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TAKE IT HOME AND USE IT

Unmanned Aerial Systems in a Part 107 World

DAN SCHOEPKE
ALLIANT ENERGY

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Todays Discussion

- Introduction to Alliant Energy
- UAS 101
  - Vehicles / Payloads
  - Why utilities?
- Regulatory Environment
  - History
  - Current Rules of the Road
- Utility Use Cases
  - More than asset inspection
- The Industry
  - Where is it going?
  - RFX considerations
  - Internal Programs

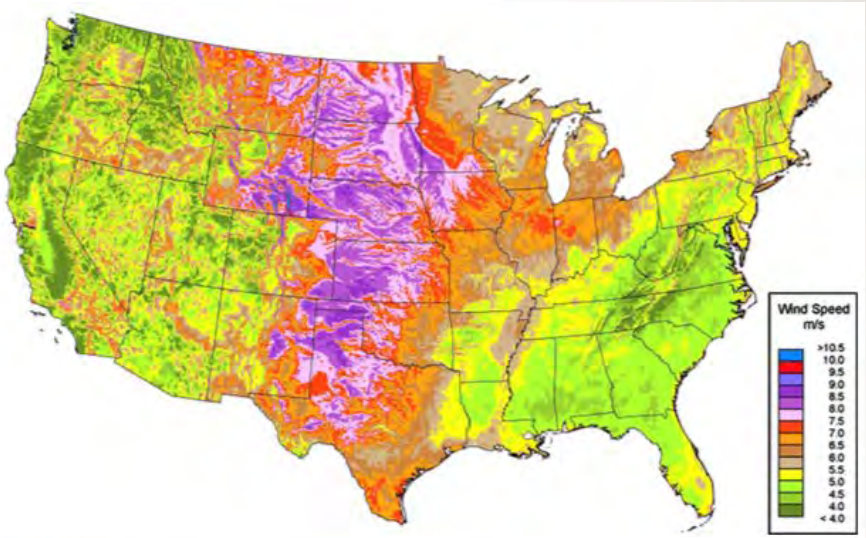
Alliant Energy

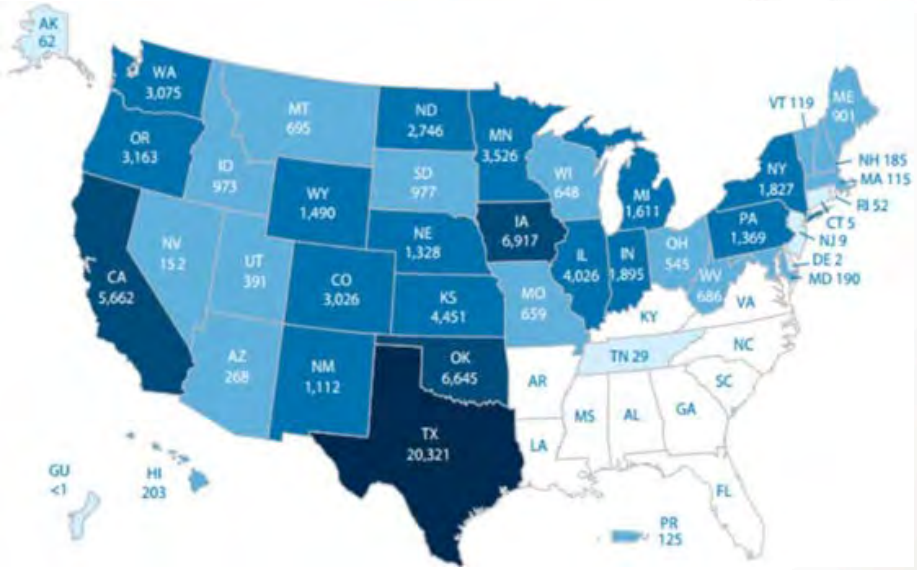
- Joined Fortune 500 in 2016
- ~4,000 employees
- 950,000 electric customers
- 410,000 natural gas customers
- 42K miles of distribution lines

- 9,500 miles of gas main
- 6,350 MW of Generation
  - 1,200 MW of Renewables
  - 650 MW of new CC Gas under Construction

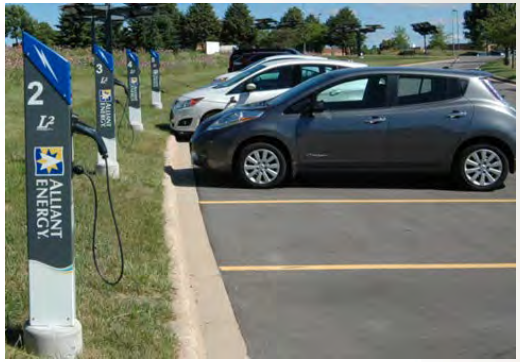
Renewables at Alliant Energy

- WIND
  - Operate four wind farms – 568 MW capacity
    - Will double in next three years
- HYDROELECTRIC
  - Operate two Hydroelectric Dams – 41MW capacity
- SOLAR
  - Riverside Expansion – 2.25MW solar farm
  - Solar Lab at Madison Headquarters



