Invenergy



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



8 Projects

4,600+ Megawatts

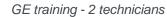
Invenergy

Evolution of Operations



modifications

Initiated Transition to Self-Operation



Gearbox & Main Bearing Inspections ~5000 borescopes completed

201

2011

Demonstrated history, continued capability expansion

12+ Years Self-Operation

End of Warranty

Inspections ~1400 drivetrain, ~1100 blade

2015

2016

2015

2016

Inspection/ Borescope

Blade Inspection

& Repairs

Over 7000 inspections,

~100 repairs

~1000 completed

Pitch Bearing

1st Operating

Wind Project Buffalo Mtn.

2004

Main Bearing Grease Purges

~1800 completed

Expanded Tech. Training

2007

GE - over 100 technicians Winergy - 6 technicians

2014 2014

Uptower GBX Bearing Repairs

High speed and intermediate bearing - combined over 100 completed

Pitch Bearing Grease Purges Over 500 completed **Additional Uptower** GBX Repair Scope

Gears & Pinions

2017

Generator Slip-Ring Replacements

2009

Over 400 completed

1st Operating **Limited-Scope Uptower Storage Project Gearbox Repairs**

Pitch tube, high-speed coupler, brake disc - over 180 completed

2012 2012

1st Operating **Solar Project**

2018

2011

Gen. Bearing Replacements

Over 100 completed

Drone Pilot

Solar performance

In-house GBX swaps

Traditional / Non-Traditional Cranes

2019

Foundation Health **Monitoring**

Over 125 evaluations

Invenergy Services

Generator **Borescopes** Over 175 completed **Additional Uptower GBX** Repair Scope High speed shafts

200+ GE trained technicians Cumulative total

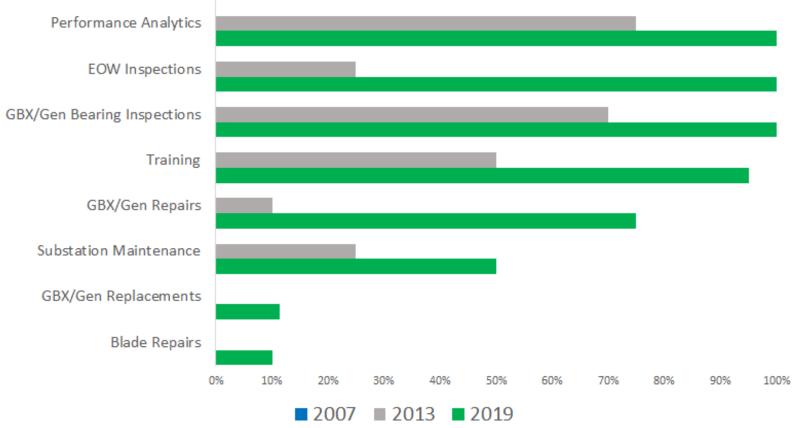
2018

In-house Borescope **Certification Program** 12 technicians

Outsource vs Self-Perform



Self-Perform Operations



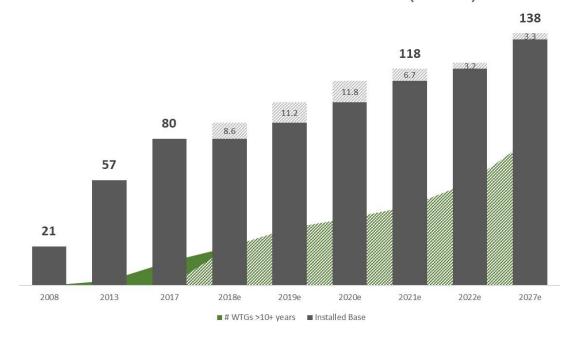


Aftermarket Services Landscape

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

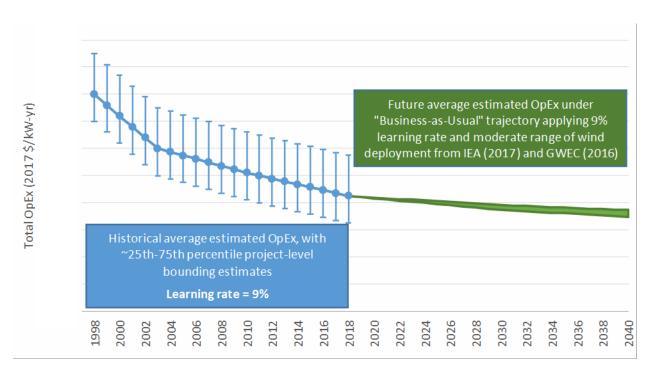
Fixed-fee Agreements do not allow for innovation and efficiency gains to be realized

	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



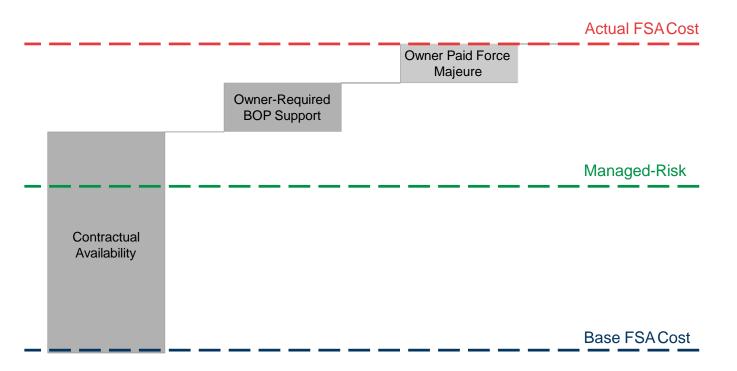
- Average all-in lifetime
 OpEx in the United States
 has experienced dramatic
 decline
- Economies of scale offer further reduction opportunities as both turbines and turbine fleets continue to grow

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



Invenergy

Invenergy Services Operate with Excellence

Join us. in f y @

