage count | % of outages | BranchFail | RootsFail | TrunkFail |
| 3 | Redwood, Coast | 1261 | 17.01% | 83% | 9% | 8% |
| 4 | Monterey Pine | 809 | 10.91% | 37% | 41% | 23% |
| 5 | Tan Oak | 565 | 7.62% | 5% | 36% | 59% |
| 6 | Blue Gum | 544 | 7.34% | 59% | 28% | 12% |

# Mapping “Fall-in Threat” Trees on Distribution

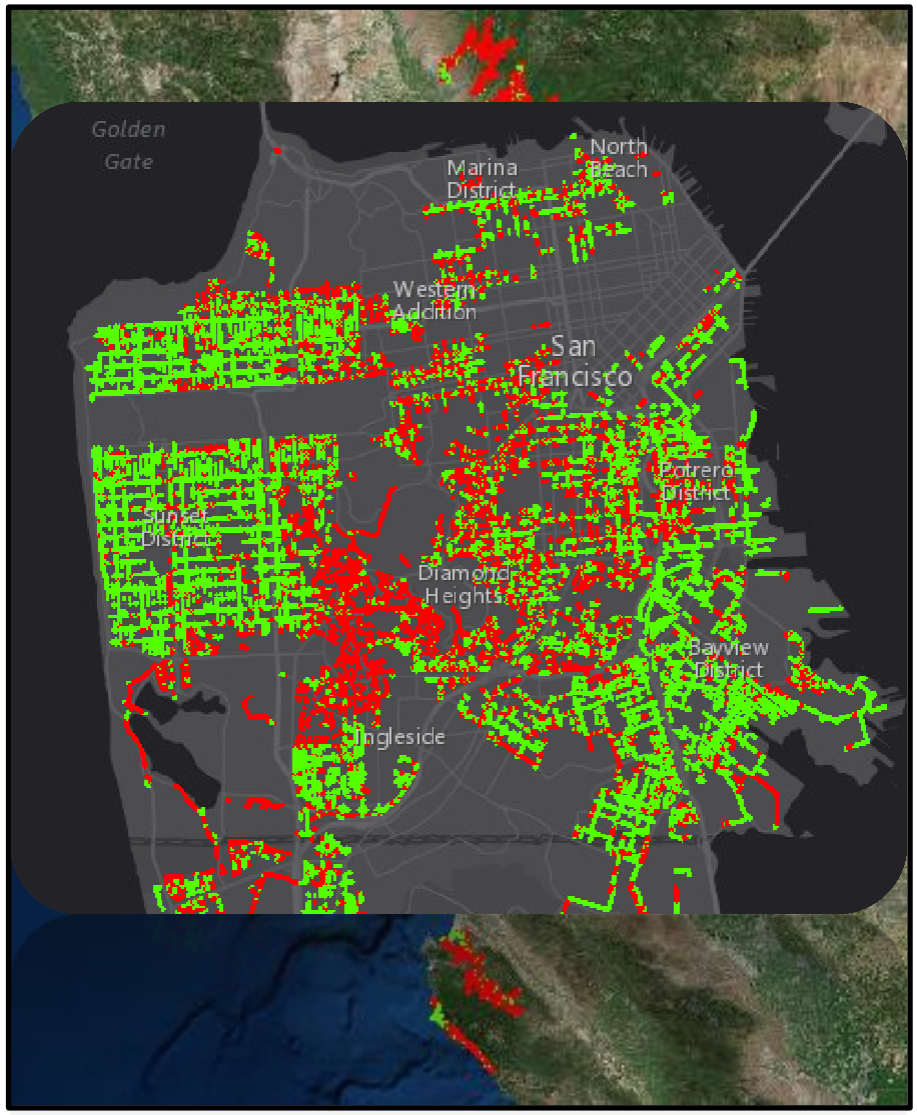
Red Dots: Potential Fall-in Threat Trees