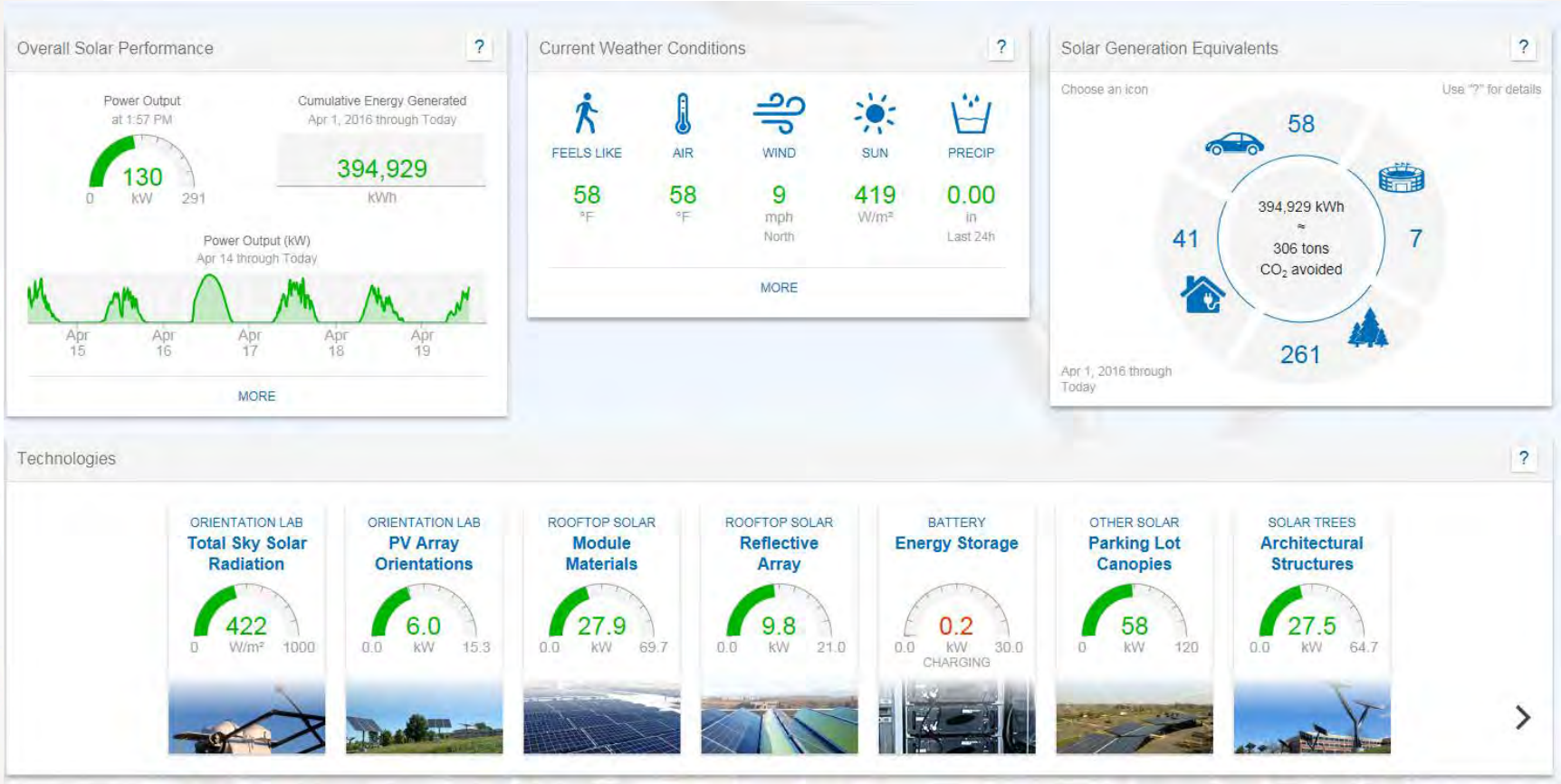


Solar Lab



- Installation of over 1000 panels
  - 11 Different Panel Types
  - Roof Mounts
  - Different angles – rotating panels
  - 13 Electric Vehicle Charging Stations – public access
  - Battery Storage System

