

CERTAIN

City Environment Range Testing for Autonomous Integrated Navigation



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Overview

- I. Understanding legal paths to sUAS flight
- II. Section 333 market research
- III. LaRC Ranges
- IV. CERTAIN program



Image Credit: Popular Mechanics

Understanding legal paths to sUAS flight



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Authorizations Granted Via Section 333 Exemptions



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The FAA is currently considering exemptions under Section 333 from several different entities. You can view the exemption requests at [regulations.gov](#).

Show entries

Search:

Grant Issued	Petitioner	Operation / Mission	Authorizations (includes both petition and grant of exemption documents)
		Image Credit: FAA.gov	

Understanding legal paths to sUAS flight

- Use-case defines many of the regulations that apply to the flight
- Hobbyist, online registration
- Public agencies, COAs, MOAs, LOPs
- For profit, multiple paths:
 - Experimental type certificate
 - Pathfinder partner
 - 333 Exemption
 - (Proposed) Part 107 rules
 - (Proposed) Micro ARC recommendations –NEW! 4/1/16



Image Credit: Economist.com

Understanding legal paths to sUAS flight

- What is a 333 exemption?
 - *By law, any aircraft operation in the national airspace requires a certificated and registered aircraft, a licensed pilot, and operational approval. Section 333 of the FAA Modernization and Reform Act of 2012 (FMRA) grants the Secretary of Transportation the authority to determine whether an airworthiness certificate is required for a UAS to operate safely in the National Airspace System (NAS). (source: FAA.gov)*
 - Exempting sUAS operators and sUAS pilots from specific airworthiness, “for-hire”, and maintenance schedule requirements



Image Credit: FAA.gov

Understanding legal paths to sUAS flight

Typical current 333 exemption restrictions

- Visual line-of-sight (VLOS) only
- Day only
- Pilot + Visual observer required
- Less than 55lbs, sUAS
- Less than 87 knots (100 mph)
- 400' AGL ceiling
- No operations within 5 SM of airport
- Class C,D,E,G Airspace VFR weather minimums



VFR Weather Minimums

Type of Airspace	Flight Visibility	Cloud Clearance	
10,000 MSL	5 statute miles	111 → 1,000 below, → 1,000 above, → 1 sm horizontal	
Below 10,000 MSL	C	152 → 500 below → 1,000 above → 2,000 horizontal	
	D		
	E		
	B	3 statute miles	Clear of clouds
1,200 AGL or higher	G (night)	3 statute miles	152 → 500 below → 1,000 above → 2,000 horizontal
	G (day)	1 statute mile	152 → 500 below → 1,000 above → 2,000 horizontal
Below 1,200 AGL	G (night)	3 statute miles	152 → 500 below → 1,000 above → 2,000 horizontal
	G (day)	1 statute mile	Clear of clouds

Image Credit: FAASafety.gov

Understanding legal paths to sUAS flight

Proposed Part 107

- Visual line-of-sight (VLOS) only
- Day only
- ~~Pilot + Visual observer required~~
 - sUAS certified operator
- Less than 55lbs, Less than 87 knots
- 400' AGL ceiling
- No operations within 5 SM of airport
- Class C,D,E,G Airspace VFR weather minimums
- Micro ops over non-participating people authorized (pending)



VFR Weather Minimums

Type of Airspace	Flight Visibility	Cloud Clearance
10,000 MSL	E	5 statute miles 111 → 1,000 below, → 1,000 above, → 1 sm horizontal
Below 10,000 MSL	C	3 statute miles 152 → 500 below → 500 below → 2,000 horizontal
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Below 1,200 AGL	G (night)	3 statute miles 152 → 500 below → 500 below → 2,000 horizontal
	G (day)	1 statute mile Clear of clouds

Image Credit: FAASafety.gov

Understanding legal paths to sUAS flight

Micro ARC Recommendations

- Micro UAS ARC (Aviation Rulemaking Committee) recommendations (April 1)
- Four categories, more to flight than just weight/speed (all under 55 lbs.)
- Not stipulated recommended requirements:
 - FAA testing site v. online test
 - TSA background check



Image Credit: FAASafety.gov

Understanding legal paths to sUAS flight

Micro ARC Recommendations

Category	Weight	Manufacturer Certified Risk Level	Less than 1% chance of serious injury at max force?	Flight over people?
One	Less than 0.5 lbs.	Very-low	Yes	Yes, unrestricted
Two	Less than 4.4 lbs./2 kilos	Low	Yes	Yes, restricted: 20' vertically, 10' laterally
Three	Less than 55 lbs.	Unspecified	No, set at 30% or less chance	Yes, but restricted-access, participating population only
Four	Less than 55 lbs.	Unspecified	No, set at 30% or less chance	Yes, but with unspecified "strict regulation including development of flight risk plans & safety certifications administered by FAA." (Associated Press)

Section 333 Market Research



Section 333 market research

Methodology and the validity of data available

- Is it “just noise?”
 - If the 333 Exemption process is a stop-gap or temporary solution, does this data mean anything?
- No exemption pdf left behind
 - Every summary that indicated industry-use related to our infrastructure inspection was opened and read for data.
- What was the criteria? ...



