

Invenergy



Creating Value for Wind

Manage the risk or pay for it?

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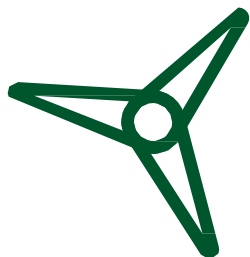


Services Experience Across Technologies

12+ years

Self-perform O&M, 24/7
monitoring, analytics and
engineering services

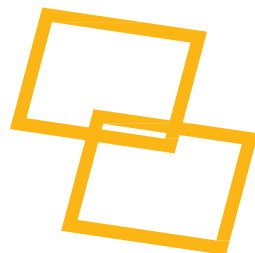
Operating Portfolio



Wind

50 Projects

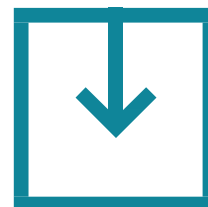
6,200+ Megawatts



Solar

6 Projects

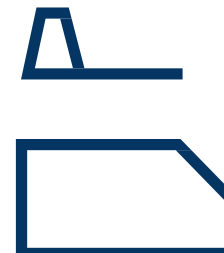
160+ Megawatts



Storage

4 Projects

68 Megawatts



Natural Gas

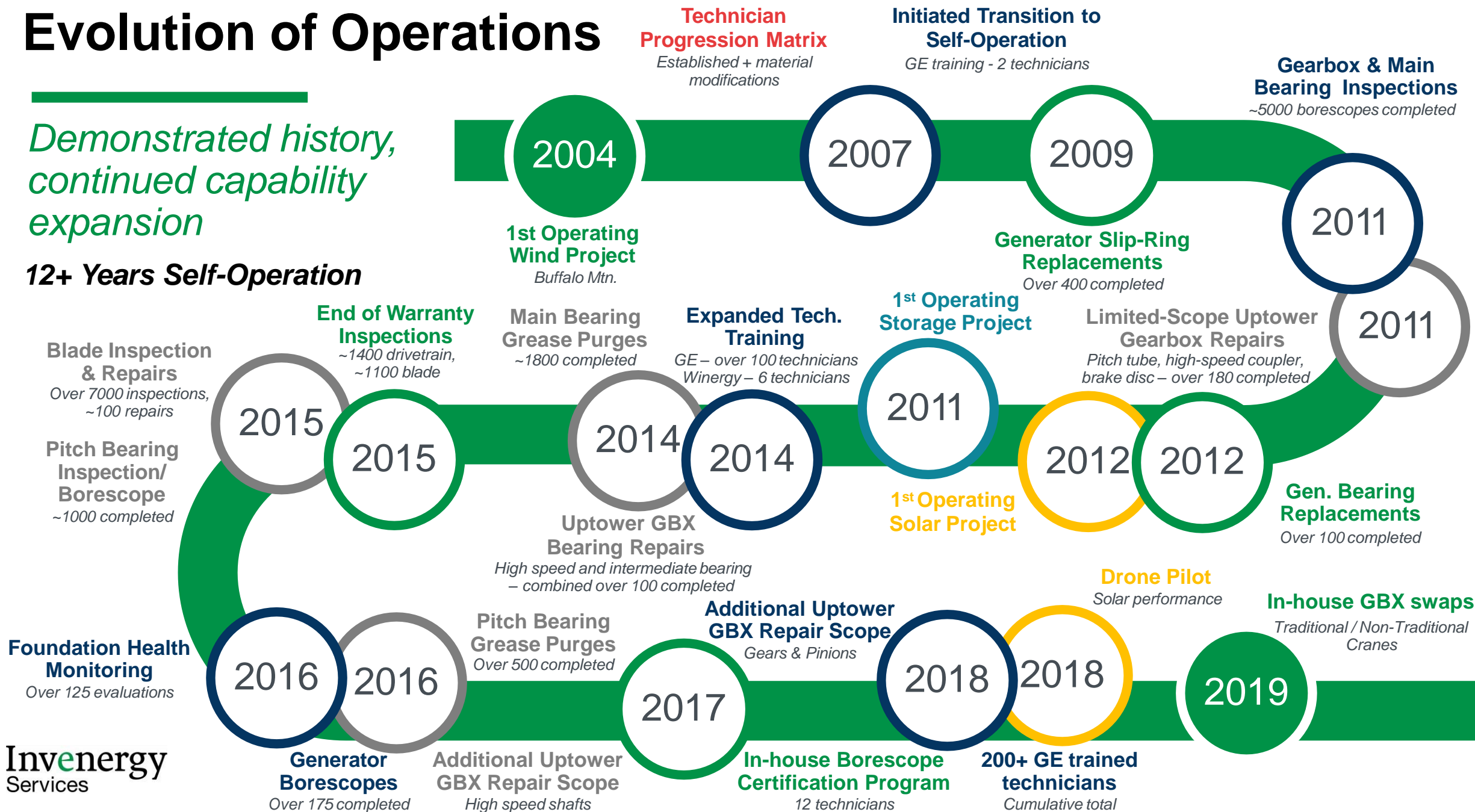
8 Projects

4,600+ Megawatts

Evolution of Operations

Demonstrated history,
continued capability
expansion

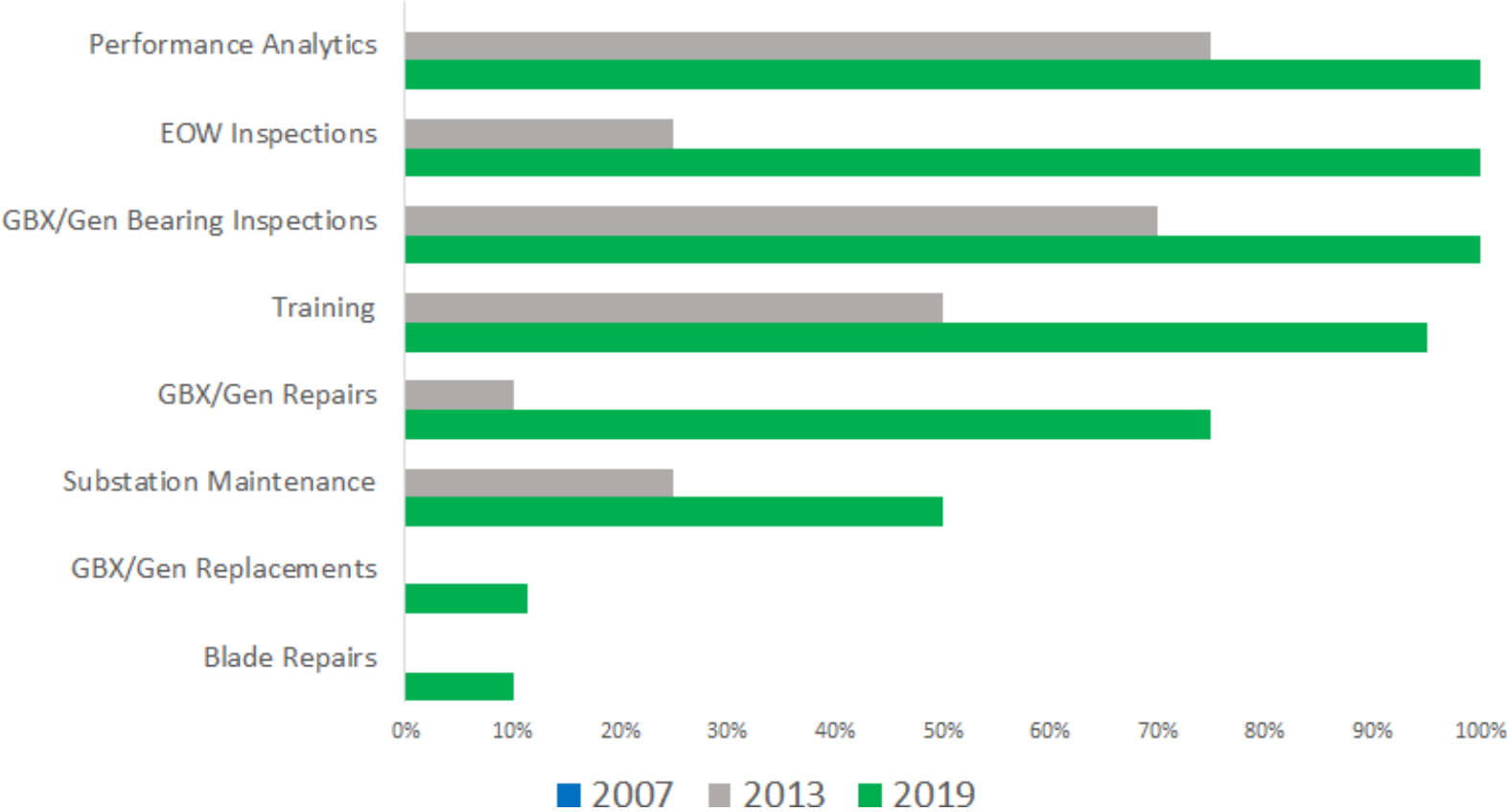
12+ Years Self-Operation



Outsource vs Self-Perform