Green Dots: Encroachment Trees

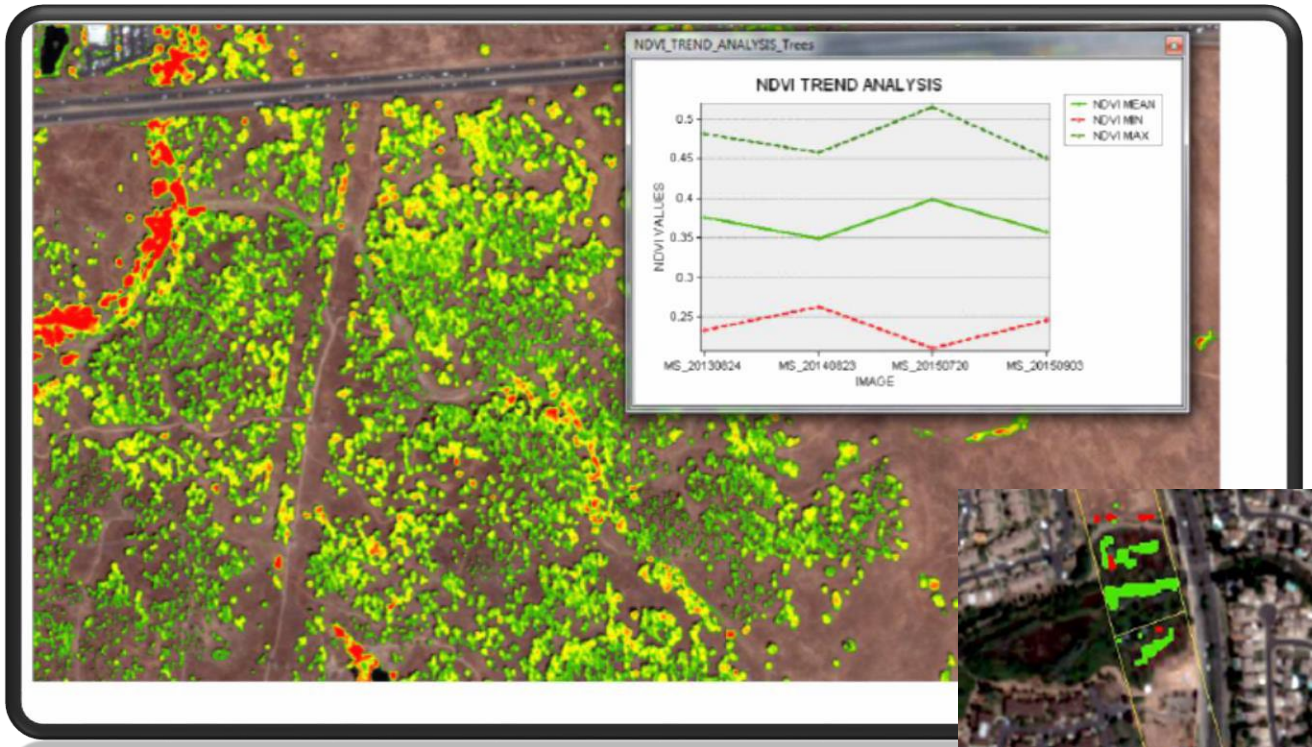
# Identifying “Clear Spans” on Distribution

