Leveraging Technology Innovation
Xcel Energy at a Glance

- 4th largest utility in the United States
- 8 State service territory (CO, MI, MN, NM, ND, SD, TX, WI)
- Electric revenue = $7.6 billion
- 3.3 M electric / 1.9M gas customers (1.7M in CO)
- Approximately 90,000 miles of electric lines
- Approximately $53 million vegetation management budget
Outline

- Colorado Mountain Pine Beetle Epidemic
- Remote Sensing Technology (LiDAR/imagery)
  - Hazard Tree Identification/Mitigation
  - Wildfire Heat Protection (Transmission)
- Geospatial Work Management Systems
- Unmanned Aerial Systems (aka drones)
Colorado Mountain Pine Beetle (MPB) Epidemic

Increased risk of:

- Tree-conductor contact, outage & fire ignition
- Wildfires through T&D right of way, damaging/destroying facilities
Wildfire Trend - Western US
What is LiDAR?

- LiDAR stands for Light Detection And Ranging

- LiDAR quickly and accurately builds a three-dimensional “point cloud” model of facility infrastructure, corridor terrain and adjacent vegetation

- LiDAR data can provide physical location accuracies of ~15cm and distance between object accuracies of ~5cm. The data is geo-referenced and compatible with industry work environments such as GIS and PLS-CAD
LiDAR & Imagery – One Pass

- GPS satellite Signal
- Inertial navigation & mapping system
  - On board computer & storage
- Digital Still Camera
  - Structure imagery
- 90° Digital Still Camera
  - Downward Ortho images
- Downward looking LiDAR
MPB Transmission Hazard Tree Identification & Wildfire Heat Protection
AS SURVEYED VEGETATION HEALTH CLASSIFICATION FIELD MAP

ROBINSON RACK - GILMAN SUB

9257A_ROB-GMN-0094-1
Hazard Tree Mitigation Totals
(2008-2015 YTD February: 8th year of engagement)

Transmission:
$5.7M (~143,000 trees)

Distribution:
$11.8M (~86,000 trees)

No hazard tree ignitions

Transmission Wildfire Fuels Reduction:
$11.2M (~92,000 trees/brush clearing)
MPB Transmission - Wildfire Heat Protection
MPB Transmission- Wildfire Heat Protection

- Structure focus (~3,500 poles/structures)
  - Wood (60%)
  - Aluminum (16%)
  - Steel (24%)
- Determine heat tolerances
- Plots ground surveyed to quantify fuel load and crown fire potential
- Established strong correlation (82-87%) between ground survey data and LiDAR data (algorithmic association)
- Establish Triggers for mitigation:
  - Ground fuel load- 10 tons/acre
  - Crown closure- >40%
MPB Transmission- Wildfire Heat Protection
Risk = Line Criticality + Hazard (flammable material/material type) + Probability of fire start (susceptibility)

Some additional factors considered:

- **Predictive wildfire behavior by Wildfire Influence Zones (WIZ)**
- **Wildfire Susceptibility Index (WFSI), Rocky Mountain Research Station (RMRS)**
- **Merge with line criticality**

- Utilize LiDAR generated grid patterns data to more precisely quantify “hazard”

- Prioritize higher risk lines/structures for mitigation
Validation of Fire Science Work

http://firelab.org/document/vegetation-clearance-distances
Enterprise-wide Geospatial Work Management System

Analytics

Core Data (enterprise integration)

Mobile

Optimization of work
- Outage history
- Root cause analysis results
- Total customer exposure
- Critical customer exposure
- Growing seasons since last maintenance cycle
- Voltage gradient
- Tree density
- Precipitation/environmental
- RMRS wildfire susceptibility index
- SME input

Work Management
- Historical data
- Manage output from Analytics
- LiDAR/imagery output
- Multi year plan/scenario build
- Management of annual plan
- Work status (proactive/reactive)
- QA/QC
- Core integration points
  - LandWorks
  - NMS
  - CRS
  - AVMS
- Dispatch
- Geospatial work completion

Planner/Crew Application
- ~350 users across eight states
- Ability to function in disconnected environment
- Geospatial work completion
- Time capture (labor/equipment)
- Near real-time reporting
- Simplify, simplify, simplify
- Automate
- Reverse invoicing
- Support?
Work Planning Software
Crew Mobile Application
Unmanned Aerial Systems (UAS) Research

- **Vertical Take-Off and Landing UAS (VTOL)**
  - High precision
  - Comprehensive assessments
  - Greater take-off and landing flexibility

- **Short Take-Off and Landing UAS (STOL)**
  - Rapid assessment
  - Linear asset compatibility
  - Take off and landing requirements
FAA UAS Flight Mechanisms

- **Certificates of Authorization (COA)**
  - Filing of approval document to fly a specific aircraft in a specific area, typically for research purposes

- **Section 333**
  - Grants relief from Part 91 of the FAA code that governs full-scale aircraft, allowing for commercial operations of UAS (case for safety and public benefit)

- **Beyond Line of Sight Designation**
  - Additional approval that builds on existing COA and Section 333

- **Part 11 General Exemptions**
  - Last step towards nationwide operations
UAS Sensor Options

- LiDAR
- High Resolution Imagery
- 3D Video
- Infra Red
- Corona
- Thermal
- Natural Gas Leak Detection
UAS Proof of Concept Missions

- Electric Transmission Inspections
  - Comparative analysis of helicopter acquired LiDAR

- Distribution Inspections/Planning
  - Pruning workload identification
  - Risk tree identification
  - Wildfire prevention/protection

- High Pressure Gas
  - Vegetation workload analysis, leak detection, mapping, assessments

- Electric System Post Storm Assessments
UAS Data Interface Demo

vtol-comprehensive-a.mov
Wildfire Protection:
http://www.youtube.com/watch?v=khSBGoYMeDo
http://www.youtube.com/watch?v=sRCLvbMassE&feature=youtu.be

Tree Worker Safety:
http://www.youtube.com/watch?v=wo4nlwKLPYk

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