The Importance of Addressing Disagreements Between Nominal and Effective Treatments During Bat Mortality Minimization Validation Studies

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Grand Challenges to Carbon-Free Energy

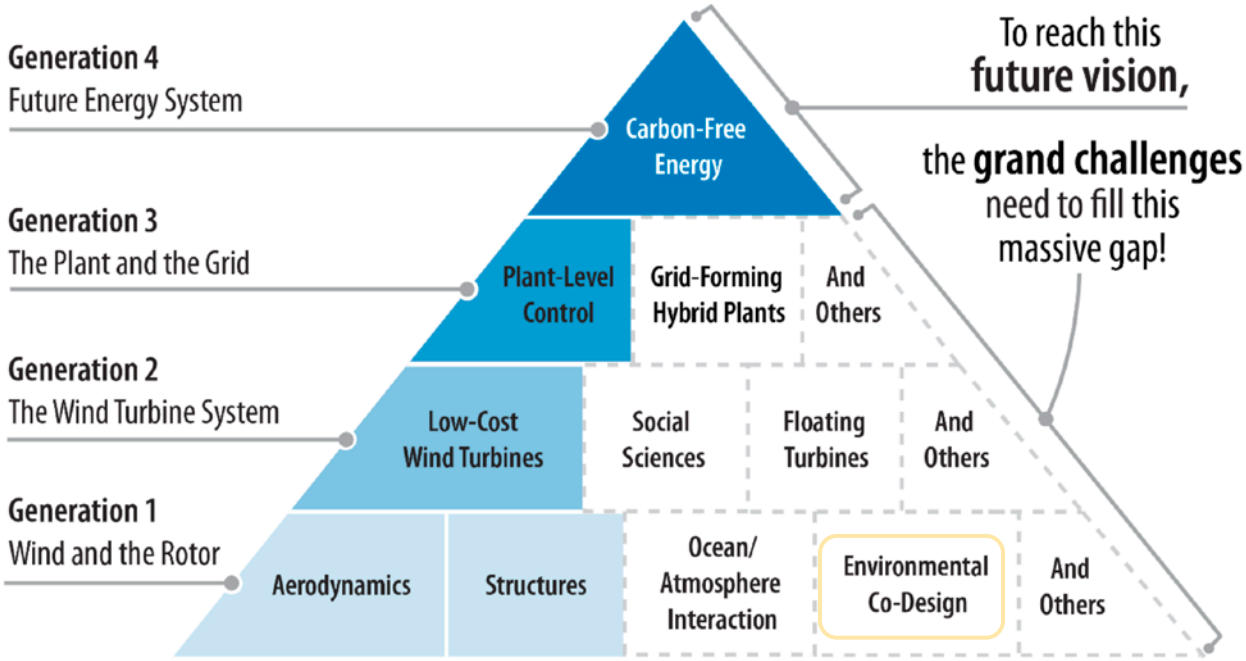


Figure 1. Achievements of wind energy development (blue) science currently unresolved (white). *Image from Veers et al. (2022)*

Veers, P., Dykes, K., Basu, S., Bianchini, A., Clifton, A., Green, P., Holttinen, H., Kitzing, L., Kosovic, B., Lundquist, J.K., 2022. Grand Challenges: Wind energy research needs for a global energy transition. Wind Energy Science Discussions, 1-8.

