



What Gets Measured Gets Done

Choosing the Right Metrics and Action Plans are Key to Optimal Performance

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What Gets Measured Gets Done

"if you can't measure it, you can't manage it ..." W. Edwards Deming

"if you can't measure it, you can't manage it!" Robert Kaplan

Floyd said, if you can't measure it, you can't manage it ...

Remember Gordon Baskerville's famous forest management dictum: "If you can't measure it, you can't manage it ..."

A quote from George Webster that says "If you can't measure it, you can't manage it ..."

Grove is known for an almost ruthless analytic zeal (at Intel, one of his best-known maxims is "If you can't measure it, you can't manage it"),


Peter Drucker is noted for saying, 'if you can't measure it, you can't manage it ...'

"You can't measure it, you can't manage it," Sugrue says ...


The famous quote attributed to Frederick W. Smith, the founder of Federal Express-"if you can't measure it, you can't manage it"



You Still Need to Manage the Un-measurable



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You Still Need to Manage the Un-measurable

Albert Einstein reportedly had a sign on his office wall that stated:

“Not everything that counts can be counted, and not everything that can be counted counts.”

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Agenda

Wind Industry Metrics
 Key Performance Indicators
 Top Drivers to Improve Performance
 Deeper Dive into Number One Metric



Wind Industry Metrics

- NERC GADS

- Resource Indicators (16)

- REFOF
- REUF
- REPOF
- REMOF
- REUOF
- RESOF
- RGF
- RNCF
- RNOF
- RERAF
- REPOR
- REMOR
- REFOR
- REUOR
- RESOR

- Equipment Indicators (15)

- EEF0F
- EEUF
- EEAF
- EEPOF
- EEMOF
- EEUOF
- EESOF
- EGF
- ENCG
- EEPOR
- EEMOR
- EEFOR
- EEUOR
- EESOR
- EROR

- Other Standard Industry Metrics

- MTBF
- MTTR
- Project Availability
- Turbine Availability
- Operating Efficiency- Power Curve Performance
- Average Response Time
- Energy Yield
- Contract Availability
- Commercial Availability
- Cost Per kWh
- Lost Energy
- LTAR
- Near Miss
- TRIR

System	Number Available	Number of Available	Production (MWh)	Production (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)	Production energy (MWh)	Production energy (MW)
17	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	10,000	10,000	1,000,000	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key Performance Indicators

- Safety
 - ✓ TRIR
 - ✓ Audit Results
- Quality
 - ✓ Inspection Rating 1-10
- Operational/Financial
 - ✓ Commercial Availability
 - ✓ \$/kWh



Safety Program

Top Five Safety Drivers:

1. Employee Orientation
2. OSHA Compliant Training Program
 - Electrical Safety (NFPA70E)
 - LOTO
 - Confined Space Entry
 - Etc.
3. Accident, Incident & Near Miss reporting and investigation
4. Site Safety Audits
5. Sharing Lessons Learned



Safety: Number One Priority!





Safety



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Safety



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QA/QC Program

Top Five Quality Drivers:

1. Hiring Practices/Culture
2. Procedural Compliance
3. Technician Training
4. Quality Inspections
5. Best Practices

Do the Right Thing the Right Way the First Time and Every Time!



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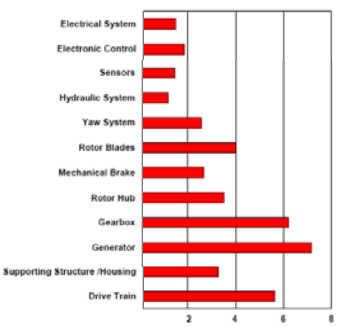
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Commercial Availability

Top Five Drivers to Increase Commercial Availability :

1. Sense of Urgency/Response Time
2. Data Driven Approach/ Statistical Analysis
3. Inventory Management
4. Root Cause Analysis
5. Flexible Work Force/ Resource Planning

Down Time per Failure (In Days)¹



Component	Down Time per Failure (In Days)
Electrical System	~1.5
Electronic Control	~1.5
Sensors	~1.5
Hydraulic System	~1.5
Yaw System	~2.5
Rotor Blades	~4.0
Mechanical Brake	~2.5
Rotor Hub	~3.5
Gearbox	~6.0
Generator	~7.0
Supporting Structure /Housing	~3.5
Drive Train	~5.5

CA= Actual Revenue/Expected Revenue

¹For illustrative purposes only. Does not represent the results of an actual wind farm.

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Cost/kWh

Top Five Drivers to Lower Cost/kWh:

1. Scale
2. Turnkey Major Maintenance Solutions
3. Fleet-wide Spare Parts Solutions
4. Skilled Technicians
5. Condition Based Maintenance

\$10k/WTG cost reduction = \$6 million NPV

Part Costs, by System (Over 20 years period)

System	Percentage
Gearboxes	38%
Generator	23%
Rotor	21%
Brakes and Hydraulics	6%
Control Systems	5%
Yaw Systems	3%
Electric & Grid	2%
Misc	1%
Drivetrain	1%

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Comprehensive, Cost Effective Solution

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Condition Based Maintenance

Condition Based Maintenance:

- Borescope Inspections
- Oil Analysis
- Thermographic Imaging
- Blade Inspections
- Vibration Analysis

Blade Repair: \$10-\$20K
Blade Replacement: \$100-\$400K



Lightning Damage on Blade



Fracture on
Low Speed
Gear Tooth

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Fleet-Wide Parts Solutions Value Drivers

Downtime Avoidance	<ul style="list-style-type: none"> ▪ Reduced downtime associated with spare parts availability translates into increased revenues.
Sourcing Savings	<ul style="list-style-type: none"> ▪ Leveraging purchasing scale & expertise provides access to lower parts prices.
Inventory Reduction	<ul style="list-style-type: none"> ▪ Reduce or eliminate spare parts inventory investment, benefiting from pooling power across a fleet. ▪ Reduce working capital & carrying costs tied to spare parts. ▪ Reduce or eliminate excess & obsolete inventory on-hand.

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Parts Savings Potential of \$0.5M-\$1.0M 100 WTG Site

Region	Sites	Size (MW)	Units (WTGs)	Distinct OEMs	Cap'y Factor				
South	1	1.5 MW	100	1	0.35				
Opportunity		Basis	Baseline Amount	MIN	Annual Amount	MAX	Annual Amount		
Downtime	Minimize revenue losses due to unavailable parts	1% Increase in Uptime	\$299,280	50%	\$149,640	100%	\$299,280		
Sourcing	Savings on WTG Parts	Baseline Spend	\$1,049,969	5%	\$52,498	22%	\$230,993		
Inventory	Avoid investment, carrying cost, obsolescence	Carrying Costs, Cost of Capital, etc.	\$1,569,969	15%	\$235,495	25%	\$392,492		
Expediting	Reduced expediting	Annual Expediting	\$25,080	60%	\$15,048	80%	\$20,064		
Storage & Overhead	Storage	Free-up onsite storage; Eliminate offsite storage	Off-Site Storage	\$6,667	50%	\$3,333	100%	\$6,667	
	IT	IT-related costs	Licensing and Maintenance	\$25,000	50%	\$12,500	100%	\$25,000	
	Personnel	Reduced personnel costs	Annual Salaries & Benefits	\$33,750	80%	\$27,000	100%	\$33,750	
Subtotal					\$495,515		\$1,008,246		



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