Evaluation of the Turbine Integrated Mortality Reduction (TIMR) Technology as a Smart Curtailment Approach

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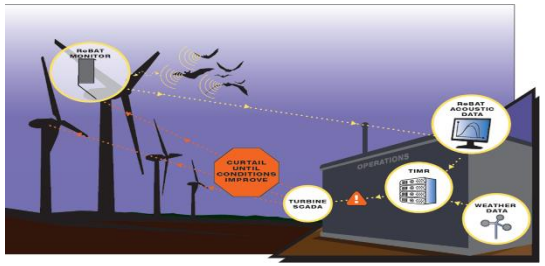
Turbine Integrated Mortality Reduction (TIMR) Technology
The First "Smart Bat Curtailment" R&D

TIMR Background

- 2010: We Energies approached EPRI to develop technology to minimize bat fatalities
- TIMR is an EPRI technology collaboratively funded by We Energies (WEC), Duke, Exelon, and Alliant
- 2012-2015 R&D by Normandeau Associates, Inc. at We Energies' Blue Sky Green Field in Wisconsin
- Field Test July 15 through September 30, 2015 (77 days)
    - Control (n=10)- Operate normally (e.g. pitched if wind speed is < 3.5 m/s)
    - TIMR (n=10) - If wind speed is ≥ 3.5 m/s and < 8.0 and > 1 bat call in the previous 10 minutes. Above 8.0 m/s, the turbines would not be curtailed regardless of the level of bat activity.
    - 80x80 m plots searched daily



Key Results

- 84.5% lower overall bat fatalities vs control
    - [3.1 (95% CI: 2.1–4.1)] versus 18.2 (95% CI: 15.5–20.8), p-value <0.0001]
- 91.4% lower little brown bat fatalities vs control
    - [0.3 (95% CI: 0.02–0.58 versus 3.0 (95% CI: 1.7–4.3), p-value = 0004].
- Reduced power generation/estimate annual revenue < 3.2%
- TIMR reduced curtailment time by 48% relative to turbines operated under a 7.0 m/s blanket curtailment rule

References

EPRI. *Bat Detection and Shutdown System for Utility-Scale Wind Turbines*. 3002009038. https://www.epri.com/#/pages/product/000000003002009038/.

Hayes, M. A., L. A. Hooton, K. L. Gilland, C. Grandgent, R. L. Smith, S. R. Lindsay, J. D. Collins, S. M. Schumacher, P. A. Rabie, J. C. Gruver, and J. Goodrich-Mahoney. 2019.A smart curtailment approach for reducing bat fatalities and curtailment time at wind energy facilities. Ecological Applications 00(00):e01881. 10.1002/eap.18812017

Evaluation of the Turbine Integrated Mortality Reduction (TIMR) Technology as a Smart Curtailment Approach

- Project Objectives:
  - Test the TIMR system in two calendar years.
  - Test the TIMR system over summer and fall bat activity seasons.
  - Evaluate the operational and commercial cost of the TIMR system.

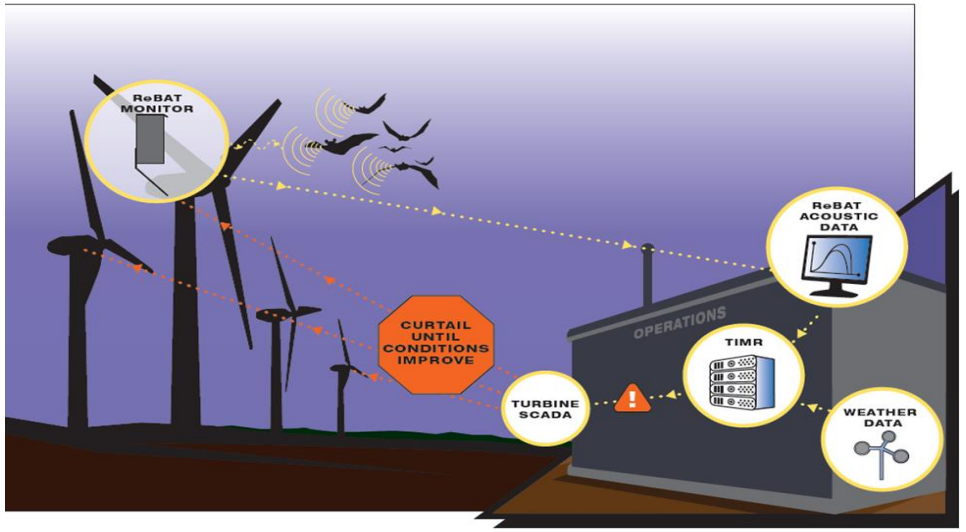
Validating, improving and building off of previous study