Red: Spans with Vegetation

Green: Spans without Vegetation

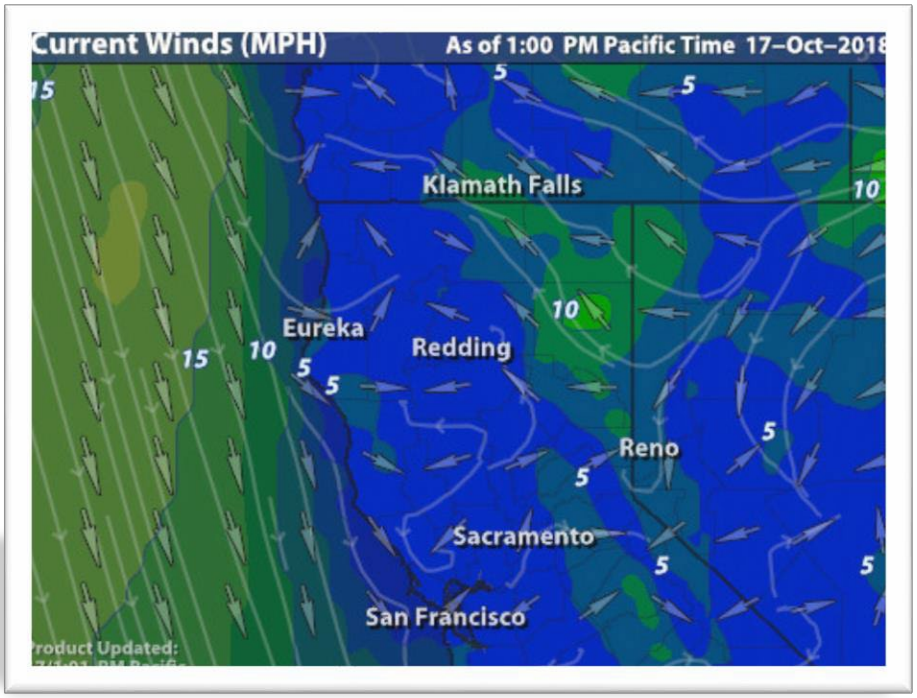


# Satellite Imagery: Assessing Vegetation Health and Changes in Vegetation




# Weather Data

PG&E is installing 200 additional weather stations




*Following the wildfires in 2017, some of the changes included in this presentation are contemplated as additional precautionary measures intended to reduce future wildfire risk.*

# Creating a Model with Machine Learning

Location

Species

DBH

Height

Overhanging?

Fall-in?