Image Credit: SlideBean.com

Section 333 market research

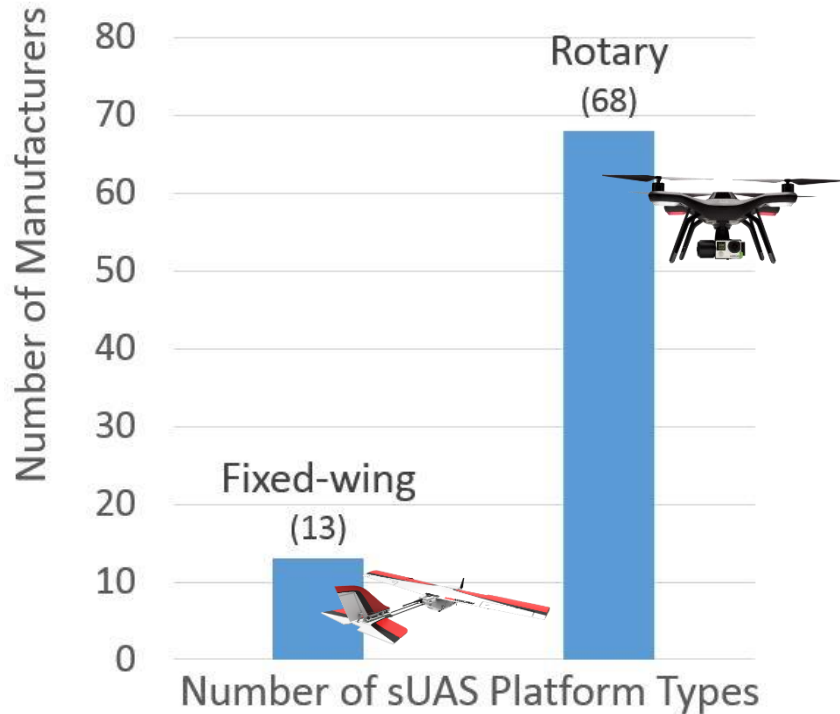
Identifying the right identifiers of industry

- Industry
 - Utility (primary)
 - Pipeline (secondary)
 - Turbines or Towers (tertiary)
- Established business presence
- Located in contiguous United States



Manufacturer: Data patterns and market insights

Making fixed vs. rotary



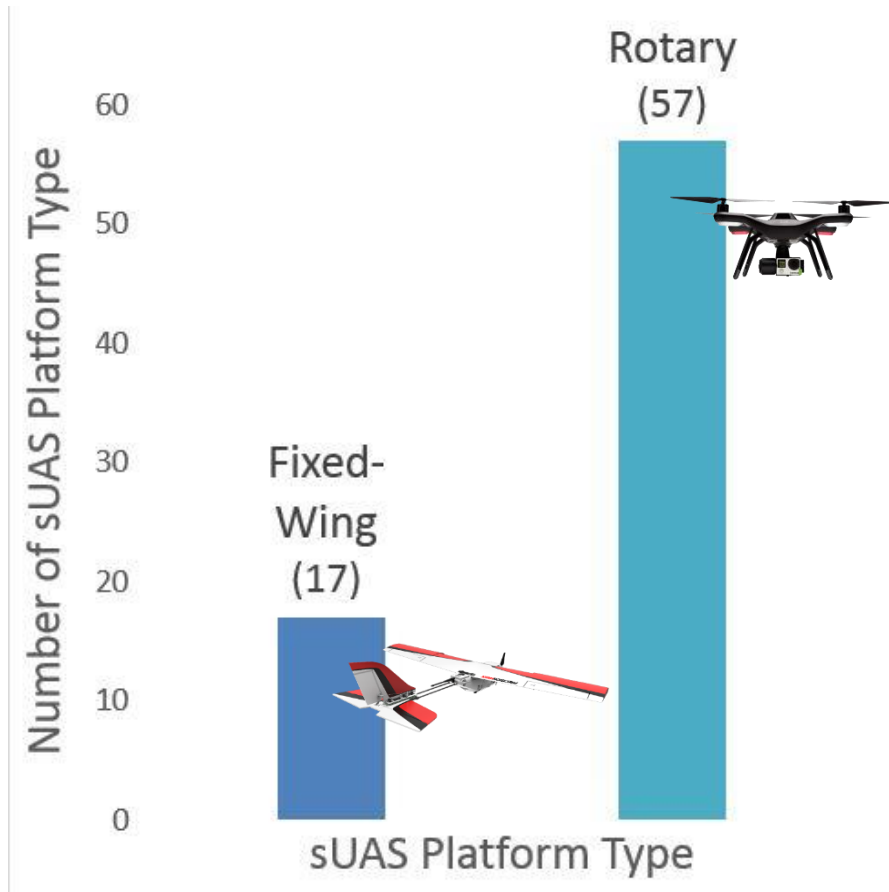
Market leaders (Top 5)

Rank	Name	Concentration	Type
1	DJI	48 of 62	Rotary
2	Aeryon	11 of 62	Rotary
3	Draganfly	8 of 62	Rotary
4	3DR	8 of 62	Rotary
5	Precision Hawk	6 of 62	Fixed