Solar Dashboard



Current Best Reference

An Early Survey of Best Practices for the Use of Small Unmanned Aerial Systems by the Electric Utility Industry

Richard M. Lusk
William H. Monday

February 2017

UAS 101

- **Fixed Wing**
  - Longer flight time / Higher Speeds
  - Simpler and Quieter
  - Need Take-off / Landing Areas
- **Rotor Wing**
  - Able to carry wider range of payloads
  - Vertical take-off and landing
  - Greater maneuverability
- **Power Sources**
  - Batteries (most common) – limited flight time
  - Gas Powered – longer duration, safety concerns
  - Tethered (indefinite flight time), Solar, Fuel Cells
- **Featured Technologies**
  - Auto TO/L – Return to Home
  - GPS Stabilization
  - Map Interface
  - Sense-and-Avoid
  - Geo-fencing
  - Automated Flight Planning

Start with Why

- **Safety**
  - Risk the machines, not the people
    - Reduce exposure to hazards
- **Efficiency**
  - Opportunities with BVLOS flight
  - Video record of past inspections
  - Faster access to high-quality real-time data
- **Access**
  - Ability to collect imagery impossible by other means
- **Cost**
  - Good quality UAS = One hour Helicopter Rental

UAS Regulation

- 2012 - FAA Modernization Act
  - Need FAA permission to fly a UAS for COMMERCIAL OPERATIONS
  - Very restrictive parameters placed on these operations
  - Set deadline of September 2015 to allow commercial use of UAS
  - Did not impact hobbyists
- 2013
  - Six institutions given FAA permission to conduct UAS research
    - Commercial entities as partners
- 2014
  - First FAA approvals for commercial UAS operations (333 exemption)

Utilities Jump In

- 2015
  - First Utilities gain 333 exemptions
  - EEI UAS Team is formed to share learnings
  - New Use Cases Tested

ComEd. An Exelon Company	February	• Grid inspection • Damage assessment
SOUTHERN COMPANY	March	• Routine line inspection • Damage assessment
ppl PPL Electric Utilities	April	• Infrastructure inspections
Consumers Energy Count on Us	April	• R&D for safety • Damage assessment • Routine inspections
SDGE A Sempra Energy utility	May	• Aerial inspection • Damage assessment
Xcel Energy	May	• Infrastructure Inspections

UAS Regulation

- 2015

  Pathfinder Programs announced

  –FOCUS AREAS
    - CNN – Newsgathering in Urban Areas
    - Precision Hawk – crop surveys w/ extended Line-of-Sight (LOS)
    - BNSF – Beyond Visual Line-of-Sight (BVLOS)

  –Collect real-world, actionable data on UAS applications
    - Safety Concerns Impact Legislation

  –Xcel Energy begins BVLOS flights (Flot Systems, FAA)

- August 29, 2016

  –FAA Part 107 enacted

Section 333 vs. Part 107

Topic	333 Waiver	Part 107
Pilot Training Requirement	Sports-Pilots Licence	Pass Aeronautical Knowledge Test every two years and pass TSA Screen **OR** Have Pilots Licence, pass a flight review and pass online test every two years
Medical Certificate	FAA Medical Certificate	Ensure pilot has no condition that would impact a flight
Crew	Pilot + Observer	1 Certified Pilot **OR** 1 Certifed Pilot supervising operator
Altitude limit	400 feet	400 feet **OR** Within 400 feet of a structure
Moving Vehicle Operations	Not allowed	Allowed from ground or water vehicles in sparcely populated areas
Stand off-distance	Must be 500 feet from people/property	Can not operate over people or others property

1,338 people took UAS Pilot Test in first 48 hours (88% passed)

Technological Advances

•"The number of transistors incorporated in a chip will approximately double every 24 months."

