Mapping Tools for Siting Wind Turbines
Who is Apex Clean Energy?

Developed 1,165 MW of operational facilities

- 300 MW, Canadian Hills, OK
- 300 MW, Balko, OK
- 300 MW, Kay, OK
- 100 MW, Hoopeston, IL
- 165 MW, Cameron, TX

150 Employees

Including 4 GIS Professionals
Headquartered in Charlottesville VA
Projects Planned for 2016/2017

1,969 MW

capable of 2016 COD and PTC/ITC qualified

- 150 MW
  Perryton II, TX
- 170 MW
  Patriot, TX
- 150 MW
  Perryton, TX
- 250 MW
  Chapman, TX
- 160 MW
  Midway, TX
- 200 MW
  Cotton Plains, TX
- 300 MW
  North Rim, OK
- 149 MW
  Grant Plains, OK
- 152 MW
  Grant, OK
- 70 MW solar
  Mills Branch, MD
- 18 MW solar
  Phantom Solar, TX
- 200 MW
  Pumpkin Farm, TX
Asset Management Services - “The ROCC”

4 Wind Farms
Under Management by Q1 2016

Remote Operations Control Center staffed 24/7 will be managing 1,015 MW by Q1 2016
Customers and Investors

Customers like low-cost energy. Investors like compelling returns.

Both like the benefit of a long-term hedge against inflation and carbon risk.
**Typical Development Site**

**Landscape**
Size: 30 - 50 Square Miles

Topography: Relatively Flat in the West/Midwest or Ridge top

Agriculture – Corn, Soybean

Relatively Unpopulated

Active Oil and Gas Areas

**Project Specifics**
# of Turbines: 50 – 150

3-5 Meteorological Towers

Project Substation

345kV Transmission Line
Example: Balko Wind Farm in Beaver County, OK

GE Turbines
440Ft Tall
Rotor Diameter of 350Ft
5 Mile 345kV Transmission Line
Heading in Right Direction with the Right Technology?

Searching for the Old Chickchaw Migration Trail in “Moonrise Kingdom”

Paper Maps!

Apex Team

Apex Bosses...“Where did you put that Turbine?”
How does Apex Use ArcMap?

- Lease Tracking
- Visualizing Wind Speeds
- Setback Calculations (What to Avoid)

Online Mapping Portal: Atlas

Legal Exhibits
Wind Turbines...Good Neighbors?

Will Farrell in “Everything Must Go”

Turbine Location Selection?

How Close is Too Close (Not Apex)?

Good Neighbor?
Setbacks – Where Turbines Should **NOT** be Located

- Create Setbacks – Delineate what to avoid and create a “buildable area layer”
- Wind Resource team creates turbine array
- Create Map Books with all available data using Data Driven Pages Extension

**Layers Included:**
- Planimetric Data/ High Res Aerial
- Turbine locations
- Underground Collection Lines
- Access Roads
- Landowner Names
- Setbacks
- Water/Wildlife features
- Structures – Houses, Barns, etc.
- Underground Pipelines
- Cell Tower Beam Paths
- Contour Lines
- Transportation Routes
- Oil and Gas Infrastructure
- Noise Level (db)
- Shadow Flicker (hrs/yr)
Desktop Review with Engineering Team

- Verify Setbacks and review turbine locations with Engineering team using ArcMap, CAD and Google Earth.

Check List

• House Verification
• Pipeline Identification
• Check oil/gas well activity
• Double check setback distances
• House/Barn?
Desktop Review with Engineering Team

- Review Historic Images on Google Earth

2014 Aerial Image

2014 – Near Corpus Christi

1961 - Near Corpus Christi
Desktop Review with Engineering Team

- Measure from edge of house
- 1200Ft for Participating Landowners in OK
- 1400Ft for Nonparticipating Landowners in OK
Field Visit Preparation

PDF Avenza App

- Load setback maps and turbine KMZ files on to Iphones/Ipads to use in PDF Avenza App. Useful for staff that doesn’t have ArcMap on a field computer.

- Add turbine KMZ with simple schema onto setback map in PDF Avenza.

Turbine Schema

- Visited – Yes/No/Viewed from Road
- Approved – Yes/No/Alternate
Location
Field Visit Preparation

**GPS Enabled PC Running ArcMap 10.3**

- On office computer create data package to be loaded onto tablet computer.

- Utilize high-resolution aerial imagery flown for each project.

- Clip any national layers to the project extent

- Review data layer list to confirm all necessary layers are included.
Field Visit Preparation – Safety First

- Water
- Food
- Snake Chaps
- Data/Maps!
In the Field – Iphone/Ipad Use

- Ipad with setback map/turbine locations used for navigating the site.

- Iphone/Ipad Data Capture - Use detailed setback pdf map as the base map with PDF Avenza App.

- Drop pins and take notes with PDF Avenza. Add georefenced photos to notes.
In the Field – Tablet PC/ArcMap Use

- Create new line, point, and polygon layers, in order to take notes.

- Edit each layer as needed, adding in notes on features not previously captured.

- Details accessible: setback distances, landownership information, pipeline widths and companies, etc.

- Allows on the fly measurements to check distances from turbines to structures or other features to avoid.

- ArcMap is by far the most useful tool we use in the field during the turbine siting process.
In the Field – Underground O&G Pipelines

- The biggest challenge, in terms of identifying/locating.

- Data from state agencies not always reliable, nor is data from pipeline companies.

- Witness posts, visible scars on aerial imagery, and easements derived from title commitments seem to provide the most information.

- Ground Penetrating Radar (GPR) necessary.
Back in the Office

- Roll up all notes and pictures into a single KMZ and share with engineering team.
- Update Setbacks to include field data.
- Meet up with Engineering team to help create “final” micro-sited turbine array.
Back in the Office

- File Micro-sited Turbine Locations with FAA....wait on approval (60-90 days).
What Tools Should Apex be Using?

- Collector App
- ArcGIS Online
- ArcGIS Pro
Post Construction Success

Location!