EPRI TIMR Study Team

- Project Manager- C. Newman (EPRI)
- Principal Investigators
  - United States Geological Survey (USGS)
    - M. Huso- Study design and analysis lead
  - Bat Conservation International (BCI)
    - M. Schirmacher- Field study lead, study design and analysis contributor
      W. Frick- Study design and analysis contributor
  - American Wind Wildlife Institute (AWWI)
    - S. Webster- Inter project/team coordinator, host site liaison, study design and analysis contributor
  - National Renewable Energy Laboratory (NREL)
    - C. Hein- Study design and analysis contributor
  - Electric Power Research Institute (EPRI)
    - B. Fitchett- Power/economic analysis
- Vendor- Normandeau Associates, Inc. (Normandeau)
    - G. Forcey (PM), K. Gilland (Software), S. Arnold (Hardware), M. Costello (Installation)
- Host Site- MidAmerican Energy Company (MEC)
    - J. Leckband (Coordinator)

TIMR "System" for Study

- 4 ReBAT ® Systems on 4 Turbines
  - ReBAT ® System= custom computer, detector, two microphones, housing, & real-time data transmission
  - Target study area ~15-20k acres
- Datalogger
  - Device btw TIMR and SCADA
  - SCADA Input- Wind speed, direction, etc..
  - TIMR Output- Bat alert code
- TIMR Server
  - Ingests data from ReBAT® Systems
  - Distinguish bats calls from non-bat calls.
  - Retrieve data from the datalogger, integrate that information with the ReBAT® Systems 'acoustic data, and then
  - Provides curtailment instructions to data logger/SCADA.

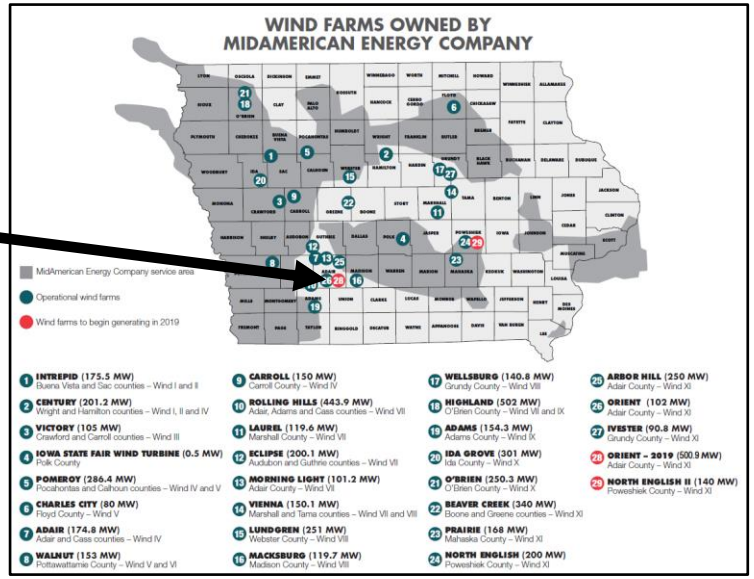


TIMR Project Plan Overview

High Level Tasks and Schedule

- TIMR/ ReBAT® Systems Technology Coordination and Integration
  - Winter-Spring 2020
- TIMR/ ReBAT® Systems Installation
  - May
- TIMR & ReBAT® Systems (4) Testing & Field Preparation
  - May-June 15
- 2020 Field Test and Monitoring
  - 126 nights from mid-June to mid-October
  - ReBAT® Systems Winterization
- 2021 Field Test and Monitoring
  - 108 nights respectively from mid-June to mid-October
  - TIMR/ ReBAT® Systems decommission
- Reporting & Analysis 2021 to 2022