- Gordon Moore, Intel co-founder

Creativity

- 300 Shooting Star Quadcopters
- 280g each
- Pre-recorded show

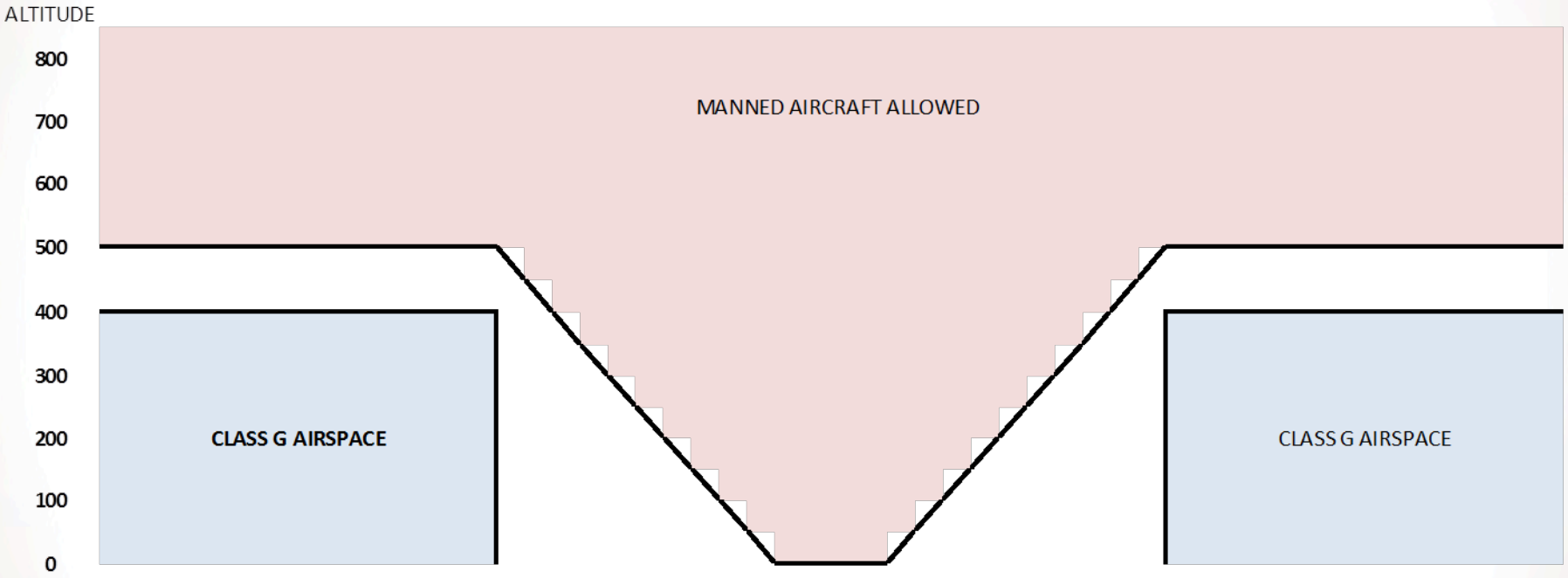
- Algorithm schedules the vehicles based on location, battery life, and image