Grand Challenges to Carbon-Free Energy

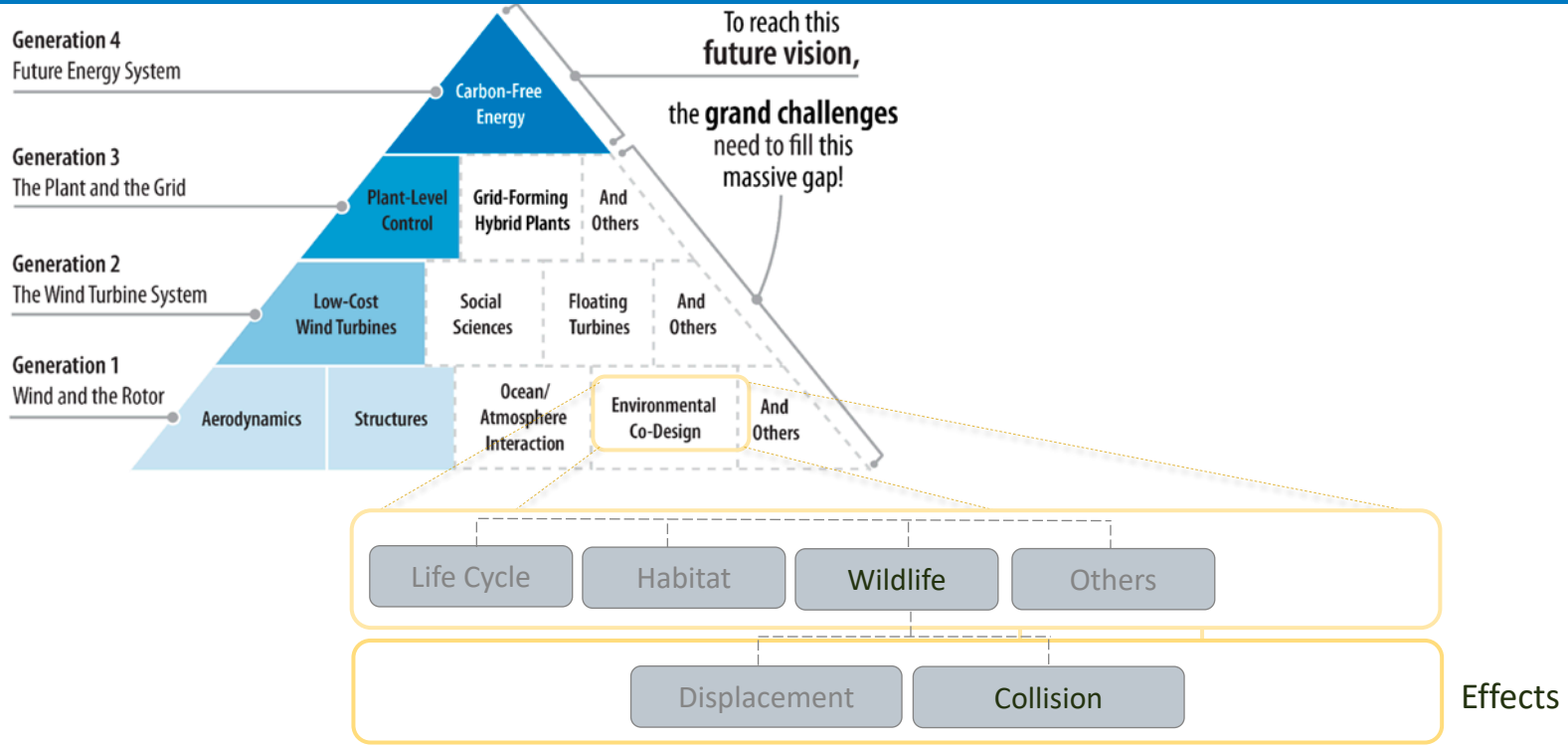


Figure 2. Expanding unresolved environmental codesign domains. ***Top image from Veers et al. (2022)***

Current Minimization Solutions: Wind-Only "Blanket" Curtailment

Curtailment

Can reduce mortality but cuts into energy production, making the solution less appealing for voluntary implementation