Host Site- Orient Wind Farm

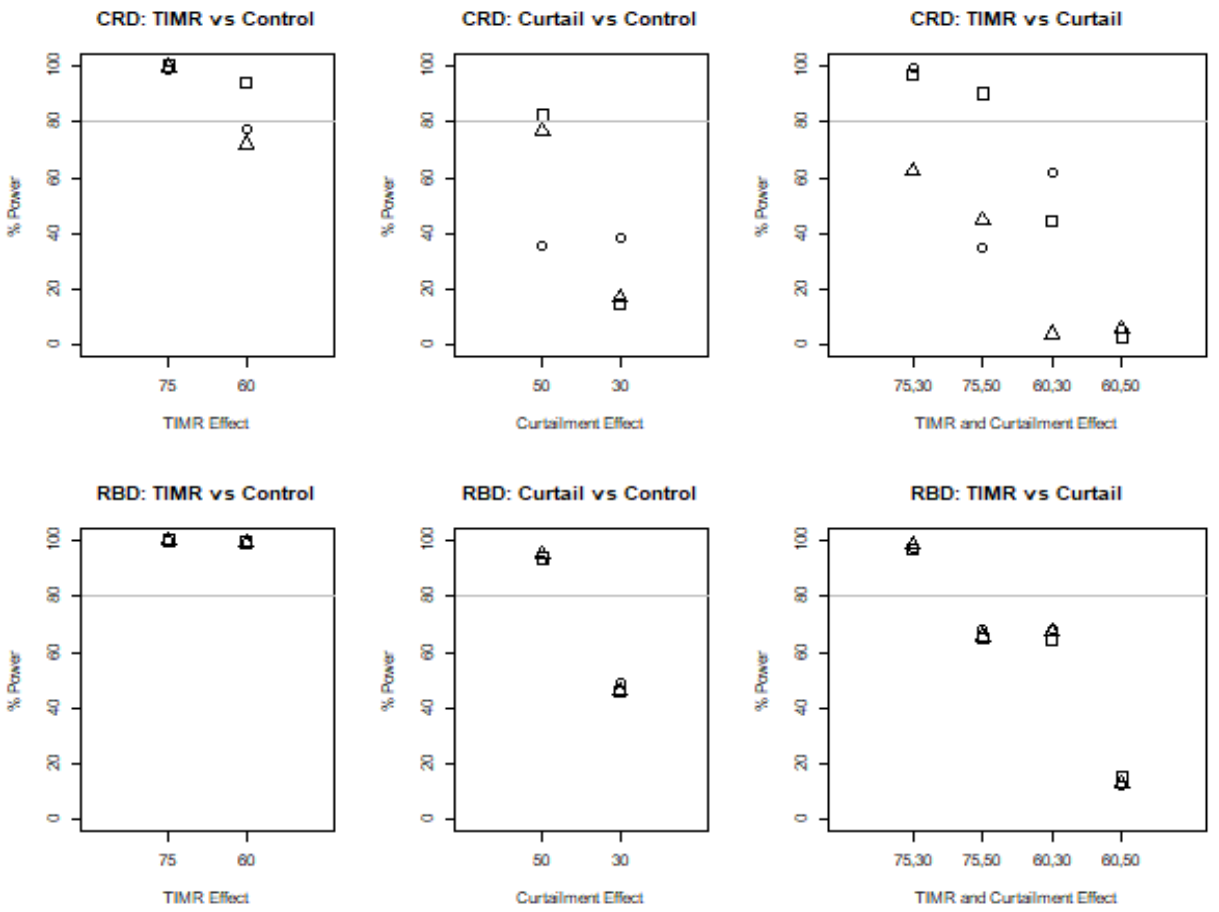


Cover Type	Acres	Percent (%)
Cultivated crops	60,272	70
Hay/pasture	20,945	24
Developed, open space	2,720	3
Deciduous forest	1,113	1
Developed, low intensity	689	<1
Open water	364	<1
Shrub/scrub	161	<1
Woody wetlands	119	<1
Herbaceous	110	<1
Developed, medium intensity	29	<1
Evergreen forest	18	<1
Emergent herbaceous wetlands	7	<1
Developed, high intensity	4	<1
Mixed forest	1	<1
Barren land	0	0
Total*	86,554	100

TIMR Project Plan Overview

Key Experimental Design Assumptions & Parameters

- Overall Bat Fatality = 15 bats/turbine
- 3 experimental treatments (all treatments pitched if wind speed is < 3.5 m/s)
  - 1) TIMR (Curtail turbines when bats are present and wind speeds below 6.9 m/s)
  - 2) 5.0 m/s curtailment (Curtail turbines below 5.0 m/s)
  - 3) Control (Turbines operate normally).
- 18 turbines in the study (244 total turbines)
  - Vestas Turbines (180 V110-2.0 MW)
  - 6 turbines per treatment
  - Rotate every 3 nights between the eighteen turbines over the study period (RBD- randomized block design)
- Yr 1 160x160 m plots → Y2 TBD (140x140? m plots)
- Daily searches
  - Yr 1 dogs → Y2 TBD dogs or human



Power of CRD (upper row of graphs) and RBD (lower row of graphs) to detect differences in treatments: The symbols represent different assumed variance among turbines: square = 1x mean = 15; circle = 2x mean = 30; triangle = 3x mean = 45.

Questions and Thanks

- Collaborative Team Effort
  - Contact: C. Newman, cnewman@epri.com

- Thanks to DOE EERE

https://www.energy.gov/eere/wind/environmental-impacts-and-siting-wind-projects [energy.gov]

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