Self-Perform Operations

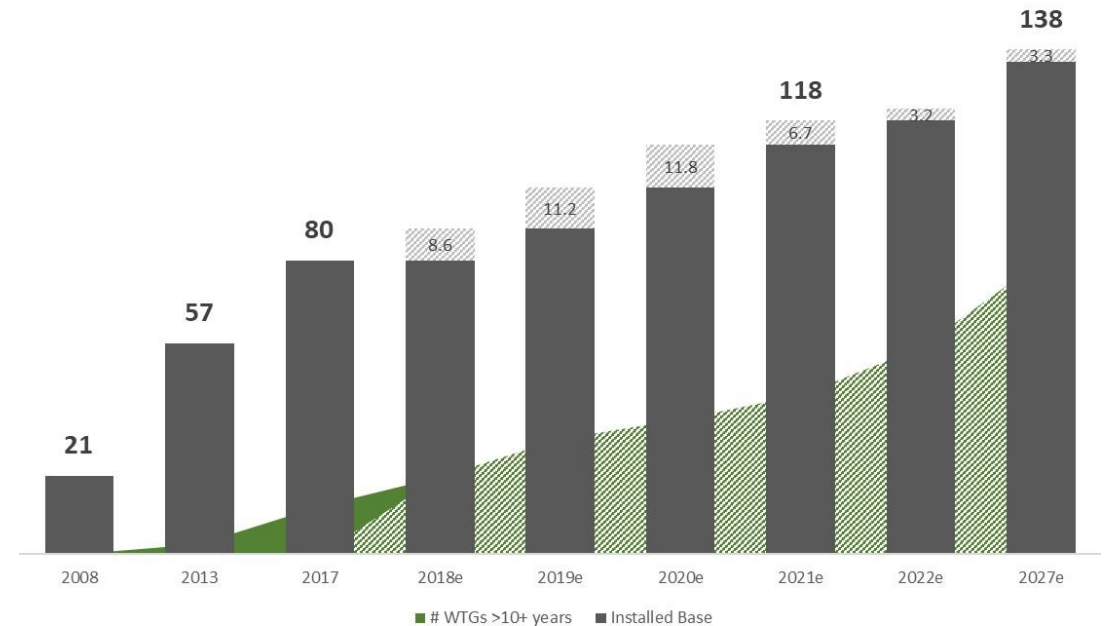


Aftermarket Services Landscape

Strong market catalysts exist for innovation and efficiency gains within the aftermarket

- 4X growth of installed base over last 10 years
- 30+ GWs will reach 10 years in operation by 2021
- Expect supply chain capacity easing under post-PTC outlook

U.S. Wind Turbine Market* (GWs)