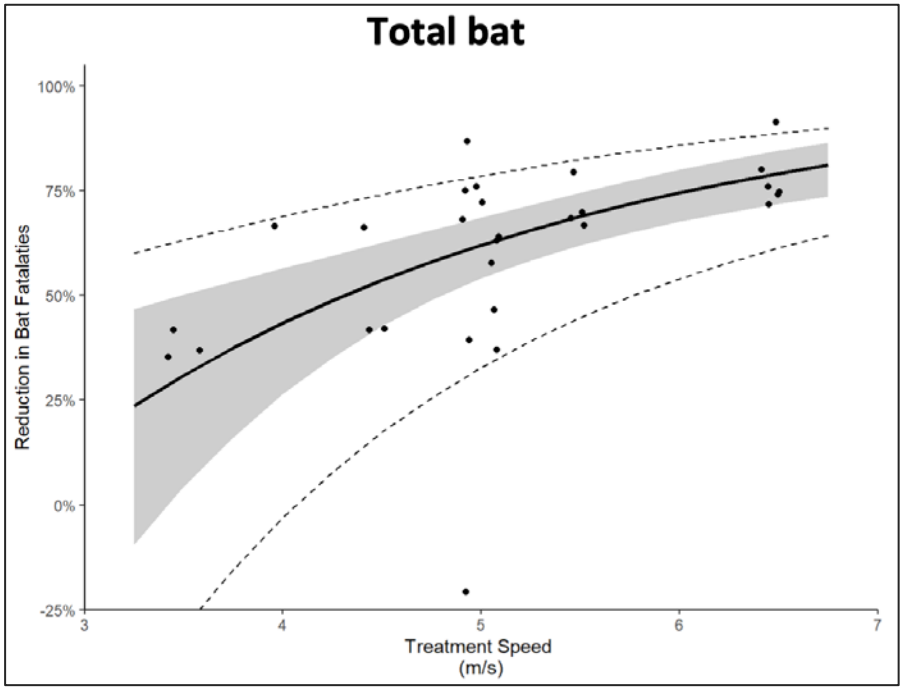


Figure 3. As wind turbine cut-in speed increases, bat fatalities decrease. *Image from Whitby et al. (2021)*

Whitby, M.D., Schirmacher, M.R., Frick, W.F., 2021. The state of the science on operational minimization to reduce bat fatality at wind energy facilities. A Rep Submitt to Natl Renew Energy Lab. Austin, Texas.

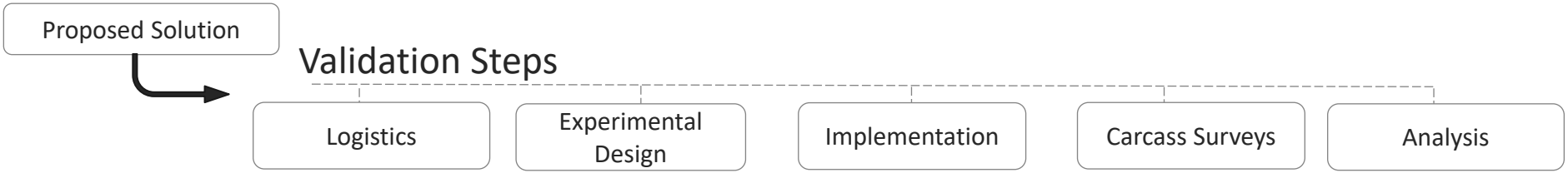
Improving Curtailment Minimization Solutions

Current Minimization Solutions: Deterrent Technologies

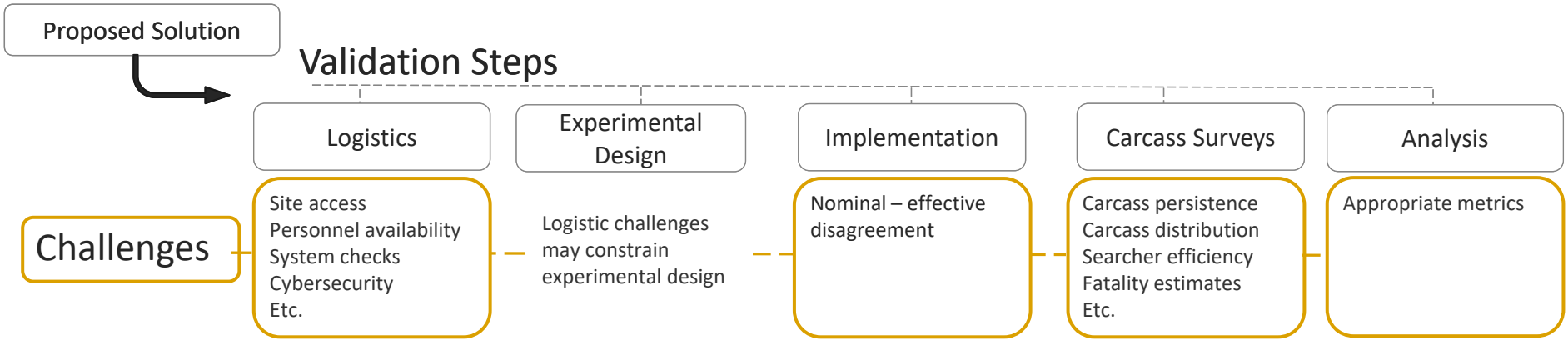
Acoustic deterrents have shown mixed efficacy in some cases, leading to mortality reduction, and showing no effect or even causing increased mortality in others.