The market is very concentrated and rotary manufacturers outnumber fixed-wing manufacturers by roughly 5:1

Exemptee: Data patterns and market insights

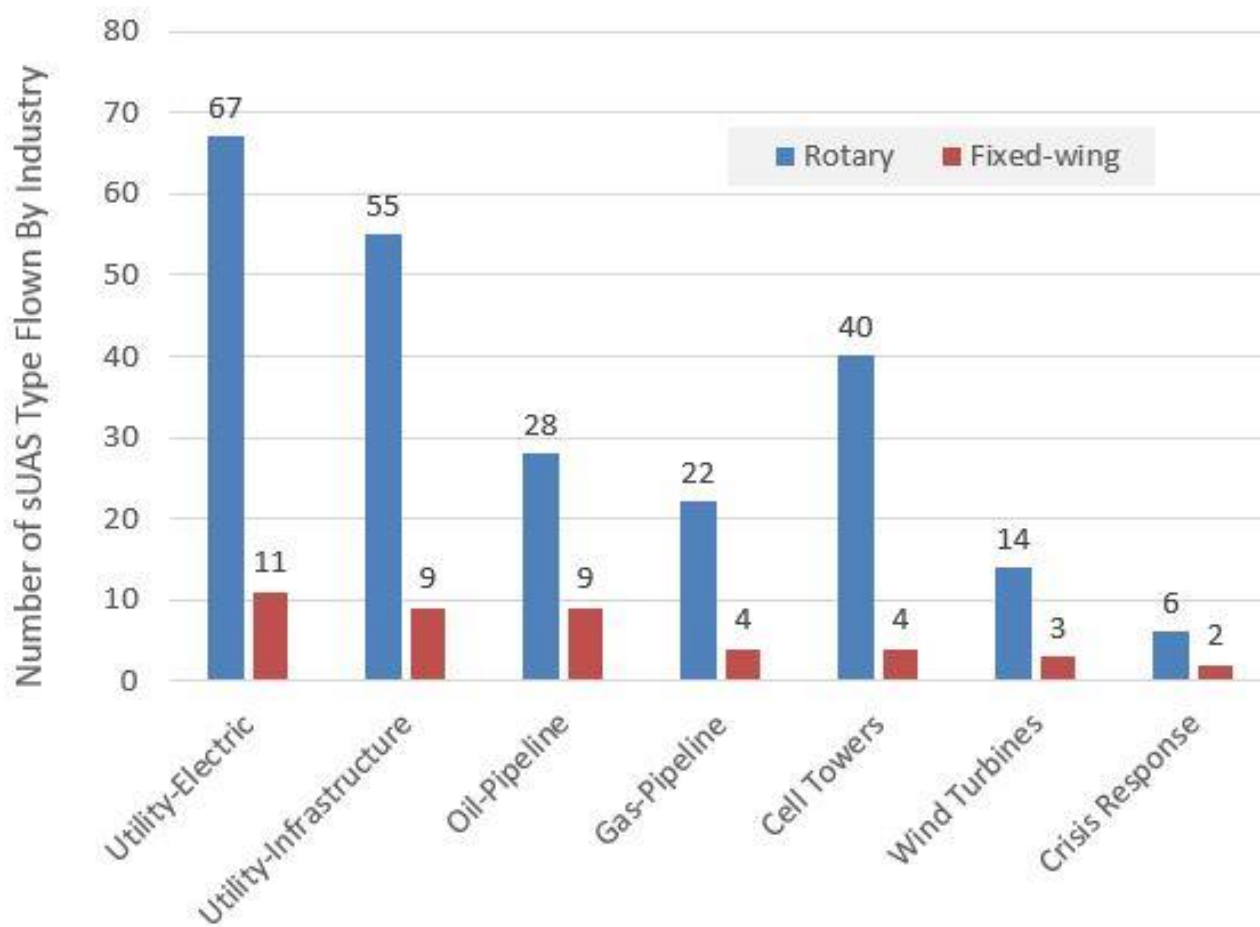
Exemptee to sUAS type



Of the 62 Exemptees identified, 12 requested both fixed-wing and rotary drones in their exemptions.