Source: adapted from AWEA, MAKE Consulting
* Includes WTGs >1MW capacity

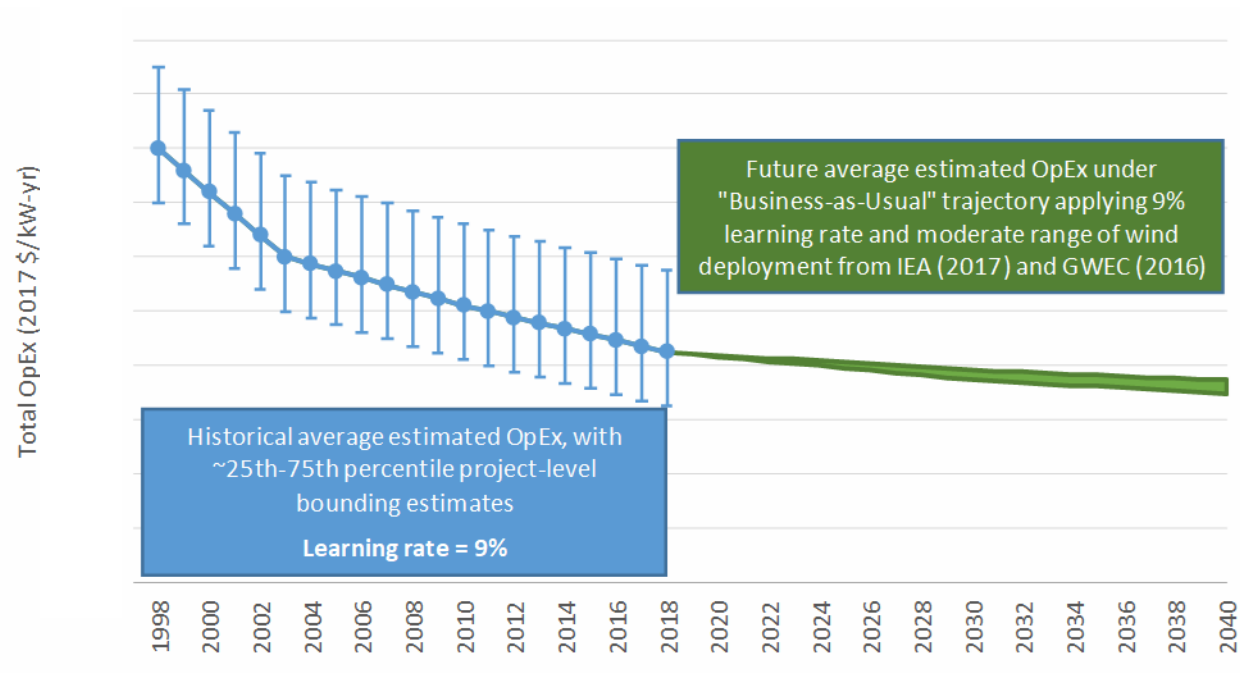
Innovation Examples

Fixed-fee Agreements do not allow for innovation and efficiency gains to be realized

	Pre-2013	2015	2018	Future
Gearboxes	Primarily shop based rebuilds, OEMs dominated market (\$300K+/event)	Improved analytics, introduction of independent rebuild shops and up-tower repairs (\$30-250K/event)	Mature analytics and up-tower repairs, alternative crane solutions entering market (\$30-\$200K/event)	Market scale fosters competition and continued innovation (<\$200K/event)
Blades	Basket based inspection, reactive repairs (1-3 WTGs/day)	High resolution ground based inspections (3+ WTGs/day)	Drone technology becoming a reliable approach (6-8 WTGs/day)	Thermal imaging inspection technology (12+ WTGs/day)

Market Maturity Impact

Conservative projections offer material OpEx improvement

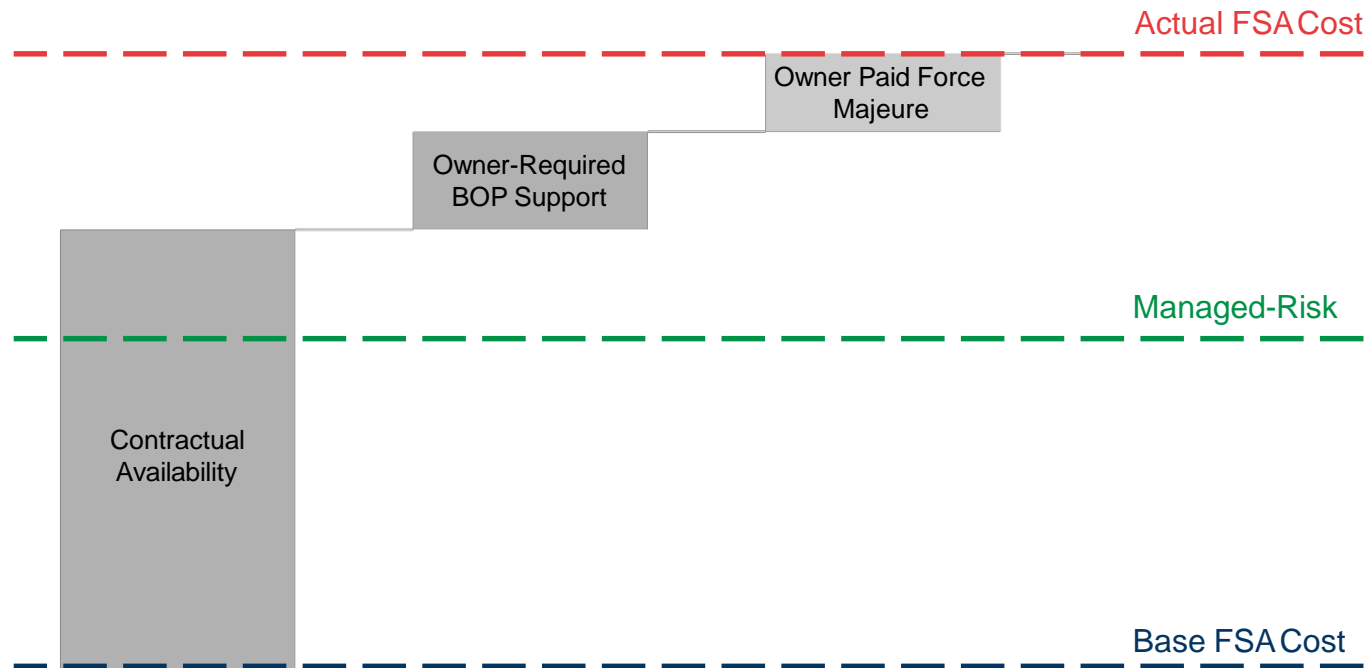


- Average all-in lifetime OpEx in the United States has experienced dramatic decline
- Economies of scale offer further reduction opportunities as both turbines and turbine fleets continue to grow