Figure 4. Acoustic deterrent secured to the nacelle wind turbine. Photo from Cris Hein

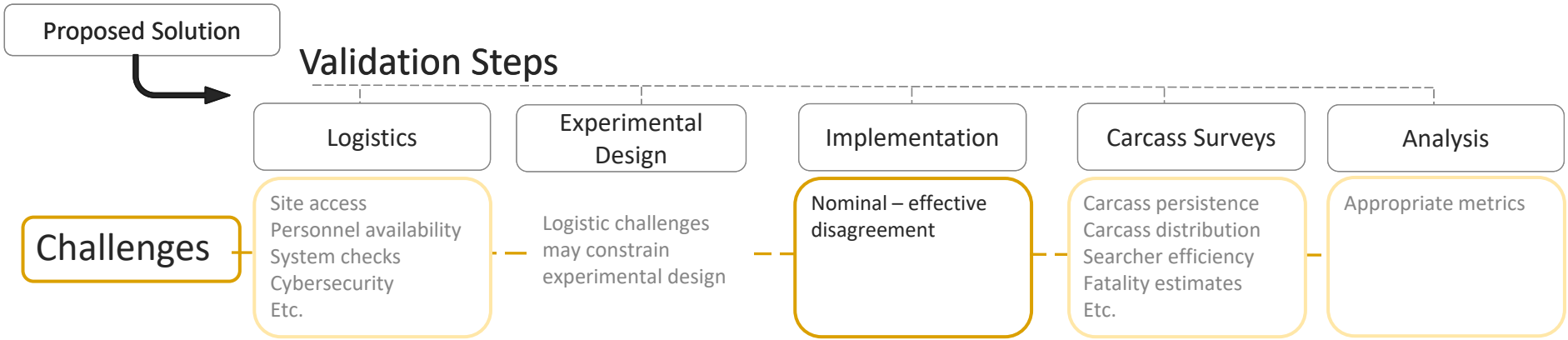
Validation Studies



Validation Studies

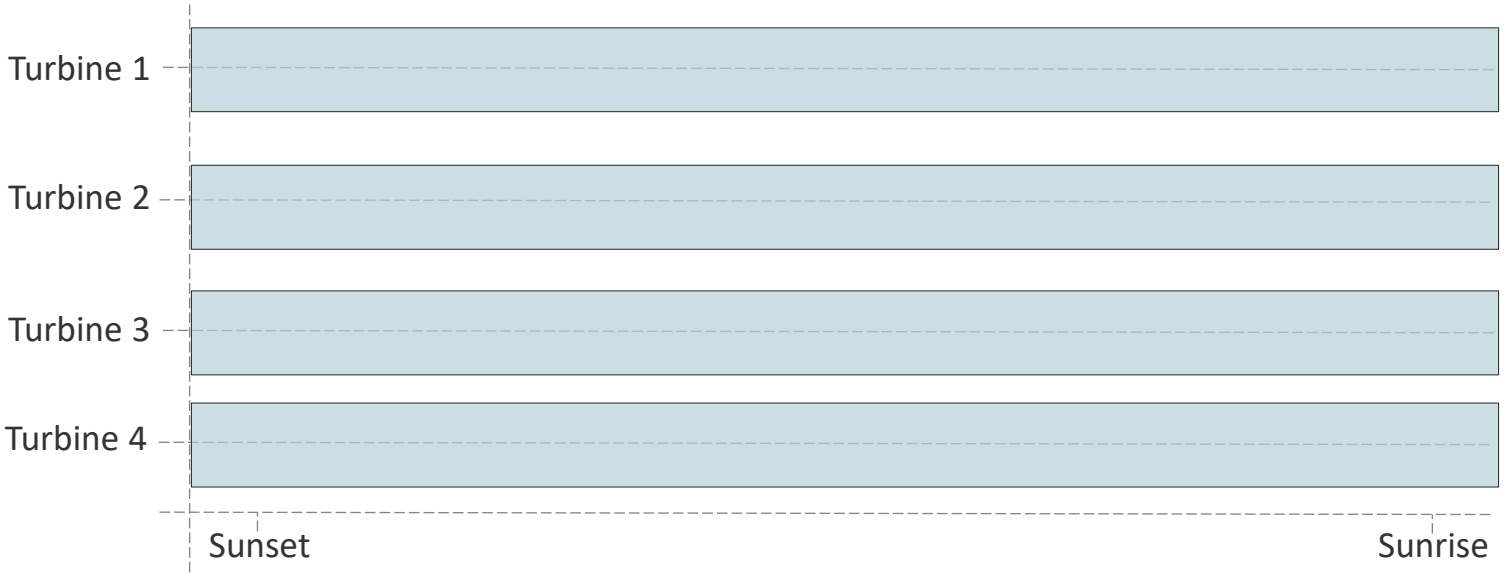


Validation Studies



Disagreement Between Nominal and Effective Treatments

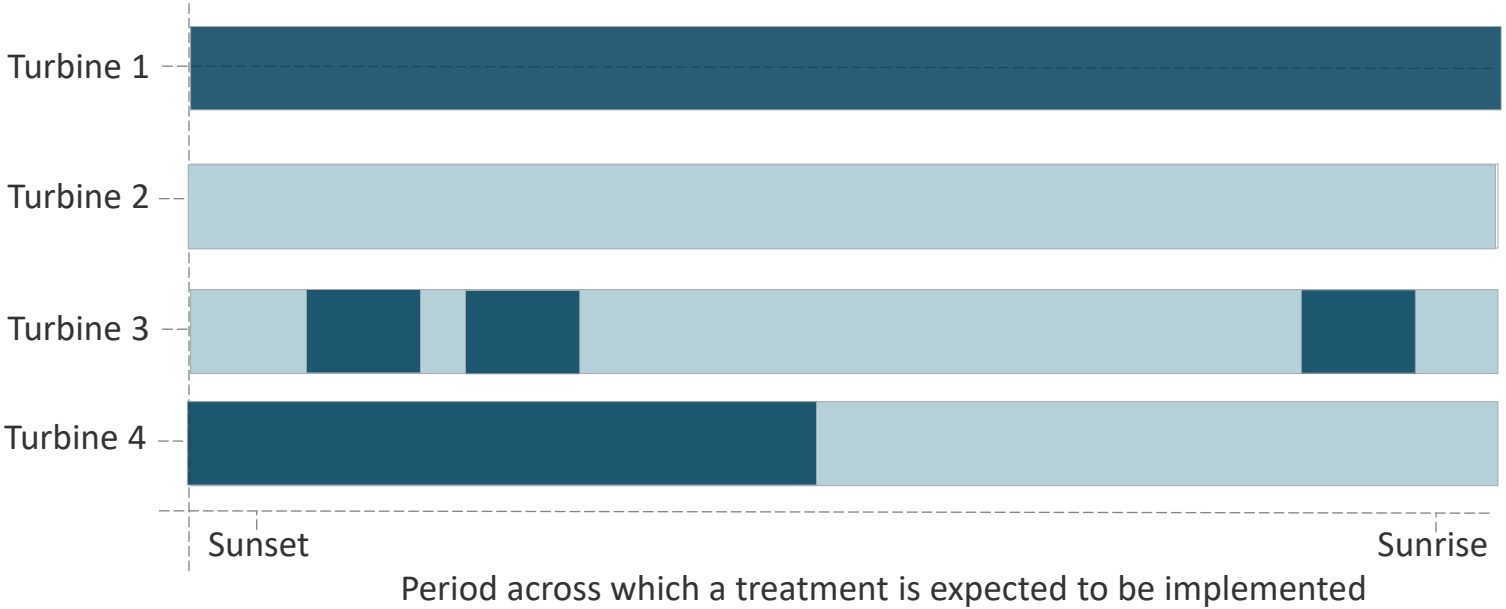
During validation studies we expect treatments to be implemented as they are assigned



Period across which a treatment is expected to be implemented

Disagreement Between Nominal and Effective Treatments

During validation studies we expect treatments to be implemented as they are assigned, **however, this may not always be the case**.



Nominal and Effective Treatment Agreement

Nominal treatment: curtail when wind speeds are ≤ 5 meters per second (m/s)