Industry: Data patterns and market insights

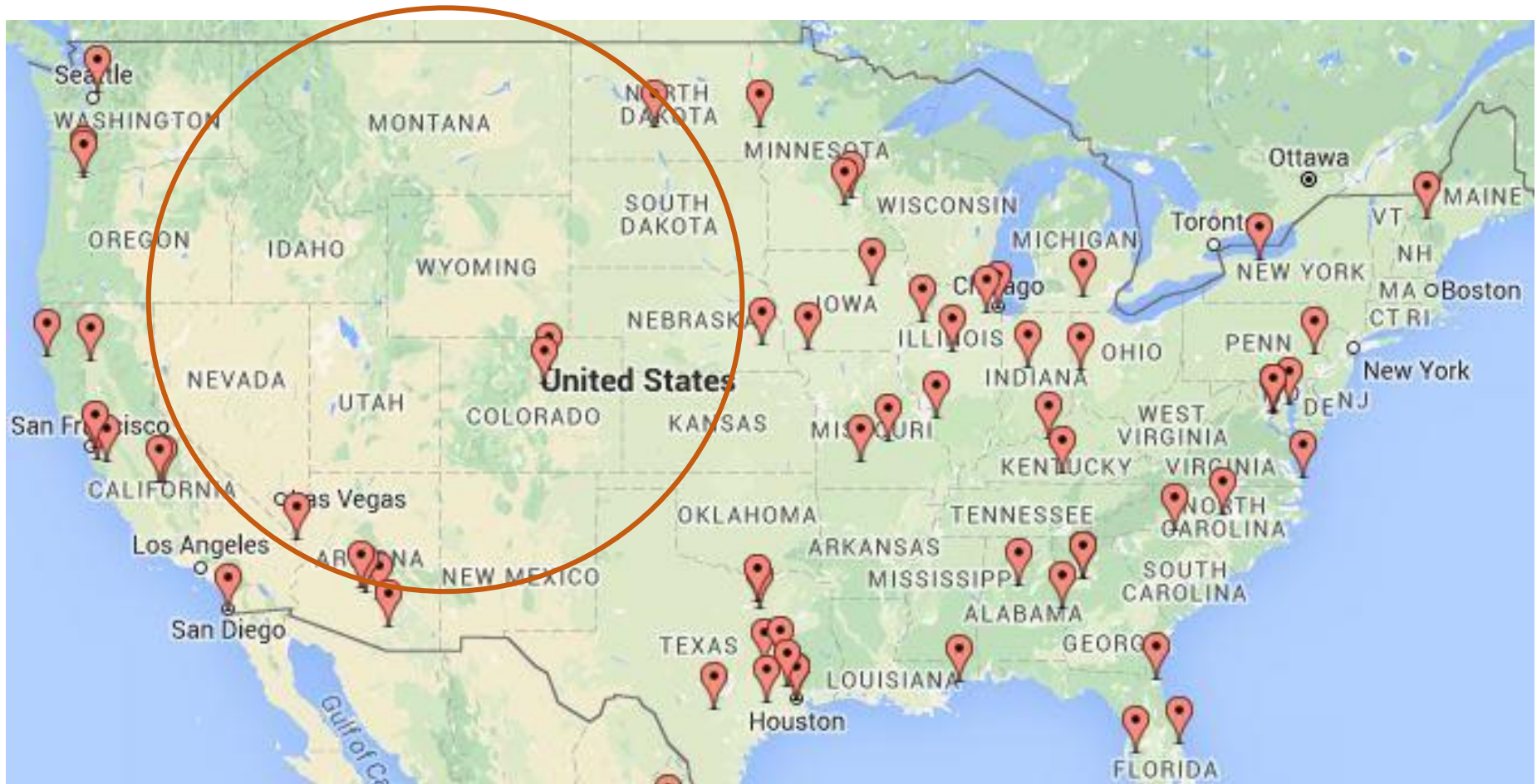
sUAS platforms by industry type



Every sUAS platform in an exemption was tallied along with the intended operation type.