Creativity

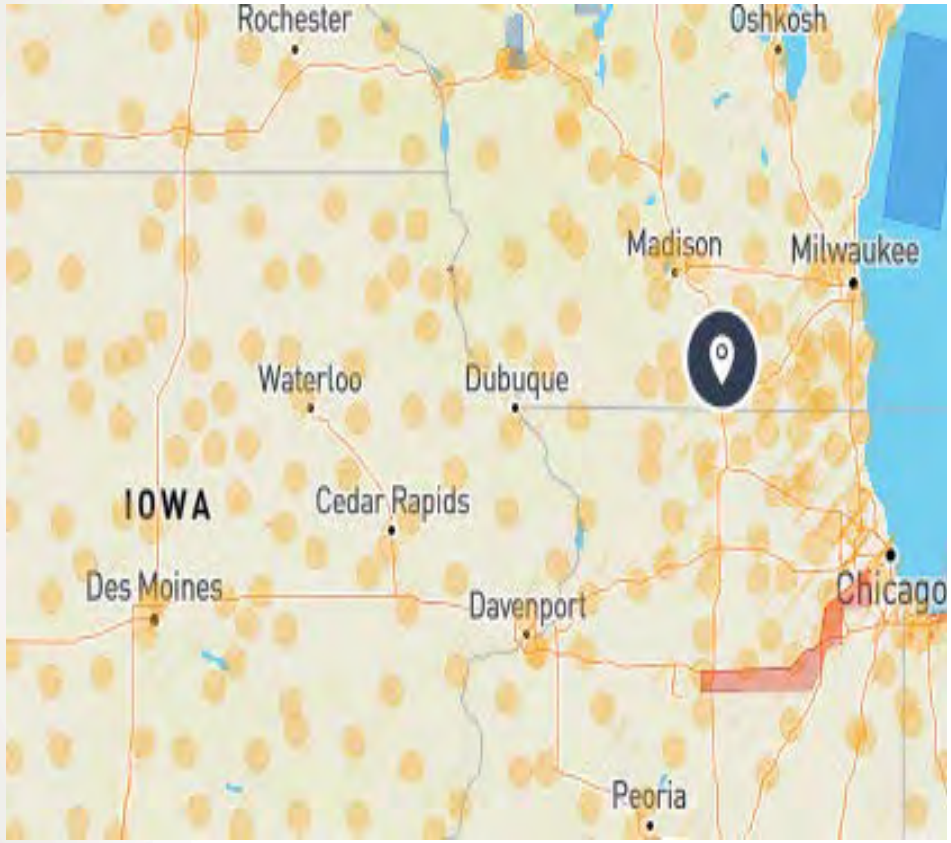
NASA Airspace Management Program

- August 2015
  - Rural applications
  - “Rules of the road” set
  - Vehicle scheduling
- October 2016
  - Rural BVLOS flights
- January 2018
  - Moderately populated areas
  - Vehicle “spacing”
  - Include non-responsive UAV’s
- 2019
  - Urban Areas
  - Package delivery, news gathering

US Airspace 101



Airspace Waivers



Other Waivers – as of May 2, 2017

- ☐ 107.25 Operations from a moving vehicle or aircraft
- ☐ 107.29 Daylight operation
- ☐ 107.31 Visual line of sight aircraft operation
- ☐ 107.33 Visual observer
- ☐ 107.35 Operation of multiple sUAS
- ☐ 107.37(a) Yielding the right of way
- ☐ 107.39 Operation over people
- ☐ 107.41 Operation in certain airspace
- ☐ 107.51(a) Operating limitations: ground speed
- ☐ 107.51(b) Operating limitations: altitude
- ☐ 107.51(c) Operating limitations: minimum visibility
- ☐ 107.51(d) Operating limitations: minimum distance from clouds

• **Daylight Operations**	**727**
• **Multiple Aircraft**	**12**
• **Visual Line of Sight**	**4**
• **Operating Limitations**	**4**
• **From Vehicle**	**3**
• **Over People**	**2**
• **Visual Observer**	**1**
• **AIRSPACE**	**N/P**

- **LOS Waivers**
  - FLIR Unmanned Aerial Systems
  - Precision Hawk
  - BNSF Railway
  - Astraeus Aerial

Utility Use Cases

- Emergency Response/Storm Assessment
- Search and Rescue
- Construction Documentation
- Security Assessments
- Building Inspections
- Economic Development (layout, site selection)
- Bridge Inspections
- Railway Inspections
- Power Line Inspection and Mapping
- Vegetation Management
- Real Estate/Right of Way
- Reading Energized Nameplates
- Video Productions
- Inventory Coal Piles
- Asset and Surface Mapping
- Internal Boiler Inspections
- External Piping/Ductwork Inspections
- Tank Inspections
- Water Inlet/Outlets
- Cooling Pond Temperature Analysis
- Stack Inspections
- Hanger Assemblies
- Wildlife Studies
- Conveyor Inspections
- Ice Formation on Stacks/Equipment
- Gas Pipeline Inspections
- Switchyard Inspections
- Solar Panel Inspections
- Wind Turbine inspections
- Project Design (map sites)

Choose the Right Application

Great | Depends | Horrible

Visual Inspections

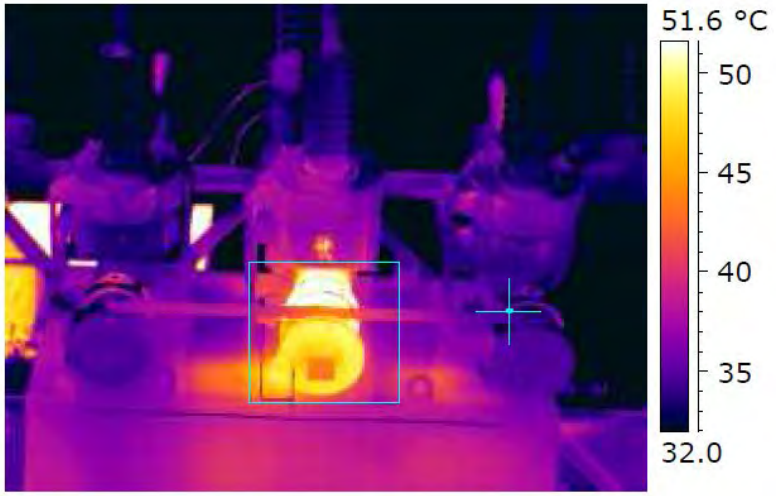
- Focus on Safety
  - Wind Turbines
- Efficiencies
- Better Data – Information?