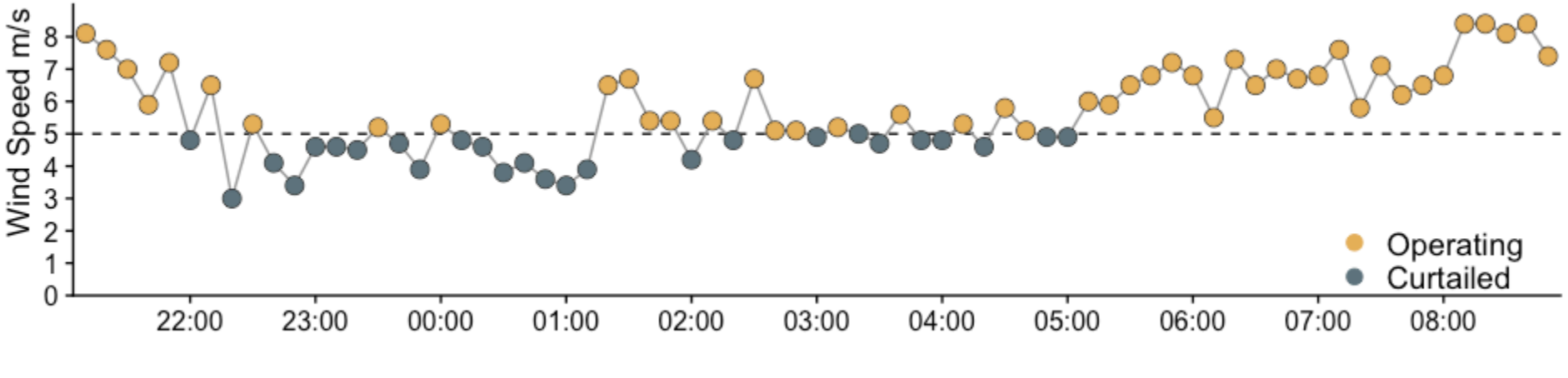


Figure 5. Agreement between turbine nominal and effective treatment

“Matched” Treatment Disagreement

Nominal treatment: curtail when wind speeds are ≤ 5 meters per second (m/s)

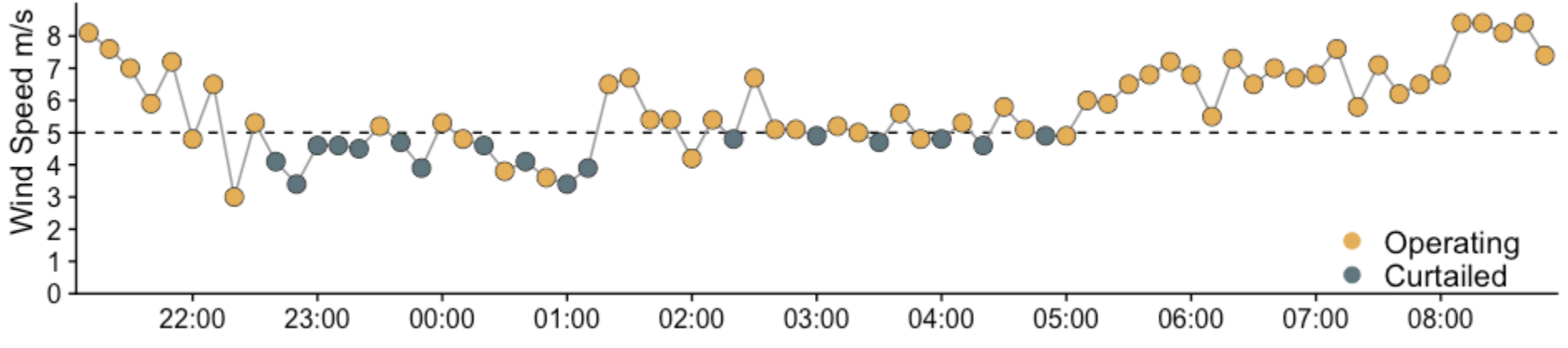


Figure 6. Disagreements between turbine nominal and effective treatments occurs below the cut-in speed

“Mismatched” Treatment Disagreement

Nominal treatment: curtail when wind speeds are ≤ 5 meters per second (m/s)