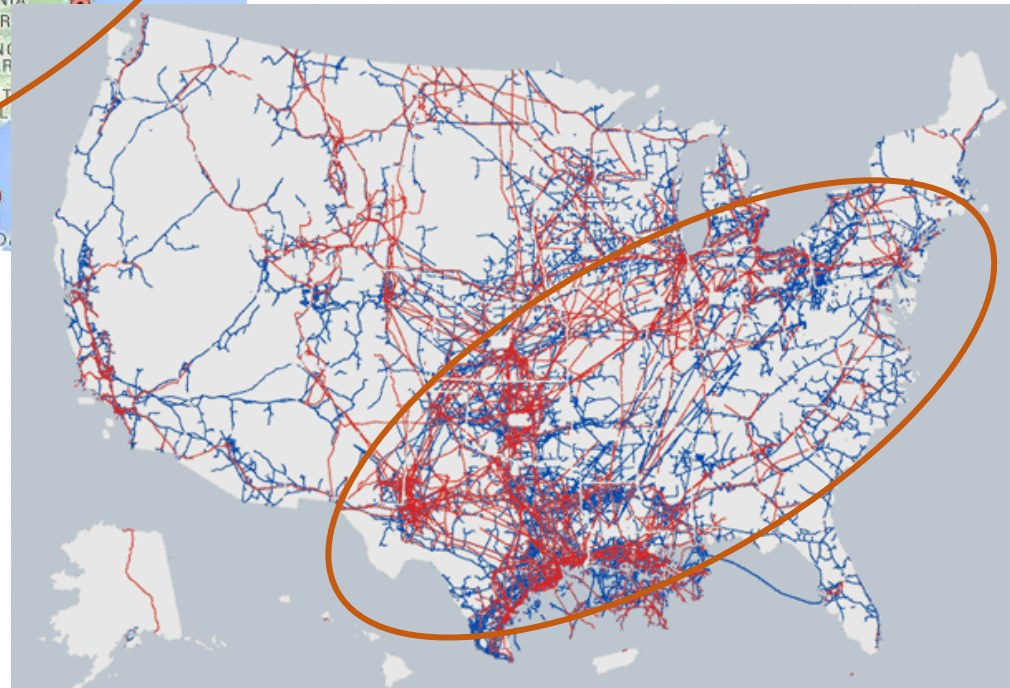
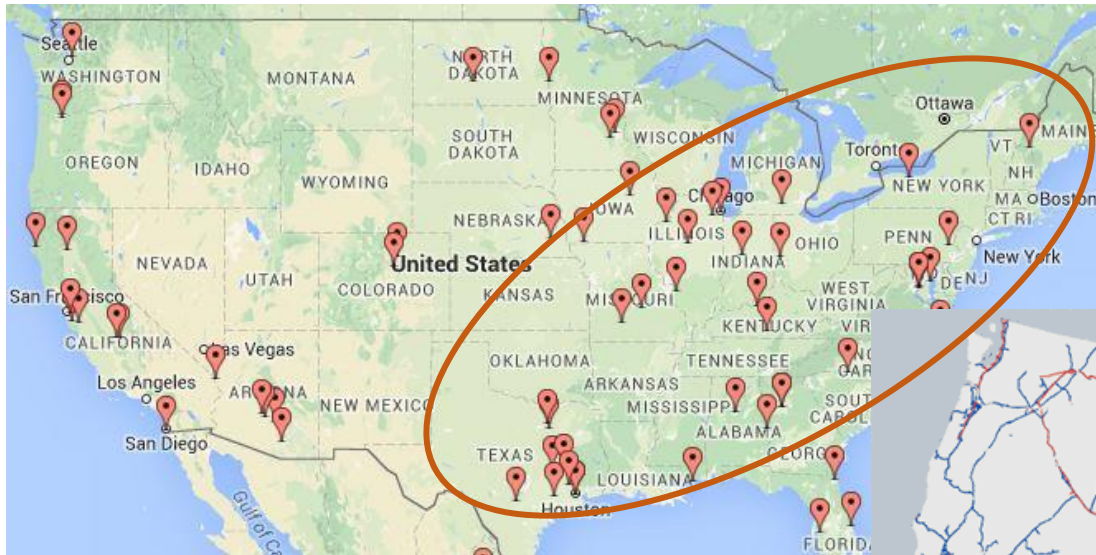
Exemptee: Data patterns and market insights

Exemptee potential partners locations



Exemptee: Data patterns and market insights

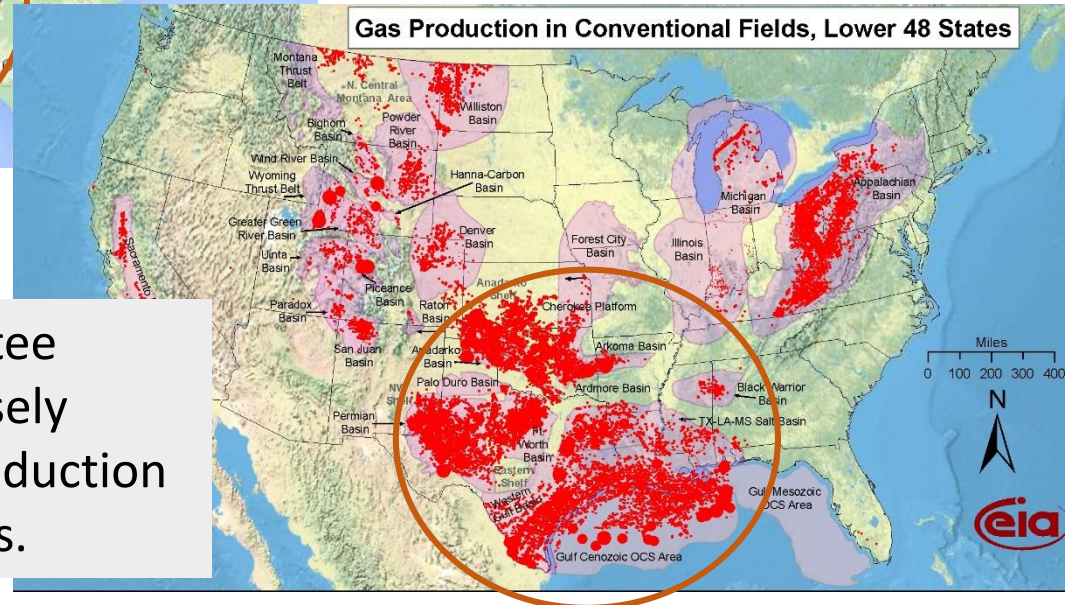
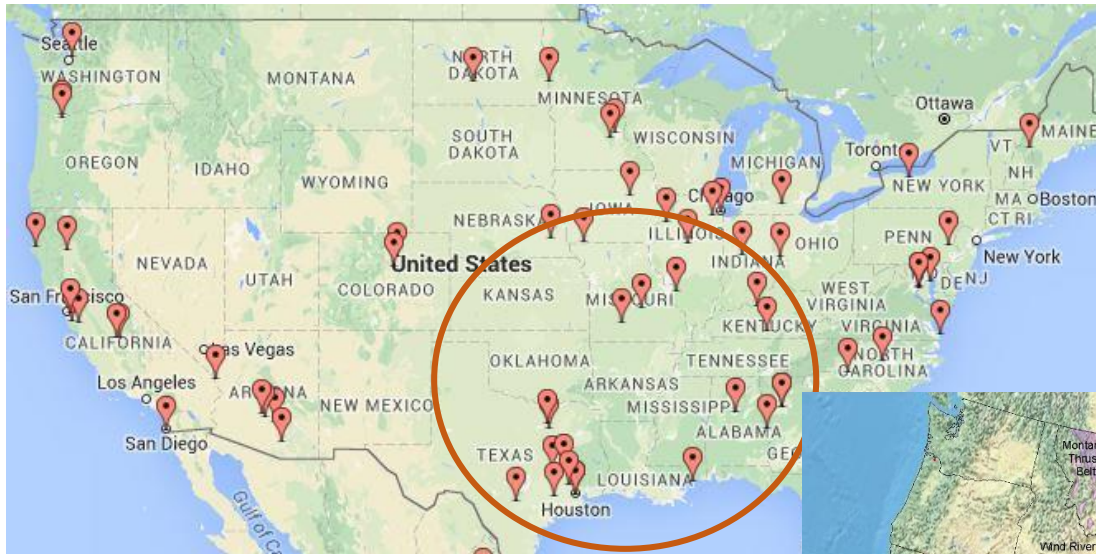
Exemptee potential partners locations