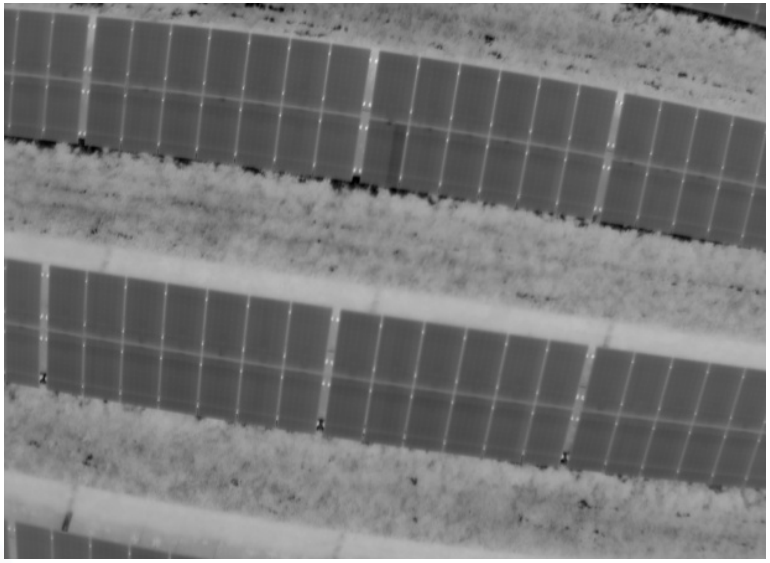
- Record of Past Inspections
- Predictive Analytics