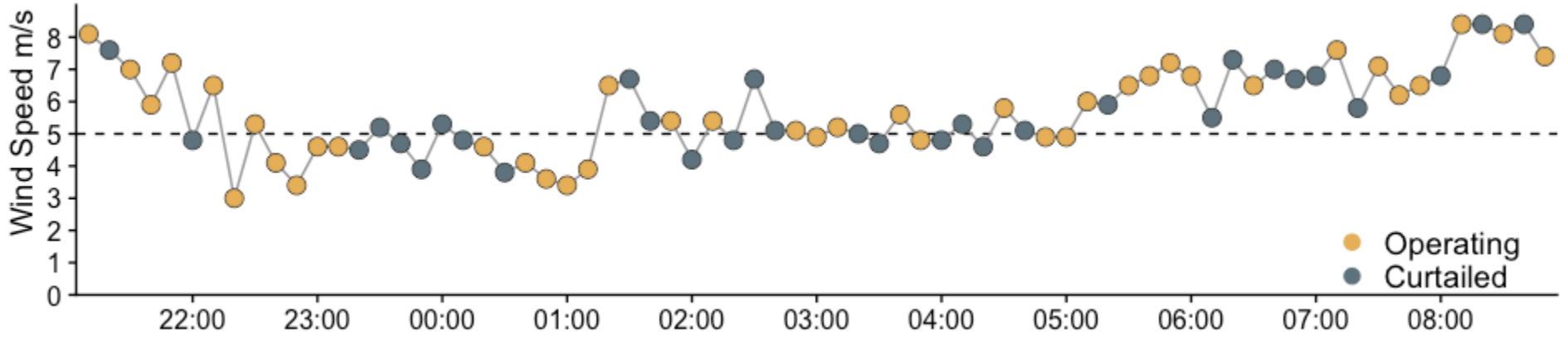


Figure 7. Disagreements between nominal and effective treatment may occur above and below cut-in speed

Consequences of Treatment Disagreement

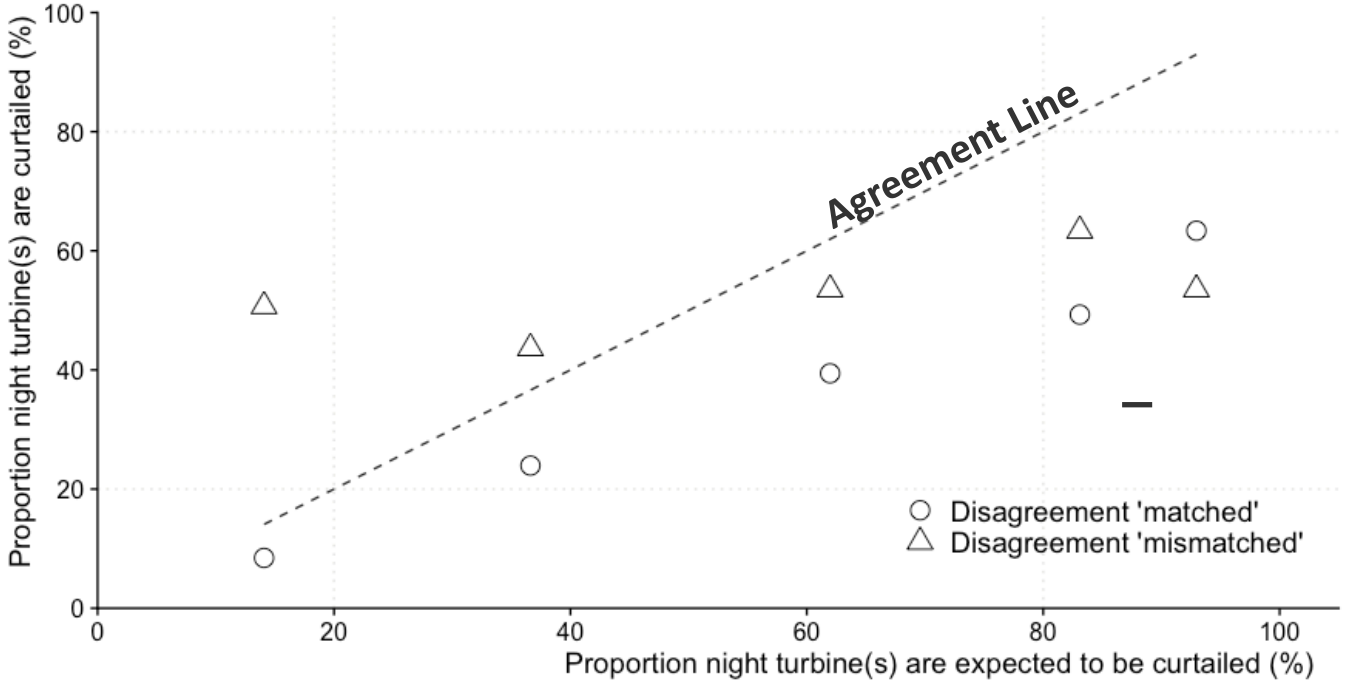


Figure 8. Simulated disagreements between nominal and effective treatments with five "matched" and five "mismatched" scenarios

Identifying the challenges associated with validation studies supports strong inference and ultimately expedites the path to identifying viable solutions.

Thank you

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