Midwestern, Northeastern and Eastern coastal Exemptee locations closely follow pipeline infrastructure grids.

Exemptee: Data patterns and market insights

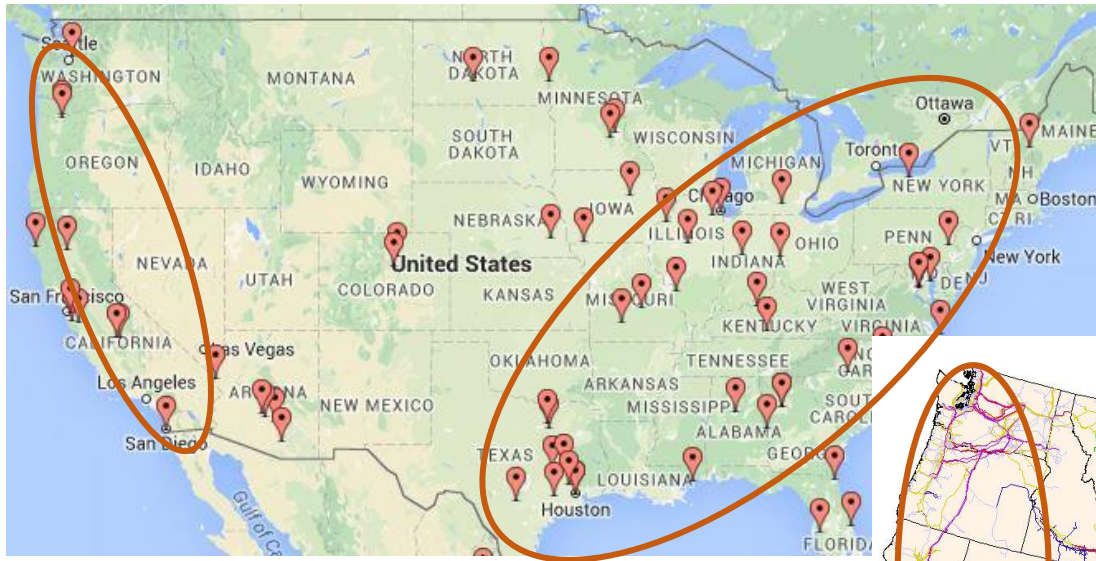
Exemptee potential partners locations



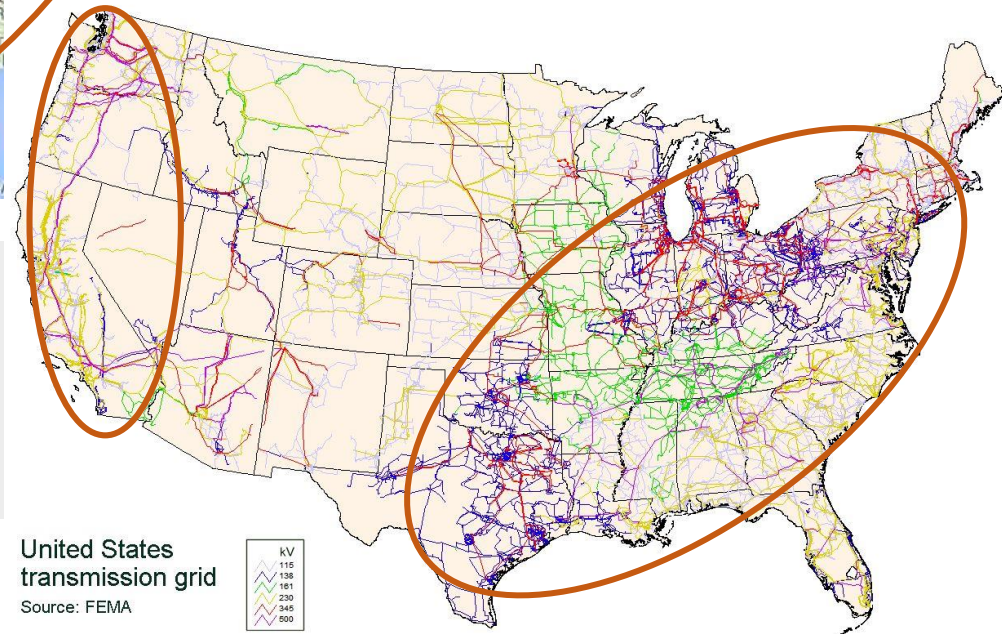
Gulf Coast Exemptee concentration closely follows gas/oil production conventional fields.