Source: Lawrence Berkeley National Laboratory, Benchmarking Wind Power Operating Costs in the United States, 2018 draft

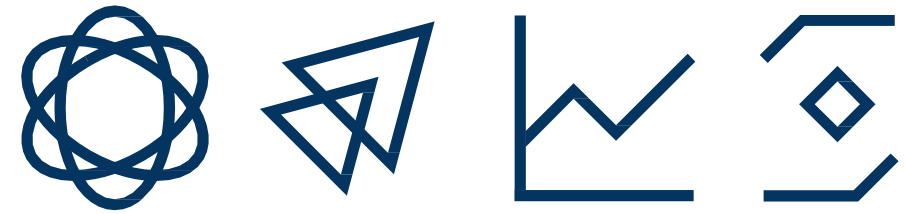
Managed-Risk vs. FSA Structure

Equalized O&M Cost Basis



Key Considerations

- Contractual availability does not equal realized availability (*or production*)
- Owner costs include;
 - lightning strikes
 - high wind events
 - crane pads, turning radii
 - road/crop mitigation
- Post contract turbine condition

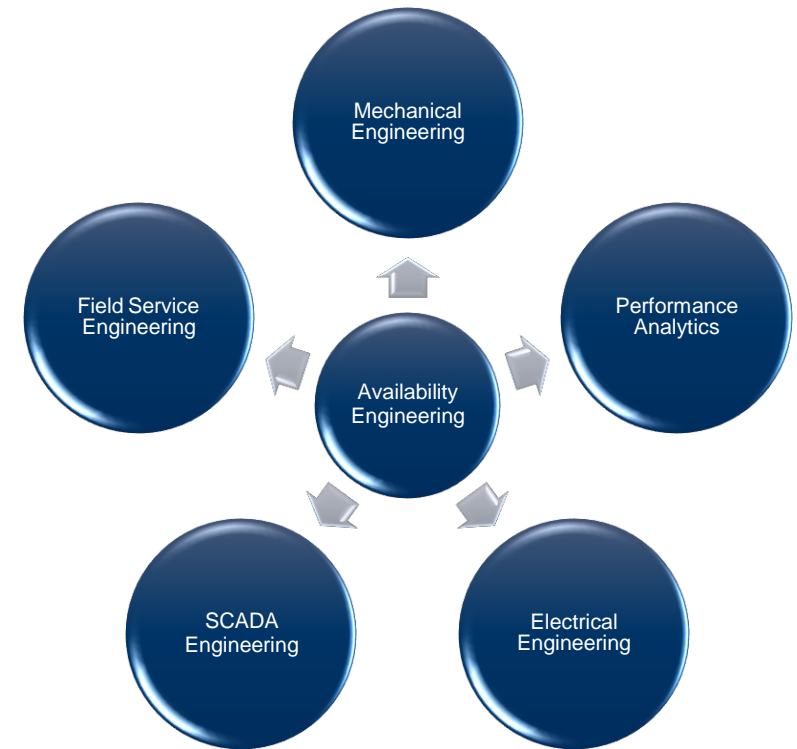


Managing Risk

Engineering and Sourcing

Operations Engineering

- **Mechanical – Reliability-Focused Subject Matter Experts**
- **Analytics – Anomaly Detection, Metrics, etc.**
- Electrical – BOP and Equipment Electronics
- SCADA – Controls and Data Historian
- Field Service – Advanced Troubleshooting and repair
- Availability – Region-focused Engineers



Strategic Sourcing

Efficient Access to Equipment & Services

Pricing

- **Scale:** Negotiate fleet-wide pricing
- **Volume-based discounts:** Negotiate discounts with primary suppliers based upon volume tiers

Risk Mitigation

- **Single sourcing:** Use qualified primary suppliers, and often secondary supplier for major equipment, and top parts, and select services
- **Downtime:** Secure delivery/return-to-service guarantees and delay damages
- **Long lead times:** Hold select inventory of collection system and substation equipment
- **Supplier evaluations:** safety, qualification (repairs), and ongoing performance evaluation

Quality Management

- **Specifications:** In collaboration with Engineering team, provide preferred specs for Gearboxes, Main Bearing and Shaft, Generators, Blade Repairs, Parts
- **Warranty Response Guarantee:** Expedited for Down Turbine/Site
- **Reporting:** Tied to invoice payments to ensure quality

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