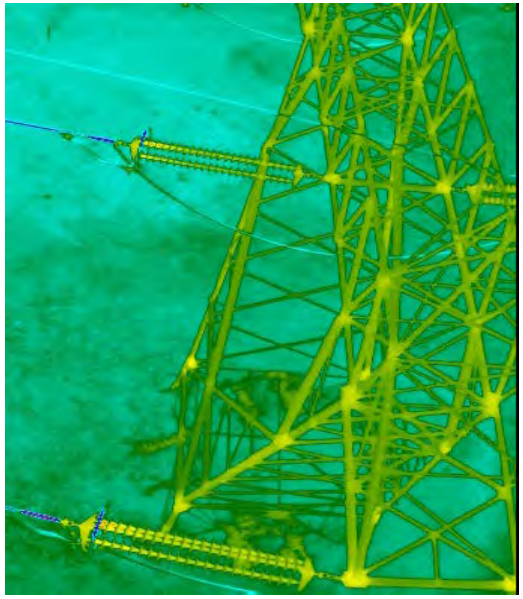
- Need
  - Repeatability
  - Autonomy

Infrared Imagery

- Substation
- Lines
- Solar Panels

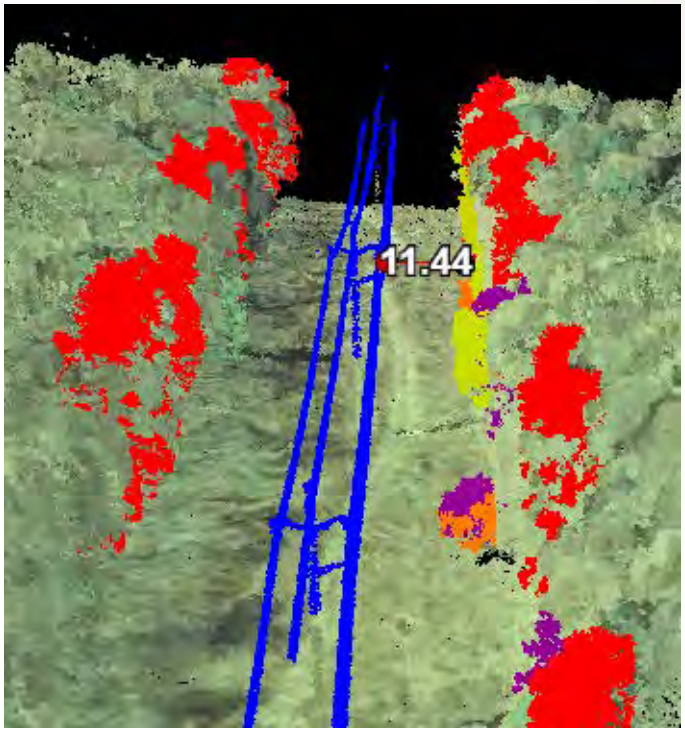




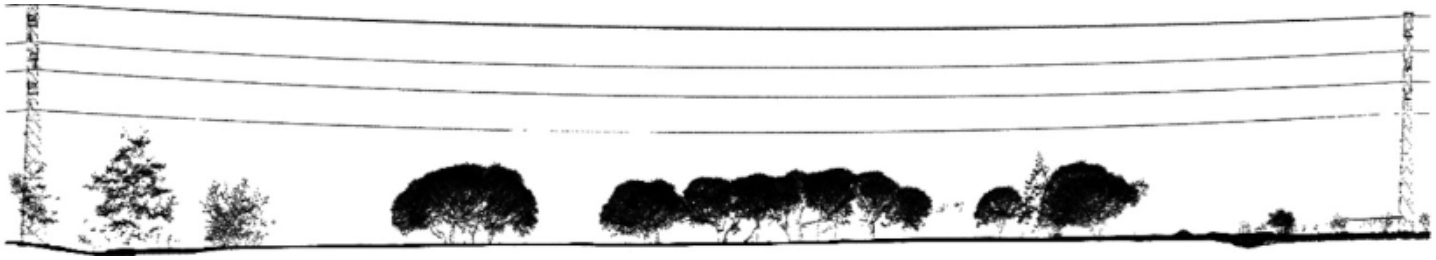


Vegetation Management

- Great LiDAR application
  - Identify Distances
  - Identify “potential” of a tree
  - Line Sag



- Type of Trees?



Emergency Response

- Rapid Damage Assessment
  - Major areas of damage
  - Scope of Damage
  - Access Limitations
- Detailed Damage Assessment
  - Poles down
  - Broken/Missing equipment
  - Vegetation Management
  - Materials List Development
- Understand TFR's
- Real-Time Data Capability
  - Can you turn this into information

Cedar Rapids 2008

Cedar Rapids 2016

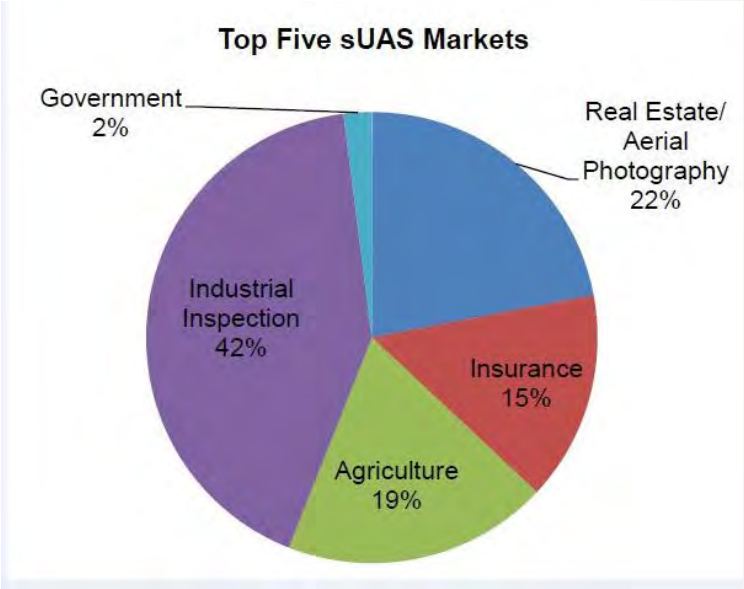
An Emerging Market

- UAS Registration required on December 21, 2016
  - As of April
    - 400K Registered Hobbyist Vehicles
      - Are they "qualified"?
    - 400K Registered Commercial vehicles

      (Federal Aviation Administration)

- Next Decade
  - Generate $82B for economy
  - Create 100K new jobs

    (The White House, 2016)



UAS RFx - Contractors

- Safety Evaluation
  - Industry based comparisons
  - Flight hours / Number of Flights
  - FAA Reports
  - Property Damage Events
  - Lost Vehicle Events
  - Flyaway Events
  - Procedures
  - Insurance
  - Unmanned Safety Institute

UAS RFx - Contractors

- Procedures
  - Backup Vehicle
  - Emergency Landing Areas
  - Control of the Flight Area
  - Roles and Responsibilities Detailed
  - Battery Damage
  - Pre-Flight Checklists
  - Maintenance Procedures

UAS RFx - Contractors

- Capability and Scalability
  - Number of Pilots
  - Experience of Pilots
    - Recurrent Training
  - Number and Type of Vehicles
  - Available Payloads
  - Data Analysis Capability and Turnaround Time
  - Utility Experience
  - Airspace Waivers / Authorizations
  - Cyber Security
    - UAS and Data Captured

UAS RFx – Vehicles

- **"What information do you want"**
  - Not "What data do you want"
  - Vehicle Endurance
  - Atmospheric Conditions (cold/heat, wind)
  - Payloads
- **IT Considerations**
  - Click-through IT agreements
  - Encryption
    - Command and Control
    - Broadcasted data
  - Data Processing Functions