Exemptee: Data patterns and market insights

Exemptee potential partners locations



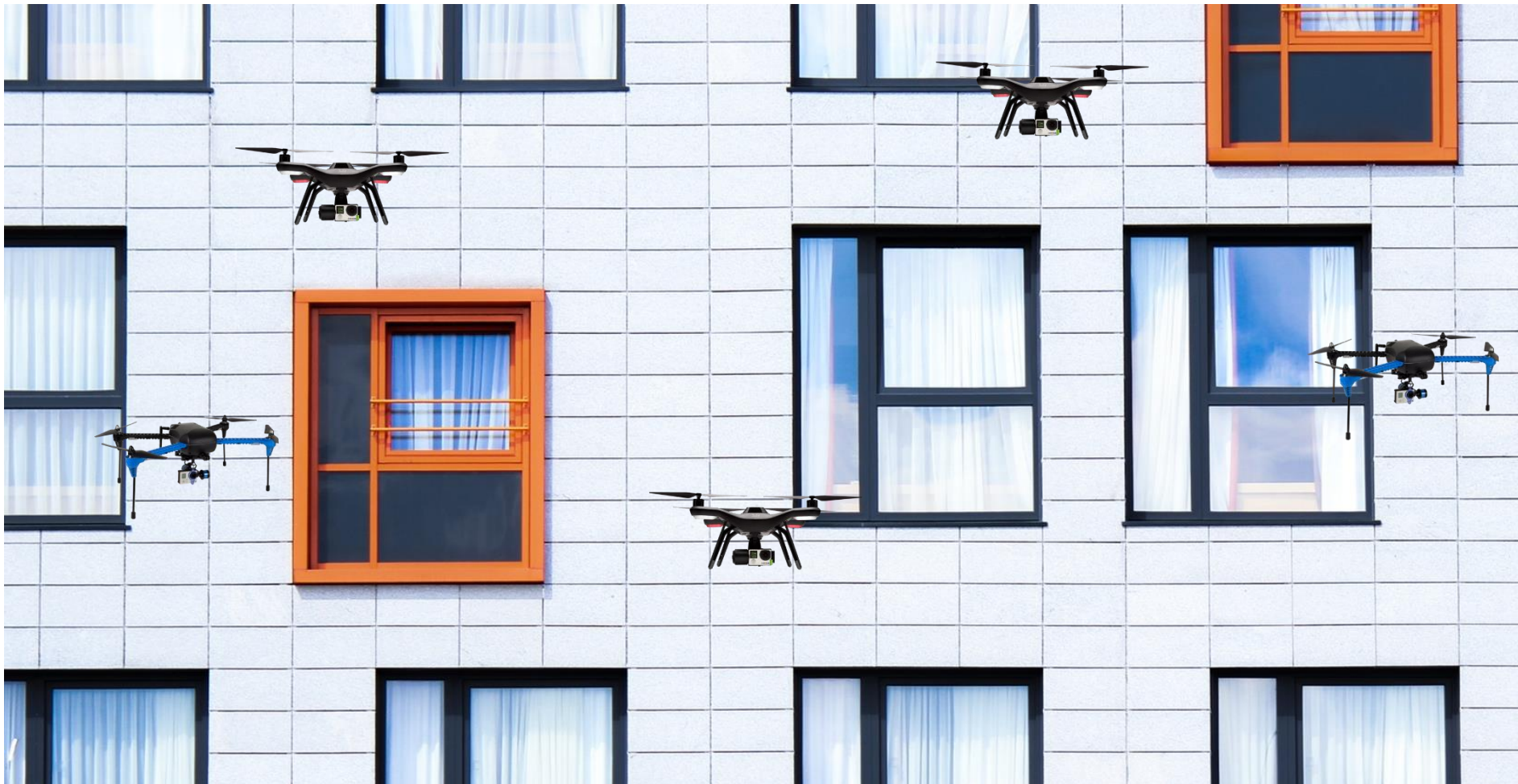
Eastern, Midwestern and Western coastal Exemptee locations closely follow transmission grids.