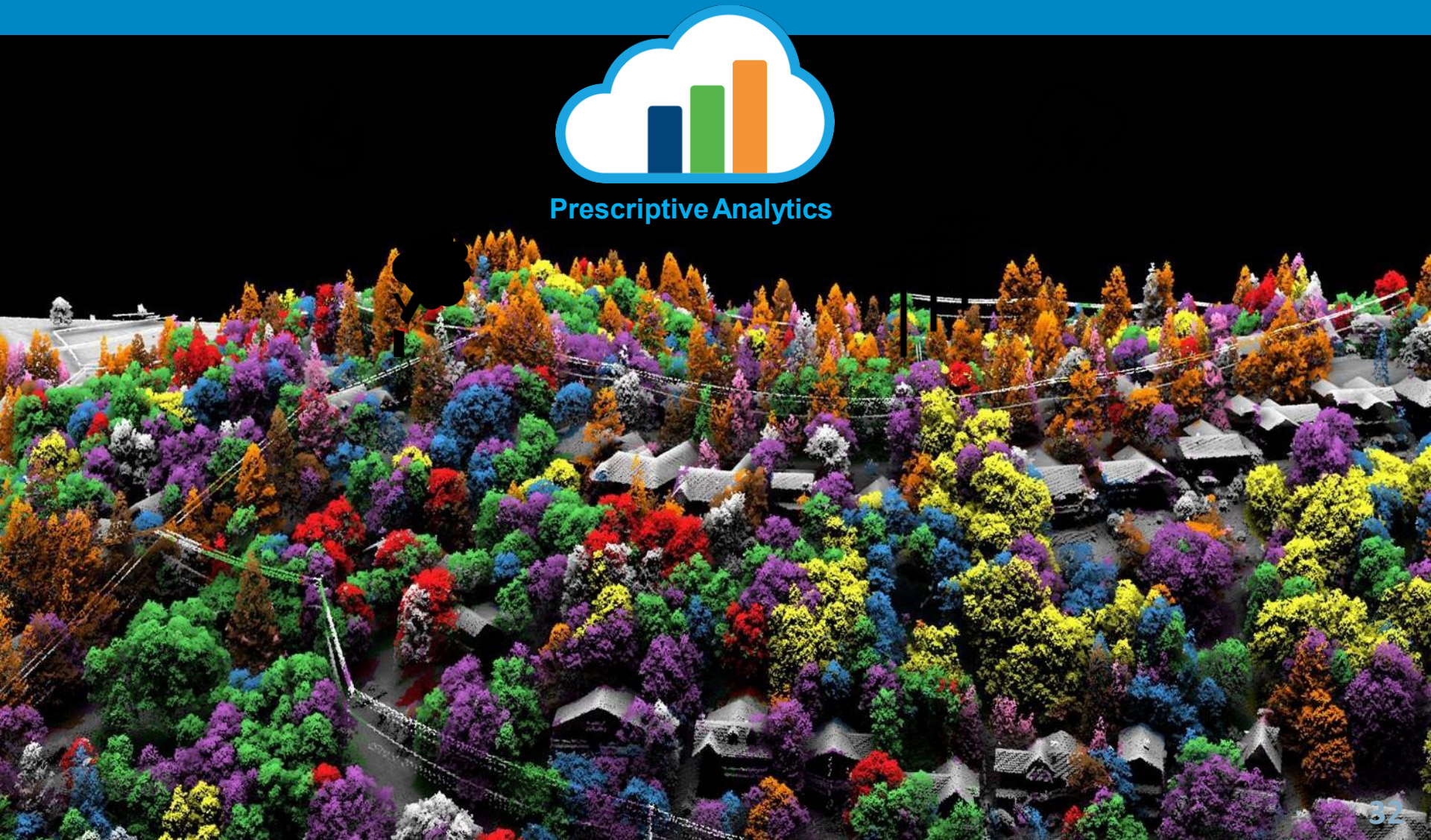
Last Trim Date

Last Pruning
Clearance

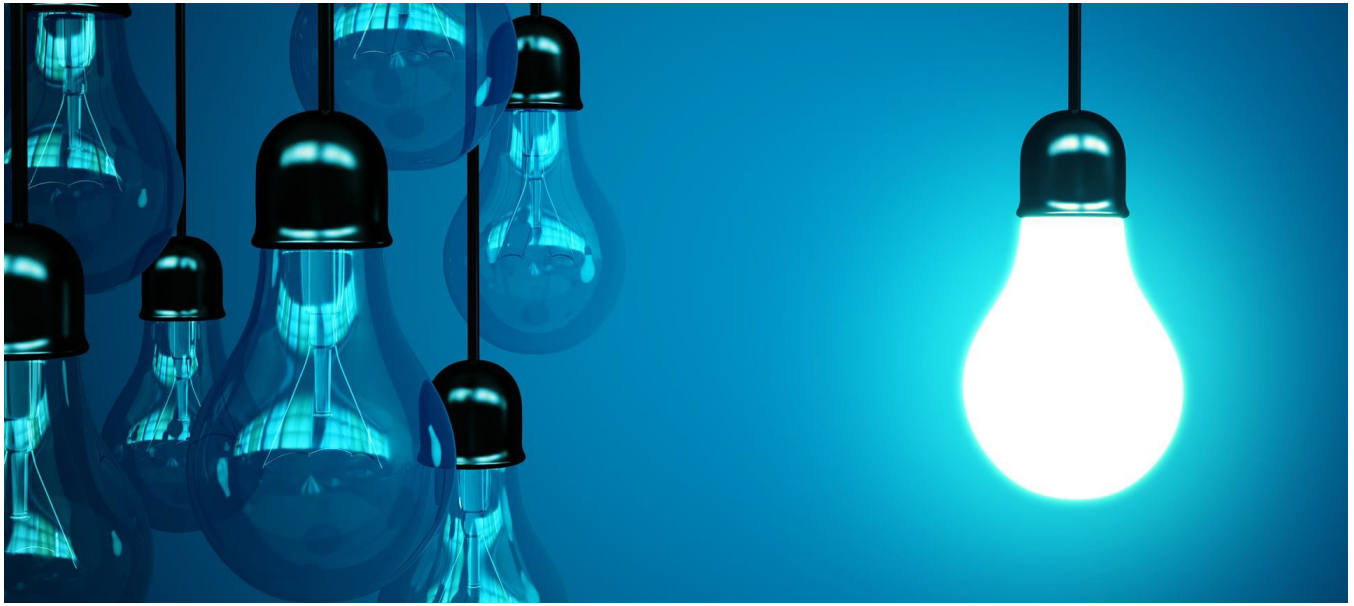
Tree Health

## Bringing it all together…

# Asset Management in 3D…



# Discussion



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