UAS RFx – Vehicles

- Disposable “field” UAS
  - $300-$500
  - Line Crews
- Medium-Quality UAS
  - $1000 to $2000
  - Autonomous Flights
  - Sense and Avoid / GIS Integration
- High-Quality UAS
  - $20-$50K, BVLOS - ($150K)
  - Highly Advanced Cameras
  - Wider option of payloads

Internal Programs

- Leverage Corporate Communications
  - Social Media
  - Use Existing Systems (Line Clearance Notifications)
  - Public Affairs (local ordinances)
  - Brand your vehicle
  - Handout for the public
  - Privacy Policy

- Training
  - How trained are your Mechanics? Lineman? Technicians?
  - Don't try it first in the field
  - Understand the rules
  - Understand the technologies – stay current

Internal Programs

- Data Processing
  - Chain of Custody
  - Handling
    - Metadata, Storage, Access, Analytics
  - Internal Capabilities to process?
- Safety
  - Read the Oak Ridge report
  - Engage all safety teams, get their approval for procedures and policies
  - Give people time to train
- Hybrid Approach
  - Vertical Inspections only
  - Little to no data analysis
  - Visual Inspections only

Summary

- Rapidly transforming technology
  - Stay in touch
  - Continue to evaluate
- Regulations
  - Almost There
  - Help Lobby!
- RFX
  - Understand the outcome
  - Understand your partner
- Internal or External Program
  - Know your lane
  - The road is changing

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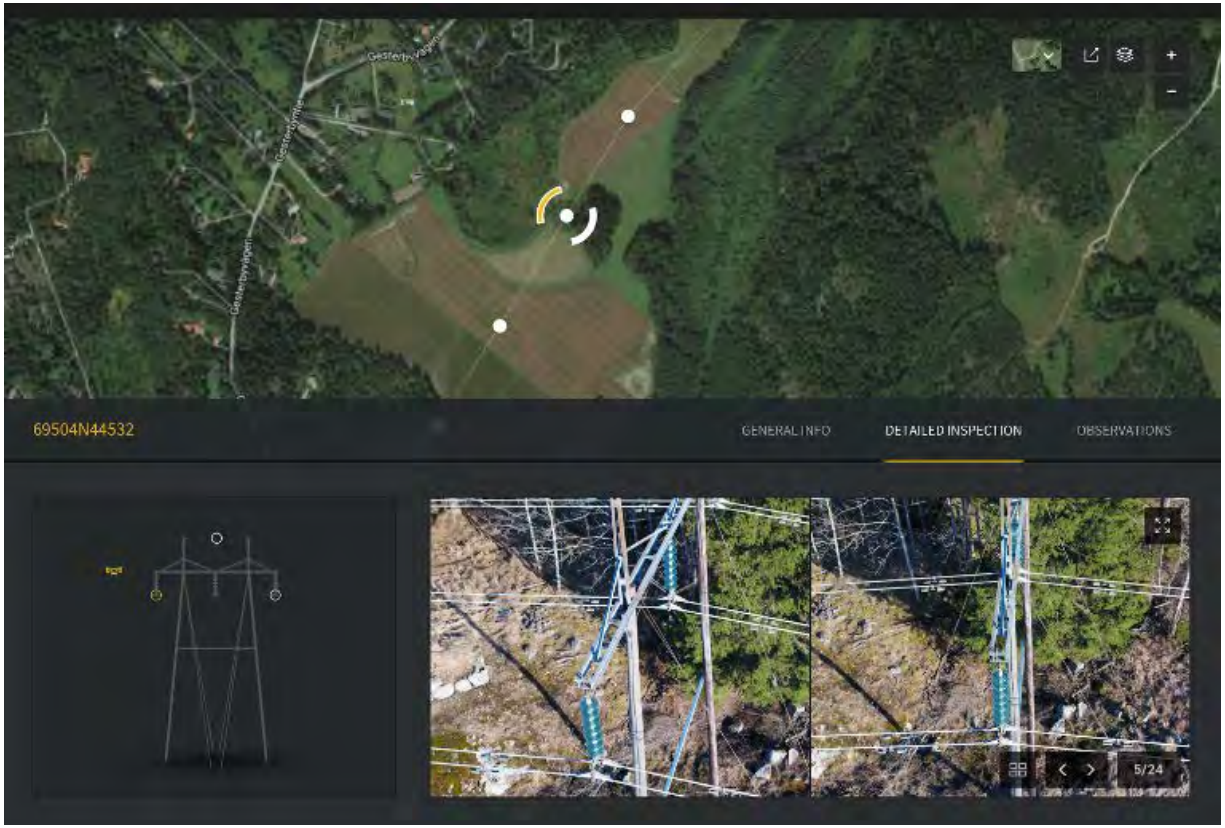
Questions ?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