United States transmission grid
Source: FEMA



NASA Langley Research Center UAS Operation Ranges



NASA Langley Research Center UAS Operation Ranges

- **NASA MOA**
 - Oliver Farms Range
 - Class G, up to 1200' AGL
 - Virginia Beach/Pungo Range
 - Class G, up to 700' AGL
- **LaRC COA**
 - CERTAIN
 - Class D, up to 400' AGL
 - Fort Eustis
 - Class D, up to 400' AGL
- **Restricted Airspace**
 - Fort A.P. Hill Range, agreement with restricted airspace range operator/controlling authority
 - Up to 9,000' AGL



CERTAIN: City Environment Range Testing for Autonomous Integrated Navigation



What is CERTAIN?

CERTAIN is a NASA Langley Research Center capability

- Urban, relevant unmanned test range facility
- LaRC airspace being utilized as a facility
- Multi-phase build up of airspace access to facilitate sUAS technological research



Who benefits from CERTAIN?

CERTAIN provides airspace access for:

- **Industry Partners:** test innovative technologies, new platforms, avionics, software, sensors, both for and independent of sUAS platforms
- **NASA researchers:** LaRC and all NASA Center researchers can access the range for testing and research (platforms, payloads or sensors) as well as utilize the airspace for their tools (GIS)
- **Governance:** Knowledge transfer of these CONOPS into routine integration of sUAS in the NAS and urban environments for the public's benefit and guidelines/standards to agencies (e.g. FAA)



CERTAIN Program Phase I

Phase I – initiated in 2015. “North 40”

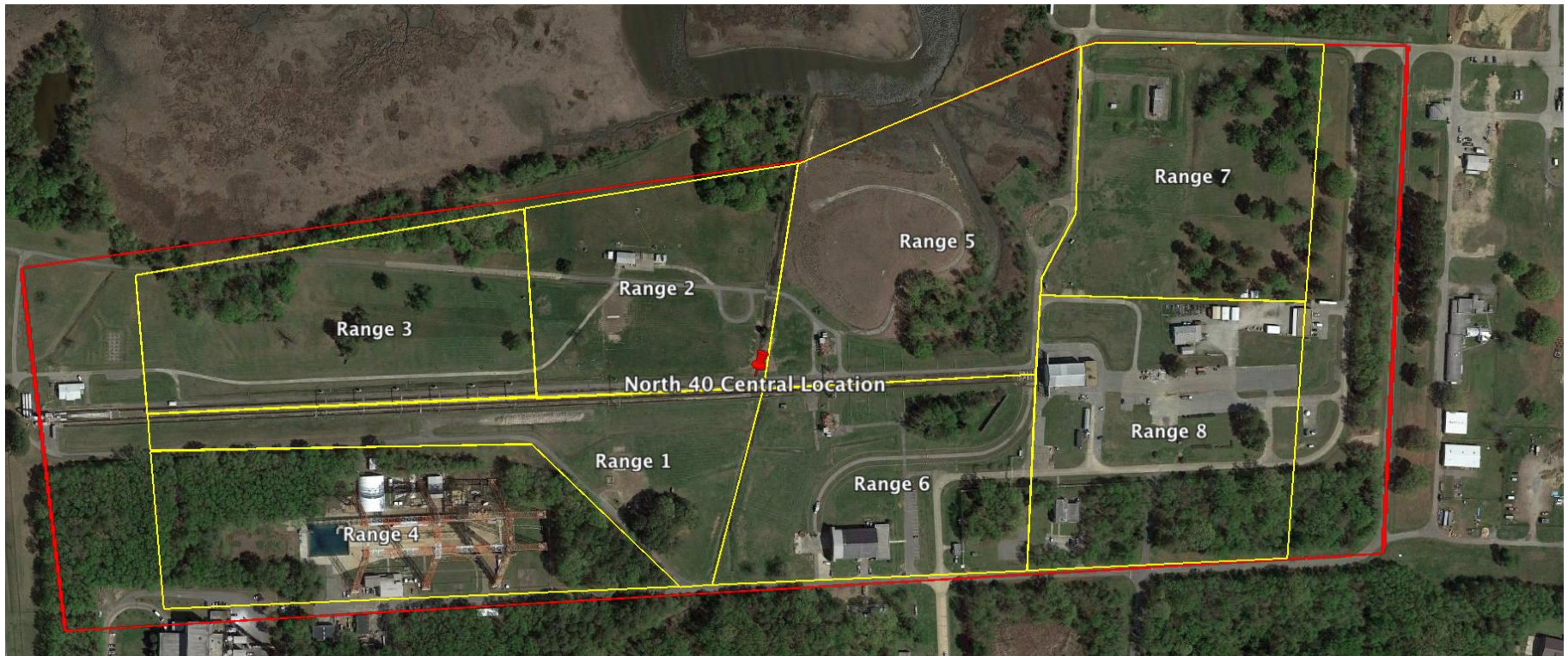


Image Credit: Google Maps

CERTAIN Program

Phase I – Phase II

Phase I – initiated in 2015. We call the North-40 (highlighted in blue).

Phase II – started 2016.

Expanded operations from blue area, Phase 1, to gold area Phase 2.

Phase III – slated 2017/FY2018.

Expand operations into the green area (include the whole center).



Image Credit: Google Maps

CERTAIN

City Environment for Range Testing of Autonomous Integrated Navigation



Questions?

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